Application: Making High Power Measurements with Little to No Attenuation

By Allen Cary, Director of Marketing, Ophir-Spiricon LLC

High power is a fairly indistinct term that means different things in different contexts. High power laser beams are handled by using reflective materials, and the level of reflectivity is dependent on the wavelength of the laser light.

"High Power" Defined
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 scan head and heat it up. Nonetheless, at 5000W this represents a heat load of 100W that will raise the temperature of the internal components and may cause damage to the detector and encoder electronics.

The Photon High Power NanoScan is designed for short-term measurements at these "high 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 scan head is allowed to cool down.

Power Levels Measurable with Standard NanoScan Scan Heads
The High Power NanoScan is based on the same operating principles of the standard NanoScan. These instruments use the moving slit measurement system, one of the strengths of which is the natural attenuation of the technique. It is only when the slit traverses the beam that light hits the detector. As the powers increase, it is possible to use a pyroelectric detector, which has the benefit of responding across the entire electromagnetic spectrum from UV to far IR.
For beams up to 100W (IR) the standard pyroelectric detector equipped NanoScan is a good choice. The pyro NanoScan uses standard alloy slits. The power handling

capability can be extended a bit by the inclusion of the optional copper slits used in the High Power NanoScan.

Applications for high power measurements

Both the high power and standard NanoScan beam profilers are used for measuring lasers that can be considered "high power." Depending on the application of the laser there are several approaches to making these measurements.

The simplest approach is to measure the beam directly with the High Power NanoScan. This is best for lasers in the 100-500W range and long IR wavelengths, especially CO_2 lasers. These are often used in laser marking applications where small spot sizes and precise alignment are important parameters.

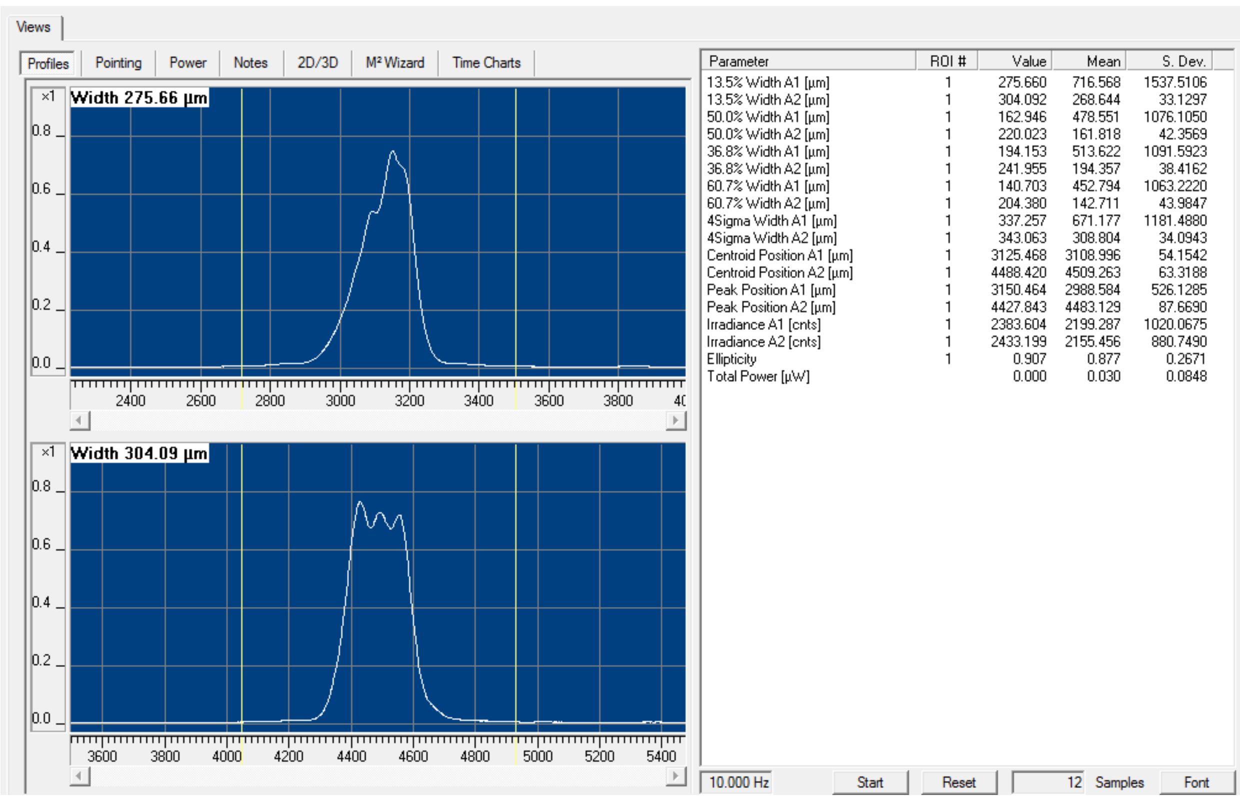

Fig 1. 1kW CO_2 Laser Beam 275µm diameter

Prism Front Surface Attenuation

Even though the NanoScan is renowned for the ability to measure laser beams directly, it is often useful to insert a front surface reflection attenuator into the beam path to reduce the power to 4% or 0.16% if two surfaces are used in conjunction. This will allow a standard NanoScan to be used for profiling a very high power beam without the need to limit the exposure time of the measurement.

Using a dual prism a 1kW YAG laser is reduced to around 16W, well within the power range of the standard Pyro NanoScan.

Using Magnification to reduce power density
Sometimes a laser that would not normally be considered a “high power” beam still has enough power density to damage the scan head. In this case, it can be useful to expand the beam with magnifying optics. The power density will be reduced by the square of the magnification (i.e., a 10X magnification will reduce the power density by 100X).

This has been successfully used with lasers for scribing solar panels. These applications use very small beams, 10 to 20um diameters with power of 10-15W, generating a power density that can damage a NanoScan. But when magnified 10X with a simple aspheric lens, the power density is easily handled by the standard system.

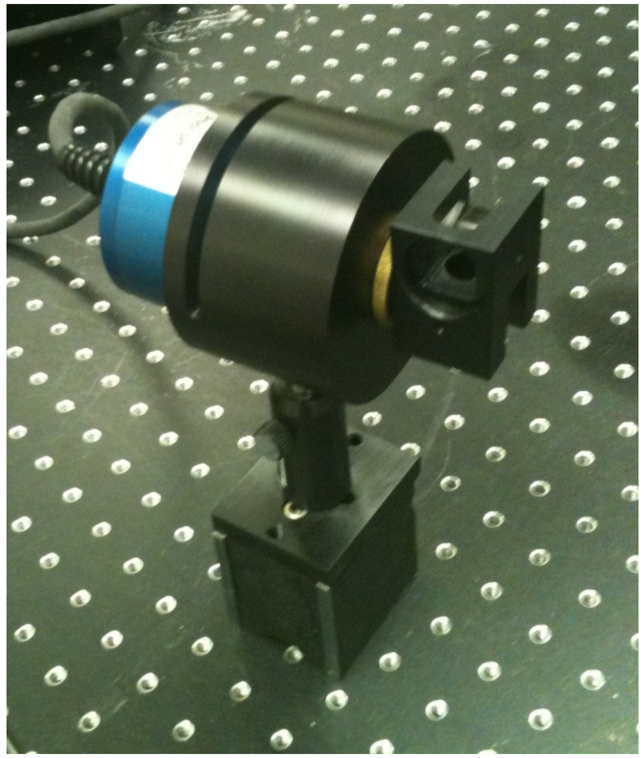

Fig 2. NanoScan with prism attenuator

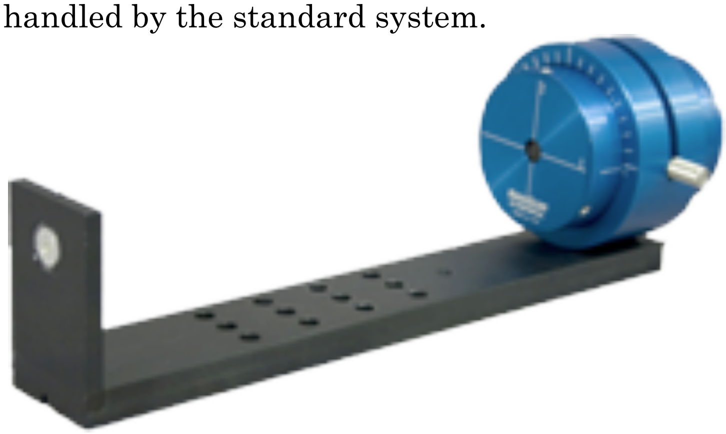

Fig 3. NanoScan with 10X asphere lens for profiling solar panel scribing beam

Ophir Photonics Group
http://www.ophiropt.com/photonics

Ophir Photonics Group
3050 North 300 West
North Logan, UT 84341
Tel: 435-753-3729
www.ophiropt.com/photonics