



BeamMaster

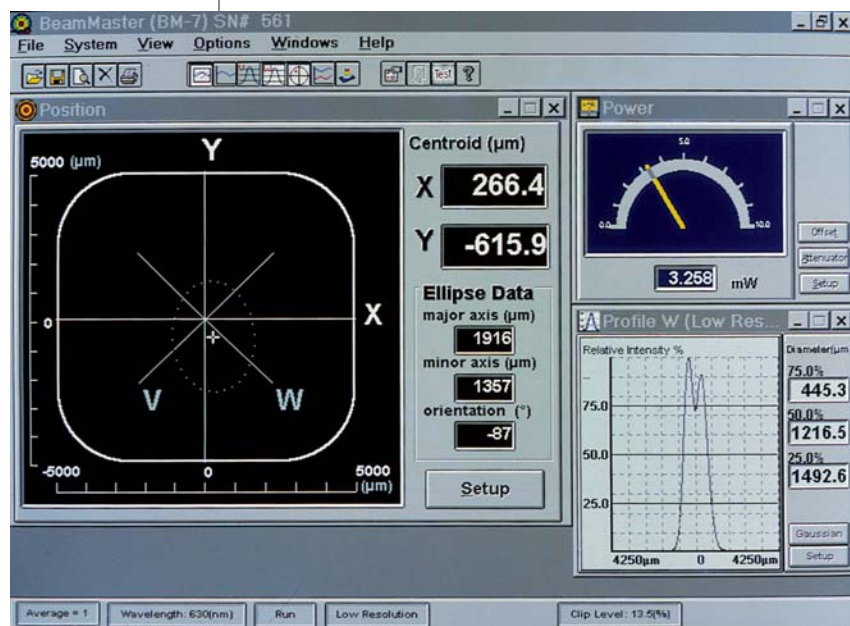
Knife-edge Beam Profiler

- CW laser beam shape, power and position measurements
- Beam sizes from $3\ \mu\text{m}$ to $9\ \text{mm}$ with $0.1\ \mu\text{m}$ resolution and high dynamic range
- Real-time Windows display, analysis and data logging system
- Wavelengths from $190\ \text{nm}$ to $1800\ \text{nm}$



BeamMaster is a high-precision, multiple knife-edge scanning laser beam profiler, which can be configured to sample, measure and display cross-sectional profiles and/or 2D and 3D image plots in real time up to 5 Hz. Selectable averaging of 1-20 samples provides noise reduction and maximizes measurement accuracy. Data can be collected, displayed, stored and continuously streamed to the RS-232 port. All screen images can be captured and stored, or be printed to any Windows-supported printer.

BeamMaster can measure focused beam spots as small as $3\ \mu\text{m}$ with $0.1\ \mu\text{m}$ resolution and has an aperture as large as $9\ \text{mm}$ with $1\ \mu\text{m}$ resolution for larger beams. Measurements can be made from $190\text{-}1100\ \text{nm}$ (Si-Enhanced) and from $800\text{-}1800\ \text{nm}$ (InGaAs). Input powers can be as low as $10\ \mu\text{W}$. There is automatic gain control and an internal distortion-free optical attenuation filter is provided (Si models).



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Beam Profiles and Widths

On each rotation of the drum, BeamMaster captures and processes the data from the passage of the seven knife edges across the beam (three knife edges with BM-3) as power, position and profile information. This information can be displayed every rotation, be strip-charted, and be sent to file or to the RS-232 port. Two orthogonal profiles can be displayed and the beam widths can be digitally displayed for any three user-chosen clip levels. A Gaussian fit profile can be overlaid on any chosen measured profile and the fit and correlation parameters can be displayed.

To obtain the maximum profile detail, the system automatically centers the profile and zooms to display ~3 times the beam width, and the profile intensity data is autoscaled (optional) to fit the display height. Added detail can be obtained in a special high-resolution mode. This is very useful for analyzing beams that are far from Gaussian in shape or smaller than 100 μm .

Beam Position and Ellipticity

The beam centroid position can be continuously monitored relative to the center of the sensor area, along with the beam shape, ellipticity (major and minor axes) and angular orientation. A zoom function is available and the user can choose the clip level and strip-chart the position (X and Y) data to monitor short- or long-term, time-dependent stability or drift.

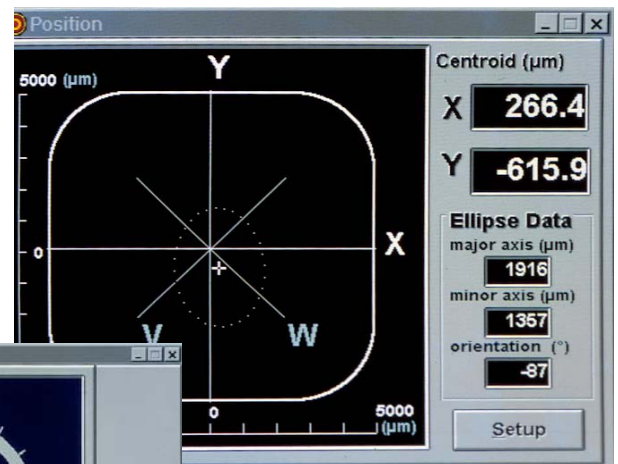
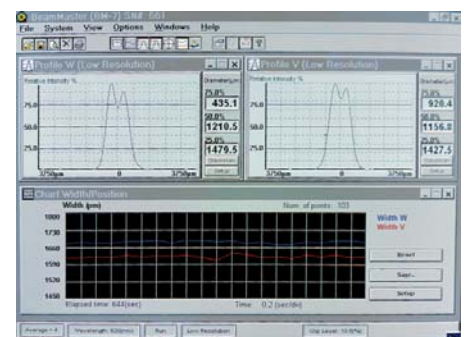
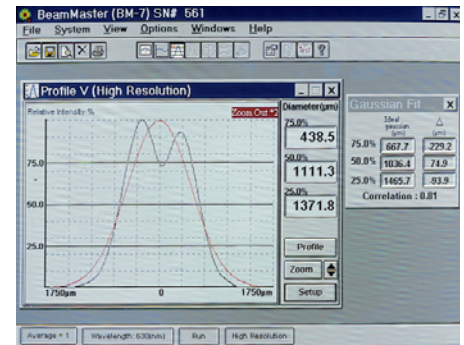
Power Measurement

The beam power can be displayed either as a digital readout or in combination with an analog "needle." Units can be chosen as μW , mW or dBm, and the user can offset the zero and zoom in on any part of the power range. Attenuator (filter) files can be selected, and a test range can be selected and displayed to monitor beam power within specific limits, with optional audio alarms.



Data Collection and QA Testing

Not only can beam size, position and power data be continuously displayed in analog, digital and strip chart forms on the computer screen, but data can also be logged to a data file in real time for later processing or test report generation. Pass/Fail testing can be performed on measured results for acceptance within specific tolerances. Files can be transferred to another computer with an RS-232 link or data can be transferred in real time. In addition, all screen images can be captured and stored as BMP or JPG files or can be printed to any Windows printer.



Test Parameters	Min	Max	Measured	Pass/Fail
Power (mW)	2.1	3.8	3.253	Passed
Width V(μm)	600.0	700.0	1595.745	Failed
Gaussian width V(μm)	460.0	469.0	1468.886	Failed
Gaussian fit V(%)	84.0	87.0	83.764	Failed
Width W(μm)	680.0	700.0	1628.336	Failed
Gaussian width W(μm)	550.0	568.0	1553.729	Failed
Gaussian fit W(%)	88.0	90.0	78.701	Failed
Position X(μm)	300.0	340.0	-289.142	Passed
Position Y(μm)	300.0	200.0	2412.077	Failed



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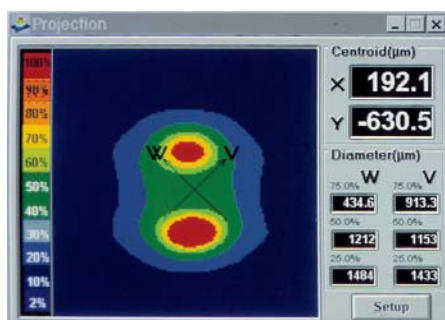
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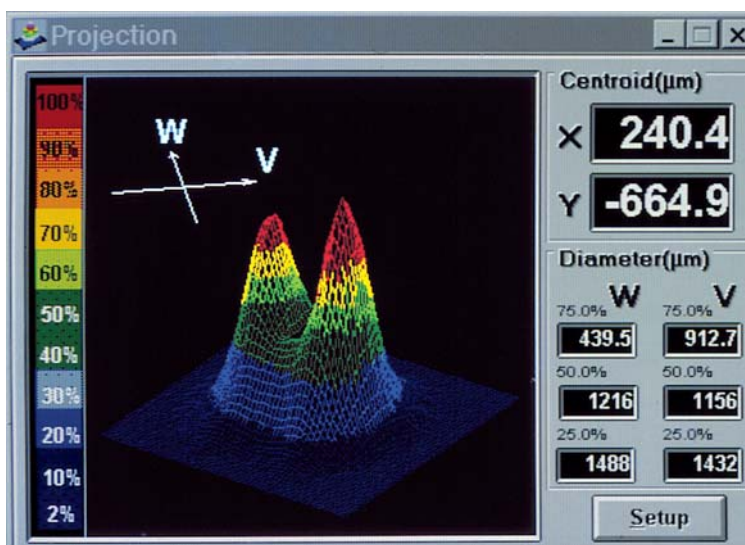
2D and 3D Intensity Plots

The projection function provides either a 2D or 3D view of the beam intensity profile. The projection is created using reconstructive tomography. The same method is used to produce 3D images with X-ray systems. The more knife edges, the greater the level of detail that can be obtained. For a beam distribution that is significantly non-Gaussian, such as that from a diode laser, the standard seven knife-edge system can reconstruct a plot that closely matches the real beam. When examining near-Gaussian beams, the three knife-edge system can give an accurate intensity distribution.

The 2D contour maps and the 3D isometric plots can be displayed with or without scan axis and grids, and the isometric plots can be rotated for easier viewing of the detailed structure.



Data about the beam size and centroid position are conveniently displayed digitally.



BeamMaster System Components

Each BeamMaster system consists of a sensor head, complete with a 1.8 m cable, a 1/2-length (187 mm) 32-bit PCI card to plug into a PC computer, complete Windows software on a CD-ROM disk, a printed instruction manual, a 0.5" mounting post (threaded 8-32) and appropriate optical filters (for Si-Enhanced).

Optical Filters

The BM-7 and BM-3 Si-Enhanced heads come complete with two neutral density filters. NG4 and NG9 filters (complete with transmission curves) are provided to extend the power range of the heads from 5 mW to 1W in the 400-1100 nm range. The NG4 filter comes pre-installed and provides 10% transmission at 633 nm. The NG9 filter is in a protective filter case and provides 0.5% transmission at 633 nm. There is no filter in the BeamMaster InGaAs head configurations.

Computer Requirements

The user provides a Pentium PC (586 or higher, 233 MHz) operating Windows 98, ME, NT4.0, 2000 or XP with a free

PCI card slot. The system should have 32 megabytes of RAM, a CD-ROM drive, ~20 megabytes of free hard-disk memory and a display resolution of 800 x 600 or higher.

Rotation Mount

An optional mount is available to enable rotation of the BeamMaster sensor head about the optical axis. This mount has a 360-degree calibrated scale with a locking screw.

C-Mount and Fiber-Optic Adapters

A C-Mount Adapter Plate is available to allow attachment of any C-Mount, threaded optical accessory, such as a BCUBE high-power attenuator pickoff optic (see the Beam Diagnostics Accessories section on page 113). A fiber-optic Adapter Plate is also available to allow attachment of a fiber-optic cable using an FC connector.



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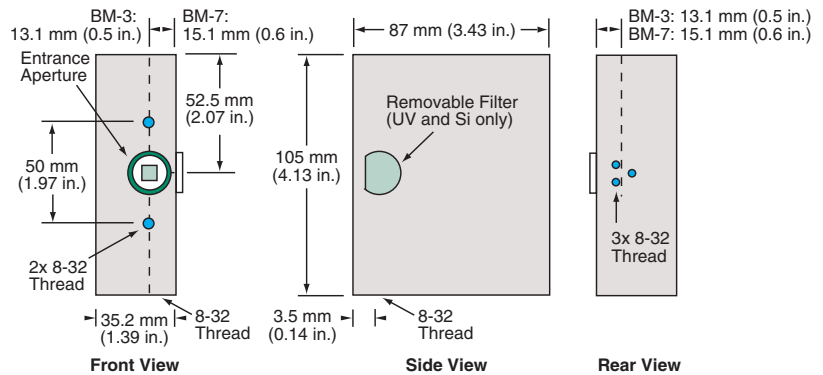
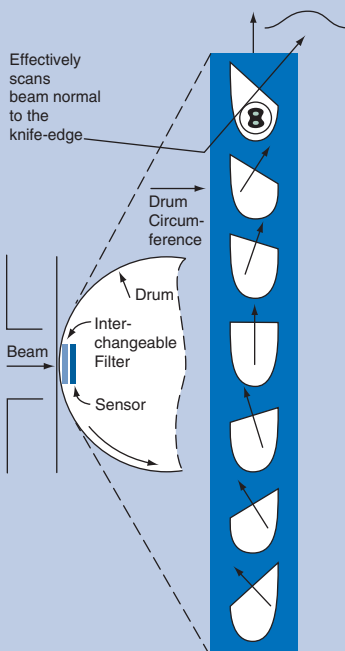
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Multiple Knife-edges for Greater Resolution and Accuracy

BeamMaster is an advancement over the more common types of beam profilers, which use two orthogonal knife-edges or slits to scan the beam profile. The BeamMaster model BM-7 uses seven individual knife-edges on a rotating drum to scan the beam through seven different axes in a single rotation. This provides more accurate measurements of the true beam shape and dimensions, by tomographically combining the data from all seven scans to reconstruct a profile of the beam. This also makes locating the angular orientation of elliptical beam major/minor axes much easier than searching by rotating the sensor head about the optical beam axis. For applications with circular or near-Gaussian beams, the lower-cost BM-3, with only three knife-edges, is also available.



Specifications

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Measurement Rate	5 Hz
Wavelength Range	190-1100 nm [BM-7 Si-Enhanced, BM-3 Si-Enhanced] 800-1800 nm [BM-7 InGaAs (3 or 5 mm), BM-3 InGaAs (3 mm)]
Sensor Aperture	9 mm square [BM-7 (Si-Enhanced)] 5 mm circular [BM-3 (Si-Enhanced)] 3 mm circular (optional BM-7 InGaAs 5 mm available) [BM-3 and BM-7 (InGaAs)]
Minimum Beam Size	15 μm (BM-7 all models) 3 μm (BM-3 all models)
Beam Size Resolution	1 μm for beams $>100 \mu\text{m}$ in size 0.1 μm for beams $<100 \mu\text{m}$ in size
Position Measurement Resolution	1 μm
Position Measurement Accuracy	$\pm 15 \mu\text{m}$
Beam Width Measurement Accuracy	$\pm 2\%$
Beam Power Range	10 μW to 1 W (with supplied internal filters), saturation 0.1 W/cm ² without filter, 20 W/cm ² with NG9 filter [BM-7, BM-3 (Si-Enhanced)] 10 μW to 5 mW (no filters provided), saturation 0.1 W/cm ² [BM-3 InGaAs, BM-7 InGaAs]
Relative Power Measurement	0.1 μW resolution
Sensor Head Weight	56 g
Part Number	BeamMaster BM-7 Si-Enhanced BeamMaster BM-3 Si-Enhanced BeamMaster BM-7 InGaAs (3 mm) BeamMaster BM-7 InGaAs (5 mm) BeamMaster BM-3 InGaAs (3 mm) BeamMaster Rotation Mount BeamMaster C-Mount Adapter Plate BeamMaster Fiber-Optic Adapter Plate BeamMaster PCI Upgrade Kit

