COHERENT

User Manual

BeamMaster™-USB

Beam Diagnostics Measurement System

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BeamMaster-USB
Beam Diagnostics Measurement System

COHERENT.
27650 SW 95th Ave.
Wilsonville, OR 97070

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Preface

This manual contains user information for the BeamMaster™-USB Beam Diagnostics Measurement System.

U.S. Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification should be obtained from Coherent or an appropriate U.S. Government agency.

Publication Updates

To view information that may have been added or changed since this publication went to print, connect to www.Coherent.com.

Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word "***NOTICE***" is used when there is the risk of property damage:

NOTICE!
Indicates information considered important, but not hazard-related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

SECTION ONE: INTRODUCTION

In this section:

The BeamMaster-USB is a beam diagnostics measurement system for real-time measurement and display of CW lasers, fiber-optic, and laser diode beam profiles. The BeamMaster-USB is designed to provide maximum flexibility, speed, and user-friendliness for a variety of beam measurements. Measurements include: beam width, shape, position, power, and intensity profiles. Some of the applications include: beam alignment, on-line monitoring, gaussian fit analysis, beam position measurement, laser beam optimization, and quality control.

The BeamMaster-USB external box and software can be integrated into a variety of compatible PC computer platforms running under a Windows XP, Windows Vista, or Windows 7 operating system. The BeamMaster-USB system will meet a wide range of automated laser analysis requirements in the laboratory, factory, and field.

System Contents

A basic BeamMaster-USB system includes:

Detector Head

- BM-3 (InGaAs)—a three knife-edge head for the 800 to 1800 nm wavelength range.
- BM-3 (Silicon-UV)—a three knife-edge head for the 190 to 1100 nm wavelength range.
- BM-7 (InGaAs)—a seven knife-edge head for the 800 to 1800 nm wavelength range.
- BM-7 (Silicon-UV)—a seven knife-edge head for the 190 to 1100 nm wavelength range.

USB External Box

This device is used for connecting the various detector heads to the computer via a USB 2.0 port.

Installation CD

The CD includes:

- BeamMaster-USB software
- User manual (in PDF format)
- Readme.txt file
- Required support files

Printed Manual

Filter Kit

The BM-7 and BM-3 Silicon heads come with two NG neutral density filters. The NG4 & NG9 filters are provided to extend the power range of the head from 5 mW to 1W. The NG4 filter comes pre-installed and provides 10% transmission at 633 nm. The NG9 is in a protective filter case and provides 0.5% transmission at 633 nm. The filter kit also includes a hex wrench that can be used for swapping the filters, a filter blank for 100% transmission, and filter transmission data.

Mounting Post

The mounting post is 105 mm long and has an 8-32 thread. The post is used for mounting the detector head.

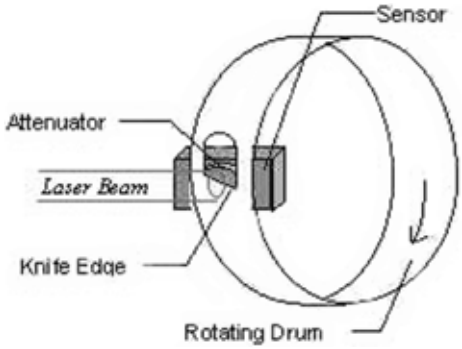
Declaration of Compliance to CE Mark

This system can be ordered pre-installed in a variety of computer configurations

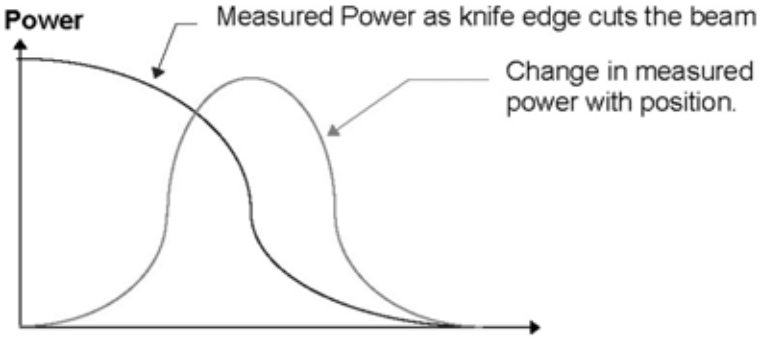
Theory of Operation

The BeamMaster-USB measures beam intensity profiles, widths, position, power, and the basic beam shape of CW lasers. The detector head utilizes multiple knife-edges to scan across the beam and capture the intensity distribution of the laser.

A simplification of a BeamMaster-USB detector head is shown below.

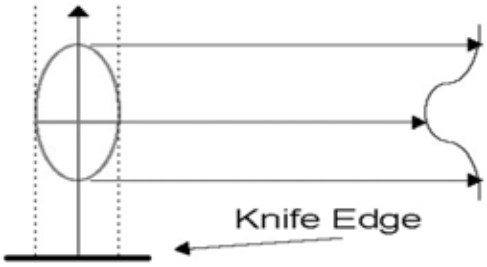


The rotating drum contains multiple knife-edge apertures (only one is shown in this diagram). As an aperture passes between the laser beam and the stationary power sensor, there is a period where the entire beam is allowed to reach the sensor. At this point, the BeamMaster-USB can measure the total power of the beam. As the aperture is scanned across the beam, the knife-edge blocks off an increasingly larger portion of the beam power. The power sensor measures this change in power versus knife-edge position, creating a power versus position plot, as shown below.

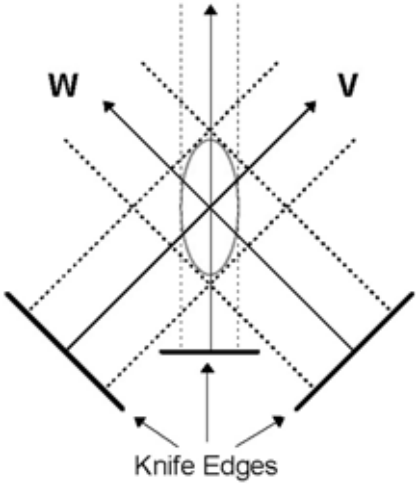


The analog power reading is digitized with a high speed A/D (Analog-to-Digital) converter. At the same time, the exact position of the knife-edge is monitored so that beam width information can be determined. The beam profile for each knife-edge is then obtained in software by taking the derivative of the measured power curve. The beam profile is perpendicular to the knife-edge and each

point of the profile is the sum of all intensities along the axis of the knife-edge at that knife- edge position. The digitized beam profiles are then stored in memory.



The BeamMaster-USB obtains profiles from multiple knife-edges at different orientations and has the ability to use this information to create 2D and 3D plots of the beam. The mathematical reconstruction process is known as "Reconstructive Tomography." The same type of process is used by X-ray systems to create X-ray images. A larger number of knife-edges will create better detail on non-gaussian beams. For a beam distribution that is significantly non-gaussian, the standard seven knife-edge system can reconstruct a plot that closely matches the real beam.



There are two primary knife-edges used for the main profile display. These knife-edges generate profile—referred to as W and V—that are set perpendicular to each other and are oriented at 45 degrees in relation to the base of the head. These profiles are used to provide beam width, position, and gaussian fit analysis. The other knife-edges are used for reconstructive tomography.

To increase the usable power range of the Silicon heads to 1W, the NG4 (~ 10% transmission) and NG9 (~ 0.5% transmission), filters can be inserted between the knife-edge and the sensor. This location will prevent the attenuation from distorting the beam, since it is behind the scanning plane.

The data is combined with user-selected graphics and calculated analysis results for display in a user-controlled window. A wide variety of system functions also provide the ability to print information, perform pass/fail testing, control capture rates, and log data.

BeamMaster-USB and Beam Diagnostics

Two general types of instruments measure laser beam intensity. The following paragraphs explain the strengths and weaknesses of both measurement techniques. The BeamMaster-USB bridges the gap between the two techniques.

CCD Array Camera Diagnostics

Camera-based diagnostics use an array of sensor pixels to measure simultaneously the intensity over the face of the entire laser beam. This allows them to capture data from pulsed lasers and display the data in 2D contour plots and 3D views. The pixels are of finite size (6 to 12 μm) and the smallest measurable beam size is typically 40 times larger than the pixel. CCD camera-based diagnostics are very sensitive and require high optical density laser grade filters to prevent saturation and beam distortion. In some cases, this is not desirable or practical.

Scanning Aperture Diagnostics

Scanning Aperture Diagnostics operate with either knife-edges or slits. The knife-edge method is described in “Theory of Operation” (p. 1-3). The Slit method is similar to the knife-edge method but uses a very narrow slit instead of a knife-edge. These systems usually obtain one or two high-resolution beam profiles from which accurate measurements can be made. The resolution along the scanned profiles is very high compared to camera systems, enabling resolution in “tenths of microns” instead of “tens of microns” in a camera system. Consequently, they can measure beam widths down to several microns. Their dynamic range is much larger than CCD camera systems, enabling measurement at relatively high power. They are unable to provide true representative 2D intensity contour plots of the beam. They are unable to measure pulsed lasers, but offer measuring capabilities at wavelengths where the CCD cameras cannot work, utilizing sensors other than silicon.

BeamMaster-USB Solution

The BeamMaster-USB bridges the gap between CCD and scanning aperture beam diagnostics. The BeamMaster-USB is based on Scanning Aperture technology so it has all the benefits of a Scanning Aperture System, but is enhanced with a patented multiple scanning knife-edge system. Unlike standard Scanning Aperture systems, the

seven scanning knife-edges and a mathematical process called "Reconstructive Tomography" provide 2D and 3D reconstructions of CW laser beams. Because the BeamMaster-USB uses knife-edges as opposed to slits, it can measure laser power. BeamMaster-USB can also measure beams up to 1 watt with its unique ability to insert filters behind the scanning knife-edge, thus preventing distortion of the beam measurement.

SECTION TWO: SETUP

In this section:

Hardware Installation

Before installing the BeamMaster-USB hardware into the computer, make sure the PC computer system meets the requirements listed under "System Requirements" (p. 2-2).

NOTICE!
The BeamMaster-USB warranty is void if a power-protection outlet (surge protector) is not used. A surge protector will protect the BeamMaster-USB from high-voltage spikes, power fluctuations, and surges associated with laser laboratory equipment.

Care and Handling

Detector Head

The detector head is a precision instrument and should be handled with care. If the head is dropped it may be damaged. When not in use, keep the cap over the aperture to prevent dust from accumulating on the sensor and the knife-edges. The knife-edges are delicate and will be damaged if they hit any object. The filters, (if provided) are the only objects that may be safely inserted into the detector head. Do not remove the covers, since the internal systems are delicate and can easily be damaged.

Filters

Filters are provided with the silicon versions of the detector heads. These filters have been precisely calibrated to a particular BeamMaster-USB head; therefore, they share the same serial number. Dust, scratches, and other types of contamination will degrade the accuracy of the system. Keep unused filters in the storage case. Be gentle when handling these fragile items—see “Selecting a Filter” (p. 2-4) for more information.

Laser Safety

WARNING!
Comply with all relevant laser safety procedures and precautions when using this device. The instrument will reflect a portion of the laser light and the resulting diffuse and specular reflections may be dangerous.

System Requirements

To run the BeamMaster-USB, the computer system must meet the minimum requirements shown in the following table. Where helpful, there are also system recommendations.

Table 2-1. Hardware Requirements

	Minimum Requirement	Recommended
CPU	Pentium IV Core 2	Pentium IV Core 2 Duo
System RAM	1 GB	2 GB
CD drive	Required	
Hard disk	200 MB free	300 MB free
Operating system	Windows XP, Windows Vista, or Windows 7	
Mouse	Microsoft mouse or compatible pointing device	
VGA	128 MB memory	512 MB memory
High speed USB 2.0 port	Required	

Installing the Software

To install the software:

1. Insert the CD disk into the CD-ROM drive and wait for an automatic start of the BeamMaster-USB installation process.
2. Follow the on-screen instructions.
3. When the following screen appears, fill in your user name, company name, and the system serial number (available on the system CD).

Note: If a window similar to the one shown below appears, click the "Install this driver software anyway" button to continue the installation.

Connecting the Detector

The detector head has a cable with a 15-pin connector. The detector cable is connected to the corresponding 15-pin connector on the USB external box.

Selecting a Filter

When a *Silicon* head is ordered with a BeamMaster-USB, it will come with two filters. This section will help the user determine which filter to use. Here is the general guideline:

No filter: **Power up to 5 mW**

NG4 filter: **Power up to 50 mW**

NG9 filter: **Power up to 1 W**

The actual filter transmission is dependent on wavelength and can also vary from batch to batch. The transmission values for a particular wavelength can be found in the filter files included with the software (NG4.FLT and NG9.FLT).

Focused Spot

When measuring a focused beam at a focused spot, the system will usually need attenuation. A convenient way to determine the correct attenuation is to first measure the power of the beam before focusing and then focus and measure the power with the detector head using the NG4 10%. If the power reading is low by more than 10% of the unfocused reading, use the NG9 0.5% filter. The power densities associated with focused beams can easily saturate the silicon detector. A saturated detector output will result in a low power reading.

Installing the Filters

1. Remove the blank filter plate with the supplied Allen wrench.
2. *Carefully* insert the desired filter
3. Secure the new filter with the Allen wrench.

NOTICE!
Dust, scratches, and other types of contamination will degrade the accuracy of the filters. Keep unused filters in the storage case.

Custom Filters and Power Calibration

A custom filter file can be made to accommodate other filters for absolute power calibration. See help for “Create Filter File” under the File menu.

Installing the USB External Box

Windows XP

1. Plug the BeamMaster-USB external box into a high-speed USB 2.0 port.
2. Insert the USB connector into the USB port of the computer. When the following message appears, press the Next button.

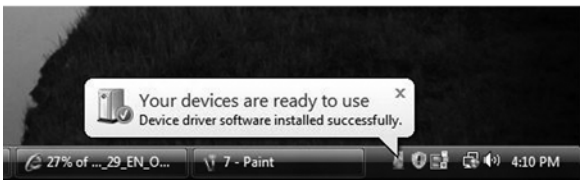
3. Click the Finish button on the following screen.

4. Click the Next button on the following screen.

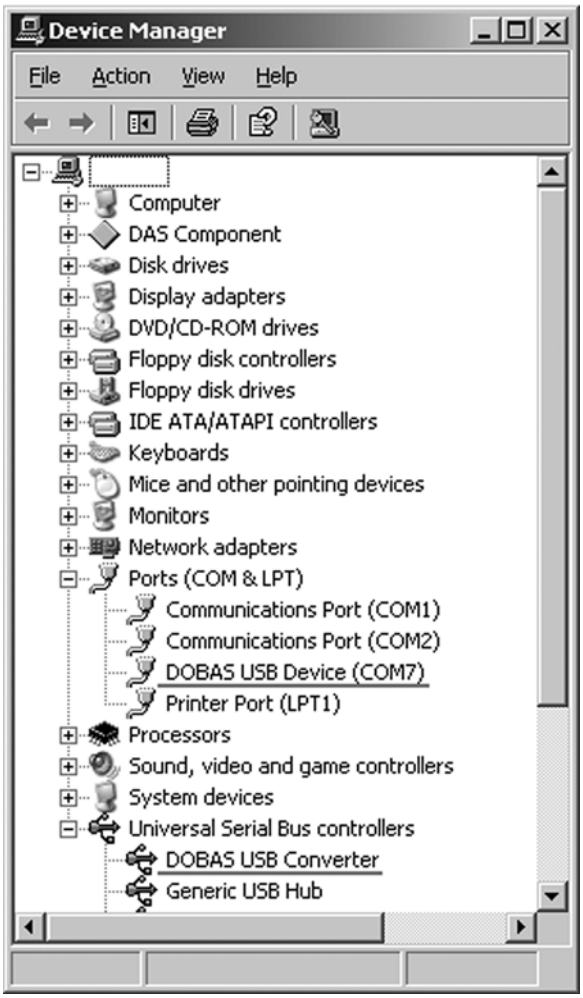
5. Press the Finish button to complete the installation.

Windows Vista and Windows 7

1. Plug the BeamMaster-USB external box into a high-speed USB 2.0 port.
2. Insert the USB connector into the USB port of the computer. The following messages display:



3. After completion of the installation, verify that the device was properly installed by looking under System Properties, Device Manager Tab (DOBAS USB Device), as shown below:



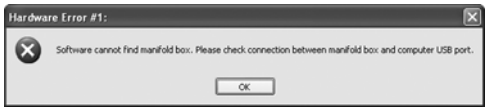
Running the Software

To run the software, do one of the following:

- Click on the BeamMaster-USB icon ( ) on the desktop, or
- In Windows, click Start, select Programs, and then choose BeamMaster-USB from the list.

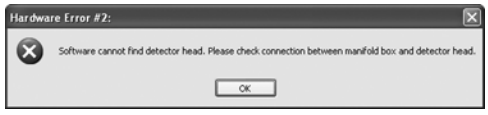
The following Welcome screen is displayed:

The software will perform a hardware check and will display the following error message if the USB manifold box is not found:



If there is no error, the software performs a test to identify the measuring head being connected to the USB manifold box:

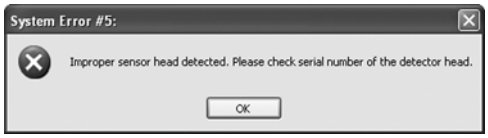
If the software cannot detect a measuring head, the following error message displays:



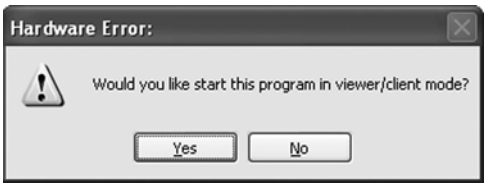
If there is no error, the software performs a test to identify the measuring head type being connected to the USB manifold box:

The screen shown below will appear only in one of the following cases:

- Whenever a measuring head is being connected to the manifold box and the calibration files in use do not match. If this is the case, you will need to change the head S/N—refer to "Add Detector Head" (p. 4-71) for more information.
- When the measuring head is malfunctioning. If this happens, contact Coherent—refer to "Obtaining Service" (p. 10-2) for contact information.



The following error message appears when the hardware test is completed and no hardware was found. In this case, you can start the software in Viewer/Client mode by clicking the Yes button.



Several common symptoms result from a conflict with the USB external box. If your symptoms match one of those listed below, proceed to the suggested section:

- Hardware failure error in the toolbar. See "System Errors" (p. 7-1) for possible solutions.
- If the BeamMaster-USB software was working at one time and has now stopped working, connect the USB external box to another USB port and see if that solves the problem. If the problem persists, contact Coherent—refer to "Obtaining Service" (p. 10-2) for contact information.

Configuring the Software

Before capturing data, configure the following settings in the software to insure a successful first run of the BeamMaster-USB.

From the System menu, select System Setup:

- Enter the wavelength of the test source.
- Choose an industry standard Clip level (13.5 or 50%).
- You may increase the average if values vary more than desired—refer to “Average” (p. 4-66) for more information.
- Using *Run* mode captures continuously and is best for general operation. Using *Step* mode captures only one measurement data when a user clicks a button.

There is no longer a configuration for “High Resolution” measurement for beams < 100 µm, as was previously required with the PCI version of BeamMaster. Measurements for all beam sizes are performed in high resolution mode with the BeamMaster-USB.

SECTION THREE: OPERATION

In this section:

When the BeamMaster-USB application is started, the main BeamMaster-USB window appears. The BeamMaster-USB window consists of display and control elements similar to most Windows applications, along with elements specific to the BeamMaster-USB interface.

The main elements of the BeamMaster-USB window interface are shown in the following figure:

Figure 3-1. BeamMaster-USB Window Interface—Main Elements

Title Bar

The Title Bar displays the name, "BeamMaster-USB," followed by the detector head type and serial number. The Windows operating system provides special controls in the title bar of a window. From the title bar, the main window can be closed, moved, sized, minimized to icon form, or maximized to fill the screen. For more information on these controls see the Windows manual or find the Windows Tour program.

Menu Bar

The Menu Bar lists menus available for the BeamMaster-USB software. The menus listed in the Menu Bar contain items that allow specific actions to be performed. Sub-menus or dialog boxes may result from a menu item selection. These secondary items provide various controls of such functions as graphics, analysis, configuration setup, etc.

Selecting a Menu

There are three ways to select a menu:

1. Press ALT and then the arrow keys, then Enter.
2. Hold down the ALT key and press the underlined letter (hot key) in the desired menu item.
3. Press a shortcut key combination. Shortcuts are available for some menu items and are displayed next to the menu item.

Tool Bar

The tool bar is a collection of shortcut buttons to menu items that are frequently used. Each shortcut is represented with a special icon (picture) called a *tool button*.

To activate a tool button, place the mouse over the button and click the LEFT mouse button. The button will change both color and shadow to designate the function is active. To view the function of any icon button, place the cursor on the icon and wait momentarily—a brief function description will appear near the icon.

Tool Bar Buttons

The following buttons are available on the tool bar:

Figure 3-2. Tool Bar Buttons

Inactive Tool Buttons

If a tool is not available, it will be displayed in a gray outline form. The Log button requires setup information to be available. The Step button will not be available unless the system is set in Step Mode.

Start Log (disabled)

Step (disabled - so system is in RUN mode)

Toggle Tool Buttons

The toggle group of tool buttons will turn display windows ON and OFF. These tool buttons act as a toggle switch. When the corresponding window is active, the button will appear to be pushed down. When the corresponding window is not active, the button appears in the UP position.

 W profile ON

 W profile OFF

Hide the Tool Bar

See “Tool Bar Command” (p. 3-3).

System Errors

System errors are displayed in the data and time location, when necessary. See “System Errors” (p. 7-1) for more information.

Date and Time

The current date and time are presented on the right side of the tool bar. System errors are also displayed in the date and time location, when necessary. See “Status Bar Panels” (p. 3-4).

Tool Bar Command

The tool bar can be hidden or shown by selecting Tool Bar from the View menu, or using the Shift + Insert keyboard shortcut.

This option enables the user to toggle between Show Tool Bar and Hide Tool Bar.

When the Tool Bar is selected (Activated), there is an additional line on top of the window containing Tools (picture shortcuts to some of the most commonly used system functions), along with date/time information.

When this option is not selected, the Tool Bar line disappears. In this case the user has to activate the various system functions from the menu or via keyboard shortcuts.

Window Area

The Window Area is utilized for the graphical display windows. The BeamMaster-USB windows can be arranged in any configuration. The Windows can show beam profiles, position diagrams, 2D and 3D contours, charts, and a power meter. Interactive mouse control of each window allows a variety of customized configurations.

Arranging Windows

Several special commands for arranging windows can be found under the Windows menu. See "Windows Menu" (p. 4-72).

Status Bar

The Status Bar is located at the bottom of the BeamMaster-USB window. It indicates the current status of key system measurement, configuration, and operational parameters.

If the BeamMaster-USB system is not operating as intended, the Status Bar provides a quick summary of why it is not functioning properly; for example, the laser being used may have a different wavelength. The Status Bar is a valuable aid in diagnosing unexpected results and can quickly help you get back to desired operation.

Figure 3-3. Status Bar

The Status Bar also provides quick access to System setup parameters. Click the current Wavelength value to access System setup. Toggle between Run/Step modes by clicking the current mode on the Status Bar.

Status Bar Panels

Date & Time—The current date and time are presented on the right side of the Tool Bar. This information is shown in American Standard format.

Wavelength—This panel will display the current wavelength—refer to "Wavelength" (p. 4-65).

System Clip Level—The clip level displayed on the Status Bar corresponds to the System Clip Level. The System Clip Level is utilized to calculate beam diameter on the Chart window, etc. See "Clip Level" (p. 4-66).

Average—The displayed Average value corresponds to the number of samples averaged before calculation and display—see "Average" (p. 4-66).

Head Tilt—The Head Tilt value corresponds to the user-entered value for the current detector head azimuth rotation—see "Head Tilt" (p. 4-67).

Run/Step—The Run/Step display indicates the current mode of data collection. If the screen does not appear to update, verify that the system is not set to Step Mode—see "Mode" (p. 4-67).

Filter—The current Filter selection is indicated. See "Create Filter File" (p. 4-2).

Power—The Power reading display is indicated. See "Power Setup" (p. 4-26).

To hide or show the Status bar, read the information under "View Status Bar," next.

View Status Bar

The Status Bar can be hidden or displayed by selecting Status Bar from the View menu or using the Ctrl+Insert keyboard shortcut.

This option enables the user to toggle between Show Status Bar and Hide Status Bar.

When Status Bar is activated, there is an additional line appearing at the bottom of the window. This line contains panels displaying general system information and user settings.

Keyboard Operation

 The keyboard can be used to enter text data or control most BeamMaster-USB functions utilizing keyboard shortcuts.

Help

Press the F1 keyboard key to obtain Help on the active window.

Selecting a Menu Item

Use one of the following methods to select a menu item:

- Press ALT and then the arrow keys and then Enter to select a menu item.
- Hold down the ALT key and press the underlined letter (hot key) in the desired menu item.
- Press a shortcut key combination. Shortcuts are available for some menu items and are displayed next to the menu item.

Closing a Menu

To close a menu, press the ESC key.

Dialog Boxes

Text Entry

Select the text box you wish to change. Use the keyboard to enter the desired text. When the correct text has been entered, press the TAB key to finish data entry and move to the next control in the dialog box. If an error is made while typing text, pressing the BACKSPACE key will remove the character to the left of the text cursor and move the cursor to the erased location. See also "Value Entry Box" (p. 3-8) for changing spin buttons.

ESC Key

This key is used to select the Cancel button in a dialog box. This function resets settings to their previous values before the dialog box was opened.

ENTER Key

This key is used to select the OK button in a dialog box.

TAB Key

This key moves the input focus to the next control in a dialog box.

The following table summarizes all the software shortcuts and control keys:

Table 3-1. Software Shortcuts and Control Keys (Sheet 1 of 2)

Command	Description	Shortcut	Icon
Load Configuration File	Displays Open dialog to load a (*.ini) configuration file	Ctrl+O	
Save Configuration File	Displays Save dialog to save a (*.ini) configuration file	Ctrl+S	
View File	Displays Open dialog to view a log file	Ctrl+V	
Create Filter File	Starts the Create Filter File process	Ctrl+A	
Print Text File	Displays an Open dialog to load and print any saved Beam-Master-USB file in text format	Ctrl+P	
Print BMP File	Displays an Open dialog to load and print any saved Beam-Master-USB file in .bmp or .jpg format	Ctrl+B	
Setup Data Collection	Displays the Data Collection Setup dialog		
Start Data Collection	Starts the Data Collection process		
Print Screen	Prints the entire screen	Ctrl+F12	
Exit	Exits the BeamMaster-USB software	Ctrl+X	
Add Detector Head	Add Detector Head dialog	Ctrl+D	
Start Link	Starts the RS-232 Link communication	Ctrl+K	
Slave Mode	Activates the Slave Communication mode	Ctrl+M	
Help Active Window	Displays Help information on current active window	F1	
View Power	Displays Power window	F2	

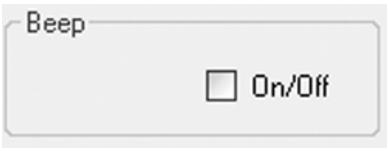
Table 3-1. Software Shortcuts and Control Keys (Sheet 2 of 2)

Command	Description	Shortcut	Icon
Profile V	Displays Profile V window	F3	
Profile W	Displays Profile W window	F4	
Plot	Displays the Power Plot window	F7	
Step	Increments the Step display if the system is in Step mode	F9	
Test	Opens the Test window		
Print Window	Prints the current active window	F12	
ToolBar	Toggles the Tool Bar on and off	Shift+Insert	
Status Bar	Toggles the Status Bar on and off	Ctrl+Insert	
Close All Windows	Closes all active windows	Ctrl+W	
About	Displays the BeamMaster-USB About dialog	Shift+F1	
Search For Help For	Activates the BeamMaster-USB Help search function	Ctrl+F1	

Methods of Data Entry

Check Box

Use the following selection method to turn an option ON:



A check box is utilized in cases when there is a need to toggle a parameter ON or OFF. When the parameter is active, a check mark (✓) is displayed inside the option box.

Place the mouse cursor at the option box and click the LEFT mouse button. Click the LEFT mouse button again to deactivate the selection. The check mark is than removed from inside the box.

Highlight the required parameter box by pressing the TAB key. Press the SPACEBAR to toggle the Check Box parameter.

Radio Button

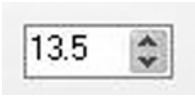
Use this typical radio button entry to select a value from a short list of options:

Move the mouse cursor and place it at the required option. Click the LEFT mouse button once to select the option.

Move the cursor to the required option—either by moving the mouse or by pressing the TAB key—until the cursor is within the option list zone. Press the arrow keys to select the option from the list.

Value Entry Box

Use the Value Entry Box to set a digital value parameter:

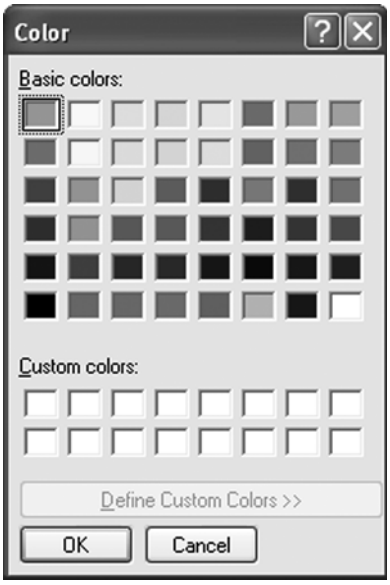


Place the mouse cursor at either the Up or Down arrow buttons displayed to the right of this box, and then click the LEFT mouse button to change values for the selected parameter.

Move the cursor to the required data box either by moving the mouse or by pressing the TAB key. Type the desired value. The ENTER key may change the value to meet the system requirements.

Color

The Color option enables the user to set the background color, data color, and plot color for the various windows. Select the desired color from the standard Windows color pallet. Custom colors are also available with the appropriate video card and Windows color setting.



The Position, Profile W, and Profile V windows allow the selection background, data, and plot color. The Power and Projection windows allow for the selection of background and data color. Plot and Chart windows allow for the selection of background and plot colors.

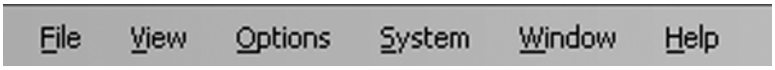
Selecting a Color

Place the mouse cursor over the desired Color Box and click the LEFT mouse button once. Press and hold the Preview button to view the selected colors without accepting the settings and exiting the dialog.

SECTION FOUR: MENUS AND COMMANDS

In this section:

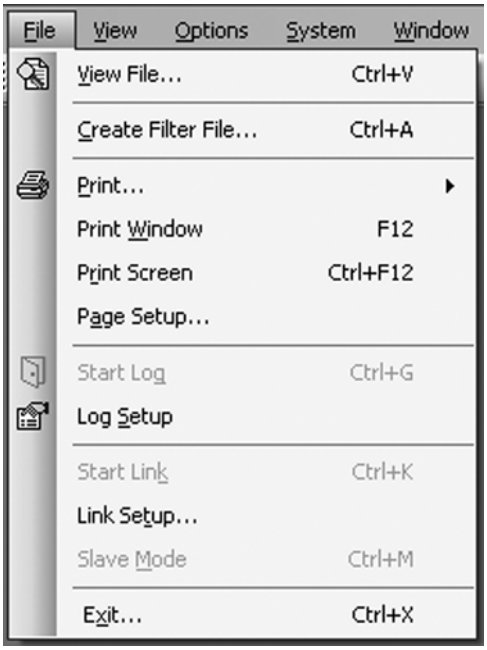
The following Command menus are available on the Beam-Master-USB Menu Bar:



File Menu

The File menu allows the user to perform many file operations.

The following commands and menu items are available from the File menu:



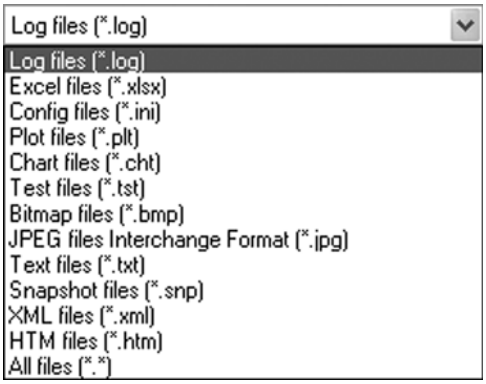
View File

This option provides the user with the ability to view any stored file, including: Data Log, Power Plot, Width/Position strip chart, Test, Profile Snapshots, and .ini files.

To access this option:

1. Select the View File menu item from the File menu. Alternatively, press the CTRL + V keys or click the  button on the Tool Bar. A standard Windows file dialog will display.

2. Select the "File Type" for the file to be viewed.



The dialog will default to the BeamMaster-USB directory where the files are typically located.

3. Click on a file from the list on the left.

4. Click OK. The file can now be displayed in the Notepad application.

Create Filter File

This option enables the user to define a new optic filter file (Filter).

To access this option:

Select the Create Filter File from the File menu or press the CTRL + A keys.

Because silicon detectors saturate easily, it is frequently necessary to insert one or more filters in front of the detector to attenuate the beam and prevent saturation. The wavelength response of these filters is not flat, so it is necessary to install the transmission properties of the Filter in the software to obtain proper power measurement and gain setting for the detector amplifier.

Filter File Contents

The Filter file contains a table with two columns. The first column is the wavelength (in 1 nm, or larger, steps). The second column is the known transmission of the filter for the corresponding wavelength. The BeamMaster-USB software uses straight-line interpolation to determine transmission values for wavelengths that lie between wavelengths listed in the file.

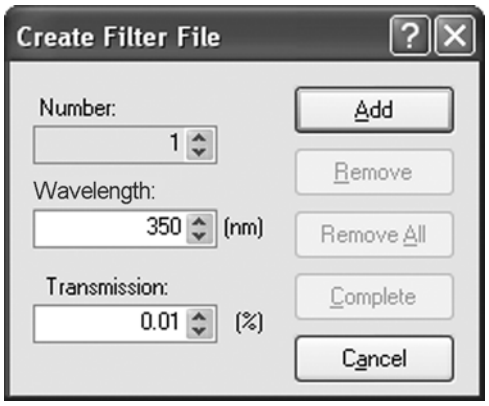
Absolute Power Calibration

A filter file can be created to provide power calibration. First measure the power of the beam with a calibrated power meter. Then measure the reported power with the BeamMaster-USB Power Window—see "Power" (p. 4-22)—with the Filter option OFF—see "Filter" (p. 4-23). Now perform the following calculation and use the % transmission value obtained when creating the filter file.

% Transmission Value = (Real Power / BM Power) * 100

Creating a New Filter File

1. Select Create Filter File from the File menu (or press the CTRL + A keys).



2. There are 3 Value Entry boxes: line number, wavelength (nm), and transmission value (%). The data box labeled "Number" starts with the line number value "1".
3. Type a value for wavelength, or change it by using the arrow keys in this data box. If a wavelength outside the operating range of the detector head is entered, a warning will be displayed.
4. Type the percent transmission, or change it by using the arrow keys in this data box.
5. Press the Add button to insert the next data line into the Filter file. The data box labeled as "Number" will display the value

of "2." Go back and repeat steps 3, 4, and 5 until all the desired wavelength/transmission points have been entered.

6. Press the arrow keys in the data box labeled "Number" to navigate the entered points of the new filter file. You can use the Remove button to delete a current point in the filter file or the Remove All button to delete all points.

7. Press the Complete button when you are done with the Filter creating procedure. BeamMaster-USB will then display a file storage dialog. Press the Cancel button to cancel attenuation data file creation.

8. In the file dialog there is no need to change the "File Type" because FLT is the default.

9. The BeamMaster-USB data files are located in the "Data" folder in the BeamMaster-USB directory. By default, the BeamMaster-USB directory is located in "Program Files."

10. Type a filename for the filter file in the box below the word "File name". There is no need to have the file name end in .FLT because the program will automatically save the file with a .FLT extension.

11. Click the Ok button.

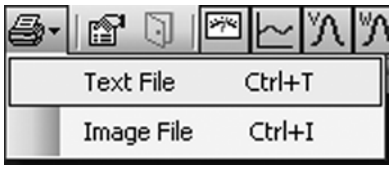
Print

Print allows the user to print an entire saved data file. Saved data files include a pre-saved text file or a pre-saved image file.

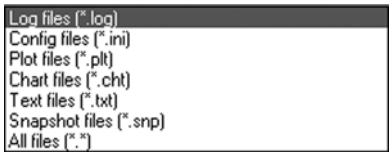
Printing a Text File

1. Select the Print menu item from the File menu, press the CTRL + T keys, or click the  tool bar button.

2. Select the Text File menu item.



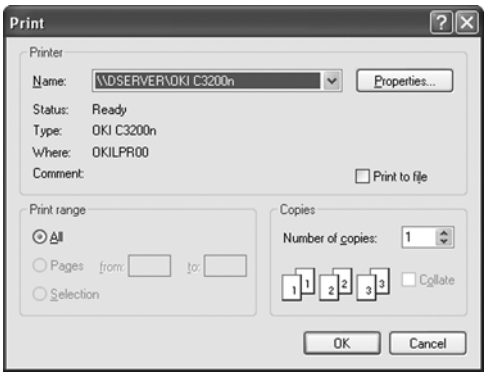
3. Select the "File Type" for the file to be printed.



The BeamMaster-USB data files are located in the "Data" folder in the BeamMaster-USB directory. The BeamMaster-USB directory is located in "Program Files" by default.

4. Click on the desired file from the file list on the left.

5. Click the OK button. A standard print setup dialog is displayed.

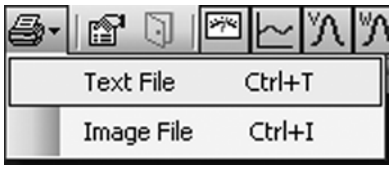


6. Select the printing variables and then click the OK button.

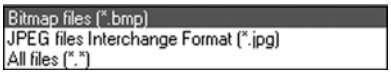
Printing an Image File

1. Select the Print menu item from the File menu, press the CTRL + I keys, or click the  tool bar button.

2. Select the Image File menu item.

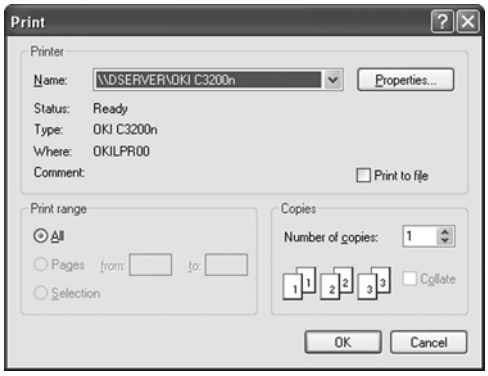


3. Select the “File Type” for the file to be printed.



4. Click on a file from the file list.

5. Click the OK button. A standard print setup dialog is displayed.



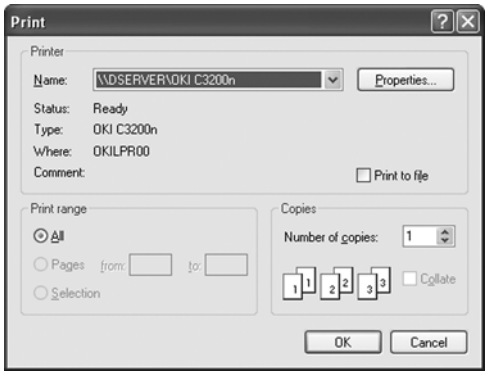
6. Select the printing variables and then click the OK button.

Print Window

Print Window enables an immediate printing of the active window. The colored title bar indicates the current active window.

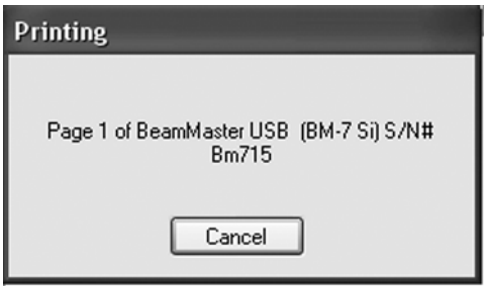
Printing an Active Window

1. Select Print Window from the File menu, or press the F12 keyboard shortcut to display a standard print dialog screen.



2. Select the printing variables and then click the OK button.

A message box “Printing...” is displayed when the window graphics is being transferred from the program to the printer via the Windows Print Manager.



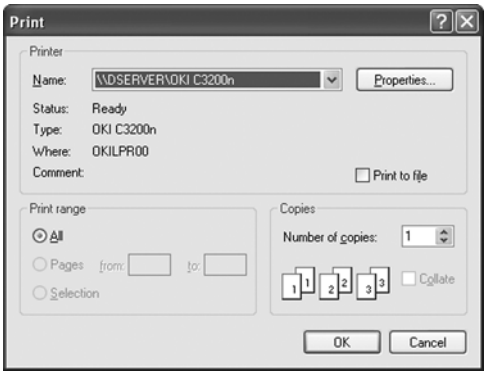
The time required for printing graphic screens in a Windows environment is dependent on the computer resources.

Print Screen

Print Screen enables an immediate printing of the current full screen display.

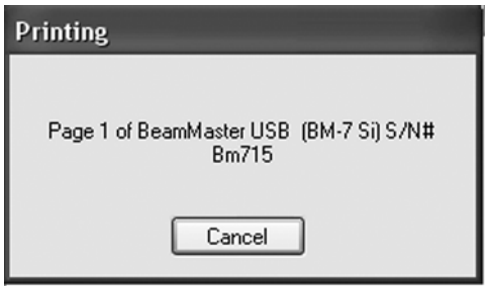
Printing a Screen

1. Select Print Screen from the File menu, or press the CTRL + F12 keyboard shortcut to display a standard print dialog screen.



2. Select the printing variables and then click the OK button.

A message box “Printing...” is displayed when the window graphics is being transferred from the program to the printer via the Windows Print Manager.



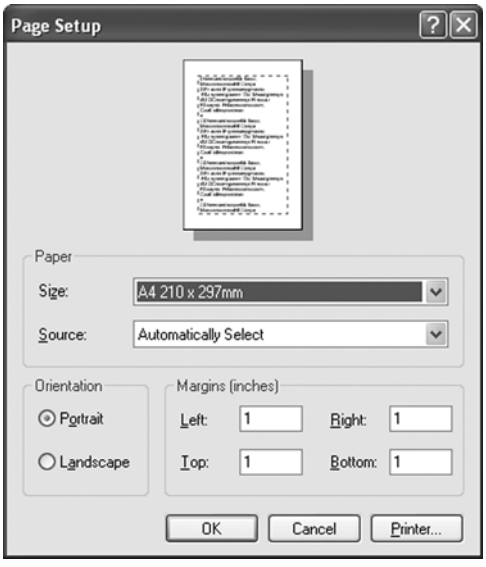
The time required for printing graphic screens in a Windows environment is dependent on the computer resources (speed and memory), on the printer’s internal memory and speed, and on the number and type of other Window application programs running at the time printing is initiated.

Page Setup

This option enables the user to set the orientation and paper size, and to load the appropriate driver from the standard Page Setup window.

Setting up a Page

1. Select Page Setup from the File menu to display the Page Setup dialog screen:



2. Change the necessary parameters on the screen and then click the OK button.

Start/Stop Log

This option enables the user to start or stop a log data file.

Starting/Stopping a Log Data File

- To start a log operation, select Start Log from the File menu or click the  button on the Tool Bar.
- To stop a log operation, select Stop Log from the File menu or click the  button on the Tool Bar.

Start Log is disabled until the following parameters are configured in the Log Setup (refer to Log Setup, below, for more information):

- The duration of the experiment
- The rate of data logging
- The Log filename

When the data saving process is active, a log banner is displayed on the top corner of the Tool Bar area.

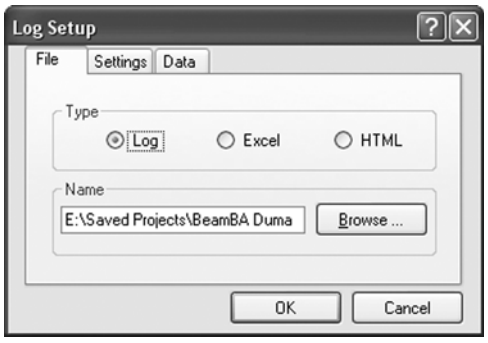
During data collection, the Start Log menu item and tool bar icon change to Stop Log.

Log Setup

This setup window allows the user to customize the log operation.

Customizing the Log Operation

1. Select Log Setup from the File menu or click the  tool bar button to display the Log Setup screen:

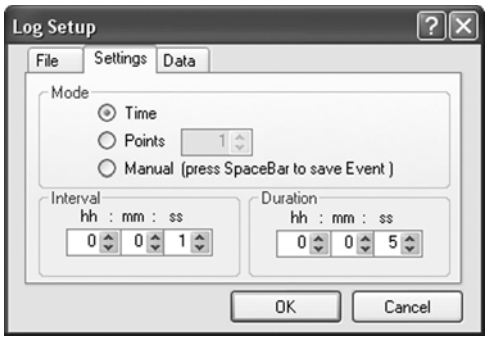


File Tab

- **Log Type**: Select the desired file type: Log file or Excel file. The Log file is saved in a standard text format. The Excel file is saved as an Excel Workbook.

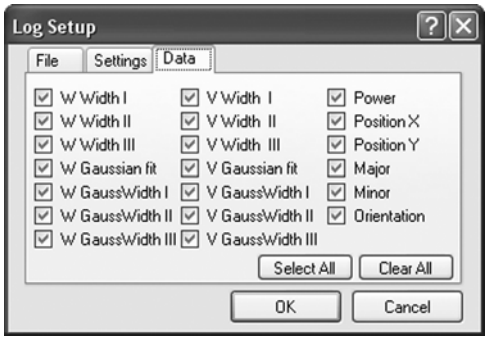
- **File name**: Click the Browse button to assign a file name and location for the data file.

Note: When LOG file type is selected, all data collected will be saved with the file extension *.log. The .log extension designates the data as a text file and can be imported into other programs. When the Excel file type is selected, data will be saved as a file name *.xls or *.xlsx, depending on the version of Microsoft Excel being used. When the HTML file type is selected, data will be saved in two files with *.xml and *.htm extensions for viewing in an Internet browser.



Settings Tab

- **Log Mode**: This mode selection determines the method of data collection. The Time mode selection allows data collection at a rate resulting from the interval and duration settings. The Points mode sets data collection according to the specified number of points. The Manual mode enables saving one single measurement by pressing the Space Bar button.
- **Interval**: The time interval determines the time between consecutive data points.
- **Duration**: The total amount of time required to complete the data collection.



Data Tab

- **Data**: Allows you to select the data that will be stored in a log file.

When the desired setup parameters are selected, click the OK button. The data collection process (Log file) is initiated by selecting the Start Log menu item—refer to "Start/Stop Log" (p. 4-9).

The end of each Log file contains a statistics summary, which includes: Minimum value, Maximum value, Mean value, and Standard deviation value for each parameter saved.

Log Setup is disabled while Log is in progress.

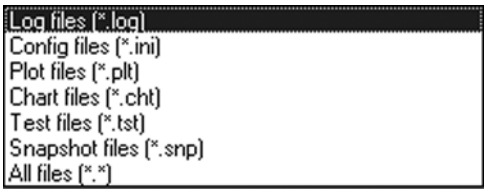
Press OK to confirm the selection or CANCEL to restore previous settings.

Start Link

The Start Link command provides the capability to operate an RS-232 communication channel for serial data transmission. Any displayed data or a pre-saved file can be transmitted when using Start Link. Typically this feature is used to transfer real time data from the BeamMaster-USB system to another computer over a null-modem serial cable. The other computer can receive the data using a program that can communicate over a COM port, like the Windows HyperTerminal program.

Transmitting a File Over RS-232

1. Connect the BeamMaster-USB system to another computer using a null-modem cable—see "Making a Null-Modem Cable" (p. 4-12).
2. Before using Start Link, set the Link parameters in Link Setup. Each link parameter must be configured to match the communications protocol of both computers receiving data.
3. Enable the receiving program to receive the data.
4. Select Start Link from the System menu. A standard Windows File box is displayed.



5. Select the "File Type" for the file that will be sent. There should be no need to change the directory because most files should be stored in the default BeamMaster-USB directory.

6. Click on a file from the file list on the left.
7. Click OK. A link status window will be displayed in the upper left-hand corner of the Window area.

The file is transmitted in the Background while BeamMaster-USB continues to capture data. When finished, the Linking status message will disappear. To stop a Link in progress, select Stop Link from the System menu.

Making a Null-Modem Cable

A null-modem cable can be made from a standard RS-232 cable by connecting the pins on one end of the cable to the pins on the other end, as shown in the following figures.

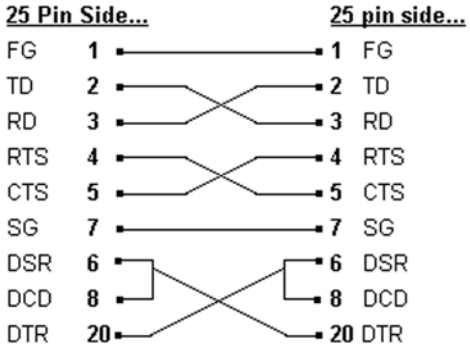


Figure 4-1. Null-Modem with 25 Pins on Both Sides

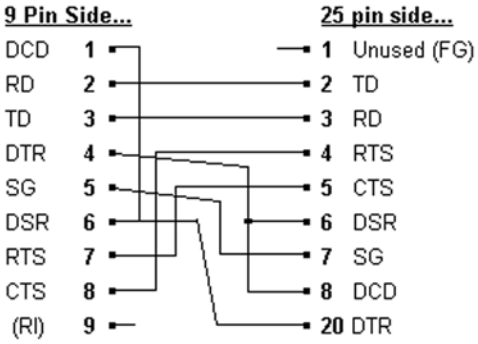


Figure 4-2. Null-Modem with 9 Pins on One Side and 25 Pins on the Other Side

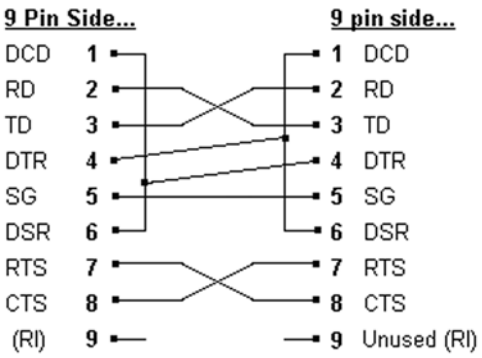
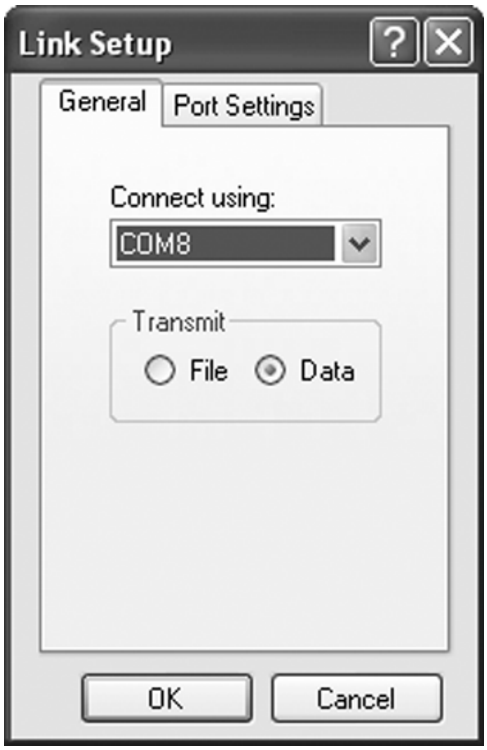


Figure 4-3. Null-Modem with 9 Pins on Both Sides

Link Setup

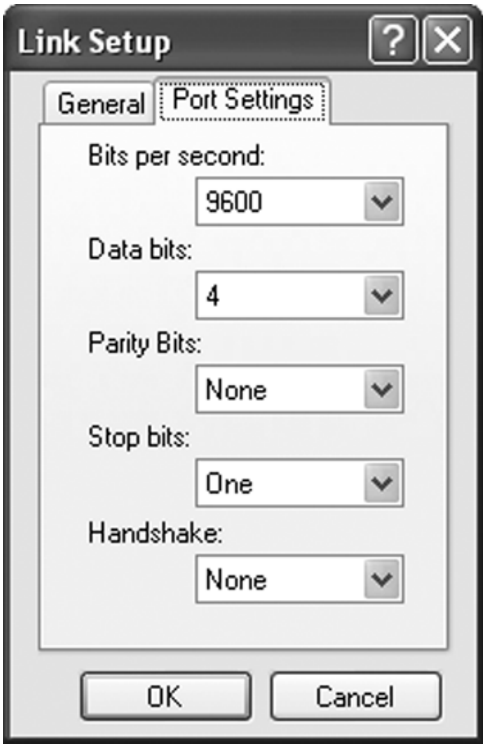
Link Setup allows the user to configure the system for a particular set of parameters needed for the RS-232 or TCP/IP transmission. The default values are typical for this kind of transmission and are show below.



General Tab

- **Connect using**: The COM port setting selects the port utilized for RS-232 transmission from the BeamMaster-USB-based computer.

Transmit: The Transmit radio button selection toggles the transmission type between transmit a file and real-time data.



Port Settings Tab

Use the settings on this tab to set RS-232 serial parameters.

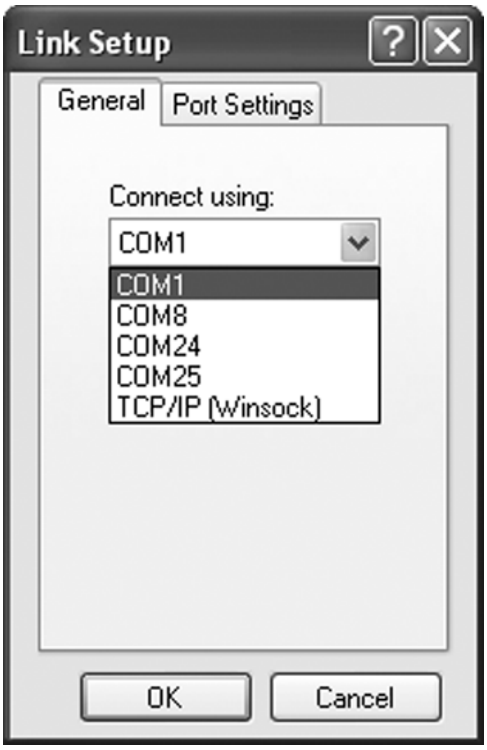
- **Bits per second**: This selection determines the transmission rate (baud rate) of the data transmission. See “Bits per second” (p. 4-16).
- **Data bits**: The Data Bits selection determines the number of data bits utilized for transmission. See “Data Bit” (p. 4-17).
- **Parity Bits**: This selection determines the parity bit utilized for robust serial communication. See “Parity Bit” (p. 4-18).
- **Stop bits**: This selection determines the number of stop bits utilized for transmission. See “Stop Bit” (p. 4-19).
- **Handshake**: Specifies the control protocol used in establishing a serial port communication. See “Handshake” (p. 4-20).

Press OK to confirm the selection or CANCEL to restore previous settings.

Port

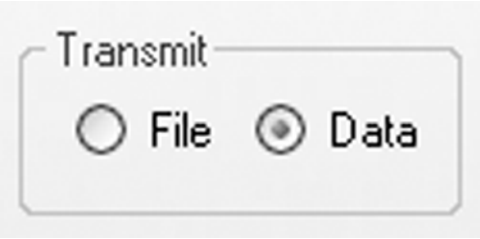
The Port selection option is accessed from Link Setup—refer to "Link Setup" (p. 4-13).

The Port setting is utilized to set the computer communication (COM) port for RS-232 data transmission or to choose TCP/IP transmit data method. *This setting should only be changed when utilizing the RS-232 or TCP/IP communication link.*



Transmit

The Transmit option is accessed from Link Setup—refer to "Link Setup" (p. 4-13). *This setting should only be changed when utilizing the RS-232 or TCP/IP communication link.*



The possible values for Link transmission port are: File and Data. Selection is made with radio buttons—see "Radio Button" (p. 3-8).

The Transmit setting is selected for either on-line transmission of live data, or transmission of a pre-saved text file. When data is selected, the system will send the following data, depending on the active window:

$ Time (x.x), Power (x.xxx), PositionX (x.x), PositionY (x.x), WidthV (x.x), WidthW (x.x), WaveValue, ClipLevel, Average, FilterName, SystemNumber

For example:

$ 2.4 0.375 230.5 400.1 1234.4 2345.5 633 13.5 4 NG4.FLT BM715

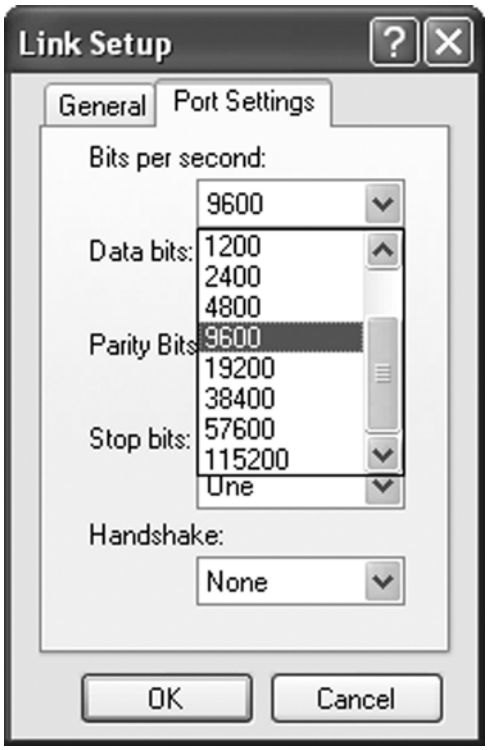
Note: To stop a link in progress, select Stop Link from the System menu.

Bits per second

This setting is accessed from Link Setup—refer to "Link Setup" (p. 4-13). *This setting should only be changed when utilizing the RS-232 communication link.*

Bits per second refers the transmission rate for the RS-232 link. The possible values are: 110, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.

This setting must match the corresponding setting on the receiving computer.

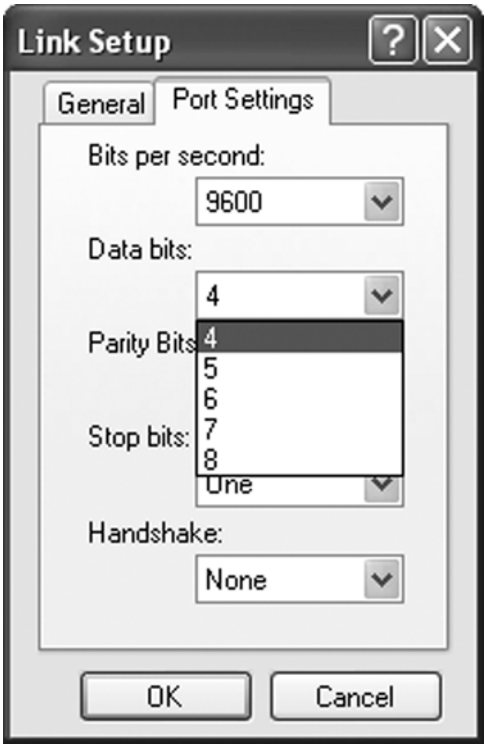


Data Bit

The RS-232 data bit selection is accessed from Link Setup—refer to "Link Setup" (p. 4-13). *This setting should only be changed when utilizing the RS-232 communication link.*

This setting determines the number of bits utilized for RS-232 transmission. The possible values are: 4, 5, 6, 7, and 8.

This setting must match the corresponding setting on the receiving computer.

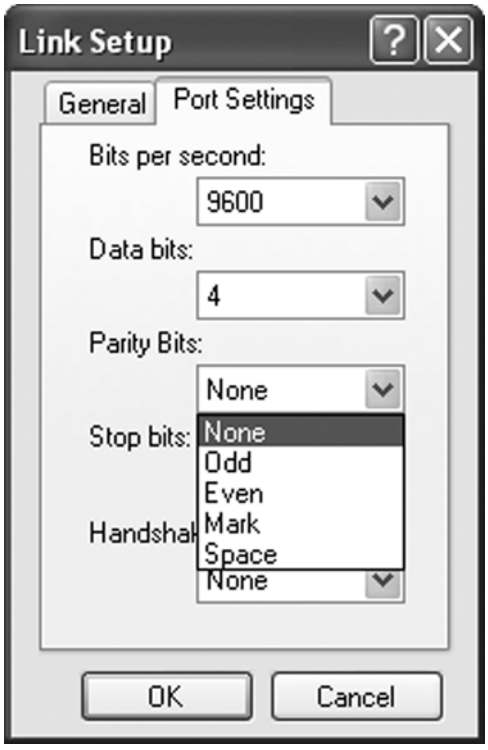


Parity Bit

The Parity Bit option is accessed from Link Setup—refer to "Link Setup" (p. 4-13). *This setting should only be changed when utilizing the RS-232 communication link.*

This setting determines whether or not a parity bit is to be transmitted. The possible values are: None, Odd, Even, Space, and Mark.

This value must match the corresponding setting on the receiving computer.

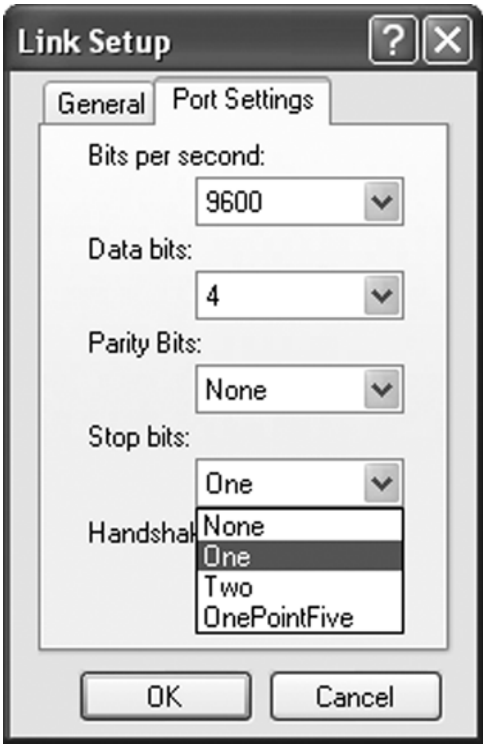


Stop Bit

The Stop Bit option is accessed from Link Setup—refer to "Link Setup" (p. 4-13). *This setting should only be changed when utilizing the RS-232 communication link.*

This setting determines the number of stop bits to be transmitted. The possible values are: One, Two, or OnePointFive.

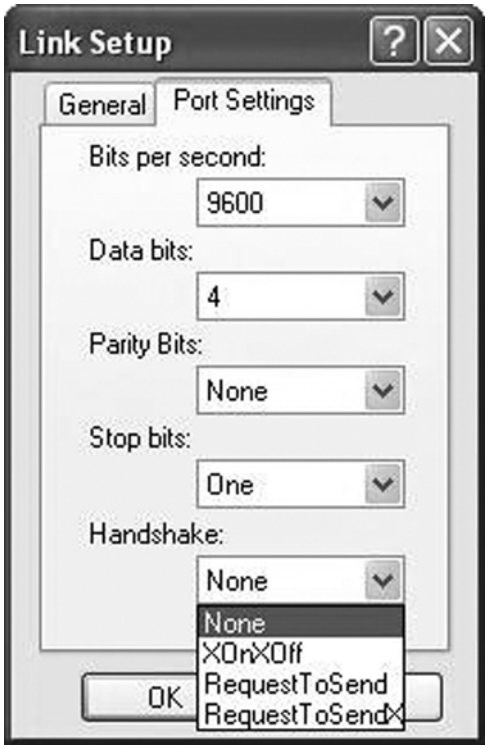
This value must match the corresponding setting on the receiving computer.



Handshake

The Handshake option is accessed from Link Setup—refer to "Link Setup" (p. 4-13). *This setting should only be changed when utilizing the RS-232 communication link.*

This setting must match the corresponding setting on the receiving computer.



- **None**: No control is used for the handshake.
- **XOnXOff**: The XON/XOFF software control protocol is used. The XOFF control is sent to stop the transmission of data. The XON control is sent to resume the transmission. These software controls are used instead of Request to Send (RTS) and Clear to Send (CTS) hardware controls.
- **RequestToSend**: Request-to-Send (RTS) hardware flow control is used. RTS signals that data is available for transmission. If the input buffer becomes full, the RTS line will be set to false. The RTS line will be set to true when more room becomes available in the input buffer.
- **RequestToSendXOnXOff**: Both the Request-to-Send (RTS) hardware control and the XON/XOFF software controls are used. Specifies the control protocol used in establishing a serial port communication.

Slave Mode

After selecting the Link Setup parameters, the user can activate the Slave Mode option from the File Menu. The keyboard shortcut for Slave Mode is CTRL + M.

Transmit parameter should be selected as Data.

After selecting the Slave Mode option, a status label will be displayed in the upper right-hand corner of the Tool Bar area.

To receive transmitted data at the master computer, either press the d key on the keyboard, or send the BeamMaster-USB program an ASCII code for d.

To terminate Slave Mode, unselect this option in File Menu (*terminate the Slave Mode from the BeamMaster-USB program*). The user can terminate the Slave Mode from the master computer by either pressing the s button, or sending ASCII code to the slave computer.

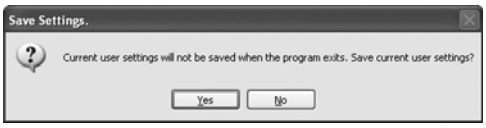
The receiving program at the master computer is not provided with the BeamMaster-USB product. It should be written according to the user's application needs.

Exit

The Exit function is selected from the File menu—refer to “File Menu” (p. 4-1). The keyboard shortcut is CTRL + X.

Use this option to terminal the BeamMaster-USB application.

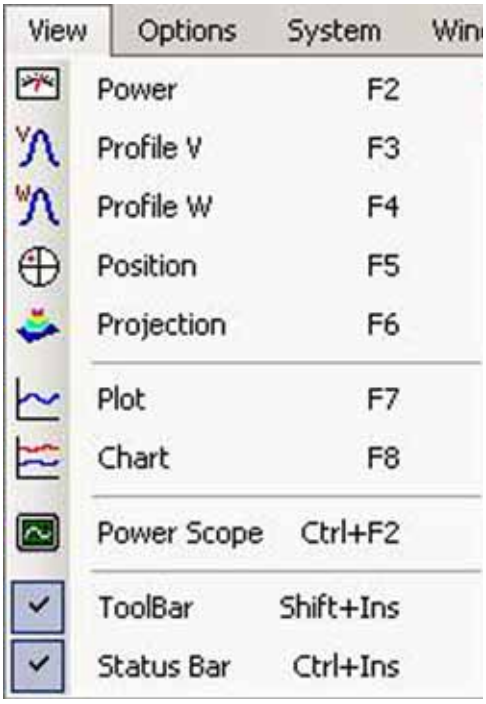
The following dialog is shown when you exit the program and Save Settings on Exit is not enabled—refer to “Options Menu” (p. 4-56) for information about the Save Settings on Exit option. It is a reminder to save the current setup parameters.



Select Yes to exit and save current user settings.

View Menu

The View menu operates the functional windows. The following commands and menu items are available from this menu:



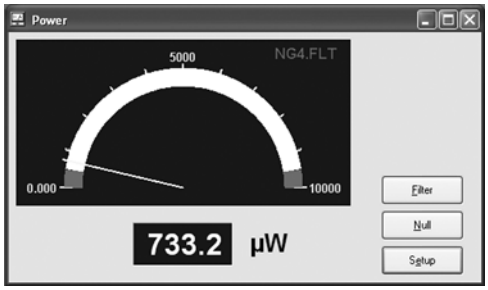
The corresponding keyboard shortcuts are shown to the left of the item. These shortcuts may be activated from the Main window by pressing the appropriate keyboard combination.

A check mark in front of a menu item indicates that the function is active.

A gray menu item indicates that item is unavailable. Conditions or Setup parameters may be required for the item to be active. Review other text in this manual text or help associated with the gray item for additional setup information.

Power

The Power window can be turned ON or OFF by choosing Power from the View menu, pressing the F2 keyboard shortcut, or clicking the  tool bar button.



The Power selection activates the power meter display window. The display shows real-time power as a needle graph or a digital value. Several buttons provide easy and quick control of the Power functionality.

Placing the mouse cursor over the Power display and pressing the left-hand mouse button twice changes the Position window to a graphical presentation, only without the measurement data display on the right-hand side of the window.

The power units can be selected by clicking on the units displayed in the Power window. Each mouse click will cycle to the next unit (µW, mW, and dBm).

Power Buttons

Filter: The Offset button will load or unload a pre-defined transmission file into the power calculation.

Null: The Null button will activate or deactivate the ambient-light suppression.

Setup: The Setup button will display the Power Setup dialog containing various power related settings.

To get help on this window, press the F1 key when Window is active. The Active window is the window with the highlighted title bar.

Filter

The Filter button is accessed from the Power window.

This button is not available when BeamMaster-USB is used with the InGaAs detector head.

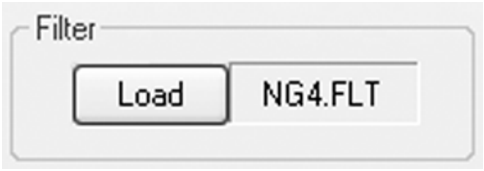
Because silicon detectors can saturate very easily, it is frequently necessary to insert a filter in front of the detector. The filter will attenuate the beam and prevent saturation. Since the wavelength response of the filter is not flat, it is necessary to install the transmission properties of the filter in the software to obtain a proper power measurement. The proper gain settings for the detector amplifier are also determined by the actual sensor output. the filter option allows the user to load or remove any pre-defined filter transmission file to be utilized by the power measurement function.

Choosing a Filter File

The silicon detector heads come with two pre-defined filter files (NG4 and NG9). For more information—refer to “Selecting a Filter” (p. 2-4). A custom filter file can be created through the Create Filter File command in the File menu. This is helpful if you want to calibrate the BeamMaster-USB system for accurate power measurement relative to a known instrument at a specified wavelength.

Selecting the Filter File

To inform BeamMaster-USB which filter is installed in the detector head, click on the Load button in the Power Setup dialog. A file list is displayed, presenting all the available filter files. Select the desired filter file and confirm with the OK button.



Using the Filter

1. Physically install the selected filter into the BeamMaster-USB head—see “Care and Handling” (p. 2-2).
2. Click the Filter button on the power meter panel display to activate the selected filter file. The power measuring function will calculate power utilizing the selected filter file. A banner containing the selected filter file name will appear in the power display.
3. Click the Filter button on the power meter panel display again to deactivate the selected filter.
4. Physically remove the filter from the detector head.

Null

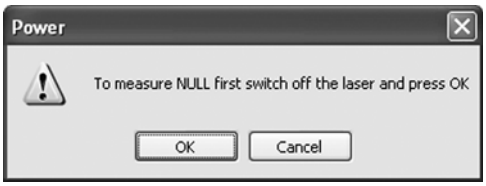
The Null button is accessed directly from the Power window.

This button provides for ambient-light suppression to permit accurate analysis of the light source. When Null is not active, the value displayed in the Power window is the total power incident on the detector surface. When Null is active, the value displayed in the Power window is the power of the input only.

 To activate or deactivate Null, place the mouse cursor over the Null button and click the LEFT mouse button.

Suppressing Ambient Light

When activating Null, a message box appears, instructing the user to remove the light source and press OK.



The system now measures the ambient light level. Clicking the OK button will cause the software to subtract the measured level from the subsequent measurements.

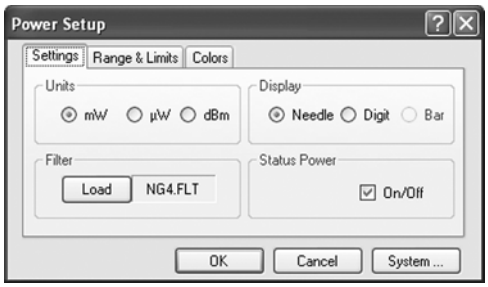
The final prompt will indicate when the measurement has taken place and the laser can be turned on again. The OK button will activate the Null.

An “Null” banner appears in the power display with the calculated value of ambient light displayed underneath.

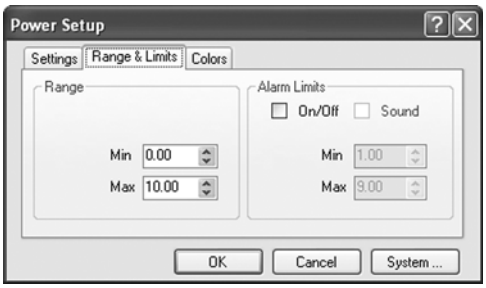
Power Setup

Power Setup is selected from the Setup button in the Power window.

Power Setup allows the user to configure the power measurement capability of the Power window.

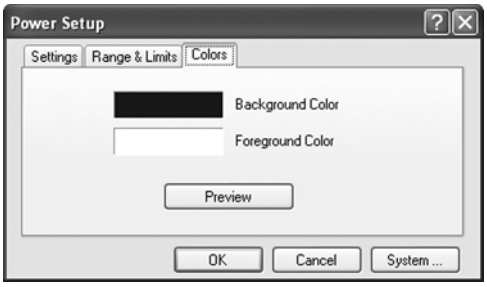


- **Units**: Select the appropriate units (mW, µW or dBm) for the power meter display.
- **Filter**: The Load Filter button displays a Windows open dialog that allows the user to select the .FLT file corresponding to the installed filter.
- **Display**: The Display radio buttons allow the user to select the desired presentation.
- **Status Power**: Toggles between displaying the power reading on the Status Bar and disabling the power reading display.



- **Range**: The Power Range selection allows the user to specify the display range. Select the values appropriate to the current laser power.
- **Alarm Limits**: The On/Off box must be checked to access the Alarm Limit values. Set the desired values for visual alarm

indicators in the Power Window. A Computer beep will also be active if the Sound box is checked.

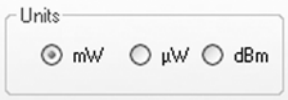


- **Colors**: The Colors tab allows the user to specify background and foreground colors for the Power window. A standard Windows color pallet is available.

Upon selecting the required parameter value, press the OK button to confirm the selection, press Cancel to restore the previous settings, or press System to reach the System Setup.

Units

The Units are selected from the Power Setup dialog.



The Units option enables changing the units on the power meter display. The possible values are: mW, µW, and dBm.

Both the needle scale and the numerical power display are updated.

Set the desired power units with the radio button—see “Radio Button” (p. 3-8). The units can also be selected by clicking on the units displayed in the Power window. Each mouse click will cycle to the next unit (µW, mW, and dBm).

Display

Select the Display option from the Power Setup dialog.

This option provides three types of presentations for the power meter:

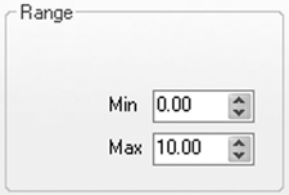
1. A graphical needle graph and a small digital presentation of the measured power.

2. A large digital presentation for better visibility at a distance.
3. A bar graph presentation of the measured power.

For the appropriate display, check the radio button—see "Radio Button" (p. 3-8).

Range

Select the Power Range from the Power Setup window.



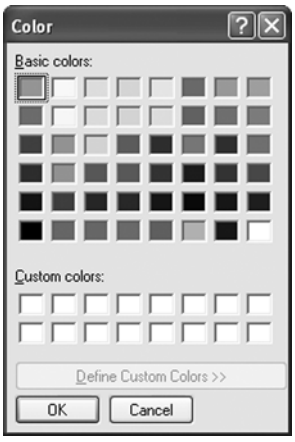
The Power Range magnifies the beam power display. The needle graph display is affected accordingly.

This is a useful feature when monitoring small changes in beam power.

Define the Zoom area by setting the minimum and maximum power levels from Min or Max box utilizing the Value Entry Box.

Colors

The color option enables the user to set the background color, data color, and plot color for the various windows. Select the desired color from the standard Windows color pallet. Custom colors are also available with the appropriate video card and Windows color setting.

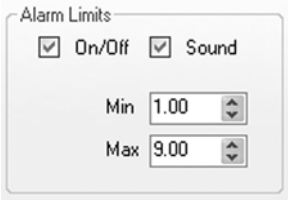


The Position, Profile W and Profile V windows allow the selection of background, data, and plot colors. The Power and Projection windows allow for the selection of background and data colors. Plot and Chart windows allow for the selection of background and plot colors.

To select a color: Place the mouse over the desired color box and click the LEFT button once. Press and hold the Preview button to view the selected colors without accepting the settings and exiting the dialog.

Alarm Limits

The Alarm Limits are selected from the Power Setup dialog.



The limits are defined by the area within the needle graph display. Audible and visual indicators will warn the user if the power drifts outside the user-specified zone. The allowed zones are marked in black, while non- permitted operation zones are marked in red on the needle graph. When the On/Off box is checked, visual indicators are provided when the user-specified limits have been exceeded. The Sound box provides additional audio beeps when the specified limits have been exceeded.

Alarm Limits Options

- **On**: Set Alarm Limits ON or OFF using the Check Box.
- **Sound On**: The Sound option is used for generating an audible warning in case the measured power exceeds the preset Alarm Limits levels.
- **Min**: The Min option is used for setting the minimum range value for Alarm Limits
- **Max**: The Max option is used for setting the maximum range value for Alarm Limits.

The minimum value set for Alarm Limits should be bigger than, or equal to, the minimum value set for Range. The maximum value set for Alarm Limits should be smaller than, or equal to, the maximum value set for Range.

Sound On

Select Sound On from the Power Setup dialog.

Use this option to enable an audible warning when power drifts outside the pre-set Max and Min alarm limits. Toggle between Sound On and Sound Off using the Check Box.

Min

Select Min in the Power Setup dialog. The min setting is displayed in the “Range and Limits” tab.

The minimum setting corresponds to a user-selected minimum power level. The Min setting in the Range dialog section will set the minimum value displayed on the power scale. The Min setting in the Alarm Limits dialog section will be displayed on the Power Window.

When the Alarm is active and the appropriate Min/Max levels are set, the user will be notified when these limits are exceeded.

Max

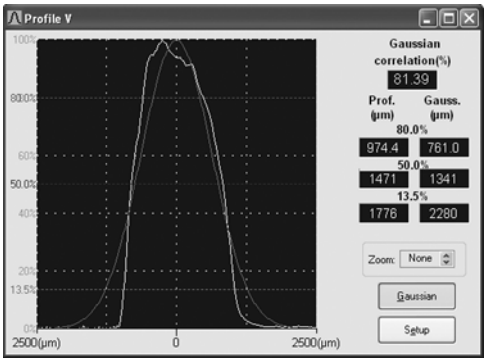
Select Max in the Power Setup dialog. The max setting is displayed in the “Range and Limits” tab.

The maximum setting corresponds to a user-selected maximum power level. The Max setting in the Range dialog section will set the maximum value displayed on the power scale. The Max setting in the Alarm Limits dialog section will be displayed on the Power Window.

When the Alarm is active and the appropriate Min/Max levels are set, the user will be notified when these limits are exceeded.

Profile V

The Profile V window can be turned ON and OFF by choosing the Profile V menu item from the View Menu, pressing the F3 key, or clicking the  tool bar button.



The Profile Window graphically displays details of the beam's intensity profile along the V axis. In addition to the profile information, there is a display of beam width at three different clip levels. The clip levels (80%, 50%, and 13.5%) may be changed using the Setup button.

- Placing the mouse cursor over the Profile display and pressing the left-hand mouse button twice changes the position window to a graphical presentation without the measurement data display.
- Placing the mouse cursor over the Profile display and pressing the left-hand mouse button twice changes the modified position window back to its original size and shape.

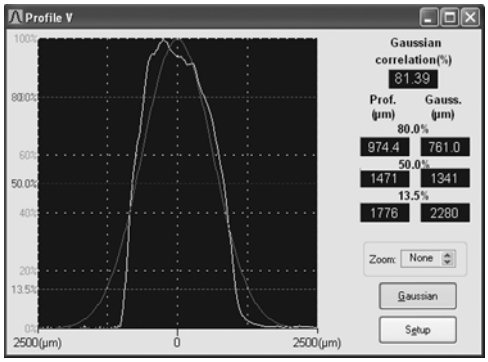
Profile Buttons

- **Gaussian**: The Gaussian selection compares the displayed profile to an ideal Gaussian in real time.
- **Zoom**: The Zoom function increases or reduces the displayed X-Axis range (spatial resolution). The profile peak will remain centered on the display when the Zoom is changed.
- **Setup**: The Setup selection provides access to the profile settings including: background color, grid lines, auto-scaling of the profile peak, and Supplementary clip level adjustment.

To get help on this window, press the F1 key when the Window is active. The Active window is designated with the highlighted title bar.

Gaussian

Select the Gaussian button from the Profile window or via the check box in Profile Setup.



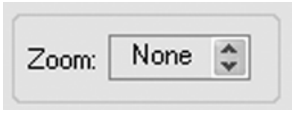
This function determines how closely the measured beam profile matches a theoretical Gaussian profile. When the Gaussian button is activated, a Gaussian profile is overlaid on top of the current measured profile in real time. The gaussian fit profile is in red.

The percent correlation and width comparisons utilize the currently-selected clip levels. The comparison data is displayed adjacent to the profile data. The comparison data includes data about the ideal Gaussian profile beam width, as well as the deformation from the ideal Gaussian beam.

To turn Gaussian Off, press the Gaussian button again.

Profile Zoom

Profile Zoom buttons are selected from the Profile windows.

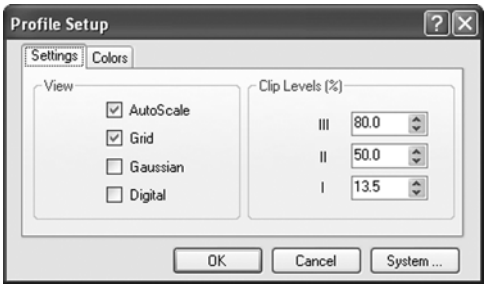


This option allows the displayed X-axis range (spatial resolution) Profile to zoom in or zoom out by a factor of two. The Beam-Master-USB software will maintain the display with the peak centered on the window.

Each time the Up/Down arrow button is clicked, the profile displayed area is increased or decreased by a factor of two.

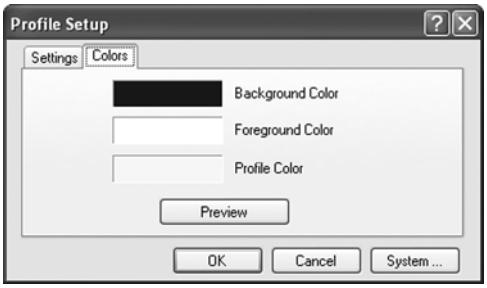
Profile Setup

Select the Profile Setup button from the Profile window.



Settings Tab

- **AutoScale**: The AutoScale selection forces the profile to be displayed utilizing the full height of the profile window.
- **Grid**: The Grid selection displays a grid pattern behind the profile. The grid is used to provide a visual point of reference on the displayed profile.
- **Gaussian**: The Gaussian selection will provide a pure Gaussian reference overlay on the displayed profile. The Gaussian selection also provides a numeral Gaussian reference value.
- **Digital**: The Digital selection will display the current measurement results as digital values only.
- **Clip Levels (%)**: This selection defines the clip levels for the two supplementary beam width measurements.



- **Colors**: The Colors tab allows the user to specify background, foreground and profile colors for the Profile Window. A standard windows color pallet is available for color selection.

All settings work independently in both the W profile and the V profile. AutoScale can be ON for one profile window and OFF in the other profile window.

Autoscale

Profile Autoscale is accessed by clicking the Profile Setup button in the display windows.

This option enables the user to toggle between Autoscale On and Autoscale Off.

Use the Check Box to turn Autoscale ON. When Autoscale is ON the beam intensity profile is always normalized to fit 100% of the display window.

Autoscale must be ON for the clip level bars to be visible.

When Autoscale is OFF, the beam intensity profile is not normalized to 100% of the display window and the beam peak is observed as it changes. The function is helpful during a focusing process. The peak intensity changes may be observed as a function of the focus, showing the variations in the beam's peak with respect to the changes in beam size.

This function affects only the graphical presentation on window.

Profile Grid

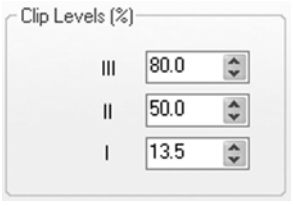
The Profile Grid is set from the Profile Setup dialog.

The Profile Grid option turns on the grid pattern displayed in the profile window.

Use the check box to toggle the grid between ON and OFF.

Clip Levels

Clip Levels are selected from Profile Setup windows.



The three clip levels determine the levels at which the width of V and W profiles are to be measured by the BeamMaster-USB system.

A clip level defines the percentage of the peak intensity profile at which the beam is measured. For example, a clip level of 50% indicates that the beam is to be measured at its full width at half maximum (FWHM); whereas, a clip level of 13.5% measures the beam at a point which is 13.5% of the profile peak. The 13.5% level corresponds to the $1/e^2$ point of a Gaussian profile.

Both V and W profile windows simultaneously display the width of the beam at three clip levels. If AutoScale is ON, the display includes three clip levels represented by solid horizontal lines superimposed on the profile. The default setup of clip levels is 80%, 50% and 13.5%.

Changing Clip Levels in the Profile Setup Window

The three clip levels are labeled I, II, and III. Change the clip level value for each one of them by entering a new value in the Value Entry Box. The clip levels may be set in 0.1% increments.

Changing Clip Levels in the Profile Window

Place the mouse cursor just above or below the width level bar to be changed, then press the LEFT mouse button and drag it up or down, while watching the change in Clip Level setting on the profile presentation. The clip level can be moved vertically to a new clip level in 0.3% increments. When performing this operation it is helpful to size the Profile Window as large as possible.

Profile W

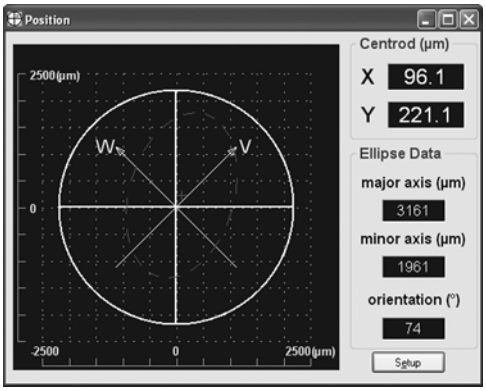
The Profile W window can be turned ON and OFF by choosing the Profile W menu item from the View Menu, pressing the F4 key, or clicking the  tool bar button.

The Profile Window graphically displays details of the beam's intensity profile along the W axis. In addition to the profile information, there is a display of beam width at three different clip levels.

Review the functions associated with the Profile V window for additional information.

Position

The Position window can be turned ON and OFF by choosing the Position menu item from the View Menu, pressing the F5 key, or clicking the  tool bar button.



The Position function provides a real-time display of the beam centroid position, as well as a beam foot print. This window can be used to align the detector head with the incoming laser beam. Settings can also be customized by clicking the Setup button.

In the main window area, the detecting area of the sensor is represented by a 9x9 mm square for the BM-7 Si Head, by a 5 mm diameter circle for the BM-3 Si version, and by a 3 mm diameter circle for the BM-3 InGaAs version. Review the current head specifications for input aperture values not previously given.

The solid cross hair target that appears within the main display area represents the local Earth reference frame. This reference display remains fixed. The intersection of these two solid lines is the center of the detector. The diagonal lines labeled V and W are the axes along which the width and profile measurements are made and displayed.

When a laser beam enters the aperture of the head, it is represented as a dotted ellipse. If the beam is circularly symmetric, a dotted circle will appear. This ellipse indicates the "footprint" of the beam in the plane of the rotating knife-edges. The ellipse will change shape and orientation as the beam expands and contracts in different directions. A small cross indicates the location of the center of the beam. The X and Y coordinates of this cross are shown in µm units under the title "Centroid." There is also a display box that contains an estimate of the size of the major and minor axes of the ellipse, as well as the angle of orientation (under the title: Ellipse Data).

Placing the mouse cursor over the Position display and pressing the left-hand mouse button twice changes the position window to a graphical presentation *without* the measurement data display on the right-hand side of the window.

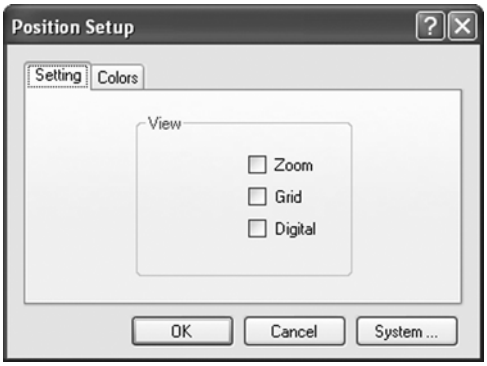
Placing the mouse cursor over the Position display and pressing the left-hand mouse button twice changes the modified position window back to its original size and shape. Also, any attempt to resize the Position screen retains the original size and shape.

These values are merely estimates and are less accurate than width measurements made in the Profiles functions.

To get help on this window, press the F1 key when the Window is active. The Active window is the window with the highlighted title bar.

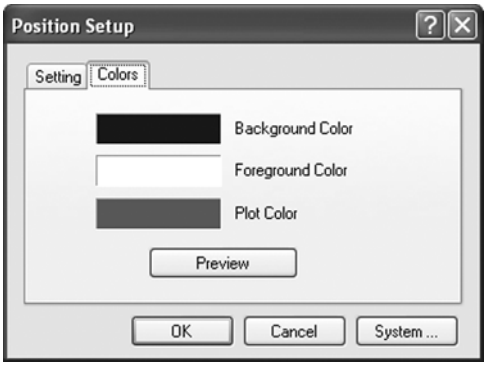
Position Setup

Select Position Setup from the Position window.



- **Zoom**: The Zoom selection activates the zooming capability of the position display. Small beams are enlarged and centered on the plot.
- **Grid**: The Grid selection enables a grid pattern on the position display.

Digital: The Digital selection displays the position data as a digital display only.



- **Zoom**: The Zoom selection activates the zooming capability of the position display. Small beams are enlarged and centered on the plot.

Position Zoom

The Position Zoom is adjusted from the Position Setup window.

The Position Zoom is used to view the footprint of small beams more clearly. It is recommended that this option be activated for beam widths of less than 300 microns. Once activated, the area immediately surrounding the beam is magnified to show the footprint in the greatest possible detail. The size of this region is automatically scaled up or down as the beam changes size.

The “ZOOM ON” message is displayed inside the position screen area.

Toggle between Zoom Position ON and Zoom Position OFF with the check box.

Position Grid

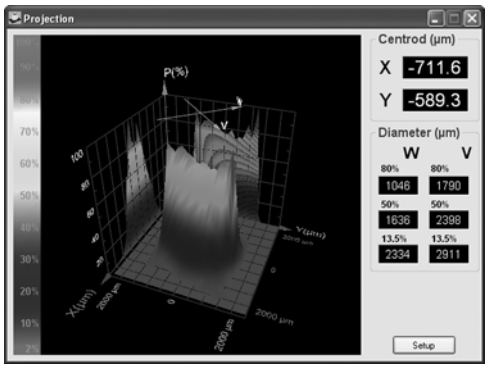
The Position Grid is selected from the Position Setup window.

This option turns on the grid pattern that is displayed in the position plot area.

Use the check box to turn the grid ON.

Projection

- The Projection window can be turned ON and OFF by choosing the Projection menu item from the View menu, pressing the F6 key, or by clicking the  button on the tool bar.



The 3D image can be rotated along the vertical and horizontal axes using the following routine:

1. Place the mouse cursor over the 3D image.
2. Hold the left mouse button down (note that the mouse cursor shape has changed).
3. Drag the mouse while pressing the left mouse button. You can move the cursor up or down, as well as left or right. The image will rotate accordingly.

Placing the mouse cursor over the Projection display and pressing the left-hand mouse button twice changes the window to a graphical presentation *without* the measurement data displayed on the right-hand side of the window.

Placing the mouse cursor over the Projection display and pressing the left-hand mouse button twice changes the modified position window back to its original size and shape.

The Projection function provides either a two-dimensional view or a three-dimensional view of the beam intensity profile.

The Projection Window has a Setup button for setting the parameters associated with this presentation.

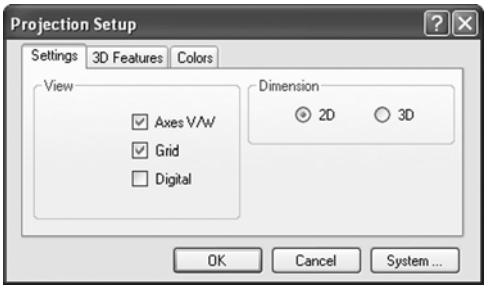
The Projection is created using a mathematical process called “Reconstructive Tomography.” The displayed resolution is 32*32, regardless of beam size. This same type of process is used by X-ray systems to create X-ray images. More knife-edges will yield a greater level of detail. For a beam distribution that is significantly non-gaussian, the standard seven knife-edge system can reconstruct

a plot that closely matches the real beam. When examining near-gaussian beams, three knife-edges can give an accurate intensity distribution.

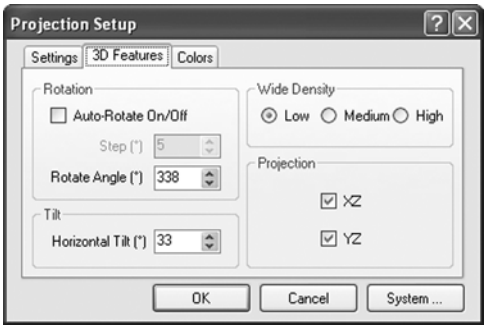
To get help on this window, press the F1 key when the window is active. The active window is indicated with the highlighted title bar.

Projection Setup

The Projection Setup button is selected from the Projection window.



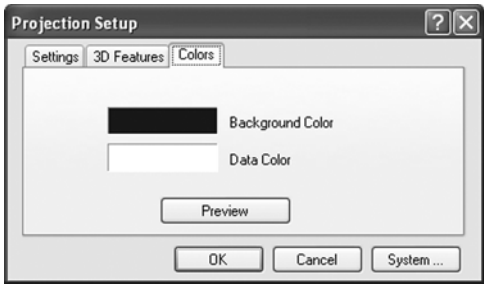
- **Axes V/W**: The Axes selection activates the axis orientation symbol.
- **Grid:** The Grid selection activates the 2D window grid.
- **Digital**: This selection displays the measurement results as a digital display only.
- **Dimension**: The selection toggles between 2D displays and 3D displays.



- **Rotation**: The Rotation selection allows the user to change the current rotation angle on the 3D display. When Auto-Rotate is selected, the 3D display will rotate continuously at the user-specified step increment. When Auto-Rotate is not selected, the angle of rotation can be set numerically.
- **Tilt**: The Tilt setting allows the user to specify a numerical value for the 3D plot tilt. *Place the mouse cursor over the*

currently displayed 3D plot and hold the left mouse button down. Drag the mouse cursor to display the 3D plot at the desired rotation and tilt angle.

- **Wire Density**: The Wire Density radio buttons allow for the selection of three separate 3D plot wire densities.
- **Projection**: The Projection check buttons allow for the selection viewing of 3D figure projections on XZ and YZ planes.



- **Colors**: The Colors tab allows the user to specify background and data colors for the Projection Window. A standard Windows color pallet is available.

Upon completing the desired setup, click the OK button to confirm the selection, click Cancel to restore the previous settings, or press the System button to reach the System Setup.

Axes

The Axes Direction indicators are selected from the Projection Setup dialog. This dialog can be accessed with the Setup button in the Projection window.

When activated, this function displays the orientation of the V and W axes.

Turn the Axes legend ON and OFF with the check box.

Projection Grid

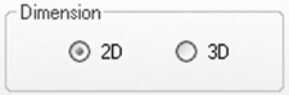
The Projection Grid is toggled from inside the Projection Setup dialog.

This selection toggles the grid pattern in the position plot area. This setting is only available for the 2D projection.

Use the check box to turn the grid ON.

Dimension

The Dimension setting is selected from the Projection Setup window.



The Projection window can display the beam intensity profile in two dimensions or in three dimensions. This function is used to toggle between the 2D and 3D representations by utilizing the radio buttons—see “Radio Button” (p. 3-8).

Both the 2D and 3D views are mathematical constructions based on the profile information obtained from the knife-edges.

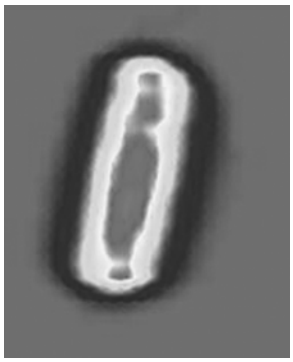


Figure 4-4. Example of 2D Resolution

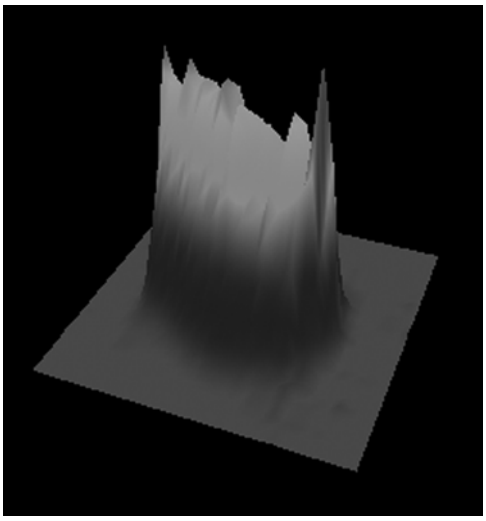
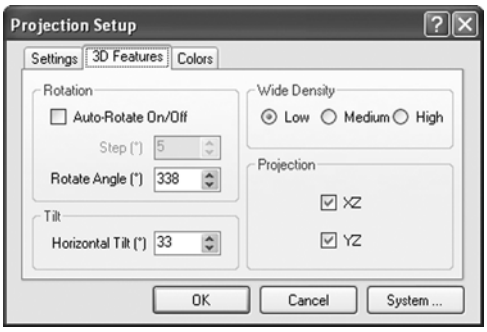


Figure 4-5. Example of 3D Medium Wire Density

3D Features

This option can be activated from the Projection Setup window.



- **Rotation**: The Rotation function affects the optical axis or azimuth of the 3D display.

  Adjust the viewing angle using the Value Entry Box. The possible values for the Rotation Angle are 0 through 360 degrees. The Rotate Angle value can only be changed when the Auto Rotate box is not selected. The projection can be made to rotate automatically with a selected step interval by utilizing the Auto-Rotate check box. When the Auto Rotate box is selected, the step increment can be set to the desired value.

- **Tilt**: The Tilt function selects the tilt viewing angle of the 3D plot. The 3D plot can be viewed at horizontal tilt angles between 0 and 90 degrees in 1-degree increments. The horizontal tilt angle can be entered in the Value Entry box.

  Free adjustment of rotation and tilt angle is accomplished by placing the cursor over the graphical 3D display while holding the left mouse button down. Movement with the left mouse button down will adjust the tilt and rotation simultaneously.

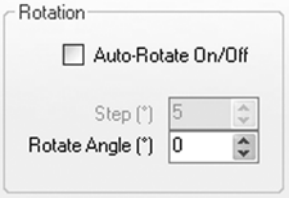
- **Wire Density**: This selection determines the number of wires utilized to construct the 3D plot. The high-density setting can affect the update rate of the displayed 3D profile, based on the performance of the computer system and video card.

- **Projection**: The Projection check buttons allow for the selection viewing of 3D figure projections on XZ and YZ planes.

When all the desired parameters are set, click the OK button to confirm the selection, click Cancel to restore the previous settings, or press the System button to reach the System Setup.

Rotation Angle

Rotation is adjusted from the Projection Setup dialog.



The Rotation function is used to change the viewing angle of the 3D projection. The rotation takes place about the optic axis or azimuth of the 3D display

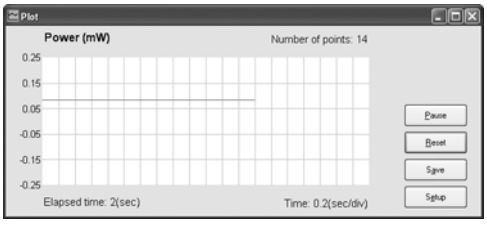
Adjust the rotation angle with the Value Entry box. The possible values for the Rotation angle are 0 through 360 degrees. When Auto-Rotate is On, the user can set Step increment between 1 and 30 degrees. The Auto-Rotate function will rotate the 3D display continuously at the user-specified step increment. When Auto-Rotate is Off, the user can set Rotation Angle to any desired value between 0 and 360 degrees.

Place the mouse cursor over the currently displayed 3D plot and hold the left mouse button down. Drag the mouse cursor to display the 3D plot at the desired rotation and tilt angle.

The projection can be made to rotate automatically in 5-degree increments by selecting the Auto check box.

Plot

- The Plot window can be turned ON and OFF by choosing the Plot menu item from the View menu, pressing the F7 key, or by clicking the  button on the tool bar.



The Plot window provides a graphical display of beam power versus time. The graph presentation includes the temporal power fluctuations and provides a way to observe long-term power fluctuations. The Plot window also displays the number of points accumulated, elapsed time clock, and the exact time/division partition.

- **Pause**: The Pause button is used to temporarily stop power logging. Press the button again to continue.
- **Reset**: The Reset button is used to reset all accumulated data (history displayed in the current session).
- **Save**: The Save button is used to save the current or the most recent 500 measurements displayed.
- **Setup**: The Setup button is used to set the relevant Plot Setup parameters.

To get help on this window, press the F1 key when it is the active Window. The Active window is the window in the window area with the highlighted title bar.

Reset

The Rest button is accessed from the Plot or Chart windows.

The Reset option enables the user to reset all accumulated data for the Plot/Chart functions in the current session (Restart operation).

To activate Reset, place the mouse cursor over the Reset button and click the LEFT button once. The Plot/Chart graph will redraw after the Reset. The current accumulated data points are discarded.

Save Plot

The Save button is accessed from the Plot window.

This option enables the user to save up to 500 data points. Several plot files can be saved during the same session.

Data is saved as text in a file named *.PLT or as an Excel file named *.XLS. The plot file name is created automatically, when the "Automatic" option is selected in the Plot Setup > Create File Name option. The file name is composed of the date and time in the following format:

ddhhmmss.PLT

Where ***dd*** = day, ***hh*** = hour, ***mm*** = minutes, ***ss*** = seconds.

The default automatic file name can be changed later. On this process will allow uninterrupted data collection.

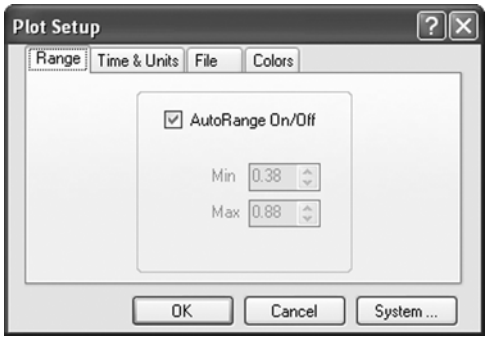
Plot File Format

The data is stored in TEXT file format and contains the following data:

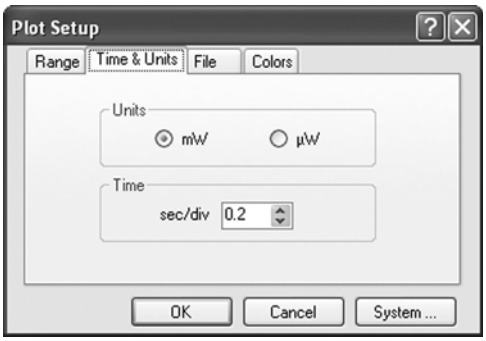
- General details like system name and date.
- A table of time values paired with the displayed power value in milliwatts.

Plot Setup

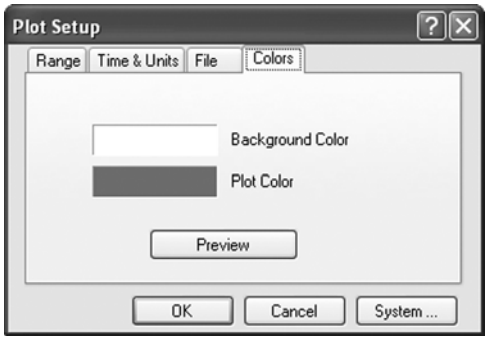
Plot Setup is selected from the Setup button in the Plot window.



- **Range**: The Range tab provides control to allow the user to specify the vertical plot scale.



- **Units**: The Units selection control works in conjunction with the Range selection for vertical scale selection.
- **Time**: The Time control allows the user to specify the rate of data collection.

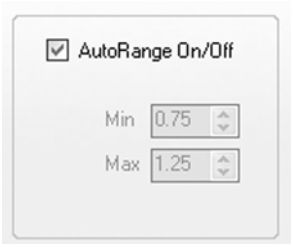


- **Colors**: The Colors tab allows the user to specify background and plot colors for the Plot window. A standard Windows color pallet is available.

When all the desired parameters are set, click the OK button to confirm the selection, click Cancel to restore the previous settings, or press the System button to reach the System Setup.

Plot Range

The Plot Range is selected from inside the Plot Setup window.



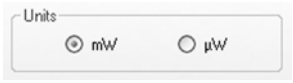
The vertical scale of the Plot graph can either be automatically scaled or held at a user-specified value.

When AutoRange is activated, the system continuously adjusts both the minimum and maximum limits of the Plot. AutoRange is designed to display the greatest amount of detail on the window.

When AutoRange is turned off, the system leaves the scale at the last auto scale setting, and manual control of the scale can be introduced. Use the Min and Max values using the Value Entry Boxes for the appropriate scale adjustment. When adjusting the Min and Max values, avoid a situation where large measurement fluctuations may go beyond the maximum and minimum vertical scale. The Off Scale value will be displayed as flat lines at the top or bottom of the scale.

Plot Units

The Units are selected from inside the Plot Setup dialog.



The user can toggle between mW and µW units for the Plot presentation. Select the units with the radio buttons—see “Radio Button” (p. 3-8).

Time Scale

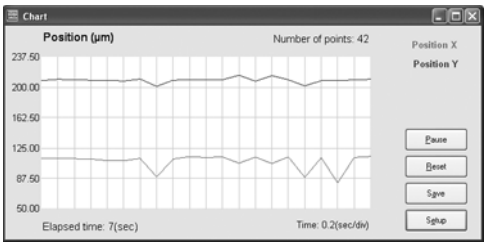
The Time Scale is selected from inside the Plot Setup dialog or the Chart Setup dialog.

The rate at which the BeamMaster-USB software plots the data is controlled with this setting. Set the desired Sec/div value via the value entry box.

The Time scale will change the horizontal scale of the Strip charts. The value can be changed in one-second increments. The fastest possible rate of display is 0.2 sec, which corresponds to the maximum 5 Hz update rate. The displayed data corresponds to a 5 Hz collection rate even though the display may not update at that rate.

Chart

- The Chart window can be turned ON and OFF by choosing the Chart menu item from the View menu, pressing the F8 key, or by clicking the  button on the tool bar.



The Width/Position Chart window provides a real-time strip chart display of beam position (X,Y) versus time, or beam width of V and W profiles measured at the System Clip Level.

These charts enable the user to observe long-term beam position stability or beam width variations. The Chart window graphically displays the absolute position or width versus time, the number of points accumulated, elapsed time clock, and the exact time/division scale increment. The Setup button is used to set chart scaling and color options. The data can also be saved as a text file for external analysis.

- **Pause**: Click the Pause button to interrupt the data collection. The current data is not lost when you use this function. When the Pause button is selected, it changes to a Continue button to resume data collection.
- **Reset**: Click the Reset button to clear the current data.
- **Save**: Click the Save button to save the current data, up to the most recent 500 points collected. The Save functions automatically assigns a file name corresponding the current date and time with a .crt or .xls file extension.

- **Setup**: Click the Setup button to access all of the Chart Setup parameters. The setup parameters allow the user to set the data collection interval, vertical chart scale, and colors.

To get help on this window press the F1 key when it is the active Window. The Active window is the window in the window area with the highlighted title bar.

Save Chart

The Save Chart button is selected from the Chart window.

This option enables the user to save up to 500 data points from the current session. The user can save several chart files during the same session.

Data is saved as text in a file named *.PLT or as an Excel file named *.XLS. The chart file name is created automatically (when option "Automatic" is selected in Chart Setup > Create File Name option). The file name is composed of the date and time as follows:

ddhhmmss.CRT

Where ***dd*** = day, ***hh*** = hour, ***mm*** = minutes, ***ss*** = seconds.

The default file name can be changed later. This process will allow uninterrupted data collection.

Chart File Format

The data is stored in TEXT file format and contains the following information:

- General details, like the system name and date.
- Time values paired with the displayed X & Y Position values, or
- A table of time values paired with the displayed V & W Width values.

All dimension values are in microns.

Example Chart File

Chart File Data

BeamMaster USB, Version 1.03

File: C:\PROGRA~1\BM1035\10160540.crt

Date: 10 Mar 2005

Time: 16:05:40

S/N: 1035

Average: 1

Wavelength: 1300(nm)

Clip Level: 13.5%

Time Width W Width V

(sec) (µm) (µm)

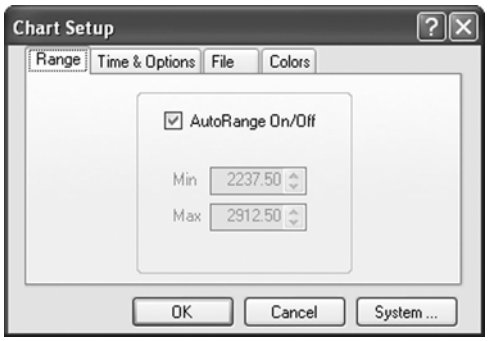
0.0 1682.566 2215.905

1.1 1661.088 2248.827

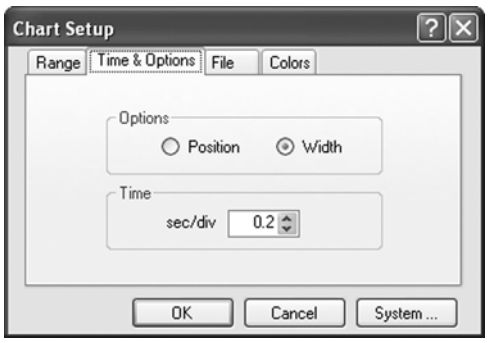
etc.

Chart Setup

Chart Setup is selected from the Setup button in the Chart window.



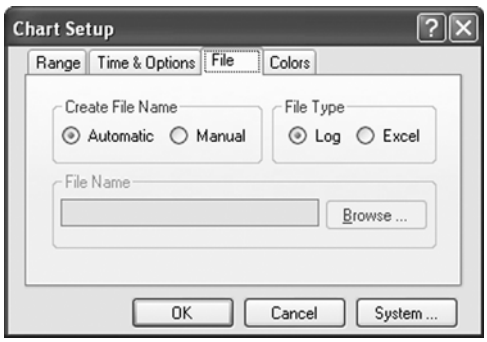
- **Range**: Select a range for the Y axis of the Chart. The Auto-Zoom box will control the Y axis mode. When the box is checked, the chart's Y axis is automatically scaled by the software. When the Auto-Zoom box is not checked, the user can set the Y scale with the minimum and maximum value entry boxes in the dialog. Data that occurs outside of the user-entered manual scale settings will be plotted as a straight line at the top or bottom of the scale, as appropriate.



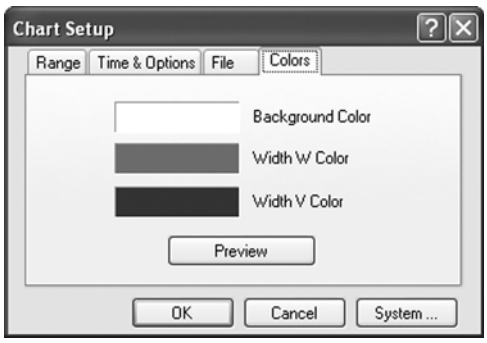
- **Options**: Selects either Position or Width versus Time Charts. The position selection will graphically display the absolute

position data vs. time in a strip chart form. The Width selection will graphically display the beam width vs. time in a strip chart form. Verify the range selection before exiting the Chart Setup screen.

- **Time scale**: The Time selection sets the horizontal scale on the strip chart. The horizontal scale contains 20 divisions. Multiply the Time value by 20 to determine the amount of time utilized for a complete chart display.



- **Create File**: Select Automatic or Manual, for the name creation of the chart data file.
- **File Type**: Select the desired file type (Log or Excel). The Log file is saved in a standard text format. The Excel file is saved as an Excel Workbook.
- **File Name**: If you select Manual mode in Create File, click the Browse button to assign a File name and path for the chart data file.

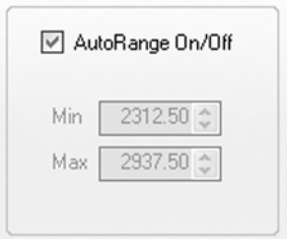


- **Colors**: The Colors tab allows the user to specify Background, Width V,W, or Position X,Y colors for the Chart window. A standard Window color pallet is available.

When all the desired parameters are set, click the OK button to confirm the selection, click Cancel to restore the previous settings, or press the System button to reach the System Setup.

Chart Range

The Chart Range is selected from inside the Chart Setup window.



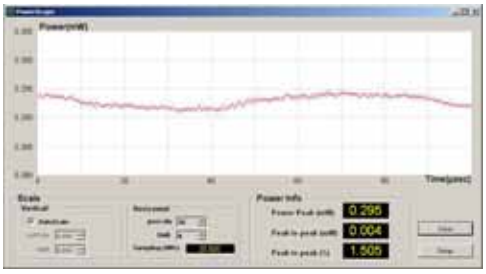
The vertical scale of the Chart graph can either be automatically scaled (using the AutoRange option), or be held at a constant value.

When AutoRange is activated, the system continuously adjusts both the minimum and maximum limits of the Chart to display the greatest amount of detail on the window.

When AutoRange is turned off, the system leaves the scale at the last autoscale setting, and manual control of the scale can be introduced, using the Min and Max values via the Value Entry boxes for the desired Manual scale settings. When adjusting the Min and Max values, avoid a situation where large measurement fluctuations may go beyond the maximum and minimum vertical settings. Off scale readings are displayed as straight lines at the top or bottom of the chart, as appropriate.

PowerScope

The PowerScope window provides a graphical display of the laser's temporal characteristics (Power Analysis function). The PowerScope window can be turned ON or OFF by choosing the PowerScope menu item from the View Menu, pressing the Ctrl+F2 keyboard button, or clicking the  button on the tool bar.



Normally when PowerScope is started, the gain is automatically adjusted to provide the best vertical scale displayed on the graphics portion of the screen. Alternatively, the user can deselect Autoscale so that a specific value for the vertical scale can be chosen. This is done by clicking on Vertical (up or down arrows). The location of the zero on the vertical scale can be changed by using the Shift

buttons (up and down arrows). The horizontal scale on the graphic display can be modified and a Shift can be introduced. The sampling frequency is displayed and automatically changed when the horizontal scale is changed.

The numeric value of power is displayed in the Power Window. The Power Peak, Peak to peak (mW) and Peak to peak (%) are part of the Power Info screen.

Main Features and Advantages of the Power Analysis Function

1. Optical power stability and noise analysis in the time domain.
2. Optical power modulation depth.
3. Complete beam analysis in one integrated system, which eliminates the need for multiple setups.

Power Scope Buttons

Save: Click the Save button to save the current PowerScope data. The Save functions automatically assigns a file name corresponding the current date and time with a .psd or .xls file extension.

Setup: Click the Setup button to access all of the PowerScope Setup parameters. The setup parameters allow the user to set the data view file options to save data and colors.

The PowerScope function is a unique feature provided with the BM-7 and BM-3* USB detector heads only and is not supported in older BM-3 heads.

To get help on this window, press F1 on the keyboard when the window is active. The Active window is the window in the window area with the highlighted title bar.

PowerScope Setup

PowerScope Setup is selected from the Setup button in the PowerScope window. The PowerScope Setup dialog contains three tabs: Settings, File, and Colors.

Settings Tab

- **View**: Select the type of data view (digital or graphical mode).

File Tab

- **Create File Name**: Select *Automatic* or *Manual* for the name creation of the PowerScope data file.
- **File Type**: Select *Log* or *Excel*. A log file is saved in a standard text format. An Excel file is saved as an Excel Workbook.
- **File Name**: If you selected *Manual* mode in the Create File Name field, click the Browse button to assign a file name and path for the PowerScope data file.

Colors Tab

- **Colors**: The Colors tab allows the user to specify background and plot colors for the PowerScope window. A standard Window color palette is available.

When you are satisfied with all of the selections utilizing each tab, press OK to confirm the settings. Click Cancel at any time to exit the PowerScope Setup screen and revert to the previous settings.

View Tool Bar

View Tool Bar can be hidden, or shown, by selecting either Tool Bar from the View Menu, or pressing the Shift + Ins keyboard buttons.

This option enables the user to toggle between the Show Tool Bar option and the Hide Tool Bar option.

When the Tool Bar is selected (activated), there is an additional line on top of the window containing Tools (picture shortcuts to some of the most common used system functions), along with date and time information.

When this option is not selected, the Tool Bar line disappears. In this case, the user has to activate the various system functions from the menu or keyboard shortcuts.

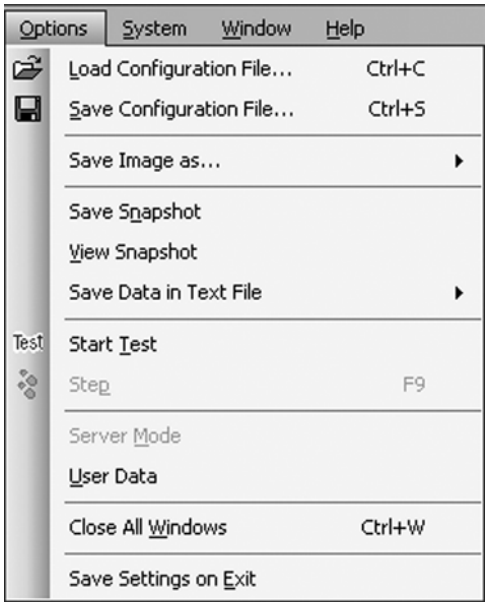
View Status Bar

View Status Bar can be hidden, or shown, by selecting either Status Bar from the View Menu, or pressing the Ctrl + Ins keyboard buttons.

This option enables the user to toggle between the Show Status Bar option and the Hide Status Bar option.

Options Menu

The Options menu allows the user to operate the saved measurement data, perform Test an save images and snapshot files.



- **Load Configuration File**: This option allows the user to load a certain configuration file containing all the system setup parameters.
- **Save Configuration File**: This option allows the user to save the current BeamMaster-USB software settings.
- **Save Image as**: This function is used to save the active window or full screen as a *.BMP or *.JPG file.
- **Save Snapshot**: This function is used to save the laser beam data information displayed to a file with a *.SNP extension.
- **View Snapshot**: This function is used to view the laser beam data information saved to a file with a *.SNP extension.
- **Save Data in Text File**: This function is used to save the profiles or projection data displayed to text file for analysis with other programs.
- **Start Test**: This function is used to start and stop automatic online Pass/Fail testing for user-selected parameters.
- **Step**: In this mode, the last measurement is displayed and the window is frozen.
- **Server Mode**: This option is provided to enable a remote operation of the application program.
- **User Data**: This option enables the user to insert any string of characters that will appear in the Log/Test files.

- **Close All Windows**: When this item is selected, all open windows are closed.
- **Save Settings on Exit**: This option allows the user to save the current software settings in a default configuration file ($$$.INI).

A check mark in front of a menu item indicates that the function is active.

A gray menu item means that the item is currently unavailable and that additional conditions must be met for this item to be active. For example, to start log, the appropriate log setup parameters must be set.

Load Configuration File

Load Configuration File can be selected from the Options menu, pressing the Ctrl + O keys, or by clicking the  button on the Tool Bar.

This option allows the user to load a specific configuration file (files with a .INI extension) containing all the system setup parameters.

Loading a Pre-saved Configuration File

1. Select Load Configuration File from the Options Menu, press the Ctrl + O buttons, or click the shortcut button on the Tool Bar. There is no need to change the file type because INI is the default.

   The BeamMaster-USB data files are located in the Data folder in the BeamMaster-USB directory. The Beam-Master-USB directory is located in Program Files by default.

2. Click on the desired INI file from the file list on the left.
3. Click OK to load the file. The BeamMaster-USB software will update all windows with the new configuration.

Automatic Configuration

The BeamMaster-USB software automatically saves the current configuration each time it is closed. Enabling the Save Settings option on Exit (from the Options menu) will cause the BeamMaster -USB software to store the current configuration into the default configuration file, ($$$.INI) upon exiting the software. When the software is started, it will automatically load the $$$.INI file.

Save Configuration File

1. Select Save Configuration File from the Options menu. There is no need to change the "File Type" because .ini is the default. The BeamMaster-USB data files are located in the "Data" folder in the BeamMaster-USB directory. The BeamMaster-USB directory is located in "Program Files" by default.
2. Type a filename for the configuration file in the box below the word "File name." The file saving process will automatically attach the .ini file extension.
3. Click OK. The configuration file can now be loaded at any time using the Load Configuration File command—see "Load Configuration File" (p. 4-57).

Configuration File Contents

The following information is stored in the Configuration (INI) file.

- System serial number
- System wavelength setting
- System clip level setting
- Setting for averaging
- Setting for head tilt
- Setting for system beep
- Active windows size & position
- Setup parameters for each window
- Test setup parameters

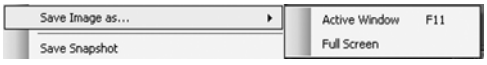
Save Image as

The Save Image as function is selected from the Options Menu.

This function is used to save the active window or full screen as a *.BMP file or a *.JPG file.

Saving an Image File

1. Select Save Image as from the Options Menu.



2. Select Active Window or Full Screen option or, alternatively, press the F11 key to start saving to the active window. A standard Windows file dialog is displayed.
3. Select BMP or JPG as the File Type.

4. Select the desired file directory.
5. Type a filename for the image file in the box below the word File name. The file saving process will automatically attach the appropriate file extension.
6. Click OK.

Save Snapshot

Save Snapshot is selected from the Options menu.

This function is used to save the laser beam data information displayed to a file having the *.SNP extension. The data is saved as a binary file and can be processed by this application program later.

Saving a Profile Snapshot

1. Select Save Snapshot menu item from the Options menu. A standard Windows file dialog is displayed. There is no need to change the File Type because SNP is the default.
2. Select the desired storage directory.
3. Type a filename for the snapshot file in the box below the word File name. There is no need to have the file name end in .SNP as the program automatically saves the file with that extension.
4. Click OK.

View Snapshot

View Snapshot is selected from the Options menu.

This function is used to view the laser beam data information saved to a file having the *.SNP extension.

Viewing a Snapshot File

1. Select View Snapshot menu item from the Options menu. A standard Windows file dialog is displayed.
2. Select a snapshot file.
3. Click Open. The snapshot file displays.

Closing a Snapshot File

To close a Snapshot file, select the View Snapshot menu item from the Options menu. The system restores real-time measurement displays. Alternatively, press the X sign at the right top corner of the Windows screen application.

Saving Data in Text File

1. Select the Save Data in Text File menu item from the Options menu.

2. Select Profiles or Projection option. A standard Windows file dialog is displayed. There is no need to change the File Type because .TXT is the default.
3. Select the desired storage directory.
4. Type a filename. The .txt file extension will automatically be attached during the saving process.
5. Click OK.

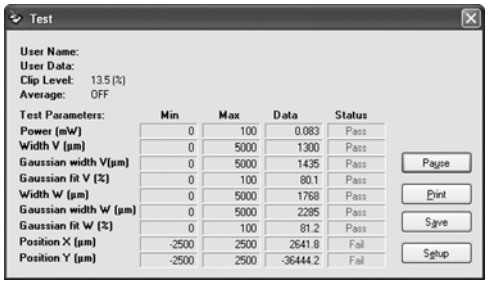
Importing Files into Excel

All BeamMaster-USB files are stored in ASCII file format for easy printing, viewing, and analysis. Loading any of the data files directly into Excel will activate the import wizard. A "fixed width" or "space delineated" file format works best when using the import wizard.

Start Test

Start Test is selected from the Options menu, or via the 

button on the Tool Bar.



This function is used to start and stop automatic online Pass/Fail testing for user-selected parameters.

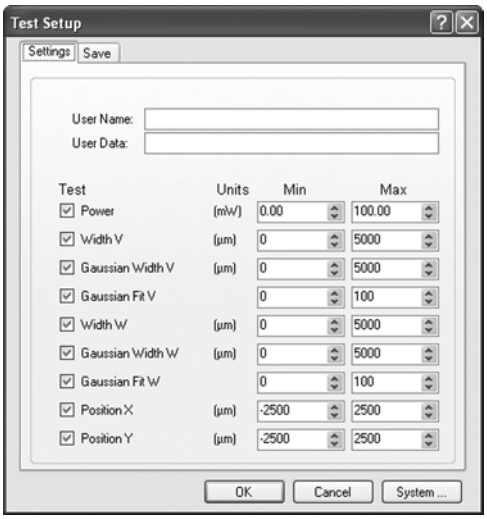
- **Pause**: The Pause button stop testing temporarily. Press the button again to continue.
- **Print**: The Print button prints the test results directly to the default Windows printer.
- **Save**: The Save button saves the test results to a file name with a .TXT file extension (for a text file) or a .XLS file extension (for an Excel file). The data file will be located in the BeamMaster-USB data folder

- **Setup**: The Setup button will display the configuration window utilized to set the test parameters, as well as file name options.

To close the Test window, select Stop Test under the Options Menu, or click the  button on the Tool Bar.

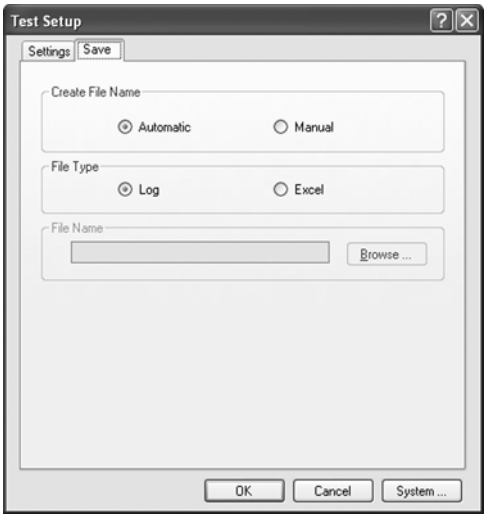
Test Setup

Test Setup is selected from the Test Window. This Setup window is used to enter general information about the test and to activate any of the nine available parameters. When configured for the first time the Min and Max values will be based on the current detector head limits.



- **User Name**, **User Data**: These fields are available to enter information associated with the test.
- **Measurements**: Any one of the listed 9 parameters can be activated by placing the mouse cursor at the option box and

clicking the LEFT mouse button once. Each active parameter requires a minimum and maximum level setting.



- **Create File Name**: One of the following two options can be activated for saving a test file:
  - *Automatic* - Automatically assigns a file name corresponding the current date and time with a .TXT or .XLS file extension. Each press on the Save button creates a new file, with the above naming procedure.
  - *Manual* - Get a file name from File Name frame.
- **File Type**: One of the following two options can be used to save test data:
  - *.TXT* - for a text file
  - *.XLS* - for an Excel file
- **File Name**: This frame is enabled if the Manual option is selected in the Create File Name frame
- When all the desired parameters are set, click the OK button to confirm the selection, click Cancel to restore the previous settings, or press the System button to reach the System Setup.

Step Mode

Access the Step mode by selecting Step from the Options window, pressing the F9 key, or by clicking the  button on the Tool Bar.

In this mode, the last measurement is displayed and the window is frozen.

The Step tool bar button will be disabled unless the system is in Step mode. To enter Step mode: Select System Setup from the System menu and toggle from Mode.

To take the next measurement, do one of the following:

- Click the  button on the Tool Bar
- Press the F9 key
- Select the Step menu item from the Options Menu

Server Mode

Server Mode is selected from the Options menu, or via the  button on the Tool Bar.

This option is provided to enable a remote operation of the application program.

1. Select Server Mode menu item from Options Menu, or press the  button on the Tool Bar. A blinking icon will appear at the Tool Bar, adjacent to the Time field.

2. Rest the mouse cursor at the blinking icon—this will display the Server Host Address (for identification of the client computer via TCP/IP protocol).

3. Using the same system CD disk, install the software on the remote computer and start the program. The following message will display:

   System Error #XX : BeamMaster-USB system cannot be started. Please contact your Provider.

4. Press OK. The following message will display:

   Would you like to initiate a remote Client application?

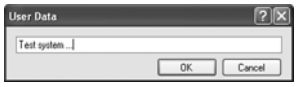
5. Press Yes.

6. Input the Host Address name of the Server computer and then press OK.

   At this point, a hardware testing routine will be performed. From this stage and on, the remote client computer will be running the same software and all measurements and analysis functions will be performed identically to the main computer which hosts the hardware.

User Data

User Data is selected from the Options menu.



User Data enables the user to insert any information required during the measurement session. The User Data string is limited to 60 characters.

After inserting the user data information and pressing the OK button, the information inserted will automatically be displayed in the Title Bar, just right of the system name.

Close All Windows

Close All Windows can be initiated by either selecting this option from the Options Menu or by pressing the Ctrl + W keys.

When this item is selected, all open windows are closed.

Save Settings on Exit

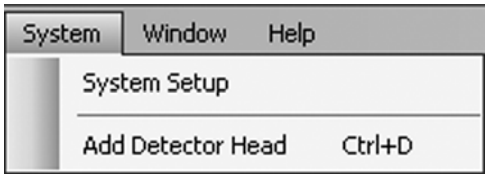
Save Settings on Exit is selected from the Options Menu.

This option allows the user to save the current software settings in a default configuration file ($$$.INI). When the software is started, it will automatically load this saved configuration file.

A check mark in front of the Save Settings on Exit menu item indicates that this function is active. The default setting is enabled.

System Menu

The System menu allows the user to operate with system data.



- **System Setup**: System Setup allows BeamMaster-USB to be configured to suit a particular set of test needs.
- **Add Detector Head**: This function allows the user to configure an additional detector head.

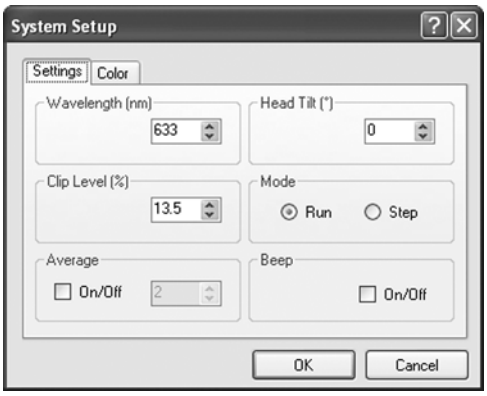
The available keyboard shortcuts are displayed on the right side of the menu. These shortcuts may be activated from the Main Window by pressing the corresponding keyboard combinations.

A check mark in front of a menu item indicates that the function is active.

A gray menu item indicates that the item is currently unavailable. For example, to start log it has to first be setup.

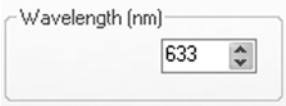
System Setup

System Setup can be accessed via the System button in each operational window, or from the System Menu. The system Setup can also be accessed by clicking the current Wavelength display in the status bar. System Setup allows BeamMaster-USB to be configured to suit a particular set of test needs.



Wavelength

This setting is accessed from the System Setup dialog.



The wavelength value is utilized to calculate the current power reading. Wavelength should be set to match the laser source. BeamMaster-USB detectors have response curves that are dependent on the wavelength. These response curves have been corrected within the calibration file. Therefore, it is important to enter the correct wavelength to obtain a correct power measurement.

Possible Values for Wavelengths

- 190 to 1100 nm for the silicon-UV version
- 800 to 1800 nm for the InGaAs version

Clip Level

This setting is accessed from the System Setup dialog.

The System Clip Level sets the clip level where most of the system calculations are performed. These calculations include: Beam Width, Gaussian Fit, and Elliptical measurements.

A clip level defines the percentage of the peak intensity profile at which beam is measured. For example, a clip level of 50% indicates that the beam is to be measured at its full width at half maximum (FWHM), whereas a clip level of 13.5% measures the beam at a point that is 13.5% of the peak of the profile. The 13.5% level corresponds to the $1/e^2$ point of a Gaussian profile.

Select a value for the System Clip Level from the Value Entry Box. The selected value will be displayed on the Status Bar.

Average

The Average setting is accessed from the System Setup dialog. The System Setup dialog can be accessed from the System Menu or by clicking on the wavelength field in the Status Bar.

The Average function provides a successive averaging feature which smoothes the Position, Profile, and Power displays of noisy or unstable lasers. The average can be set to integer values between 1 and 20. A value of 1 corresponds to no averaging.

For example, if a value of 10 is chosen, ten successive measurements are averaged and the result is displayed. When an eleventh measurement is taken, the first measurement value is dropped and the second through the eleventh are averaged.

The selected value determines the number of successive measurements that will be averaged. A successive averaging technique results in an update rate that is not affected.

Select an Average value from the Value Entry Box. The selected value is displayed on the Status Bar.

Head Tilt

This setting is accessed from the System Setup dialog.

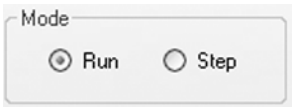
The Head Tilt option is utilized to input the actual orientation of the head. This option will orient the on-screen view to match physical reality. This option is utilized in a situation where the measured width of a laser beam does not coincide exactly with either the V or W axes defined by the BeamMaster-USB.

The Head Tilt feature is especially important when analyzing elliptical beams. When the knife-edges are not properly oriented with respect to the major and minor axes of the ellipse, the width measurements along V and W will not reflect the true maximum and minimum widths of the beam. If the beam cannot be rotated, it is necessary to physically rotate the measuring head about the optical axis of the laser beam.

Select an Head Tilt value via the Value Entry Box. The selected value is displayed on the Status Bar.

Mode

This setting is accessed from the System Setup dialog.



The Mode function is used to switch between a real-time mode of display (Run), and a manually-activated mode (Step).

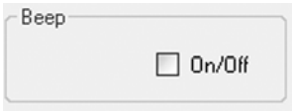
- In Run mode the window display is updated continuously in real-time.
- In Step mode the last measurement is displayed and the window is frozen. A single new set of measurements will be made only when a Step command is selected.

  The Step function is selected by clicking the  Tool Bar button or by pressing the F9 key . A Step menu item is also available in the Options menu. The Step function allows a detailed examination to be made on each profile captured.

Toggle between these two options using the radio button—see “Radio Button” (p. 3-8). The mode selected is displayed on the Status Bar.

Beep

This setting is accessed from the System Setup dialog. The System Setup dialog can be accessed from the System menu or by clicking on the current wavelength value in the Status Bar.

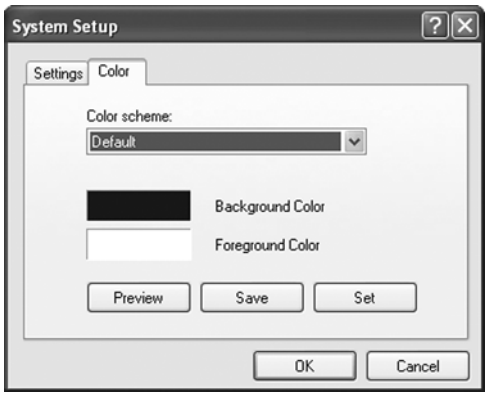


The Beep Option box controls whether BeamMaster-USB will produce the default system beep whenever an error occurs. For example, when Beep is turned ON and the laser source is OFF, the Low Power error will be displayed while the system beeps.

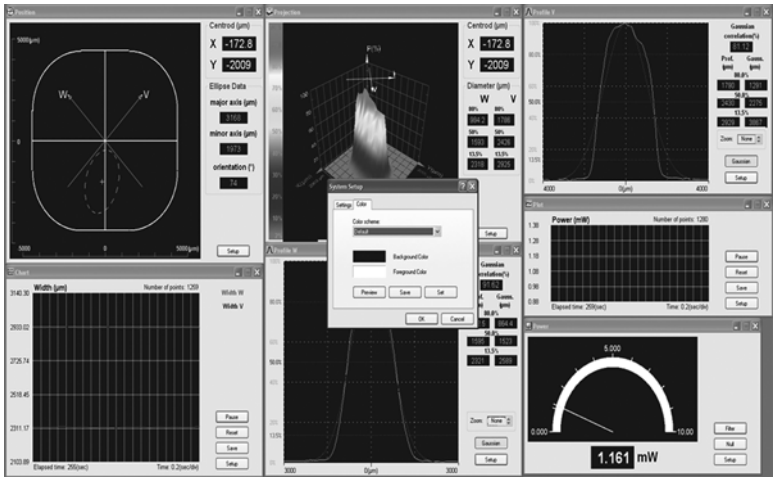
Select Beep using the Option box.

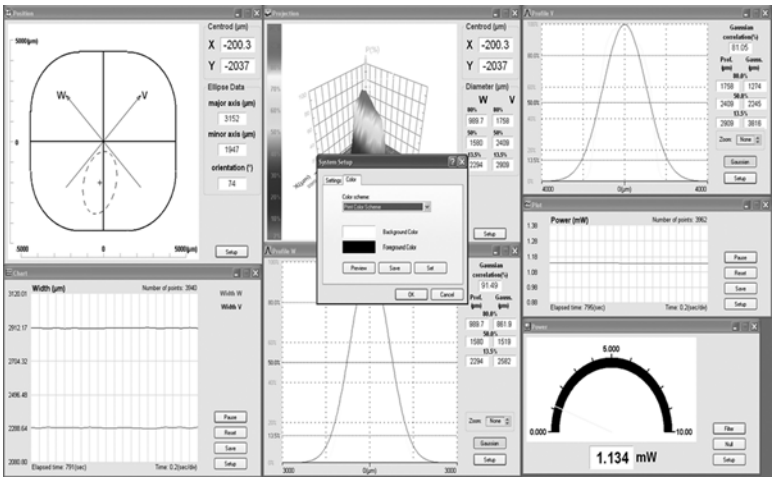
Color Scheme

The color scheme tab enables the user to set the background and foreground colors for all windows. Select the desired color from the standard Windows color pallet. Custom colors are also available with the appropriate video card and Windows color setting.



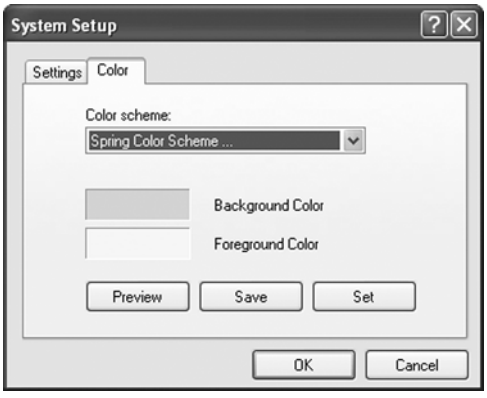
The Position, Profile W, Profile V, Power, Projection, Plot, and Chart windows allow selection of the background and foreground colors.





Selecting a Color Scheme

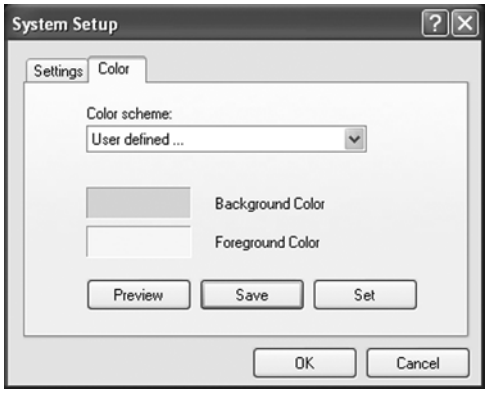
1. Click Color scheme on the Color tab of System Setup.



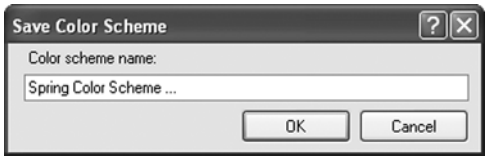
2. Select the color scheme from the drop-down menu.
3. Press and hold the Preview button to view the selected colors without accepting the settings and exiting the dialog.
4. Press the Set button to change the color scheme for all windows.

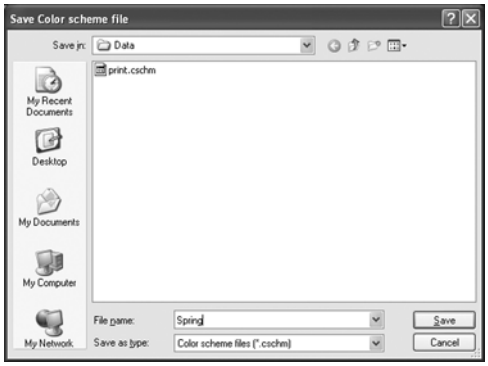
Creating a New Color Scheme

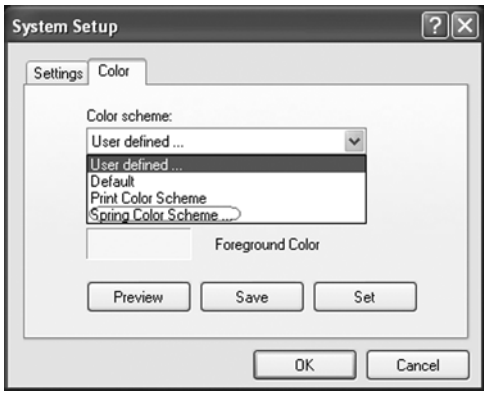
1. Click Color scheme on the Color tab of System Setup.



2. Select “User defined” from the droop-down menu.
3. Place the mouse over the desired color box and click the LEFT mouse button once.
4. Press the Save button to save a new color scheme based on the selected color labels.



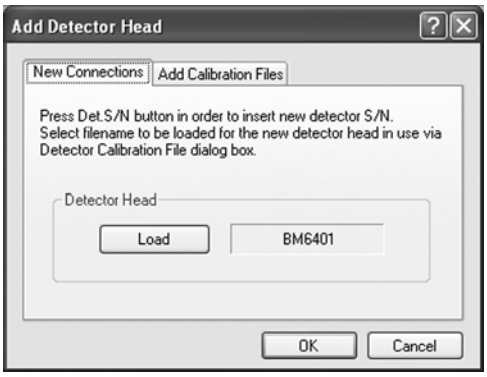




5. Press the Set button to change the color scheme for all windows.

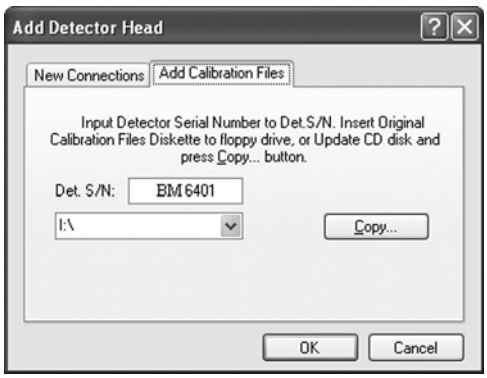
Add Detector Head

The Add Detector Head function is selected from the System Menu.



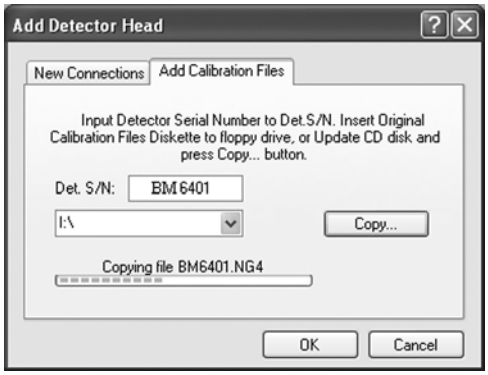
This function allows the user to configure an additional detector head.

Loading



This option enables identifying the detector head serial number which is currently being connected to the system, or selecting any required detector serial number from the calibration file list. Press the Ok button to confirm setting, or press the Cancel button to abort.

Adding Calibration Files



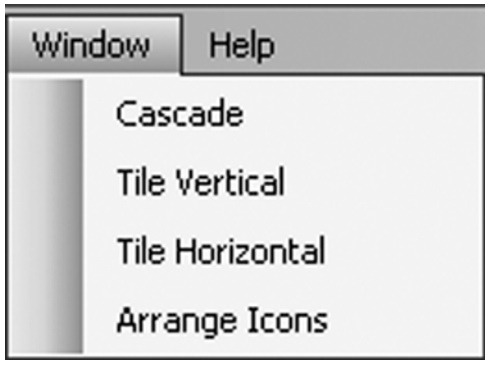
Copy all calibration files from the CD disk (or floppy disk or Flash disk) provided with the sensor head to the current BeamMaster-USB working directory.

Upon activating this option, a data entry box is displayed. Input the detector Serial Number, then appropriate drive where the disk was inserted. Press Copy to confirm the selection, Cancel to abandon.

During the copying operation, a message box is displayed, presenting the name of the file being copied to BeamMaster-USB working directory and the amount of data copied.

Windows Menu

The Windows menu allows the user to graphically arrange the open windows.

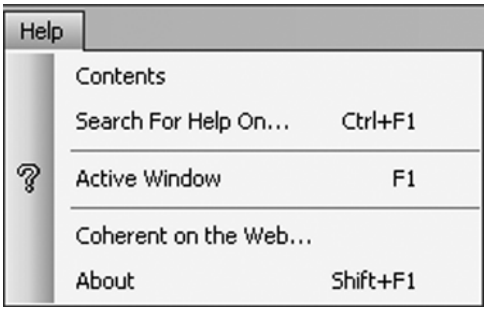


- **Cascade**: This command will attempt to arrange all open windows on top of each other, but slightly null for each of selection.

- **Tile Vertical**: This command will attempt to tile the open windows horizontally along the top of the window area. It works well with two open windows. When more windows are active they will overlap. The overlap results when the window size cannot be reduced to a level to fit the available area.
- **Tile Horizontal**: This command will attempt to tile the open windows vertically along the left edge of the window area. It works well with two open windows. When more windows are active they will overlap. The overlap results when the window size cannot be reduced to a level to fit the available area.
- **Arrange Icons**: When a window is minimized it is reduced to a icon representation and stacked along the bottom of the window area. These icons can be moved around with the mouse. To return them to a ordered group of icons along the bottom of the window area, select this function. This is useful if the icon has been covered up with another window. Higher windows screen resolutions may help.

Help Menu

When a Help subject is displayed, additional help can be displayed by pressing the F1 key.



- **Contents**: This function allows the user to access Help information on the active window.
- **Search for Help On**: This option will bring up a list of all the topics in the Help system.
- **Active Window**: This option retrieves context-sensitive help on the active window.
- **Coherent on the Web**: The link on the Website.
- **About**: The About screen provides the current software version, detector head serial number, and copyrights.

The list of keys or key combinations on the right side of the menu indicate the corresponding keyboard shortcut for that feature. These shortcuts may be activated from the Main window by pressing the keyboard combination.

Contents

The Contents function is selected from the Help Menu.

This function allows the user to access Help information on the current active window.

To access the on-line BeamMaster-USB Manual, select the Contents menu item form the Help Menu. The Contents topic are organized into chapters. To find information on a desired topic, click on the displayed chapter heading.

You can return to the Table of Contents by clicking Contents.

To find specific information fast, use the Search for Help On menu item under the Help menu.

Search for Help On

The Search for Help On function is selected from the Help Menu, or alternatively, by pressing the Ctrl+F1 key.

Additional help can be displayed on the current subject by pressing the F1 key. This option will bring up a list of all the topics in the Help system. Type the first few letters of the topic of interest. The search engine will automatically select any topic that matches the entry. If no entries match your topic, scroll through the list to a find a related topic.

You can also click the Find tab. Windows will compile a cross-reference list of all the word used in the Help file. Using Find will often pinpoint the exact topics of interest.

Active Window

The Active Window function can be accessed by selecting it the Help Menu, pressing the F1 key, or clicking the  button on the Tool Bar.

The Active Window can be identified by a colored title bar background. A depressed tool bar button indicates the windows available for selection. Activate a window by clicking on any part of the window. To get context-sensitive help on the active window, click the F1 key, select Active Window from the Help Menu or click the Help button on the Tool Bar. This will bring up the help topic for the current active Window.

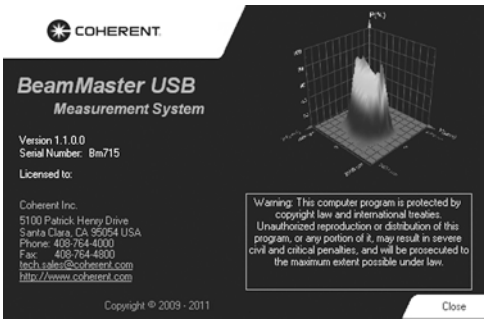
Coherent on the Web

The Coherent on the Web function is selected from the Help Menu.

The Website item in the Help Menu will start the default browser and connect to http://www.coherent.com.

About

The About box is selected from the Help Menu.



The About screen provides the current software name and version, detector head, serial number, and copyright information.

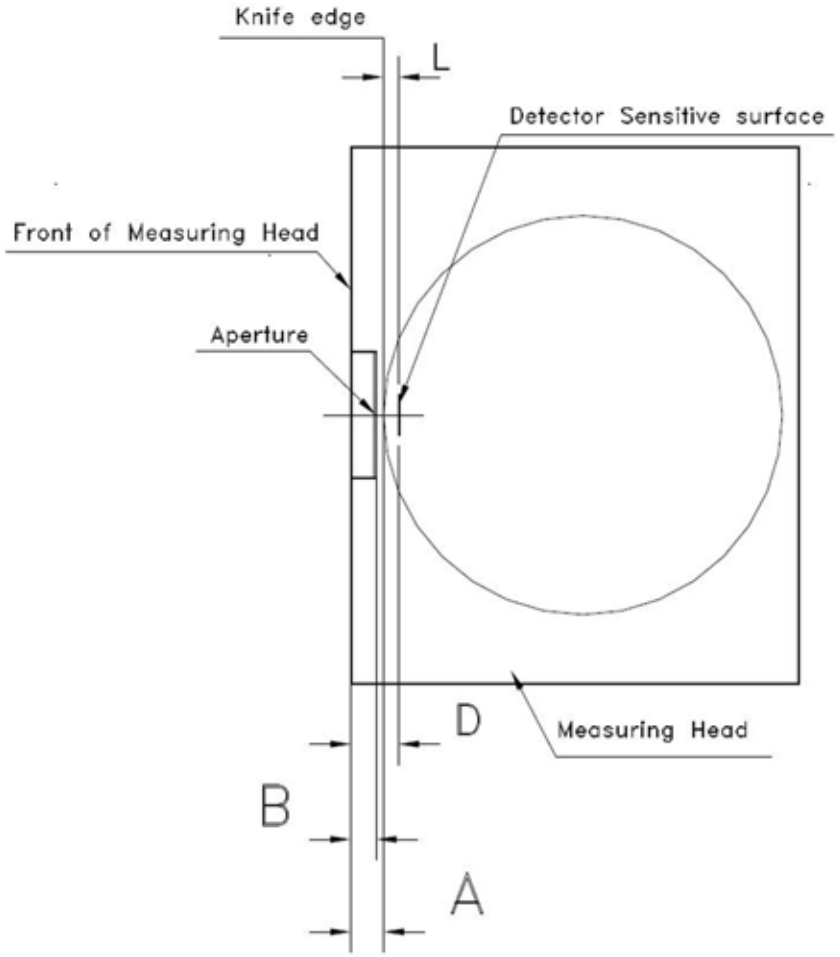
The Close button will clear the About information from the screen.

SECTION FIVE: HARDWARE

This section covers the following technical specifications:

All detector heads conform to applicable CE Mark standards.

Dimensions and Distances



Model \ Detector Type	D [mm] Distance from front surface to Detector: Silicon	InGaAs-3	InGaAs-5
BM 3	$12.2^{\pm0.5}$	$8.6^{\pm0.5}$	$10.3^{\pm0.5}$
BM 7	$10.7^{\pm0.5}$	$9.8^{\pm0.5}$	$8.3^{\pm0.5}$
BM 3*	$10.7^{\pm0.5}$	$9.8^{\pm0.5}$	$8.3^{\pm0.5}$

Model	A [mm] Distance from front surface to Knife edge	B [mm] Distance from front surface to Aperature Inner edge	
BM 3	$5.5^{+0.06}_{-0.03}$	$5.2^{+0.02}_{-0.12}$	
BM 7	$3.5^{\pm0.1}$	$3.2^{\pm0.1}$	
BM 3*	$3.5^{\pm0.1}$	$3.2^{\pm0.1}$	

Model \ Detector Type	L [mm] Distance from Knife edge to Detector: Silicon	InGaAs-3	InGaAs-5
BM 3	$6.7^{\pm0.5}$	$3.1^{\pm0.5}$	$4.8^{\pm0.5}$
BM 7	$7.2^{\pm0.5}$	$6.3^{\pm0.5}$	$4.8^{\pm0.5}$
BM 3*	$7.2^{\pm0.5}$	$6.3^{\pm0.5}$	$4.8^{\pm0.5}$

BM 3* - New revision of the BM-3 measuring head, starting from SN: 4000A.

BM-3 InGaAs Detector Head

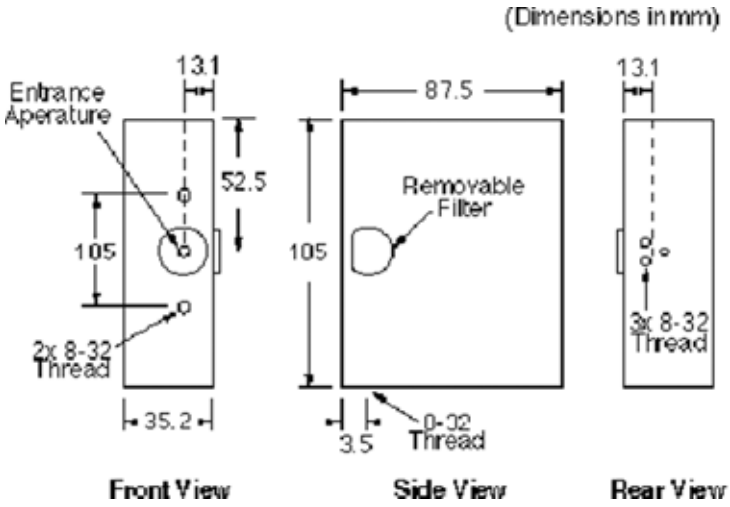


Figure 5-1. BM-3 InGaAs Detector Head Dimensions

Table 5-1. BM-3 InGaAs Detector Head Specifications

Parameter	Description
Spectral Response	800 to 1800
Number of Knife-Edges	3
Sensor Input Aperture	5 mm circular (active area Ø3)
Dimensions	35.2 mm (W) x 105 mm (H) x 87.5 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Maximum Power	Power up to 5 mW
Relative Power Measurement	0.1 µW resolution
Power Measurement Accuracy	± 10%
Damage Threshold	1W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	3 mm to 3 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	The InGaAs head does not use filters due to mechanical constraints.
Blade eccentricity for the BM-3 is ± 15 µm.	

BM-3 Silicon Detector Head

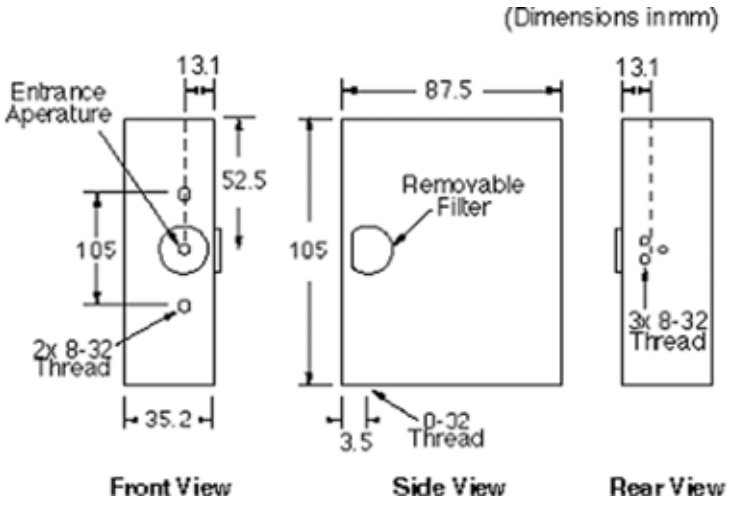


Figure 5-2. BM-3 Silicon Detector Head Dimensions

Table 5-2. BM-3 Silicon Detector Head Specifications

Parameter	Description
Spectral Response	400 to 1100
Number of Knife-Edges	3
Sensor Input Aperture	5 mm circular
Dimensions	35.2 mm (W) x 105 mm (H) x 87.5 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Maximum Power @ 633 nm	No filter: Power up to 5 mW NG4 filter: Power up to 50 mW NG9 filter: Power up to 1W
Relative Power Measurement	0.1 µW resolution
Power Measurement Accuracy	± 5%
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	5 mm to 3 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	NG4 and NG9. See filter files NG4.FLT and NG9.FLT for a text format transmission table.
Blade eccentricity for the BM-3 is ± 15 µm.	

BM-3 Silicon-UV Detector Head

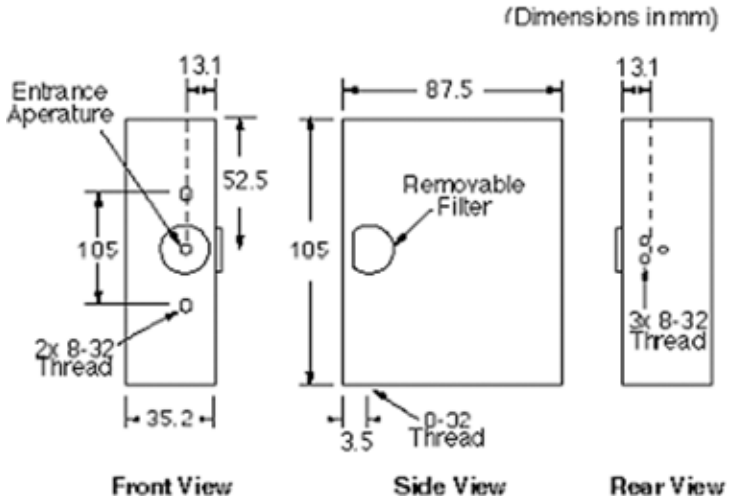


Figure 5-3. BM-3 Silicon-UV Detector Head Dimensions

Table 5-3. BM-3 Silicon-UV Detector Head Specifications

Parameter	Description
Spectral Response	190 to 1100
Number of Knife-Edges	3
Sensor Input Aperture	5 mm circular
Dimensions	35.2 mm (W) x 105 mm (H) x 87.5 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Maximum Power @ 633 nm	No filter: Power up to 5 mW NG4 filter: Power up to 50 mW NG9 filter: Power up to 1W
Relative Power Measurement	0.1 µW resolution
Detector Type	UV-enhanced Si 10*10 mm
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	5 mm to 3 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	NG4 and NG9 can be used for the 350 to 1100 nm range. See filter files NG4.FLT and NG9.FLT for a text format transmission table.
Blade eccentricity for the BM-3 is ± 15 µm.	

BM-3 InGaAs Detector Head*

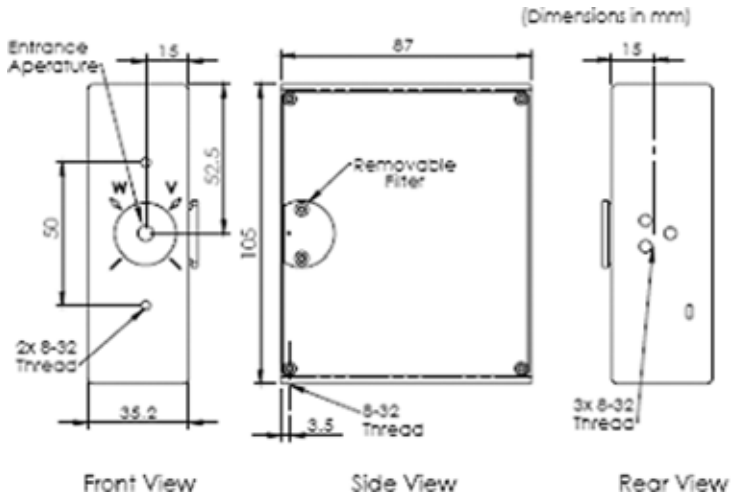


Figure 5-4. BM-3* InGaAs Detector Head Dimensions

Table 5-4. BM-3* InGaAs Detector Head Specifications

Parameter	Description
Spectral Response	800 to 1800
Number of Knife-Edges	3
Sensor Input Aperture	5 mm circular (active area Ø3)
Dimensions	35.2 mm (W) x 105 mm (H) x 87.5 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Maximum Power	Power up to 5 mW
Relative Power Measurement	0.1 µW resolution
Power Measurement Accuracy	± 10%
Damage Threshold	1W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	3 mm to 3 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	The InGaAs head does not use filters due to mechanical constraints.
Blade eccentricity for the BM-3 is ± 15 µm.	

BM-3* - New revision of the BM-3 measuring head, starting from SN: 4000A

BM-3 Silicon Detector Head*

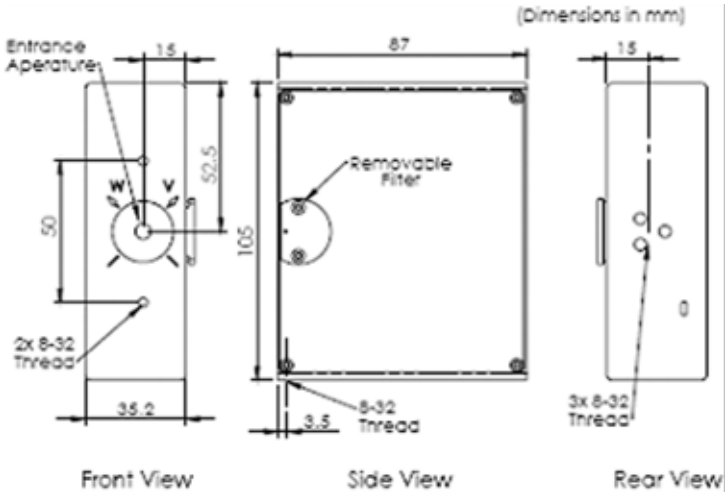


Figure 5-5. BM-3* Silicon Detector Head Dimensions

Table 5-5. BM-3* Silicon Detector Head Specifications

Parameter	Description
Spectral Response	400 to 1100
Number of Knife-Edges	3
Sensor Input Aperture	5 mm circular
Dimensions	35.2 mm (W) x 105 mm (H) x 87.5 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Maximum Power @ 633 nm	No filter: Power up to 5 mW NG4 filter: Power up to 50 mW NG9 filter: Power up to 1W
Relative Power Measurement	0.1 µW resolution
Power Measurement Accuracy	± 5%
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	5 mm to 3 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	NG4 and NG9. See filter files NG4.FLT and NG9.FLT for a text format transmission table.
Blade eccentricity for the BM-3 is ± 15 µm.	

BM-3* - New revision of the BM-3 measuring head, starting from SN: 4000A

*BM-3**
Silicon-UV
Detector Head

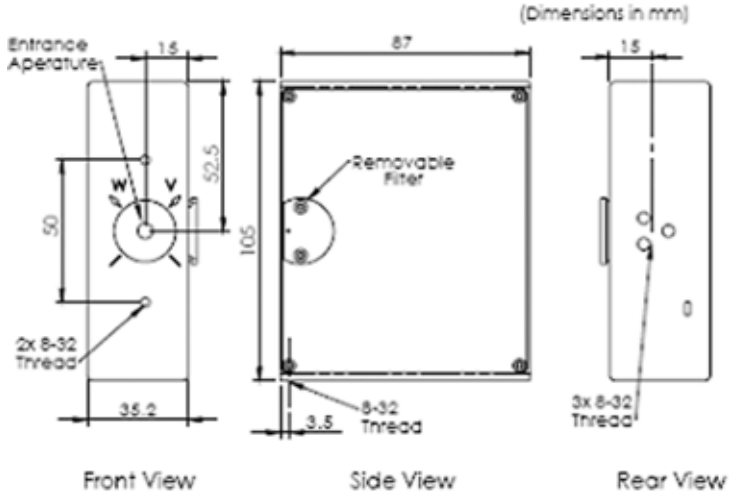


Figure 5-6. BM-3* Silicon-UV Detector Head Dimensions

Table 5-6. BM-3* Silicon-UV Detector Head Specifications

Parameter	Description
Spectral Response	190 to 1100
Number of Knife-Edges	3
Sensor Input Aperture	5 mm circular
Dimensions	35.2 mm (W) x 105 mm (H) x 87.5 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Maximum Power @ 633 nm	No filter: Power up to 5 mW NG4 filter: Power up to 50 mW NG9 filter: Power up to 1W
Relative Power Measurement	0.1 µW resolution
Detector Type	UV-Enhanced Si 10*10 mm
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	5 mm to 3 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	NG4 and NG9 can be used for the 400 to 1100 nm range. See filter files NG4.FLT and NG9.FLT for a text format transmission table.
Blade eccentricity for the BM-3 is ± 15 µm.	

BM-3* - New revision of the BM-3 measuring head, starting from SN: 4000A

BM-7 InGaAs Detector Head

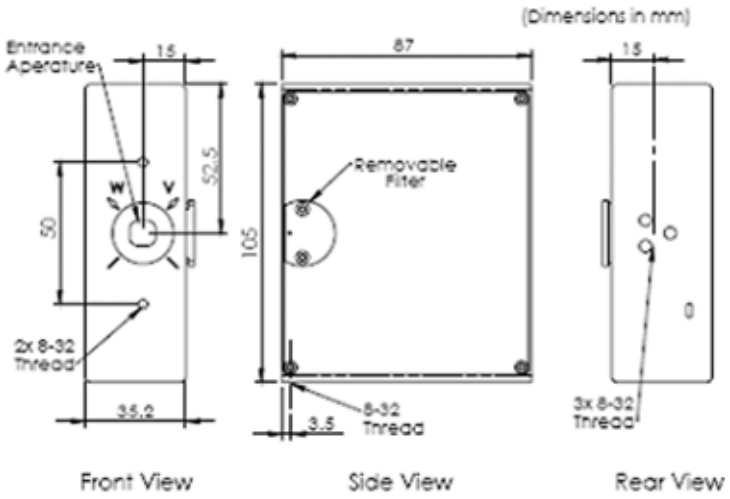


Figure 5-7. BM-7 InGaAs Detector Head Dimensions

Table 5-7. BM-7 InGaAs Detector Head Specifications

Parameter	Description
Spectral Response	800 to 1800, calibrated range: 800 to 1720 nm
Number of Knife-Edges	7
Sensor Input Aperture	9 mm square (active area Ø3)[a]
Dimensions	35.2 mm (W) x 105 mm (H) x 87 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Relative Power Measurement	0.1 µW resolution
Maximum Power	Power up to 5 mW (> 0.1 mm diam.)
Power Measurement Accuracy	± 10%
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (1/e^2)	3 mm to 10 µm
Beam Width Resolution	width < 100 µm: 0.1 µm width >= 100 µm: 1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	The InGaAs head does not use filters due to mechanical constraints.
Blade eccentricity for the BM-7 is ± 30 µm.	

a. Optional: An InGaAs 5 mm diameter detector is also available (model BM7-InGaAs-5)

BM-7 Silicon Detector Head

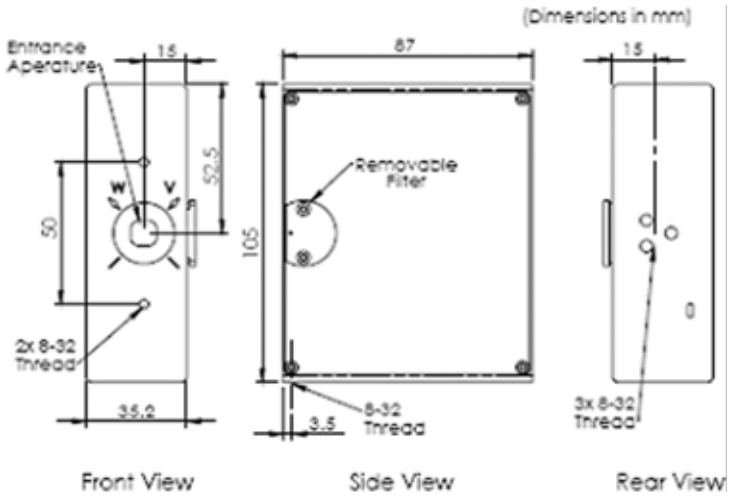


Figure 5-8. BM-7 Silicon Detector Head Dimensions

Table 5-8. BM-7 Silicon Detector Head Specifications

Parameter	Description
Spectral Response	400 to 1100
Number of Knife-Edges	7
Sensor Input Aperture	9 mm square
Dimensions	35.2 mm (W) x 105 mm (H) x 87 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Relative Power Measurement	0.1 µW resolution
Maximum Power @ 633 nm	No filter: Power up to 5 mW (> 0.1 mm diam.) NG4 filter: Power up to 50 mW NG9 filter: Power up to 1W
Power Measurement Accuracy	± 5%
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	9 mm to 15 µm
Beam Width Resolution	width < 100 µm:0.1 µm width >= 100 µm:1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	NG4 and NG9. See filter files NG4.FLT and NG9.FLT for a text format transmission table.
Blade eccentricity for the BM-7 is ± 30 µm.	

BM-7 Silicon-UV Detector Head

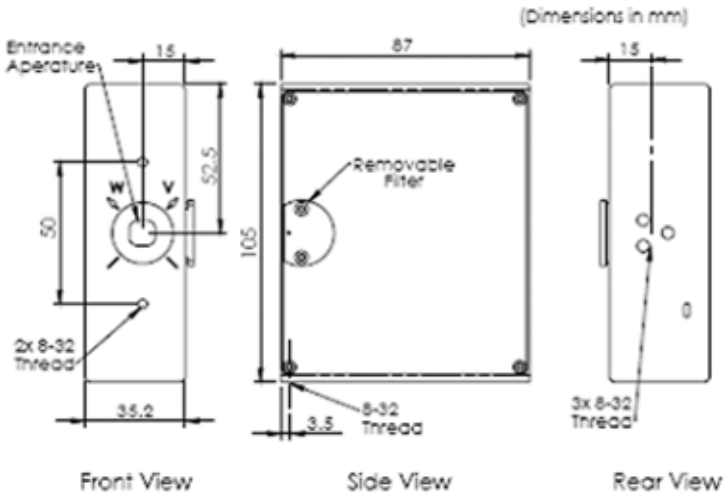


Figure 5-9. BM-7 Silicon-UV Detector Head Dimensions

Table 5-9. BM-7 Silicon-UV Detector Head Specifications

Parameter	Description
Spectral Response	190 to 1100
Number of Knife-Edges	7
Sensor Input Aperture	9 mm square
Dimensions	35.2 mm (W) x 105 mm (H) x 87 mm (L)
Weight	22 oz.
Minimum Detectable Power	10 µW
Relative Power Measurement	0.1 µW resolution
Maximum Power @ 633 nm	No filter: Power up to 5 mW (> 0.1 mm diam.) NG4 filter: Power up to 50 mW NG9 filter: Power up to 1W
Detector Type	UV-enhanced Si 10*10 mm
Damage Threshold	200W/mm^2 with total power less than 5 mW at sensor
Optical Dynamic Range	10 µW/cm^2 to 10W/mm^2 (no filter)
Beam Size Range (at 1/e^2)	9 mm to 15 µm
Beam Width Resolution	width < 100 µm:0.1 µm width >= 100 µm:1.0 µm
Beam Position Resolution	1 µm
Beam Position Accuracy	± 15 µm
Distance to Image Plane	See “Dimensions and Distances” (p. 5-2)
Maximum Update Rate	5 Hz—see “Speed Issues” (p. 6-6)
Cable	2.5 m long, attached to the head
Filters	NG4 and NG9 filters can be used for 350 to 1100 nm. See filter files NG4.FLT and NG9.FLT for a text format transmission table.
Blade eccentricity for the BM-7 is ± 30 µm.	

USB External Box

The BeamMaster-USB uses the USB external box to digitize and store the information from the detector head.

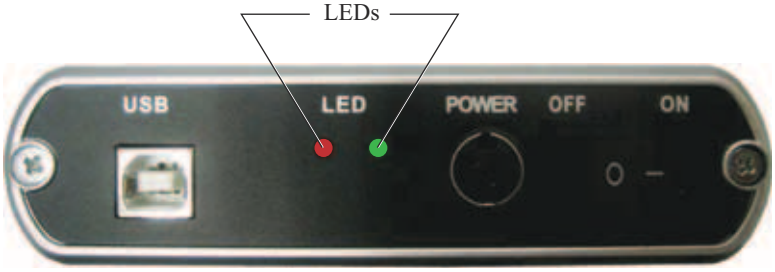


Figure 5-10. USB External Box (front view)

Table 5-10. USB External Box Specifications

Parameter	Description
Bus	USB 2.0
Cable	USB 2.0, 0.9m length
Weight	0.37 kg
Dimensions	165 mm x 120 mm x 30 mm
Power Input Requirements (typical)	+5V @ 0.1A (supplied via USB cable)
Ambient Operating Temperature	10 to 35°C
A/D Converter	20 MHz sample rate at 12 bits
CE Mark	Conforms to all applicable CE mark standards

There are two LEDs on the external box front panel:

- GREEN illuminates when installation of the external box is successful.
- RED illuminates when there is an alert (possible installation issue).

The Power connector and On/Off switch are future options.

There is 15-pin connector on the back of the external box. This connector is connected to the detector head via the detector cable.

Figure 5-11. USB External Box (rear view)

SECTION SIX: CALCULATIONS SUMMARY

In this section:

Accuracy

The following topics provide information on how to optimize the BeamMaster-USB to achieve the highest measurement accuracy.

The accuracy of all calculations is affected by beam peak intensity, centering, size, and background noise.

To insure optimum measurement accuracy, the following items must be properly maintained:

- The beam spot size should not exceed the recommended minimum or maximum beam diameter for the detector head being used (refer to the detector head specifications in the "Section Five: Hardware," section, which starts on p. 5-1).
- The beam position should be centered in the sensor area, with no beam area overlapping the edge of the input aperture on the detector head.
- The beam incidence should be normal to the face of the detector head.
- The background noise in the beam image can affect the calculated results. Ensure that all sources of background noise have been eliminated if possible ("Background Noise," is discussed, below).
- The successive Averaging feature can also be used to smooth noise and beam variations.

Background Noise

Several sources of background noise can contribute to the overall noise level in the system. This topic discusses the most common noise sources.

Electronic Noise

Electronic noise can be a concern with instruments being used in association with lasers. The BeamMaster-USB has passed CE Mark tests indicating that it is resistant to most EMI radiation. Still, Intense High frequency sources can induce noise into the cables and detector head electronics. Avoid grounding the detector head and BeamMaster-USB chassis with the laser or its power supply in a manner that could make them susceptible to ground loops. Severe damage to the detector head and electronics may result. It is also recommended that the BeamMaster-USB system power supply be surge protected and isolated from the laser power source.

Background Light

Background light noise seen by the detector head is another problem that should be closely monitored. This noise comes from sunlight, room lights, flash lamps, and instrumentation lights. One of the filters can be used to reduce background light. The Power Offset feature can be used to remove the ambient light from the power reading.

Thermal Noise

Thermal noise can also affect the long-term stability of the Beam-Master-USB. Drift in detector head voltage and A/D converter circuits due to large changes in room and instrumentation temperatures can contribute to background noise. The system should be allowed to reach a stable operating temperature each time it is used. This can take as long as 20 minutes.

Relative Total Power

The rotating drum in the detector head contains multiple knife-edge apertures. As an aperture passes between the laser beam and the stationary power sensor, there is a period of time where the entire beam is allowed to reach the sensor. At this point the Beam-Master-USB can measure the total power of the beam.

The power reading is adjusted, based on the system wavelength setting and the wavelength response curve for the detector, and the transmission of the current filter.

For details on minimum detectable power, measurement resolution, maximum power, and damage threshold limits, see the appropriate detector head specifications.

Power Accuracy

The silicon detectors are calibrated with and without the filters for power accuracy at 633. The InGaAs detector is calibrated for power accuracy at 1320 nm. The system is designed for ± 10% accuracy at the specified wavelengths; therefore, the BeamMaster-USB does not provide *absolute* power accuracy at this time. Consider the Power reading to be Relative.

If absolute power accuracy is desired, the BeamMaster-USB power reading can be hand-calibrated using a power meter. If the BeamMaster-USB reading needs adjusting, a filter file can be created that provides the necessary correction at the given wavelength.

Beam Width

The Beam Width is measured at a clip level.

A clip level defines the percentage of the peak intensity profile at which beam is measured. For example, a clip level of 50% indicates that the beam is to be measured at its full width at half maximum (FWHM). A clip level of 13.5% measures the beam at a point that is 13.5% of the peak of the profile. The 13.5% level corresponds to the $1/e^2$ point of a Gaussian profile.

The BeamMaster-USB obtains the beam profile information, as outlined under "Theory of Operation" (p. 1-3).

The maximum value in the profile is found and set to 100%. The Profile is searched to find the points most closely matching the clip level. The distance between the specified clip level points is the beam width.

If no point matches the clip level, linear interpolation is used to find the edge.

If the profile crosses the clip level more than two times, the system picks the edges closest to the beam profile center of gravity (typically the main lobe).

If the edge of the beam is cut off because it intersects the edge of the aperture, the profile will appear truncated on that edge.

Beam Centroid Location

Before each blade there is a "start-of-scan" signal acting as an indicator for the beam location on the detector surface. Each system is calibrated relative to the start-of-scan. The system calculates the

time from start-of-scan to the "center of gravity" of the profile. The "center of gravity" is determined for the W axis with the following calculation:

$$W = SUM\ [w * p(w)]/I$$

Where:

w = location along W axis
p(w) = intensity at location w on W axis
I = total intensity of W profile
W = center position of W axis

Simple axis translation is then used to present the data in X-Y coordinates.

The Affect of Background Ambient Light

Profiles are obtained by performing a derivation on the digitized power curve. Ambient light is suppressed since it is constant over the detector surface, resulting in a derivative of zero. However, if a low power, large-area beam is examined, it is important to suppress background illumination as much as possible.

Gaussian Fit

The Gaussian Fit is a least-squares fit of a Gaussian equation to the cross-section beam profiles. The correlation coefficient is the normalized sum of the residuals of the fit.

The following equation is used to determine the Gaussian Fit:

$$I = Ve^{[-(x-c)/s]^2}$$

Where:

I = the intensity of a pixel at location x

In performing a least squares fit to this equation, the following terms are derived:

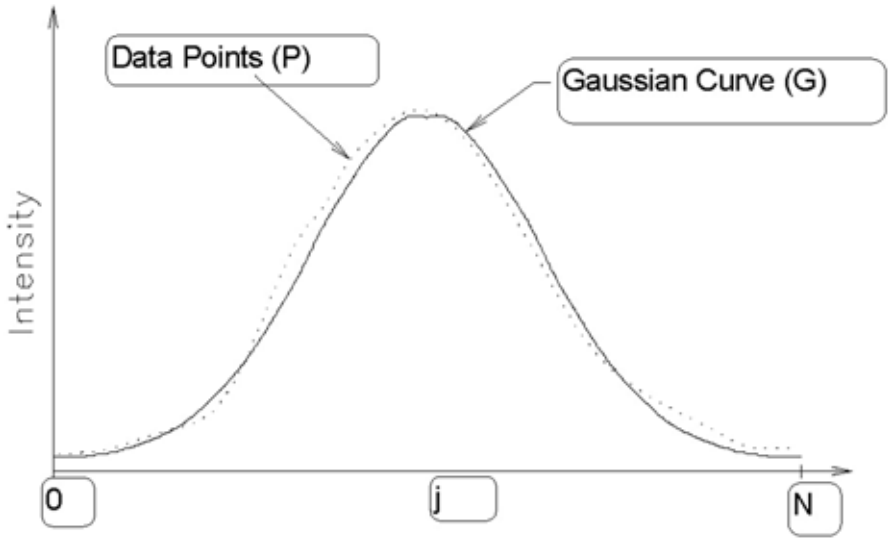
V = the maximum intensity of the fitted Gaussian curve (Peak intensity)
C = the center of the Gaussian fit peak (Centroid)
s = the radius of the Gaussian fit curve at the 1 /e^2 intensity level (Diameter)

Gaussian Fit Diameter

The Gaussian Diameter is the width of the Gaussian fit at the clip level specified.

Gaussian Correlation Coefficient

Given a theoretical Gaussian curve (G) and a set of data points from a beam profile (P), the Gaussian correlation coefficient is calculated as follows:



Where each data set is composed of points for j = 0, 1, 2, ... N. The correlation coefficient is derived, from the following steps.

1. S, the Integration of the squared differences between the two curves is found:

$$S = Integral\ [(P-G)^2]$$

2. The deformation at each point from the average, Dj, is then determined:

$$S_o = Integral\ [(G)^2]$$

3. The fit coefficient, C, is a percentage, defined with the following formula:

$$C = 100 * \{1 - [SQRT (3/S-S_0)]$$

Ellipticity

Elliptical measurements are calculated utilizing data from three blades. The actual calculation is in accordance with standard formulas for ellipse calculations utilizing three chords.

1. The major and minor axes of the fit ellipse are calculated by determining the distance from the centroid to the ellipse.
2. Orientation (Theta) measures the orientation of the major axes of the fit. Theta is measured from the positive X-axis and varies between +90º and -90º.

Speed Issues

The motor speed limits the maximum update rate to 5 Hz. The software can acquire data at 5 Hz by starting a Data Collection Log file when all graphic screens are closed.

When several windows are opened, the system may slow down, especially when using the 3D feature. High performance computers can display the data faster. The update rate of a particular computer is influenced by a variety of factors: CPU speed, computer RAM, the video card, video ram, screen resolution, screen color depth, and the specific operating system being used.

SECTION SEVEN: TROUBLESHOOTING

This section lists common problems and probable solutions for the following error types:

- System errors (this page)
- Analysis errors (p. 7-2)

System Errors

System errors are displayed on the right-hand side of the tool bar. They indicate a problem with the hardware or detector head. When these errors are displayed, all results are removed from the window.

Low power 

This message means that insufficient light is available on the detector. This error will occur if less than 10 µW of energy is detected. Verify that the laser light is reaching the sensor. If it appears that the message is incorrect, treat it as a Hardware Failure message (explained, next).

Hardware operation failed 

A Hardware Operation Failed message indicates that a problem exists with the USB external box. One of the following solutions could resolve this problem.

1. The USB external box settings do not match the software setup parameters—refer to "Installing the USB External Box" (p. 2-5).
2. The detector head is not connected, or the cable is loose—see "Connecting the Detector" (p. 2-3).
3. There is no measurement taken during 2 to 4 drum rotations. This might be due to some problem in the head or the USB external box electronics.

Power adjusting 

This message is normal and can occur when:

1. There is a sudden change in laser power.
2. The user has just completed setting the hardware or system setup parameters.

Laser power exceed limit 

This message indicates the detector is collecting an excessive amount of light. Check the input power level with a power meter to ensure the device is being used within the recommended operating limits. With small beams this error can occur below the published power limit—for a list of published limits, refer to "Section Five: Hardware" (p. 5-1). If it appears that the message is incorrect, treat it as a hardware failure—refer to "Hardware operation failed" (p. 7-1).

Frequency adjusting 

This message is normal and can occur when:

1. There is a sudden change in laser position or size.
2. The user has just completed setting the hardware or system setup parameters.

Check detector head 

This message displays in one of the following cases:

1. Whenever the measuring head is being connected to the manifold box and the calibration files in use do not match the head. To correct this error, change the head S/N—refer to "Add Detector Head" (p. 4-71).
2. When the measuring head is malfunctioning. If this happens, contact Coherent—refer to "Obtaining Service" (p. 10-2).

Analysis Errors

Analysis errors are associated with calculations and data collection.

Small beam display on the Position window

The Position window does not automatically zoom for small beams. To enable Position Zoom mode, select the Position Setup button and enable the zoom feature. The zoom function will scale the position display relative to the current beam diameter.

Power is not correct

- Check that the correct wavelength is entered into the System Setup dialog.
- Make sure the filter installed in the detector head matches the filter selected in the software.
- Ensure that the sensor is not saturated—for a list of specifications—refer to "Section Five: Hardware" (p. 5-1).

- If using a small spot, check the power density levels—see "Selecting a Filter" (p. 2-4). The relative power reading should be ± 10% of the actual power level. If an absolute power reading is required, set up a custom filter file— refer to "Create Filter File" (p. 4-2). A custom filter file allows the user to enter a power correction factor. This factor will be multiplied by the transmission value at the specified wavelength.

Calculation Issues

Refer to "Accuracy" (p. 6-1).

SECTION EIGHT: HEAD ACCESSORIES AND DRAWINGS

In this section:

BeamMaster-USB Rotation Mount

Figure 8-1. BeamMaster-USB Rotation Mount

Part number: 1038024

The rotation mount is designed to attach to the 8-32 holes on the BeamMaster-USB head and provide precise rotation of the head about the optical axis.

It is sometimes necessary to rotate the BeamMaster-USB head about the optical axis. Each head is provided with three 8-32 threaded mounting holes on its rear plate for this purpose.

Fiber Adapter

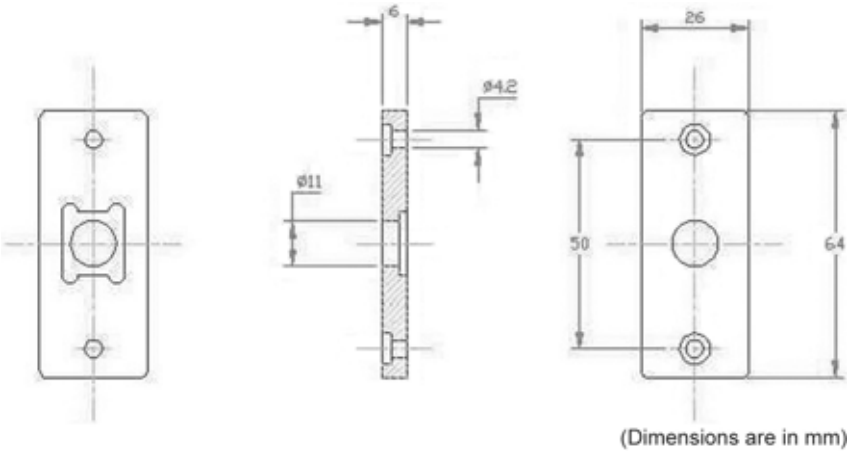


Figure 8-2. Fiber Adapter

Part number: 33-7154-000

The fiber adapter is provided with an FC connector and is designed to just fit onto the aperture of the BeamMaster-USB detector head. The fiber adapter can firmly hold an optical fiber with FC connector end quite close to the detector knife-edge plane for measurement of its output beam profile.

C-Mount Adapter Ring

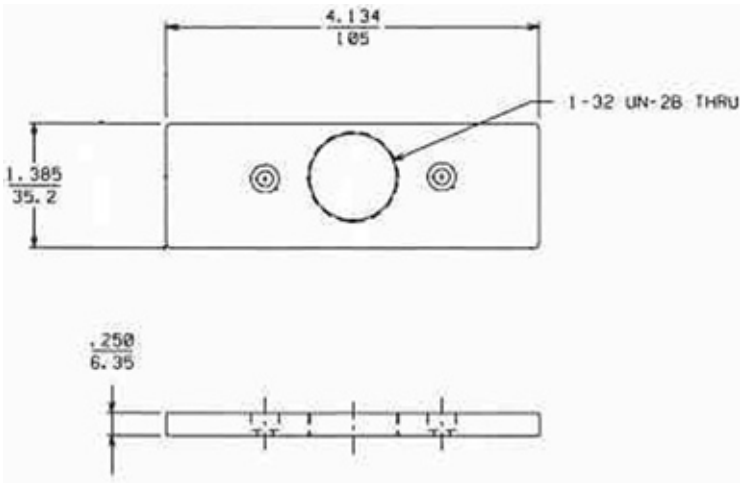


Figure 8-3. C-Mount Adapter Ring

Part number: 33-7147-000

The C-Mount Adapter Ring is designed to attach to the face of the BeamMaster-USB detector head. This adapter will accommodate optical devices utilizing a 1" x 32 thread pattern.

SECTION NINE: WINDOWS CONTROL LIBRARY

Overview

The BeamCtrlLib.dll Windows Control Library is a software package required when writing an application program for the BeamMaster-USB system.

The BeamCtrlLib.dll Windows Control Library contains easy-to-operate functions and properties that enable measuring beam parameters and help you create your own application under Windows XP, Windows Vista, or Windows 7. The BeamCtrlLib.dll Windows Control Library was written using Microsoft .Net C#.

Description of Files

Windows Control Library is a software tool for managing the BeamMaster-USB system under the Windows operating system. For proper operation, the Windows Control Library requires the following files:

- **BeamCtrlLib.dll**: Windows Control Library
- **Beam USB Control.dll**: Additional Windows Control Library
- **BM*xxxx*.up**: Detector calibration file supplied with the measuring system, where "BM*xxxx*" refers to the detector number

In the sub-directory of examples on the Installation CD, there is an example of using BeamCtrlLib Windows Control Library with the C# programming language.

Description of the BeamCtrlLib Windows Control Library Functions

- **GetCorrelation**: Function returns the correlation coefficient of the Gaussian
- **GetGaussianWidth**: Function returns the width of the Gaussian at a certain clip level
- **GetProfileWidth**: Function returns the width of the profile at a certain clip level
- **ProfileData**: Function returns the measured profile as an array of points
- **ProfileUnit**: Function returns the distance between points in microns in the measured profile
- **Start**: Function to initialize and start the measurement system
- **Stop**: Function of stopping the measuring system

Description of the BeamCtrlLib Windows Control Library Properties

- **Average**: Sets and returns the average of the measuring system
- **CurrentStatus**: Returns the current status of the state measuring system
- **EllipseError**: Returns the state of reconstruction of the ellipse of the measured laser beam
- **EllipseLevel**: Sets and returns the current ellipse level of the measured laser beam
- **EllipseMajor**: Returns the value of the major ellipse axis of the measured laser beam
- **EllipseMinor**: Returns the value of the minor ellipse axis of the measured laser beam
- **EllipseOrientation**: Returns the angle between the major axis of the ellipse and the X-axis of the measured laser beam
- **Position**: Returns the current position of the measured laser beam
- **Power**: Returns the current power of the measured laser beam
- **ProjectionData**: Returns a matrix of two-dimensional reconstruction of the laser beam
- **ProjectionUnit**: Returns the distance (in microns) between points in the matrix of two-dimensional reconstruction of the laser beam
- **Wavelength**: Sets and returns the wavelength (in nanometers) of the measured laser beam

Description of Events BeamCtrlLib Windows Control Library

- **OnErrorMessage**: Event notifying change of the status of the measuring system
- **OnUpdateData**: Event notifying the receipt of new data from the measuring system

Description of BeamCtrlLib Windows Control Library Enumerations

ErrorStatus: Specifies options for the state of the measuring system

Description of Enumerations BeamCtrlLib Windows Control Library

- **ErrorStatus**: Specifies options for the state of the measuring system

GetCorrelation

Function returns the Gaussian correlation coefficient.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Function GetCorrelation ( _
      uiNumPrf As UInt16 _
) As Double
```

Visual Basic (Usage)

```
Dim numProfile As UInt16
Dim corelation As Double
corelation = GetCorrelation(numProfile)
```

C#

```
public double GetCorrelation(UInt16 uiNumPrf)
```

Parameters

uiNumPrf

The number of measured profile.

Remarks

This method is a member of the class BeamCtrlLib. To be able to apply to this method and obtain the results of measurements, there is a need to first create an object of class BeamCtrlLib and run it with Start function.

The *uiNumPrf* parameter corresponds to the serial number of the knife in the measuring system, starting from 0.

Return Value

This function returns the Gaussian correlation coefficient.

GetGaussian-Width

Function returns (in microns) the width of the Gaussian at a certain clip level.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Function GetGaussianWidth( _
      uiNumPrf As UInt16 _
      fLevel As Single _
) As Double
```

Visual Basic (Usage)

Dim numProfile As UInt16

```
Dim width As Double
Dim level As Single
width = GetGaussianWidth(numProfile, level)
```

C#

```
public double GetGaussianWidth(UInt16 uiNumPrf, float
fLevel)
```

Parameters

uiNumPrf

The number of measured profile.

fLevel

The clip level as a percentage of the height profile.

Remarks

This method is a member of the class BeamCtrlLib. To be able to apply to this method and obtain the results of measurements, there is a need to first create an object of class BeamCtrlLib and run it with Start function.

The *uiNumPrf* parameter corresponds to the serial number of the knife in the measuring system, starting from 0.

The *fLevel* parameter indicating the percentage clip level at which the beam width profile is being measured. The values of this parameter may be in the range of 0.0, for the lowest point of the measured profile and up to the maximum value of 100.0, highest point of the measured profile.

Return Value

This function returns (in microns) the width of the Gaussian at a certain clip level.

GetProfileWidth

Function returns (in microns) the width of the profile at a certain clip level.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Function GetProfileWidth( _
      uiNumPrf As UInt16 _
      fLevel As Single _
) As Double
```

Visual Basic (Usage)

```
Dim numProfile As UInt16
Dim width As Double
Dim level As Single
width = GetProfileWidth(numProfile, level)
```

C#

```
public double GetProfileWidth(UInt16 uiNumPrf, float
fLevel)
```

Parameters

uiNumPrf

The number of measured profile.

fLevel

The clip level as a percentage of the height profile.

Remarks

This method is a member of the class BeamCtrlLib. To be able to apply to this method and obtain the results of measurements, there is a need to first create an object of class BeamCtrlLib and run it with the Start function.

The *uiNumPrf* parameter corresponds to the serial number of the knife in the measuring system starting from 0.

The *fLevel* parameter indicates the percentage clip level at which the beam width profile is measured. The values of this parameter may be in the range of 0.0, for the lowest point of the measured profile, and up to the maximum value of to 100.0, highest point of the measured profile.

Return Value

This function returns (in microns) the width of the profile at a certain clip level.

ProfileData

Function returns the measured profile as an array of points.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Function ProfileData( _
      uiNumPrf As UInt16 _
) As Single()
```

Visual Basic (Usage)

```
Dim numProfile As UInt16
Dim profile() As Single
profile = ProfileData(numProfile)
```

C#

```
public Single[] ProfileData(UInt16 uiNumPrf)
```

Parameters

uiNumPrf

The number of measured profile.

Remarks

This method is a member of the class BeamCtrlLib. In order to be able to apply to this method and obtain the results of measurements, there is a need to first create an object of class BeamCtrlLib and run it with the Start function.

The *uiNumPrf* parameter corresponds to the serial number of the knife in the measuring system starting from 0.

Each array element represents a percentage of the maximum height profile and presented in a range from 0 to 100.

To obtain the actual distance in microns between the points in the resulting profile use the ProfileUnit function.

Return Value

This function returns the measured profile as an array of points.

ProfileUnit

Function returns the distance between points (in microns) in the measured profile.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Function ProfileUnit( _
      uiNumPrf As UInt16 _
) As Double
```

Visual Basic (Usage)

```
Dim numProfile As UInt16
Dim profileunit As Double
profileunit = ProfileUnit(numProfile)
```

C#

```
public double ProfileUnit(UInt16 uiNumPrf, )
```

Parameters

uiNumPrf

The number of measured profile.

Remarks

This method is a member of the class BeamCtrlLib. In order to be able to apply to this method and obtain the results of measurements, there is a need to first create an object of class BeamCtrlLib and run it with function Start.

The *uiNumPrf* parameter corresponds to the serial number of the knife in the measuring system starting from 0.

Return Value

This function returns the real distance (in microns) between points in the array profile obtained function ProfileData.

Start

Function to initialize and start the measurement system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Function Start( _
      strFileName As String_
) As BeamCtrlLib.BeamCtrlLib.ErrorStatus
```

Visual Basic (Usage)

```
Dim numProfile As String
Dim errStatus As BeamCtrlLib.BeamCtrlLib.ErrorStatus
errStatus = Start(numProfile)
```

C#

```
public             BeamCtrlLib.BeamCtrlLib.ErrorStatus
Start(String strFileName)
```

Parameters

strFileName

The path in which the file resides BMxxxx.up.

Remarks

This method starts the measuring system and makes it automatic configuration of the necessary mode for measuring data. For the termination of the work and stop the measuring device, use the Stop function.

BAxxxx.up file is a calibration file of measuring detector and comes with the measuring system. Where “BMxxxx” = the detector number.

Return Value

This function returns one of the states described in ErrorStatus.

Stop

Function of stopping the measuring system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Sub Stop()
```

C#

```
public void Stop()
```

Remarks

This function terminates the measuring process and turns off the measuring system which was started by the Start function.

Average

Property sets and returns the average value of the measuring system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property Average() As UInt16
```

C#

```
public UInt16 Average
```

Return Value

This property returns the average value of the measured laser beam.

CurrentStatus

Property returns the current status of the measuring system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property CurrentStatus() As BeamCtrlLib.BeamC-
trlLib.ErrorStatus
```

C#

```
public  BeamCtrlLib.BeamCtrlLib.ErrorStatus  Current-
Status
```

Remarks

This property returns the current state of the measuring system, which is the state of one of the ErrorStatus.

Return Value

This function returns one of the states described in ErrorStatus.

EllipseError

Property returns the status of the ellipse reconstruction.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property EllipseError() As Boolean
```

C#

```
public Boolean EllipseError
```

Return Value

This property returns the status of the measured laser beam ellipse reconstruction.

EllipseLevel

Property sets and returns the current ellipse level of the measured laser beam.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property EllipseLevel() As Single
```

C#

```
public Single EllipseLevel
```

Return Value

This property sets and returns the current ellipse level of the measured laser beam.

Ellipse level value indicates the percentage clip level of the beam profile, where ellipse data calculated. The values of this property may be in the range of 0.0, for the lowest point of the measured profile, and up to the maximum value of to 100.0, highest point of the measured profile.

EllipseMajor

Property returns the value of the major ellipse axis.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property EllipseMajor() As Single
```

C#

```
public Single EllipseMajor
```

Return Value

This property returns the value of the major ellipse axis of the measured laser beam.

If the ellipse axes ratio exceeds limit, then the property returns a “None” value. Use EllipseError property to make sure that the reconstruction of the ellipse is correct.

EllipseMinor

Property returns the value of the minor ellipse axis.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property EllipseMinor() As Single
```

C#

```
public Single EllipseMinor
```

Return Value

This property returns the value of the minor ellipse axis of the measured laser beam.

If the ellipse axes ratio exceeds limit, then the property returns a "None" value. Use EllipseError property to make sure that the reconstruction of the ellipse is correct.

EllipseOrientation

Property returns the angle orientation of the ellipse.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property EllipseOrientation() As Int16
```

C#

```
public Int16 EllipseOrientation
```

Return Value

This property returns the angle (in degrees) between the major axis of the measured laser beam ellipse and the X-axis.

Position

Property returns the current position of the measured laser beam.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property Position() As PointF
```

C#

```
public PointF Position
```

Return Value

This property returns (in microns) the current position of the measured laser beam.

Power

Property returns the current power measured laser beam.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property Power() As Single
```

C#

```
public Single Power
```

Return Value

This property returns (in mW) the current power of the measured laser beam.

ProjectionData

Property returns a matrix of two-dimensional reconstruction of the laser beam.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property ProjectionData() As UInt16(,)
```

C#

```
public UInt16[][] ProjectionData
```

Return Value

This property returns a matrix of two-dimensional reconstruction of the laser beam.

To obtain the actual distance in microns between the points in the resulting matrix, use the ProjectionUnit function.

ProjectionUnit

Property returns the distance (in microns) between points in the matrix of two-dimensional reconstruction of the laser beam.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property ProjectionUnit() As Double
```

C#

```
public double ProjectionUnit
```

Return Value

This property returns the distance (in microns) between points in the matrix of two-dimensional reconstruction of the laser beam, obtained by the ProjectionData function.

Wavelength

Property sets and returns the wavelength (in nanometers) of the measured laser beam.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Property Wavelength() As Double
```

C#

```
public double Wavelength
```

Return Value

This property returns the wavelength (in nanometers) of the measured laser beam.

OnErrorMessage

Event notifying a change of status of the measuring system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Event OnErrorMessage As ErrorMessage
```

C#

```
public event ErrorMessage OnErrorMessage
```

OnUpdateData

Event notifying the receipt of new data from the measuring system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Event OnUpdateData As UpdateData
```

C#

```
public event UpdateData OnUpdateData
```

ErrorStatus

Specifies options for the state of the measuring system.

Namespace: BeamCtrlLib

Assembly: BeamCtrlLib

Syntax

Visual Basic (Declaration)

```
Public Enumerator ErrorStatus
```

C#

```
public enum ErrorStatus
```

Members

Table 9-1. Error Status Table

Member Name	Description
BA_OK	The measuring system is functioning properly.
BA_INMEASURE	Optional (Not used)
BA_MEASURED	Optional (Not used)
BA_INMOVE	Optional (Not used)
BA_MOVEEND	Optional (Not used)
BA_POWERADJUSTING	The measuring system is able to configure power.
BA_ADJUSTING	The measuring system is able to set the frequency.
BA_HARDFAILURE	Measuring system not functioning correctly.
BA_WRONGPARAMETERS	Optional (Not used)
BA_LOWMEMORY	Optional (Not used)
BA_TOOHIGHPOWER	Power of the laser beam more than the permissible measuring system.
BA_TOOLOWPOWER	The laser beam is less than the permissible measuring system.
BA_DARKPOWER	The measuring system is able to measure dark power.
BA_PROFILELOST	Optional (Not used)
BA_NOTOPENED	Optional (Not used)
BA_NOTIMER	Optional (Not used)
BA_WRONGMODE	Optional (Not used)
BA_SETUPNOTFOUND	Setup file from the function Start can't be opened.
BA_SETUPWRONG	Setup file is not a valid.
BA_NOTMEASURED	Optional (Not used)
BA_TOOMANYPROFILES	Optional (Not used)
BA_IRQERROR	Optional (Not used)
BA_NOTOPENEDCOEFF	Optional (Not used)

SECTION TEN: WARRANTY AND SERVICE

In this section:

Warranty

Coherent, Inc. makes no expressed or implied warranties that functions and features of the BeamMaster-USB will meet the purchaser's requirements for automated testing and beam diagnostics, or any other application, or that the program operations will be uninterrupted or error- free. The foregoing warranties are in lieu of all other warranties, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Coherent does warrant that the hardware be free of defects in materials and workmanship under normal use for a period of one year from the date of delivery to the customer and evidenced by a copy of the invoice.

In no event will Coherent, Inc. be liable for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use or inability to use the BeamMaster-USB, even if Coherent has been advised of the possibility of such damages, or for any claim by any other party. The risk in the use of the BeamMaster-USB lies entirely with the purchaser.

Any unauthorized duplication and/or dissemination of Coherent's program material or associated support documentation, is prohibited by law.

Obtaining Service

In order to obtain service under this warranty, Customer must notify the Company of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Company shall, in its sole discretion, determine whether to perform warranty service at the Customer's facility, at the Company's facility or at an authorized repair station.

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall package the product (to protect from damage during shipping) and ship it to the address specified by the Company, shipping prepaid. The customer shall pay the cost of shipping the Product back to the Customer in conjunction with annual recalibration and repair; the Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve months of time of sale or between annual recalibrations.

A Returned Material Authorization number (RMA) assigned by the Company must be included on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender.

For the latest Customer Service information, refer to our website: www.Coherent.com.

Detailed instructions on how to prepare a product for shipping are shown under “Product Shipping Instructions” (p. 10-3).

Table 10-1. Coherent Service Centers

Location	Phone	Fax	E-Mail
USA	1.800.343.4912	503.454.5777	info_service@Coherent.com
Europe	+49-6071-968-0	+49-6071-968-499	info_service@Coherent.com
International	503.454.5700	503.454.5777	info_service@Coherent.com

Product Shipping Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service—refer to Table 10-1, "Coherent Service Centers," on page 2 for contact information.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. If the original packing material and carton are not available, obtain a corrugated cardboard shipping carton with inside dimensions that are at least 15 cm (6 in.) taller, wider, and deeper than the product. The shipping carton must be constructed of cardboard with a minimum of 170 kg (375 lb.) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 7.5 cm (3 in.) on all sides, top, and bottom.
5. Seal the shipping carton with shipping tape or an industrial stapler.
6. Ship the product to:

   Coherent, Inc.
   27650 SW 95th Ave.
   Wilsonville, OR 97070
   Attn: RMA # (*add the RMA number you received from Coherent Customer Service*)

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