BeamOn Series

Laser Beam Profiler with AFW

User's Manual

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1.0 Introduction

This manual describes briefly the main capabilities of the BeamOn Series – Laser Beam Profiler System.

The BeamOn system is a beam diagnostics measurement system for real-time measurement of continuous or pulsed laser beams. It provides an extensive range of graphical presentations and analysis capabilities of laser beam parameters, such as: beam width, shape, position, power, and intensity profiles.

The BeamOn Series is based on a USB camera, software driven device, which can be connected to a Notebook (or Desktop) computer via the High Speed USB 2.0 port.

Both versions are user-friendly systems that present graphical and numerical information for intuitive interpretation of data in real-time.

Some applications for the BeamOn Series system include:

- Laser beam optimization
- Quality control
- Gaussian fit analysis
- Beam alignment

Main Software Features

The BeamOn Series system software features include:

- Customer set pass/fail criteria
- Zooming
- Average
- User set threshold levels
- Data logging to a text file (up to 99 hours)
- Shutter and gain software controllable
- Trigger level software controllable for pulsed lasers
- Video with playback for future analysis
- Tile images in matrix format
- Printing of text and pictures
- Full on line Help routine

2.0 Overview

A basic BeamOn Series system includes the following items:

A detector head WSR – Wide Spectral Range:

*** UV: 190 – 1600nm**.

* **VIS: 350 – 1600nm**

The system comes with a camera, a standard USB 2.0 cable, a post, a set of 3xND filters in housing on a built-in Automatic Filter Wheel (AFW), software on CD disk, carrying case.

Accessories:

SAM1 - Beam sampler (ration $3x10^{-3}$)

SAM2 - Beam sampler (ration $1x10^{-6}$)

SAM3-A – Reflective beam sampler, sampling reduction factor 0.0016, with adapter

SAM3-HP – Reflective beam sampler, sampling reduction factor 0.000011, with adapter

RDCX2 - Beam Reducer (ration 2.0x1)

MountB - Mounting base

Replaceable plate with infrared transmitting filter (for use at wavelength over 800nm)

Filters - filter in mount, type: ND8, ND64, ND200, ND1000.

Windows Software
The installation and application software comes on a CD disk. OS supported are Windows XP, Windows Vista, Windows 7 and Windows 8 32 & 64-bit OS.

User Manual
The user manual contains the same information as the On-line Help in the software. A README.TXT in the installation disk may have corrections to the manual and the on-line help. The user manual is saved as a PDF file on the software CD.

Filters
The system is supplied with three ND neutral density stackable filters in housings (ND8, ND64, ND200 and ND1000).

Mounting Post
The post is 105 mm long with 8-32 thread and is used for mounting the detector head.

QC test and calibration certificate.

2.1 Copyright & Manual notice

This manual describes the operation of the BeamOn Series system. Duma Optronics reserves the right to make changes to this manual and to the equipment described herein without notice. Duma Optronics has made considerable efforts to ensure that the information in this manual is accurate and complete, however will not be liable for any technical or editorial errors or omissions made herein or for any consequential damages of any nature resulting from the furnishing of this manual or operation of equipment in connection with this manual.

2.2 Revision History

Any new editions of this manual will incorporate all material updated since the previous edition. Update packages issued between editions contain replacement and/or additional pages to be appended to the current edition. A “ReadMe.TXT” file is provided during the installation and may contain additions or corrections to the manual or the help file.

The manual printing date indicates its current edition. Updates and corrections to the current edition will be indicated.

- Dec 2014 – Revision 1.0
- Feb 2015 – Revision 1.1

2.3 Warranty Statement

Duma Optronics makes no expressed or implied warranties that functions and features of the BeamOn will meet the purchaser’s requirements for automated testing and beam diagnostics, or any other application. Duma Optronics does warrant that the hardware be free of defects in materials and workmanship under normal use for a period of 18 months from the date of delivery to the customer and evidenced by a copy of the invoice.

2.4 Precautions

The BeamOn Series system is a precision instrument and in normal usage will provide years of trouble free operation. However, several precautions must be taken to ensure proper function of the devices.

- The instrument must not be subjected to physical abuse. If either USB detector head are dropped they might be damaged.
- Temperature and moisture extremes can also damage the instruments. Make sure there is adequate ventilation for the host computer.

- Make sure you have a backup copy for the system CD disk, and that the software CD is protected from long term, direct exposure to sunlight and heat.
- When not in use, keep the Detector head and filter wheel inside the carrying case to prevent dust from accumulating on the sensor and the filters.
- Filters are provided with each BeamOn head. Dust, scratches and other types of contamination will degrade the accuracy of the system. Please keep unused filters in a storage case. Please be gentle when handling these fragile items.
- Laser Safety Rules: Please comply with all relevant laser safety procedures and precautions when using this device. The instrument will reflect a portion of the laser light. The resulting diffuse and specular reflections may be dangerous.

3.0 Theory of Operation

The main technologies available for laser beam diagnostics are:

- Using spatial cameras as the beam characterization system.
- Using moving mechanical slit, or knife-edges to scan across the incoming beam.

The main advantage of the mechanical scanning devices over a camera type laser beam profiler is the large dynamic range that allows accurate measurements of beams with both high and low intensities. On the other hand, camera type laser beam profilers are excellent for fast and detailed analysis of laser beam intensity profiles, but are limited in their accuracy due to a relatively low dynamic range.

The BeamOn Solution

The BeamOn overcomes the limited dynamic range of a camera type beam profiler and accurately measures faint laser beam structures by sampling the beam several times. Each measurement is performed at a different attenuation or electronic shutter speed.

The BeamOn analyzes both continuous wave (CW) and pulsed lasers, and accepts a wide range of input powers.

The video beam images are digitized with an 8-bit resolution (256 digital levels) video capture card. The digitized beam images are then stored in memory where a variety of analysis can be performed on the stored images. The images are then displayed on the VGA monitor according to the user-selected format.

The motorized automatic filter wheel (AFW) enables optimized setting of electronics parameters and enlarging the dynamic range.

Additional functions provide the ability to print information, transmit data via an RS-232 link to another computer, and control numerous video and calibration functions including shutter speed and camera gain.

Technology

The BeamOn Series uses a USB video camera (or USB attachment) to image, capture, store, and perform two-dimensional intensity distribution analysis on laser beams.

Camera laser beam profilers are based on a mosaic of two-dimensional detectors called pixels. The two-dimensional mosaic-like detector instantly records the amount of energy impending on its surface, thus recording the optical pattern of the laser beam. The intensity distribution of the laser beam is recorded pixel-by-pixel and displayed as a two-dimensional topographic map or a three-dimensional isometric view.

The advantages of a WSR camera laser beam profiler is fully utilized by powerful software that displays any structure larger than one pixel in vivid colors, calculates the beam distribution and profile as well as total beam intensity distribution, in order to allow full analysis of the laser beam’s characteristics.

Dynamic Range Limitation

One of the main obstacles encountered when working with a WSR camera based system is its limited dynamic range. This limits the range of power levels that can be measured, as well as the ability to view features that are smaller than 1% of the laser beam's maximum power density.

The BeamOn overcomes the dynamic range limitations with software control of the electronic shutter, as well as by using a set of calibrated optical filters to attenuate powerful beams. The proprietary shutter activation allows examination of the laser beam within a fraction of a percent from the peak intensity.

The laser beam's profiles are analyzed by using multiple images. Each one is attenuated by a different known factor, which is included in the calculation. The software then reproduces the original non-saturated picture. Faint pixels, which originally were not detectable, are now visible.

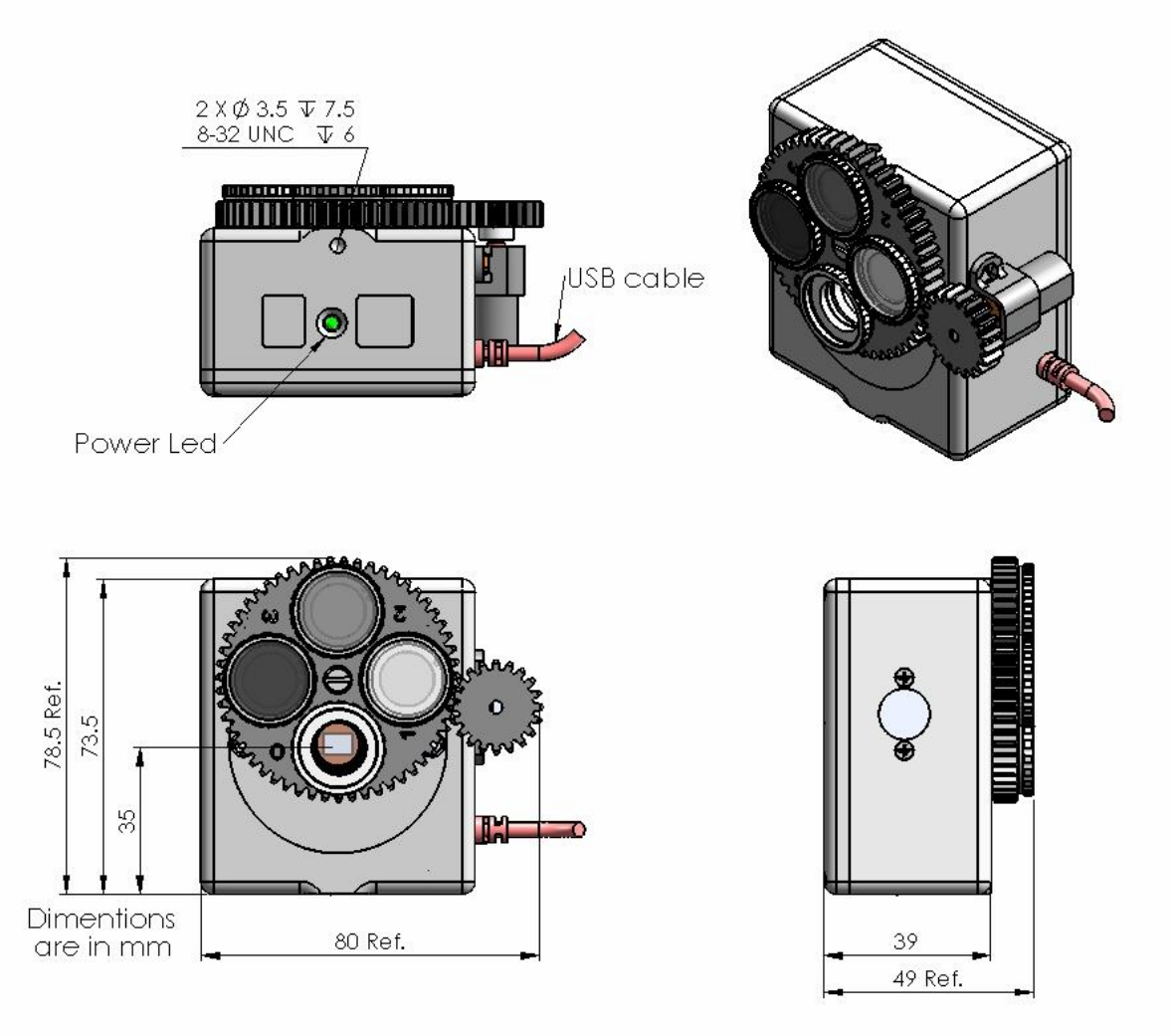
4.0 Specifications

This section describes the technical and system performance specifications.

Item	Specification
Camera type	WSR – Wide Spectral Range detector ½" format
Operation mode:	Interline camera mode for CW operation and frame transfer mode for pulsed operation.
Sensor active area:	6.47mm wide x 4.83mm high.
Pixel size	8.6 µm (H) X 8.3 µm (V)
Sensor position	Optical distance from camera front surface to sensor surface is 11mm.
Spectral Response:	UV: 190 – 1600nm.
	VIS: 350 – 1600nm
Weight:	400 gr. with cable
Power consumption:	5V, 0.6A (USB 2.0 Port)
Filters:	Filter wheel with 4xND filters (ND8, ND64, ND200, ND1000) in housing.
	One X 8/32 threaded mounting hole
Connections to PC	1.8 meter USB cable
PC interface:	USB
RS232:	Data out
Operating temperature:	-10ºc to 50ºc
Minimum host system requirements	Pentium IV, 1GHz with 128MB RAM
	100MB HDD free
	16MB 16bit color VGA card, resolution 1024X768
	One free High Speed USB 2.0 port
	One CD ROM any type
	Windows XP/Vista/7/8 32& 64-bit OS

System Performance with Software:	
Dynamic Range:	Up to 10^{11} using software controlled gain control, electronic shutter and external filters.
Shutter speeds:	1/50x256s to 1/100,000 sec, 17 steps manually, or automatic.
Software controlled gain	6dB to 41dB manually, 2dB steps manually, or automatic.
Maximum frame rate	25Hz, excluding slow (multiply) shutter operation.
Sensitivity:	~160µW/cm² at 1550nm shutter x256

Saturation intensity:	~1mW/cm² at 633nm with no filters installed.
Damage threshold	50W/cm²/1J/cm² with all filters installed.
Null:	In CW mode, null function is available to automatically subtract background.
Handling of pulses	Ability to capture and replay pictures and statistics from a slowly pulsing laser (1-100Hz) while filtering out frames with no laser pulse. Gain control and external filters make it easy to obtain optimum intensity.
Software Trigger:	In pulsed mode, sliding bar control allows setting of threshold so as to display only frames with captured pulses.



Camera Dimensions

5.0 Quick Reference

This chapter provides brief instructions for operating your BeamOn. Full explanations of these various operations can be found throughout this manual.

To install the BeamOn:

1. Check **Hardware Requirements** (chapter 6.1)
2. Follow **Software installation** (chapter 6.2)
3. Plug the USB Camera into a Hi-Speed USB 2.0 -compliant port.
4. Follow **Hardware installation** (chapter 6.3).

To configure the BeamOn hardware and software:

1. Open the Settings menu and select **Hardware Setup**.
2. Click each tab and enter your hardware information in each window.
3. Repeat steps 1 and 2 for **Software Setup**.

To set up the laser beam mode:

1. From Hardware Setup, select either CW or Pulsed.
2. If Pulsed is selected, then the  icon is displayed at the **Control ToolBar**. Select a shutter speed that enables an acceptable saturation level.
3. If the image is still saturated at the fastest shutter speed, attach ND filters to the camera until an acceptable saturation level is reached.
4. Further adjust the intensity level using the gain control 

5. Adjust the trigger level using the  icon until you get a steady reading. It is best to move to the right until triggering stops, and then move back a little.

To measure the beam width:

1. Open the Settings menu and select **System Setup**.
2. Select the **Profiles** tab.
3. Set the three clip levels values.
4. Read the beam width values from the **Measurement Data box** or from **Statistics** window.
5. To view more detailed statistics, click  to open the statistics window.

To select the profile type:

On the **Control** Toolbar, click  for Sum Profiles or  for Line Profiles.

To view the centroid and/or beam peak:

1. Click  on the **Control Toolbar** for a 2D display.
2. Click  on the **Control Toolbar** to view the centroid.

To freeze the screen graphics:

Click  on the **Control Toolbar**.

To return to real-time measurement mode, click  on the **Control Toolbar**.

To print various screens:

1. To print the entire screen, open the File menu and select **Print Screen.**
2. To print the view area only, open the File menu and select **Print Frame**.

To save screen graphics:

1. Open the Options menu and select **Save image File**. A sub-menu displays.
2. Select the screen section to be saved: **Frame**, **Statistics** or **Full Screen**. The **Save image File** window displays. Select either a BMP or JPG file type.
3. Enter a filename for the saved screen graphic and click **OK**.

To save X-Y profiles:

1. Open the Options menu and select **Save data in text file**. A sub-menu displays.
2. Select **profiles.**
3. Enter a filename for the saved file and click **Save**.

To view and print a file:

1. Click  on the **Control Toolbar**. The **View File** window displays.
2. In the **Files of Type** field, select the file type for the file you want to view.
3. Select the file and click **OK**.
4. Click on print if you want to print the file.

To test a laser beam:

1. Click  on the **Control Toolbar**. The **Analysis Toolbar** displays.

2. To run the test, click  on the **Analysis Toolbar**. The **Test** window displays the test results.
3. To save the current test result in a bitmap or test file, click **Save** in the Test window.

To calculate a beam elliptical footprint:

1. From the **Control Toolbar**, click  to freeze the screen.
2. From the **Control Toolbar**, click  . The **Analysis Toolbar** displays.
3. From the **Analysis Toolbar**, click  . The BeamOn calculates the best-fit ellipse and displays it as a dotted white ellipse just around the edges of the measured ellipse. The best-fit ellipse parameters are displayed below the Analysis Toolbar.

To measure the distance between two points on the beam image:

1. From the **Control Toolbar**, click  to freeze the screen.
2. From the **Control Toolbar**, click  . The **Analysis Toolbar** displays.
3. From the **Analysis Toolbar**, click  .
4. Select the first point by placing the cursor on the beam image and click the left mouse button. Drag the mouse to the second point on the beam image and click the left mouse button. A straight line is drawn between these two points and the line distance calculation is displayed below the Analysis toolbar.

To calculate Power in the Bucket:

1. From the **Control Toolbar**, click  or from **Analysis Toolbar**.
2. From the **Analysis Toolbar**, click  and define bucket size and location.

Note: *Total Power should be calibrated, before using the Power in the Bucket function.*

To create a data log:

1. From the **Control Toolbar**, click  to setup the data log. The **Log Setup** window displays.
2. Enter the information in the Log Setup window and click **OK**.
3. From the **Control Toolbar**, click  to start the data log function.
4. To view the data log file, open the File menu and select **View File**. Select the data log file you want to view and click **Open**.

To create a video:

1. Open the Settings menu and select **Video Properties…**. The **Video Properties** window displays.
2. Enter your information and click **OK**.
3. Click  on the **Control Toolbar**.

To play a video file:

1. Click  on the **Control Toolbar**. The **Playback Toolbar** displays.
2. Click  on the **Playback Toolbar**. The **Open Video File** dialog displays.
3. From the Open Video File dialog, select the video file you want to view and click **Open**. The video file displays.
4. Use the **Playback Toolbar** buttons to play the video.
5. Click  to close the video file.

To work with still images:

1. To capture a still image, click  on the **Control Toolbar**.
2. To view a single still image, position the cursor on the still image icon at the **Status Bar** and click the left mouse button.
3. To close an opened still image click the close button in the upper right corner of the image window. If you want to save the still image, click **Yes** in the Still Image window.

To measure two beam's centroids simultaneously:

1. From the **Control Toolbar**, click  to select the first Region of Interest.
2. Move the small rectangle marking  to the first beam presentation on the screen, magnify or shrink it to the proper size by graphical means (using the mouse).
3. From the **Control Toolbar**, click  to select the second Region of Interest.
4. Move the small rectangle marking  to the second beam presentation on the screen, magnify or shrink it to the proper size by graphical means (using the mouse).

To work with snapshot files:

1. To create a snapshot file, open the **Options menu** and select **Save Snapshot**. The **Save Snapshot File** window displays. Enter a filename for the snapshot file and click **OK**.

2. To view a snapshot file, open the View menu and select **Snapshot**. The **Load Snapshot File** window displays. Select a snapshot file and click **OK**. The snapshot file displays. Analyze the measured results by activating the system tools.
3. To close a Snapshot file, open the View menu and select **Snapshot**. The BeamOn Series restores real-time measurement displays.

To transmit serial data over an RS-232 link:

1. Open the File menu and select **Link Setup**.
2. Click the **General** tab and enter your information.
3. Select the **Port Settings** tab, enter your information and click **OK**.
4. Connect the BeamOn computer to another computer using a null-modem cable.
5. Enable the receiving program to receive the file/data.
6. Open the File menu and select **Start Link**. If you are transmitting data, the BeamOn Series automatically starts sending the data. A link-in-progress message displays in the menu bar.
7. If you are transmitting a file, the **Link File** window displays. Select the file you want to send and click **OK**. A link-in-progress message displays in the menu bar.

5.1 Software General Layout

This section covers the basic layout of the BeamOn software.

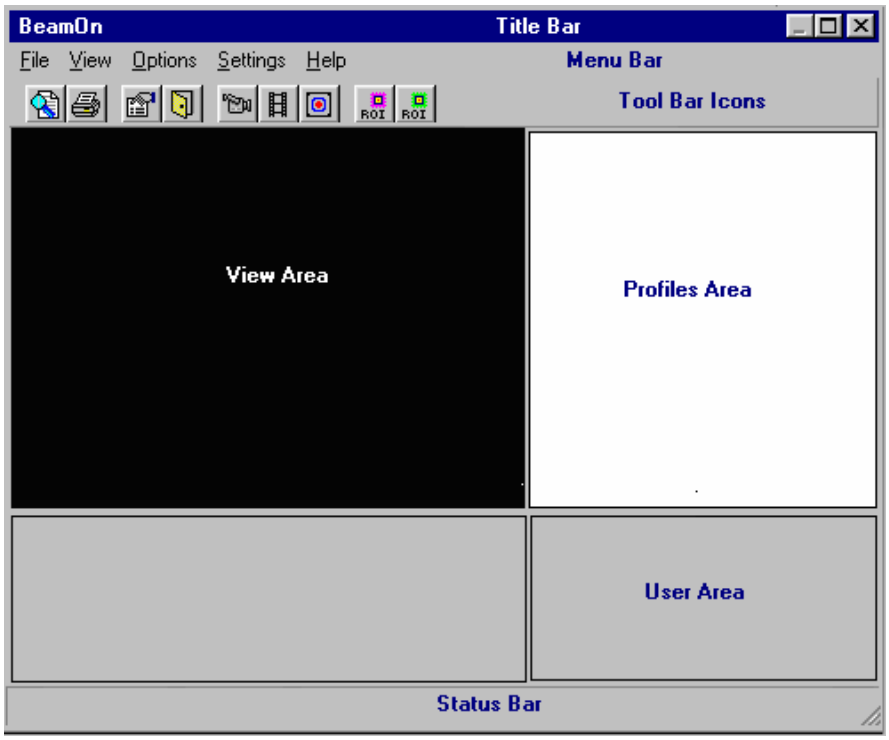
The BeamOn window display consists of display and control elements similar to most Windows applications along with elements specific to BeamOn interface.

5.1.1 Title Bar

The title bar displays the name “BeamOn Series USB”, and followed by the detector SN.

5.1.2 Menu Bar

The Menu Bar lists menus available for BeamOn system. The menus contain commands and other sub-menus or dialog boxes to be displayed which provide controls of various functions: graphics, analysis, setup configurations. All functions can be activated via the menus, some functions can also be activated via the Tool Bar.

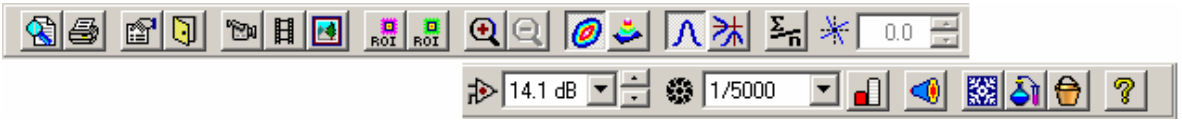


General software layout

5.1.3 Control ToolBar

The Tool Bar consists of various icon buttons, which are small symbols that provide quick access alternatives to using menus or keyboard equivalent keys to perform various functions. 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 fact that this function is activated. This is an example of ToolBar (buttons activated):



This is an example of ToolBar (buttons are disabled):

To view the function of each icon button, place the mouse cursor on the icon and wait momentarily, a brief function description will appear near the icon.

5.1.4 View Area

The View Area is used to view all the BeamOn graphical presentations, such as: beam image, intensity profiles, 2D/3D presentation, as well as summary table of measurement results and statistics table.

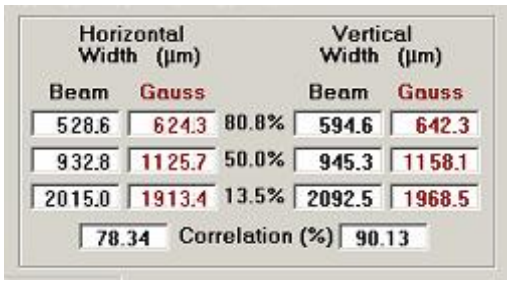
5.1.5 Status Bar

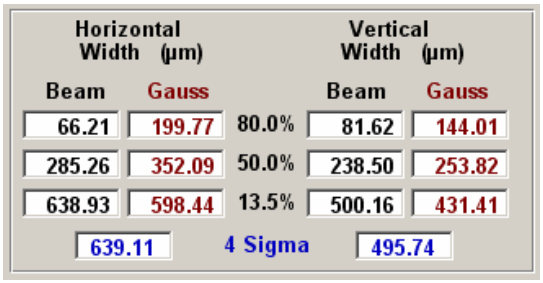
The status bar is located at the bottom of the BeamOn window. It indicates the current status of some operational parameters, such as presentation of date and time, average level, zooming level, Null status, Power reading, and up to 12 Still images taken. The Status Bar enables a fast access to system's setup screens for setting up the average level, the zoom, the null parameter as well as the power calibration: if the mouse cursor is placed at one of these parameters and then double-clicked the appropriate setup screen appears.

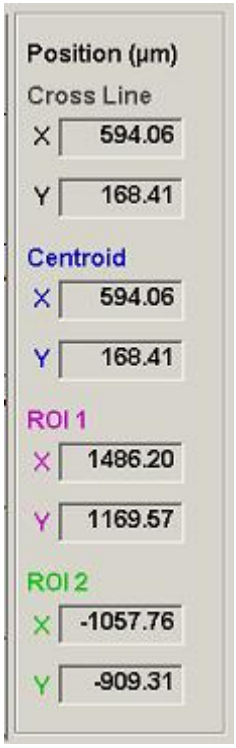
Also if the mouse cursor is placed at any one of the Still Image icons and double-clicked the image is then magnified.

5.1.6 User Area

The User Area is used to view beam centroid's presentation, as well as a summary table of measurement data, including the beam width reading at 3 different clip levels and the Gaussian fit profile at these levels as well as the correlation factor, or 4Sigma.







6.0 Installation

This chapter provides instructions for installing the hardware and software for the BeamOn system.

6.1 Hardware Requirements

To run the BeamOn USB 2014 version, the computer system must meet the following minimum requirements:

Item	Minimum Requirements	Recommended Requirements
CPU	Pentium 4, 1 GHz	Pentium 4, 2.0 GHz
System RAM	256MB RAM	512 MB RAM
Hard disk	100MB HD free	
CD ROM drive	Any type	
Operating system	Windows XP/Vista/7/8 32&64-bit	
Mouse	Microsoft mouse or equivalent	
VGA display	1024 x 768 resolution	
VGA card	16MB 16 bit color	64MB 16 bit color
USB Port	One free High Speed USB 2.0	

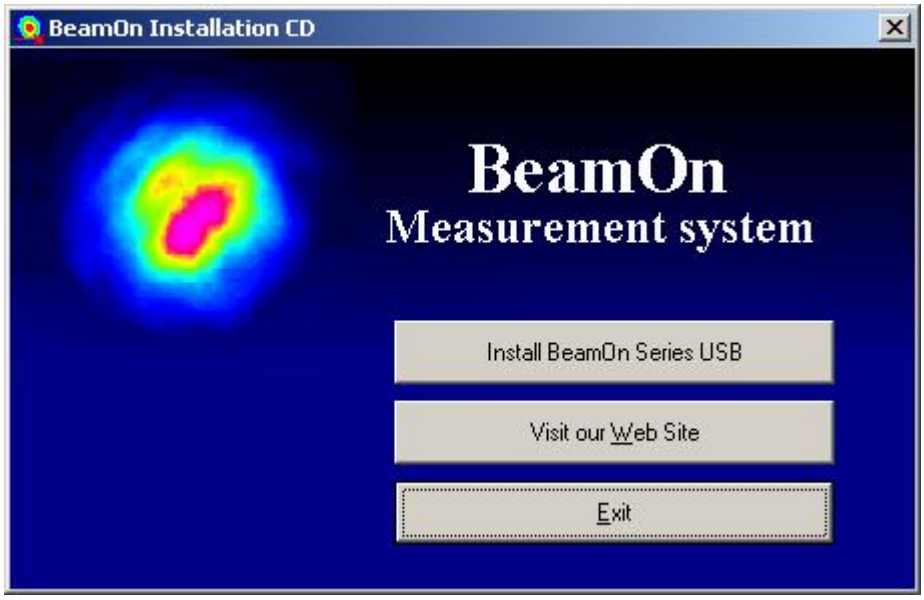
6.2 Software Installation

Important Note: ***Please install the USB device driver before connecting the USB Camera to your computer!***

Perform **Software Installation**. Only after you click “Finish” to complete the software installation procedure, continue with the **Hardware Installation**

1. Insert the BeamOn Series CD disk in the CD drive.

For software installation select **Install BeamOn Series USB** button.



Welcome Screen

1. A Welcome screen appears when beginning the software installation routine. Click *Next*.
2. Insert your User Name, Company Name and System S/N (appearing on the system CD).
3. The following screen is a Registration Confirmation. Click *Yes* in order to confirm. If you click No, the software will return back to a previous prompt (stage 6 above).
   Now provide the full path for installation of the BeamOn Series USB system software: More information about the exact folder for the software and branching in existing folder for BeamOn Series USB system software can be done in the Select Program Folder prompt.
   Click the *Next* button to proceed.
4. Copying files routine. Click Next button. At this stage the system copies all files from the CD-ROM to the selected directory in your computer. There is a graphical presentation showing the amount of data copied to the system disk. If the Cancel button is pressed the installation is aborted.
5. Setup Complete.

6.3 Hardware Installation

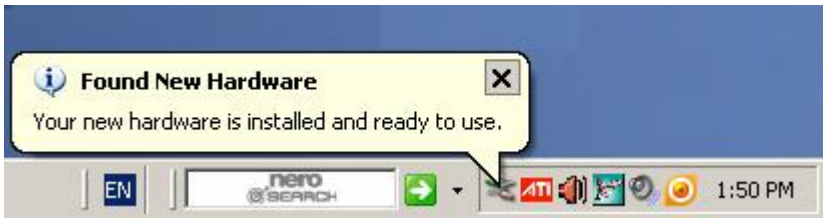
Plug the BeamOn WSR Camera into a Hi-Speed USB 2.0 port.

The USB device will be detected and the New Hardware Wizard will launch.

6.3.1 Windows XP

The following message is displayed:

Found new hardware message



New Hardware ready to use

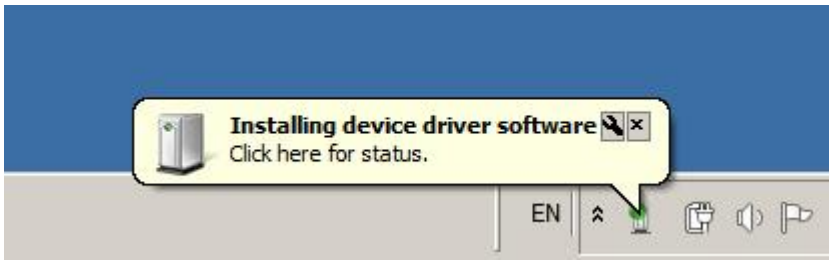
After completion camera installation, when the device is configured successfully, the blue led on the down panel of the BeamOn Camera should be on.

Additionally one can check the installation status under System Properties, Device Manager Tab and verify that **"USB 2860 Device"** line is listed under the "Sound, video and game controllers" sub-directory.

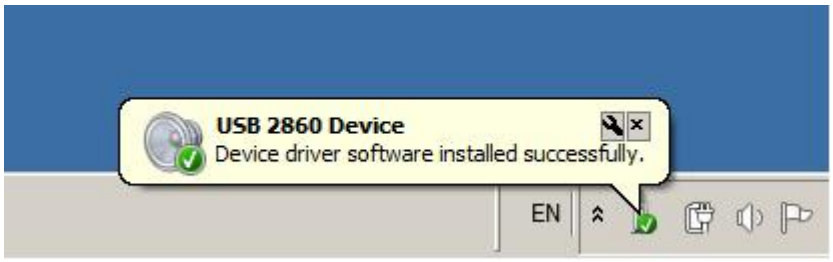
Drivers installed list

6.3.2 Windows Vista / 7

The following message is displayed



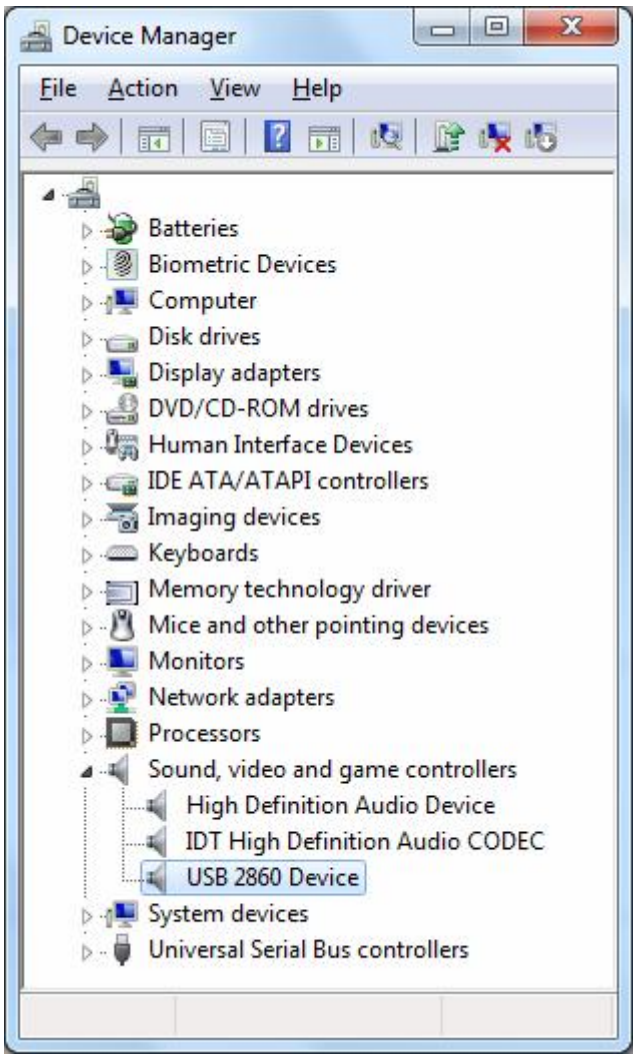
Installing device driver software



Devices are ready to use

After completion of camera installation, when the device is configured successfully, the blue led on the down panel of the BeamOn WSR Camera should be on.

Additionally one can check the installation status under System Properties, Device Manager Tab and verify that **"USB 2860 Device"** line is listed under the "Sound, video and game controllers" sub-directory.

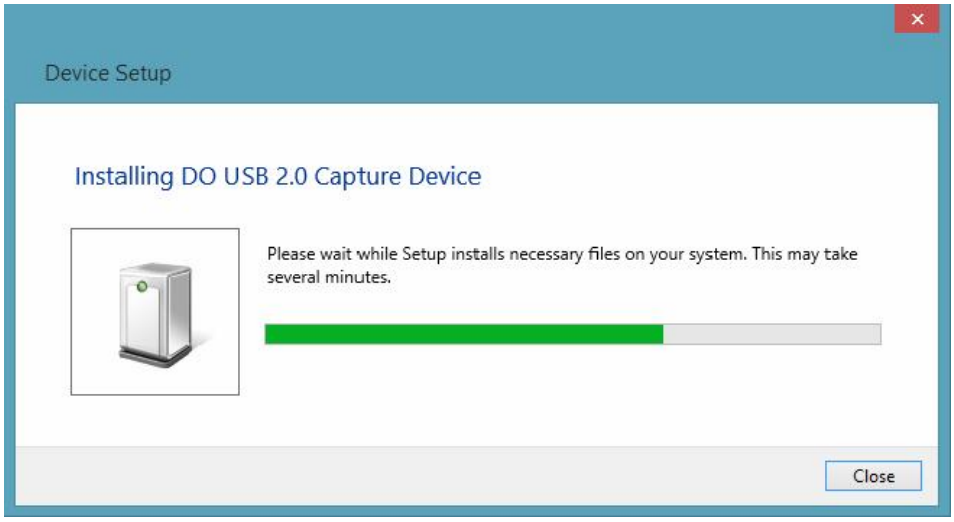


Drivers installed list

6.3.3 Windows 8

The following message is displayed

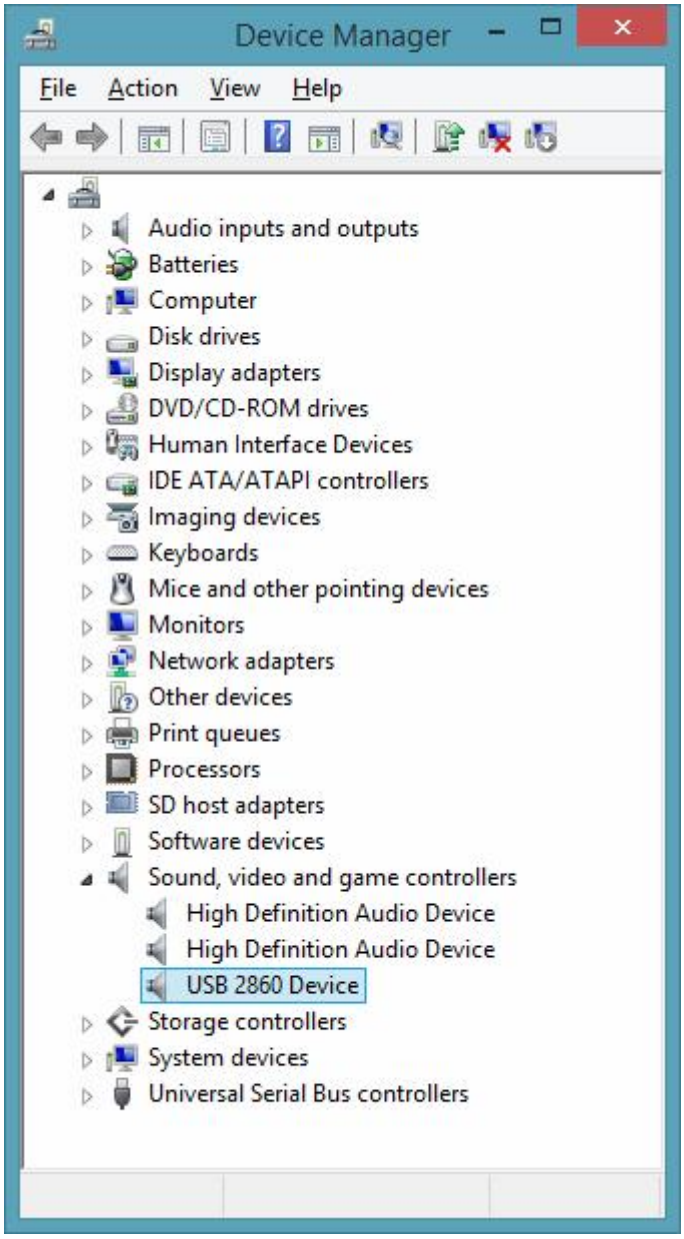
Installing device driver software



Devices are ready to use

After completion of camera installation, when the device is configured successfully, the blue led on the down panel of the BeamOn WSR Camera should be on.

Additionally one can check the installation status under System Properties, Device Manager Tab and verify that **"USB 2860 Device"** line is listed under the "Sound, video and game controllers" sub-directory.



Drivers installed list

<u>Important Note:</u> Please do not connect / disconnect WSR camera from USB port, while application program is running!

6.4 Running the Software

Make sure hardware is installed properly. (See **Hardware Installation – USB camera**). Boot the computer.

From the **Start** Menu, select **Programs**, then choose **BeamOn Series USB** folder, and then click on the **BeamOn** program. Alternatively, you can activate the software by placing the mouse cursor at the **BeamOn Series USB Icon**  and click the mouse button twice.

To end a BeamOn session, open the **File** menu and select **Exit.**

The BeamOn saves all current setup parameters when you exit a session.

Possible Errors that indicate an interface board conflict:

There are a few common symptoms, which point to an interface board conflict:

* System Lock-up during software startup.

* There is no picture displayed on the screen

* Displayed measurements are sporadic and erroneous.

If your symptoms match one of those presented above, or if the BeamOn System was working at one time and has now stopped working, check for conflicts with other plug in cards in the same computer.

If it has no affect and no new software of any kind has been installed since the BeamOn System last worked and the computer has not been moved, contact Duma Optronics Inc. for immediate support.

More information about Installation problems in the **Troubleshooting** section.

6.5 Multiple devices operation

BeamOn Series software is possible to plug into your Windows OS several devices and to control them.

Each device will get a number so that the customer will be able to identify which device being used. The application program allows you to select a USB Device via Options menu.

You can run a few BeamOn Series application programs for simultaneous measurements of laser beams. In order to do so, from **Start** Menu, select **Programs**, then select **BeamOn Series USB** folder, and then click on the **BeamOn Series** program line. Alternatively, you can activate the software by placing the mouse cursor at the **BeamOn Series USB Icon**  and click the mouse button twice. You can activate multiple applications until receiving the following message:

“Number of running application programs exceeds limit. “

7.0 Setting Up the BeamOn

This chapter provides instructions for setting up the BeamOn system. Before you can accurately use the BeamOn you must do the following:

- Configure the hardware
- Configure the software
- Configure your continuous or pulsed laser beam

The BeamOn installs a configuration file called “BeamOn Series.ini “ in the BeamOn Series USB working directory. All system setup parameters are saved in this file, including all setup modifications introduced during the last session. When you start the system software, the setup parameters in the INI file are automatically loaded.

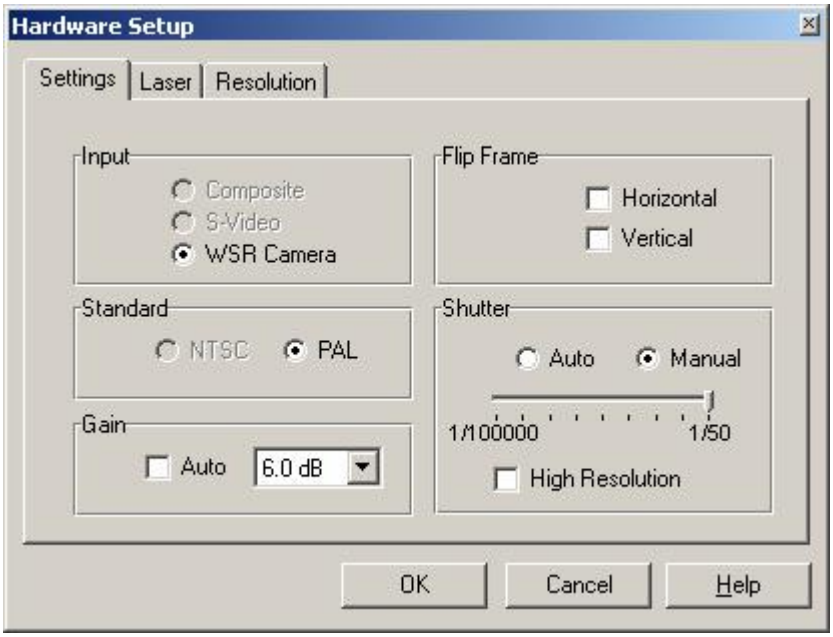
7.1 Configuring the Hardware

To configure the hardware, open the Settings menu and select **Hardware Setup**. The Hardware Setup window displays.

7.1.1 Hardware Setup - Settings

From the Settings tab, you can configure the following information:

- Type of connected camera equipment (Default PAL camera)
- Input connector
- Image display
- Shutter control
- Gain control



Hardware Setup - Settings Tab Selected

To configure the hardware settings:

1. Click the **Settings** tab.

2. Enter your information according to the descriptions below.
3. Click **OK**.

Standard Type of video equipment:

- **NTSC** - US compatible video equipment.
- **PAL** - European standard video equipment. (This is the default setting for the BeamOn camera even when it is used in the USA.)

To configure the video equipment type, select NTSC or PAL.

Input Type of video connection:

- **Composite** - RCA-style video connector.
- **S-Video** - S-Video input connector.
- **WSR** - USB video camera (This is the default setting for the BeamOn camera.).

To configure the video connection, select Composite, S-Video or MXC.

Flip Frame Flips the image presentation by 180 degrees.

To flip the image presentation, select Horizontal or Vertical.

Gain Sets the Gain level manually, values range is 6-40dB.

Auto Gain function offers an automatic gain setting, best fitted to the work condition.

Shutter The built-in electronic shutter controls the integration time of each frame. By activating the shutter you control the amount of collected light similar to the way a mechanical shutter controls the exposure time in a regular photographic camera. You select the required shutter speed to prevent saturation and distortion of the measured beam profile. This option is significant for continuous laser beams only.

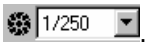
The possible shutter speeds range from 1/50 to 1/100000 second, for manual or automatic settings.

Value from 1/50x2 to 1/50x256 second for manual setting only.

To configure the shutter speed:

1. Select **Manual**.
2. Drag the slide bar along the “shutter scale” to select a shutter speed.

Or,

1. From the **Control Toolbar**, select the shutter speed using the drop down list in the shutter field 

.

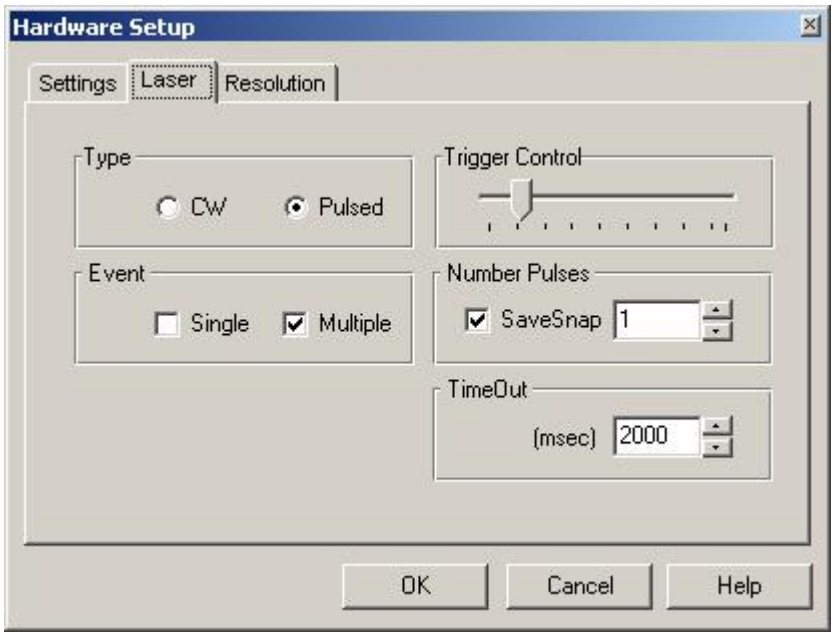
Auto Shutter function offers an automatic shutter setting, best fitted to the work condition

High Resolution Refer to **Increasing the camera’s dynamic range**.

In general, use High Resolution option to explore faint images below 1% of intensity profile. This function will further activate the double sampling procedure. The same function can be activated via the icon  at the **Control ToolBar**.

7.1.2 Hardware Setup - Laser

Laser configuration allows you to specify the type of laser used and define the synchronization.



Hardware Setup - Laser Tab Selected

To configure the laser information:

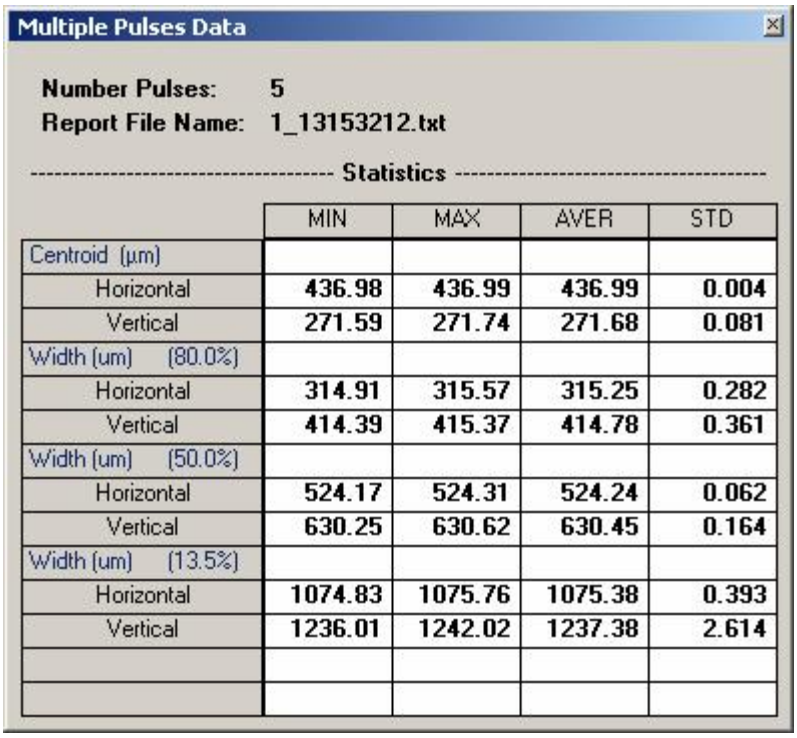
- **Type** - select one of the laser types.

  Click the **Laser** tab in Settings, then click **CW** or **Pulsed** and then **OK**. When Pulsed mode is selected, the icon is displayed at the **Control ToolBar** and next to it the Trigger Control Bar for setting up the Trigger level.

- **Event** - select one of the following options:

  Single - Capture and look at a single shot event. When single shot is activated, the freeze button acts as a run/stop button and can be toggled between Run where the system is ready to capture and freeze the next active frame and Stop where system is frozen with the single shot frame, which has been captured.

  Multiple - Capture and save data from a set of pulses, selected via **Number Pulses** parameter. When ending the pulses measurement, statistics of measured pulses are displayed in the Multiple Pulses Data window. In order to view the last measured data set press button from **Analysis Toolbar.**



	MIN	MAX	AVER	STD
Centroid (µm)				
Horizontal	436.98	436.99	436.99	0.004
Vertical	271.59	271.74	271.68	0.081
Width (um) (80.0%)				
Horizontal	314.91	315.57	315.25	0.282
Vertical	414.39	415.37	414.78	0.361
Width (um) (50.0%)				
Horizontal	524.17	524.31	524.24	0.062
Vertical	630.25	630.62	630.45	0.164
Width (um) (13.5%)				
Horizontal	1074.83	1075.76	1075.38	0.393
Vertical	1236.01	1242.02	1237.38	2.614

Multiple Pulses Data window

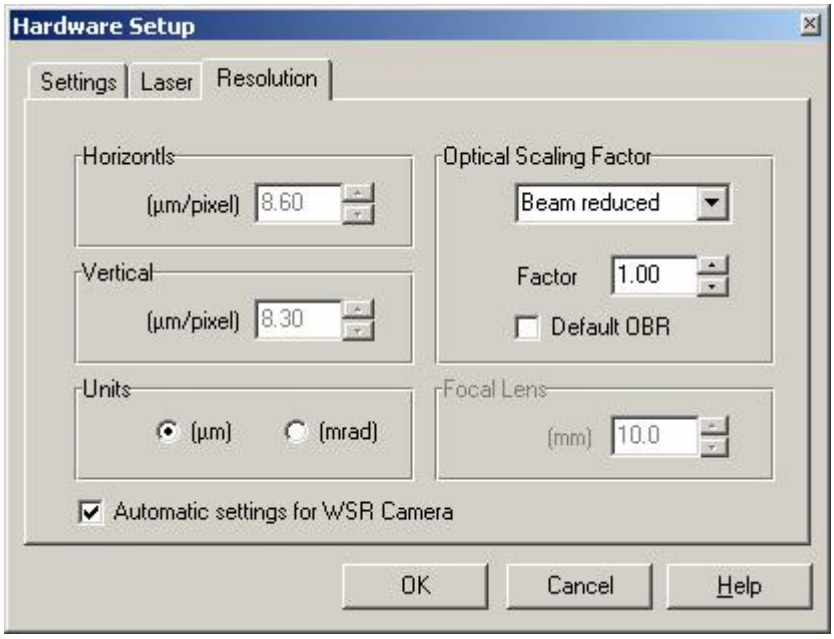
- **Number Pulses** - Select number of pulses, captured in the multiple events. For every pulse you can save snapshot data.
- **TimeOut** - Select the maximum delay time between pulses.
- **Trigger Control –** This function sets the minimum signal level at which images will be displayed on the screen. It ensures that with pulsed lasers, only frames with images will be displayed.

Upon selecting the required parameter value, press OK to confirm the selection, press Cancel to abort.

7.1.3 Hardware Setup - Optical Scaling and Resolution

If you are using external optics to reduce or expand the beam size, then set the scaling factor accordingly. After this is done, all values measured will be multiplied or divided by the value chosen.

For example, if you are using an optical attachment which reduces the beam size by a factor of 2, choose 2 as the scaling factor and all values read by the camera will be multiplied by 2 to give the true size instead of the size as it is projected on the camera.



Hardware Setup - Resolution Tab

To set optical scaling:

1. Set the scaling to multiply or divide as needed

2. If using an external optics, one needs to select the appropriate option in **Optical Scaling Factor** (toggle between Beam reduced option and Beam enlarged option). Then select the appropriate Factor parameter accordingly. Default OBR – Optical Beam Reducer with magnification x1.9.

Resolution

The resolution setting is only necessary if you are not using the BeamOn camera. These values are the resolution parameters (in microns per pixel) of your non-BeamOn camera.

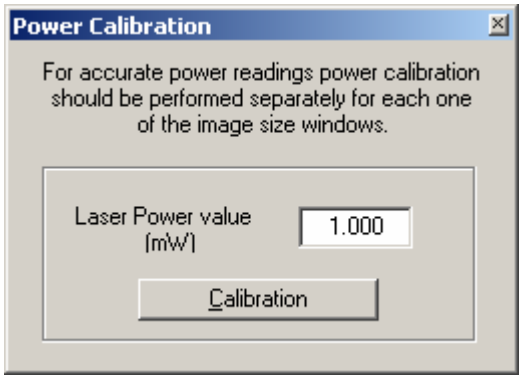
The BeamOn camera uses the default values shown in the Horizontal and Vertical fields. Please note that the **Automatic settings for WSR Camera** field is checked.

To configure the resolution:

1. Click the **Resolution** tab.
2. If you are using the BeamOn camera, select **Automatic settings for WSR camera**.
3. If you are not using the BeamOn camera, enter your camera's resolution parameters.
4. Click **OK.**

7.1.4 Power Calibration.

The power calibration function allows you to enter a power value as a "base" power level. The power calculation sets the total summed intensity of all the pixels in the subsequent captured samples to be proportional to this value.



Power Calibration Window

To configure the power settings:

1. Open the **Options menu** and select Calibrations u **Power**.
2. Follow the on-screen instructions.
3. Enter the power value of your laser beam as measured by a reference power meter.
4. Click **Calibration**.
5. Click **OK**.

The power reading itself is viewed at the Status Bar.

Note: If you place the mouse cursor at the Power field, located at the Status Bar and double click, the mouse right button you get the Power Calibration Screen.

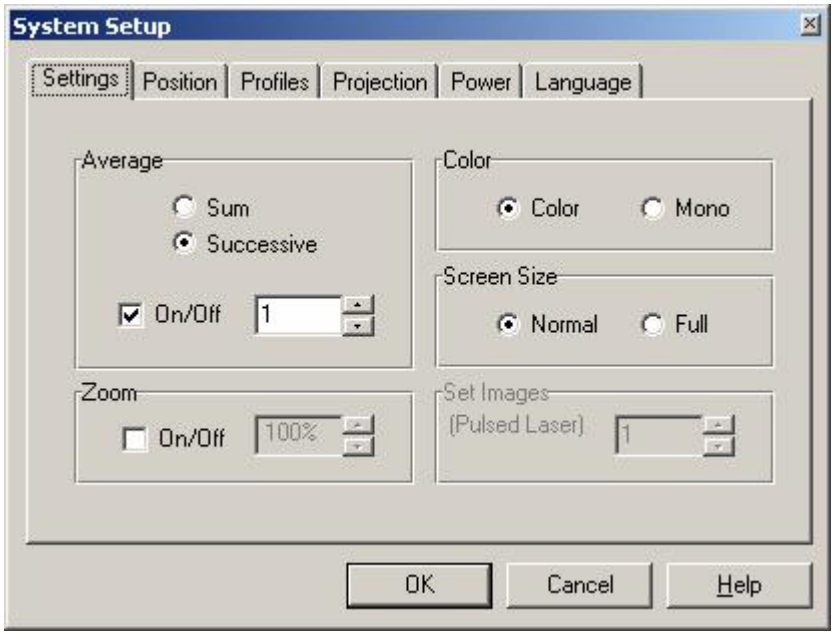
7.2 Configuring the Software

To configure the software, open the Settings menu and select **System Setup**. The System Setup window displays.

7.2.1 System Setup - Settings

From the Settings tab, you can configure the following information:

- Averaged consecutive measurements.
- Zoom On/Off and setting up the zooming level.
- Screen size
- Number of still image bitmap files taken during the Still Image function. This is useful only for cases of Pulsed Lasers. This parameter will determine the # of images that will be captured once the Still Image function is activated.
- Set color or monochrome display for the View Area.



System Setup - Settings Tab Selected

To configure the system settings:

1. Click the **Settings** tab.
2. Enter your information according to the descriptions below.
3. Click **OK**.

Average Used to smooth the data display of quickly varying sources.

When using a beam with a significant amount of jitters, set this feature on. The BeamOn takes a user defined number of successive measurements. These measurements are averaged and displayed. When Average in On, and mark is set to the "Sum" field, a few images are averaged and their summation average is displayed at a lower frame rate, according to the number of averaged images.

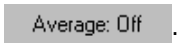
For example, you choose a value of 10, ten consecutive measurements are averaged and the result is displayed. When an eleventh measurement is taken, the first measurement value is dropped and the second through the eleventh are averaged, etc.

Because a successive averaging technique is employed, the window display update rate is only slightly affected, if at all.

***NOTE**: The Average function only affects the numerical data and not the picture. The picture is not averaged.*

To smooth the data display:

1. Select **On/Off** to activate. Or,

   From the **Status Bar**, click 

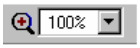
. The System Setup window displays.

2. Enter a successive measurement value. Possible values are 1-20 where 1 means no averaging and each measured value is displayed.

Zoom Enables magnification of the image displayed in the view area.

When zooming in or out, the system centers the plot as close as possible over the current crosshair cursor position.

To magnify the image:

1. Select **On/Off** from the **Control Toolbar**, click 

. Or,

   From the **Status Bar**, click 

. The System Setup window displays.

2. If Zoom is On set the Zoom level required by pressing on the Up/Down arrow buttons (select the magnification you desire,100% is normal size).

Screen Size Used to adjust BeamOn screen size to your screen. **Normal** application size is 1024x768 pixels, **Full** will automatically adapt BeamOn's display to your screen.

Set Images Sets the number of still image bitmap files that the system takes during pulsed laser operations.

If, for example, you input 4 and select the still image function, the system captures and saves the next 4 still images.

The set images function is disabled for continuous lasers.

To set the number of still image bitmap files, enter a set image value. Possible values are 1 - 12.

Color Select the graphical presentation's background color. You can choose either colored or black and white (mono).

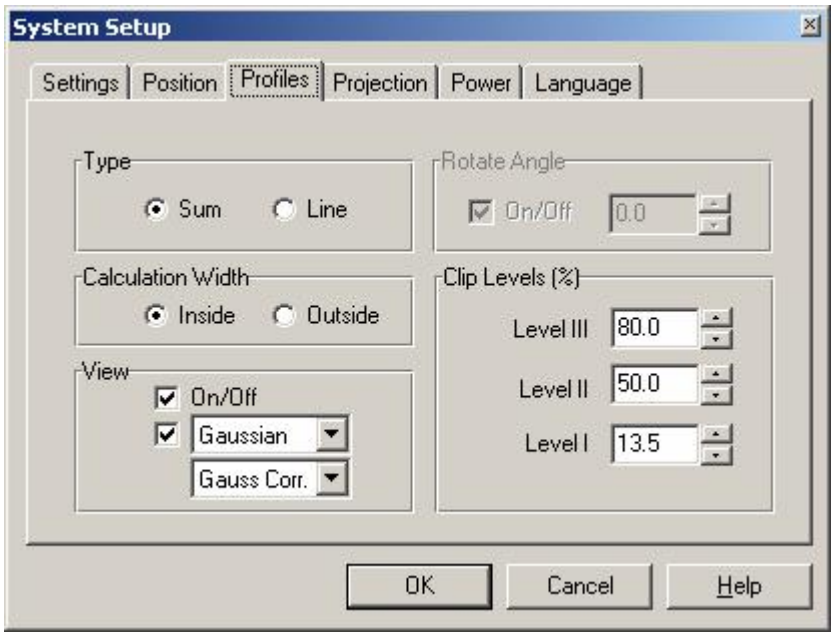
To select the background, select **Color** or **Mono**.

7.2.2 System Setup - Profiles

Profiles setup allows you to control the display in the profiles area.

You can control the following displays:

- Profile type display
- Gaussian / Top Hat profile
- Gaussian Correlation or 4Sigma
- Clip levels
- Angle of rotation at which the X-Y cross-section profiles are cut.



System Setup - Profiles Tab Selected

To configure the profiles:

1. Click the **Profiles** tab.
2. Enter your information according to the descriptions below.
3. Click **OK**.

Profile Type The following methods for profiles calculations are available:

- **Sum Profiles -** Displays the two orthogonal profiles, one along the vertical axis and one along the horizontal axis. Each profile is composed of a summation of rows and columns at a beam cross-section.
- **Line Profiles -** Displays the contour of the beam along a line parallel to the vertical axis and a line parallel to the horizontal axis. The two lines, along which these contours are displayed, are designated as a cross hair cursor. The cross hair cursor can be moved along the image screen, so that the displayed profile is the cross section line profile located by the cursor.

To select the profile calculation method:

1. Select Sum or Line. Or,

   From the **Control** Toolbar, click  for Sum Profiles or  for Line Profiles. Or,

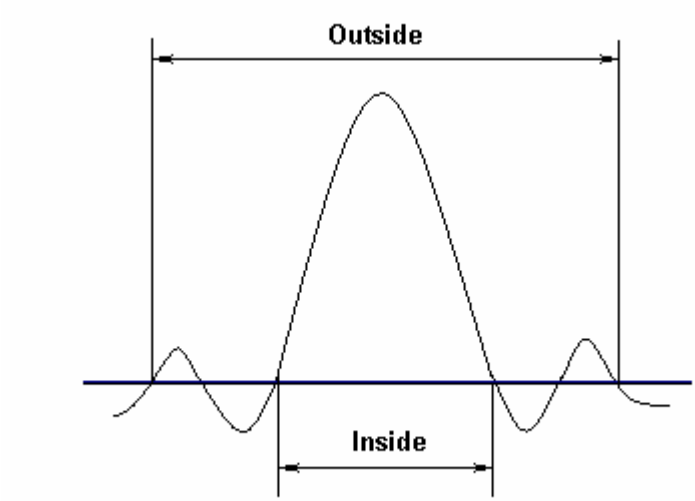
   Open the View menu and select Profiles u **Sum** or **Line**.

To select the angle at which you want to cut the X, Y profiles:

Click on the On/Off of **Rotate Angle** and select the angle desired from –45 to +45 degrees. The allowed increments are 0.1 degree.

Calc. Width There is an option enabling the user to toggle between two different methods of beam width calculation:

- **Inside** - taking into account only the central lobe.
- **Outside** - calculating beam width based on all intersections along X axis.



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

View

Controls the following profile displays:

- **AutoScale On/Off** – Displays the profiles using the full height of the profile window.

  When Auto Scale is not selected, the beam peak can be observed as it changes which can be advantageous during a focusing process. The peak intensity changes may be observed as a function of the focus, showing the variations in beam's peak with respect to the changes in beam size.

  This function affects only the graphical presentation in the profile area.

- **Gaussian/Top Hat** selects between Gaussian or Top Hat calculation and display. The display of the best fit Gaussian or Top Hat profile is overlaid in red on top of the profiles in real time.
- The **Gaussian** fit profile shows how closely the measured beam profile matches a Gaussian profile. The Gaussian fit profile is displayed on top of both the vertical and horizontal profiles in red.

  The Gaussian Fit is a least-square fit of a Gaussian equation to the cross section beam profiles. The correlation coefficient is the normalized sum of the fit residuals. The following equation is used for the Gaussian Fit calculation:

  $$I = Ve \wedge [-(x-c)/s\ ]^2$$

  Where
  I = the intensity of a pixel at location x
  V = the maximum intensity of the fitted Gaussian curve (Peak Intensity)
  C = the center of the Gaussian fit peak (Centroid)
  σ = the radius of the Gaussian fit curve at the $1/e^2$ intensity level (diameter)

- **16/84% Knife-edge** The 16/84% criteria simulates the moving knife-edge method. In this case the total beam power on the detector is integrated and represents 100% of beam energy, and the two levels 16% and 84% represents two imaginary knife-edge scanning position: one abstracting 16% of energy, other 84% of energy. The corrected beam width is given by twice the distance, between the two imaginary knife-edge locations.
- **4Sigma** is the second moment method of beam measuring device. The second moment is based on an International Standard ISO 11146, and will display the beam size diameter according to this calculation.

You can toggle between Gaussian correlation, 16/84% and 4Sigma, by pressing function name on the bottom of Measurement Data.

Note: *The beam size, when using 4Sigma, should be substantially smaller, than the detector size.*

To configure the profile view, select the desired options.

Clip Levels

Sets the levels at which the width of the vertical profile and horizontal profile are measured by the 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/e2 point of a Gaussian profile.

Both the horizontal and vertical profile windows display the width of the beam at three clip levels simultaneously.

There are three clip levels represented by solid horizontal lines superimposed on the profiles. The default clip levels are 80%, 50% and 13.5%.

The three clip levels are labeled I, II and III.

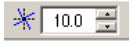
To change the clip levels:

1. Enter a value in the **Clip Level** field. The clip levels values are in 0.1% increments. Or,

1. In the profiles area, position the cursor just above (or below) the width level bar you want to change.
2. Press the left mouse button and drag the line up or down, while watching the change in the clip level setting on the profile presentation. The new clip levels can be seen in the Measurement Data window. When performing this operation it is helpful to size the profiles area as large as possible.

Rotate Angle

This option is available only when **Line Profile** option is enabled.

Click on the On/Off of **Rotate Angle** and select the angle desired from –45 to +45 degrees. The allowed increments are 0.1 degree. Alternatively, select the required value for angle rotation via the **Control ToolBar**, using the 

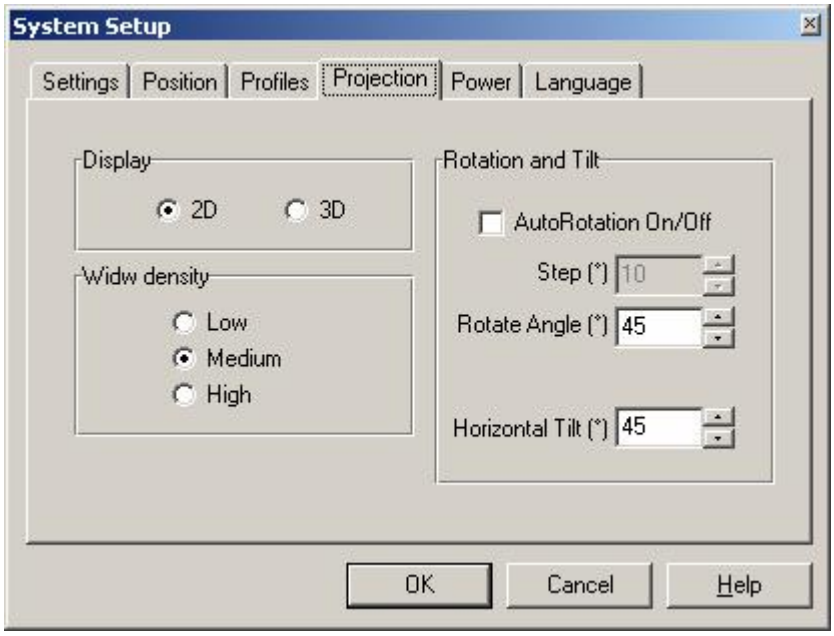
icon.

7.2.3 System Setup - Projection

Projection setup allows you to control the display of the image area.

Displays you control include:

- 2D or 3D graphic images
- Zooming factor
- Graphic image magnification
- Color or monochrome display
- Image size



System Setup - Projection Tab Selected

To configure the projection:

1. Click the **Projection** tab.
2. Enter your information according to the descriptions below.
3. Click **OK**.

Display

Toggles between a 2D or 3D graphical presentation in the view area.

To select the graphical presentation:

1. Select **2D** or **3D**. Or,

   From the **Control Toolbar**, click  for a 2D display or  for a 3D display. Or,

   Open the View menu and select Projection u **2D** or **3D**.

Wire Density

Controls the graphical presentation of the 3D plot by means of line density. There are three wire densities to choose from: **Low**, **Medium** and **High**. High density displays the best graphics for the 3D image, as the color lines are condensed, but as the graphics become more complex, it takes more time to draw the image on the screen.

To set the Wire density, select the desired wire density.

Rotation& Tilt

This function is used to change the viewing angle of a 3D graphics presentation. This enables you to view the angles around the beam's main axis as well as to flip the displayed image.

- **Auto Rotate On/Off** - When Auto Rotate is On, the image is rotated about the optical axis or azimuth of the 3D display. The amount of rotation (viewing angle) is defined by the Step parameter (in degrees). Possible values for Step are 1 through 30 degrees. When Auto Rotate is on, Rotate Angle is disabled.
- **Rotate Angle (°)** - Sets the viewing angle of the 3D projection display. Possible values are 1 through 360 degrees in 1 degrees increments.
- **Horizontal Tilt (°)** - Sets the tilt viewing angle of the 3D projection (from a top view to a side view). The values range from 0 to 90 degrees in 1 degree increments.

To set automatic rotation:

1. Select **AutoRotate On/Off**.
2. In the Step field, enter the viewing angle.

To set manual rotation:

1. Deselect **AutoRotate On/Off**.
2. In the Rotate Angle (°) field, enter the viewing angle.

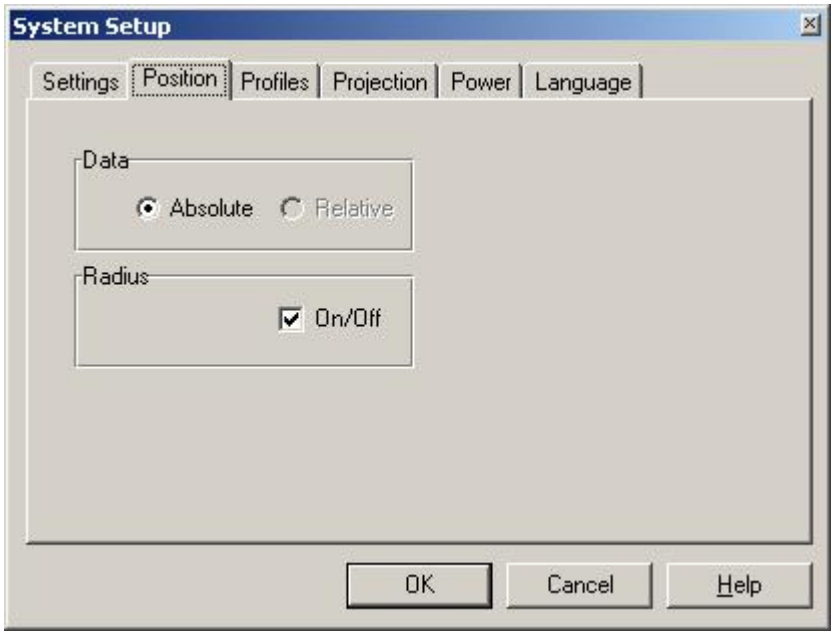
To set manual tilt:

1. In the Horizontal Tilt (°) field, enter the tilt angle. Or,
2. Place the cursor over the image and press the left mouse button. The cursor changes shape.

   Drag the cursor along the view area. The 3D plot rotates around the image main axis and flips from top view to a side view of the image.

7.2.4 System Setup - Position

The Position setup defines the attributes for the beam centroid calculation & display.



System Setup - 3D Features Tab Selected

To configure the Position features:

1. Click the **Position** tab.
2. Enter your information according to the descriptions below.
3. Click **OK**.

Data Data is used to toggle between Absolute and Relative modes of position, where the default is Absolute.

When Relative is selected then all the position centroid data will be calculated versus the Cross Line center.

The Relative point coordinates can be set by graphical means, by dragging the Cross Line center to any requested location over the View Area.

Radius Controls the numerical calculation of the position function. Some applications require a calculation of the radius of beam centroid deviations. In this case the R parameter is calculated as follows:

$\sqrt{(X^2 + Y^2)}$

Mark the Radius parameter as On in order to enable the Radius function.

7.2.5 System Setup - Power

The Power setup allows the user to configure the power measurement capability to suit a particular set of needs.

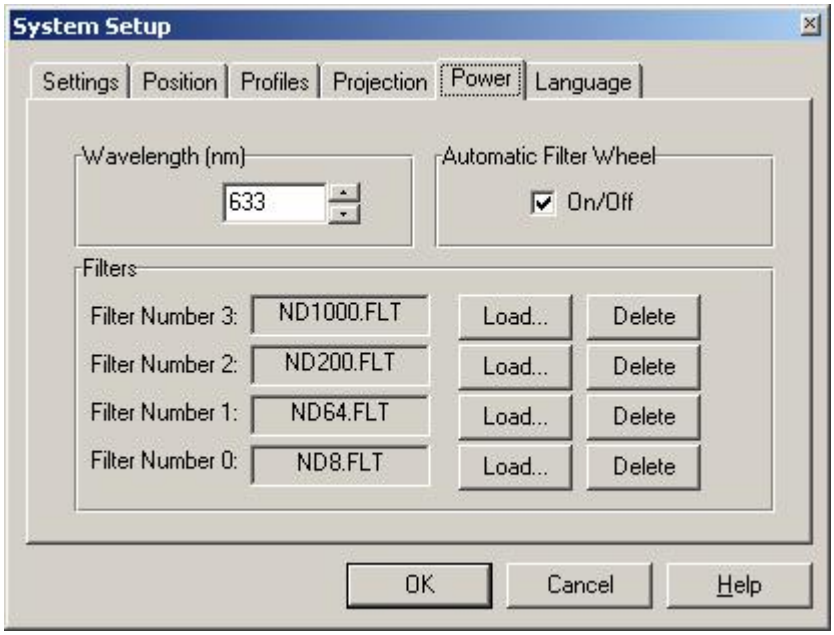


Figure 33 System Setup - Power Tab Selected

To configure the Power features:

4. Click the **Power** tab.
5. Enter your information according to the descriptions below.
6. Click **OK**.

Wavelength The wavelength value is used by the Power function to correct the sensor reading for the selected wavelength response.

This option should be used to input the wavelength (in nanometers) of the laser source used in the current measurement session.

The system will recalculate the beam power value and correct the display accordingly. The wavelength can be entered in 1-nanometer increments from the data entry box. Possible values for wavelength are: 350 - 1310 nm.

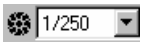
Filter Filter option is used in order to inform the system which filter file to use in the current session

Pre-Load a Filter file to the system via **Load …** button, after physically installing the filter in front of the detector. A file list is displayed, presenting all the available Filter files to choose from (all files having extension name *.FLT).

7.2.6 Configuring a Continuous Laser Beam

When using a continuous laser beam, attenuate powerful laser beams by selecting a combination of shorter shutter speeds and attaching the ND filters to the BeamOn camera until the saturation level is acceptable. Refer to **Hardware Setup - Shutter** and **Using Filters** topics for more information.

To configure a continuous laser beam:

1. Open the Settings menu and select **Hardware Setup**.
2. Click the **Laser** tab and select the **CW** radio button in the **Type** field.
3. From the **Control Toolbar**, select a shutter speed using the drop down list in the shutter field 

that enables an acceptable saturation level.
4. From the **Control Toolbar**, select a gain level using the drop down list in the gain field that enables an acceptable saturation level.
5. If the image is still saturated at the fastest shutter speed or gain selected, attach ND filters to the BeamON camera until an acceptable saturation level is reached.

7.2.7 Setting the Ambient Light Suppression (CW lasers)

The **Null** function allows you to subtract off background and display the correct power value.

When null calibration is off, the power value displayed in the measurement data or statistics window is the total power incident on the detector surface. When null calibration is on, the power value displayed does not contain the ambient light.

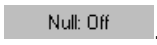
You should perform the null calibration function during your set up routine. During the null calibration routine, a message is displayed at the top right side of the screen, which reads: **Null Calibration**.

To calibrate the ambient light suppression:

1. Open the **Options** menu and select Calibration u **Null.** Or,

   From the **Status Bar**, click

.

   A message displays instructing you to turn off your laser beam.
2. Turn off or block your laser and click **OK**. The system now measures the ambient light level. Note that the power reading in the Measurement Data area is now zero.
3. Turn on or unblock your laser. The Null button on the **Status Bar** changes to 

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7.2.8 Configuring a Pulsed Laser Beam

When using a pulsed laser beam:

- Attenuate powerful laser beams by attaching the ND filters to the BeamOn camera until an acceptable saturation level is reached. Refer to **Using Filters** topic for more information.

- Set the gain setting to the optimum for displaying a full dynamic range without saturation (white on the image).

- Set the trigger level. This allows you to measure slowly pulsing lasers without displaying blank frames.

To configure a pulsed laser beam:

1. Select Pulse option via Hardware Setup Settings. The  icon will further be displayed at the **Control ToolBar** and just next to it the Trigger control panel  **.**
2. Select the slowest shutter speed (1/50s).
3. Attach ND filters to the camera until an acceptable saturation level is reached.
4. Further adjust the intensity level using the gain control 
5. Adjust the trigger level using the  icon until you get a steady reading. It is best to move to the right until triggering stops, then move back a little.

7.2.9 Using Filters

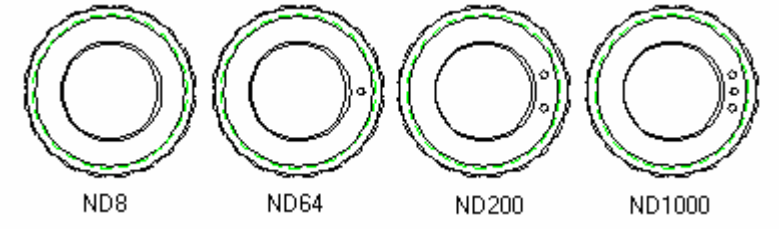
When setting up your system, use the three calibrated optical filters (ND filters) supplied with the BeamOn system to attenuate powerful beams. By doing so the amount of energy, which the BeamOn camera is sensing, is significantly smaller. The use of filters is especially significant when operating a pulsed laser beam.

To attenuate powerful-pulsed laser beams, attach filters to the BeamOn camera until the saturation level is acceptable. The BeamOn camera is supplied with a filter wheel having room for 4 stackable filters. Four different filters are supplied, which are:

- filter ND8, with coefficient transmission = 12.5%
- filter ND64, (coefficient transmission see p.90)
- filter ND200, with coefficient transmission = 0.5%
- filter ND1000, (coefficient transmission see p.93)

You can order more filters if desired.

The filter type is marked on the filter housing according to the following schematics:

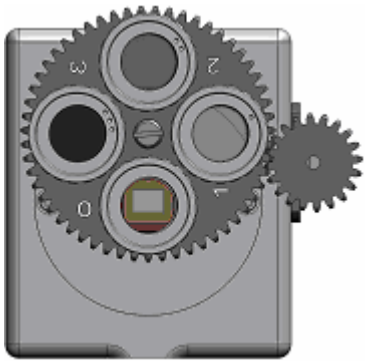


Filter type marking

To attenuate powerful continuous laser beams, select a combination of shorter shutter speeds and attaching filters to the BeamOn camera until the saturation level is acceptable.

Refer to **Configuring a continuous Laser Beam** for more information.

7.2.10 Using the Automatic Filter Wheel



Filter Wheel

The filter wheel is automatically controlled by the application program, when using AutoShutter mode.

The filter wheel image will adjust automatically to the current filter position (in front of the sensor).

The name of the selected filter is displayed at the status bar.

The software will calculate the adequate optical power, using the filter transmission curve.

All filter wheel position is automatically recognized, by the built-in magnetic sensors.

The user can select a filter manually, by placing the mouse cursor on the specific filter image, and clicking the enter key.

For using laser with wavelength over 800nm, please remove filter wheel, and exchange internal filter plate without filter to a plate with IR filter (see p.95).

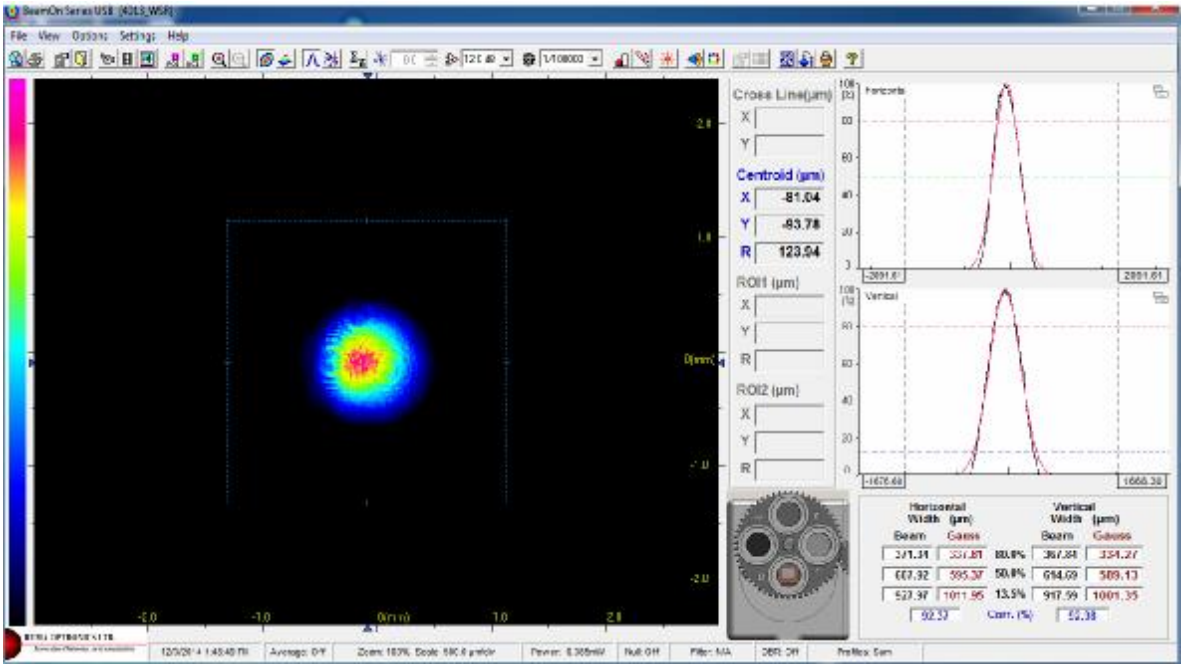
Plate without filter

Plate with IR filter

8.0 General description of Software

This chapter discusses the following BeamOn operations:

- Viewing Beam Profiles and Width
- Viewing the Centroid
- Viewing the 2D / 3D presentations
- Viewing Power
- Viewing the Beam Peak
- Viewing Measurement Data
- Viewing the Statistics
- Freezing Screen Graphics
- Printing Screen Displays
- Saving Screen Graphics
- Working with Stored Files



BeamOn Application Window

8.1 Viewing Beam Profiles and Width

Two types of profiles are being displayed by BeamOn:

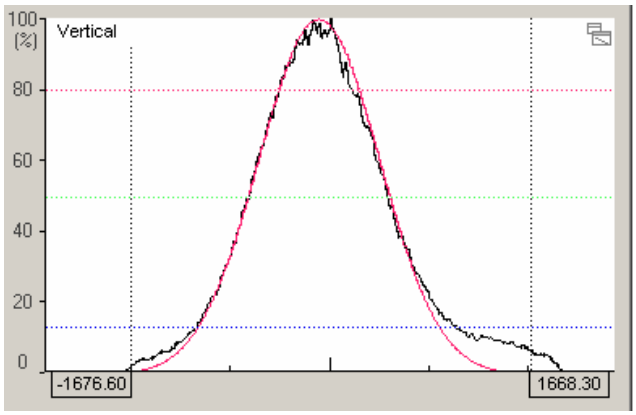
Sum Profiles- Displays the two orthogonal, one along the vertical axis and one along the horizontal axis. Each profile is composed of a summation of rows and columns at a beam cross-section.

Line Profiles- Displays the beam contour along a line parallel to the vertical and horizontal axes. These two orthogonal lines are designated as a cross hair cursor on the image plane and can be moved along the working area.

1. To select the profile calculation method:

From the **Control** Toolbar, click  for Sum Profiles or  for Line Profiles. Or,

Open the View menu and select Profiles u **Sum** or **Line**.



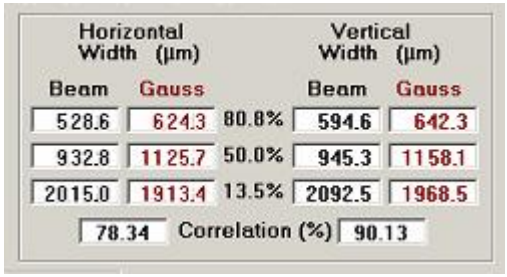
Vertical Profile

Beam widths are digitally displayed for any three user selected clip levels.

A Gaussian fit profile can be overlaid on profiles in real time, while the correlation and fit values are displayed digitally. This function determines how closely the measured beam profile matches a theoretical Gaussian profile. The Gaussian fit profile is in red. The percent correlation and width comparisons utilize the currently selected clip levels.

Two vertical bars can be moved along the horizontal axis, designating the distance (in microns) along this axis. This is a useful feature for tracing and measuring of beam phenomena at certain locations.

The comparison data is displayed in the Measurement Data Box. A top hat profile presentation and fit is also available.



Measurement Data.

8.2 Viewing the Centroid

The Centroid is the beam intensity center of gravity.

The BeamOn determines the location of the beam centroid by summing the intensities of all image pixels in both horizontal and vertical axes, and computing the center of gravity of the beam intensity. The pixel coordinates at this location define the centroid. The horizontal (H) and vertical (V) coordinates of the Centroid are computed using the following formula:

$$H = \mathring{a}\{h * i(h,v)\} / I$$

$$V = \mathring{a}\{v * i(h,v)\} / I$$

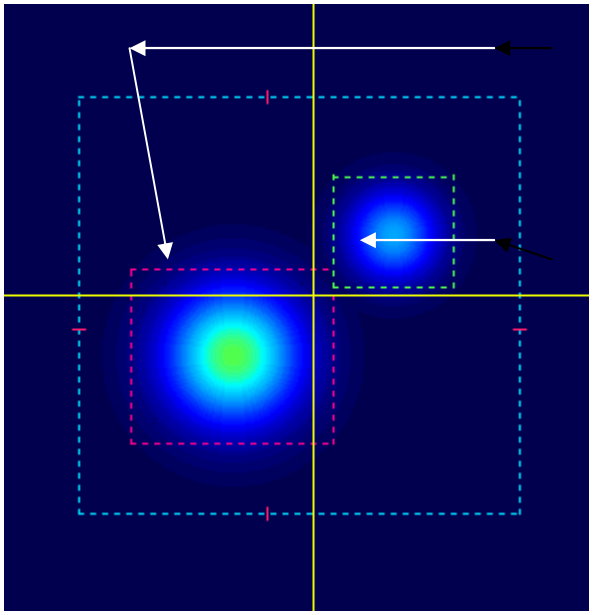
Where i(h,v) = the intensity at location (h,v) and I = the total intensity taken over the total area. The centroid calculation is displayed in the User Area window and also in the Statistics window.

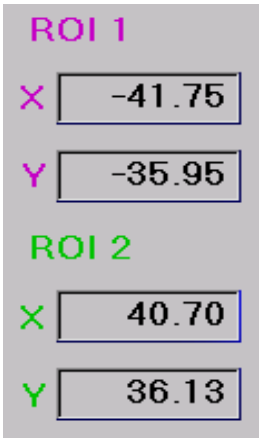
The BeamOn enables you to display the centroid in the view area when a 2D image is displayed. The centroid is located where the horizontal and vertical profiles cross in the view area. Two additional regions of interest (ROI) can be defined by the user and displayed at the Statistics table, thus enabling the user to monitor up to 3 beams' centorids simultaneously.

To display the centroid in the view area:

1. From the **Control Toolbar**, click  for a 2D display.
2. From the **Control Toolbar**, click  for a sum profiles display
3. Open the View menu and select **CrossLine -Centroid**.

.**The ROI function selects a region of interest within the total detector area.**
To activate the ROI press the appropriate ROI button on the **Control ToolBar**. The ROI region is defined by a square, the color of which is identical to the numerical presentation at the **User Area,** as well as to the ROI tool button color. The user can control the size of the ROI and its location by graphical means using the mouse.





ROI's represntation

The software calculates the centroid of the beam, which resides inside the ROI area only, disregarding the energy outside of this region. Thus, the result of the beam centroid calculation will be displayed in the appropriate ROI area at the User Area. In case the Radius parameter is set On at the Position Setup – Position tab, then there is an additional calculation and display of the R value, which is the radius of beam centroid with regards to the cross line.

Note: *The default ROI is the total centroid of the energy impending on the entire area.*

The user can change this default by graphical means, by dragging the ROI frame to the location and size at the screen, which is of interest.

The default setting of the system when it boots up is the entire detector area is being considered the area main region of interest and the beam centroid calculation is performed over the entire detector area. This default can also be changed by graphical means, the same way both other ROI's borders and location can be set.

In order to resume the default setting, double click on the mouse Left button.

Position Data in User Area

The User Area displays four numerical results. There are two types of presentations, according to the system setup setting:

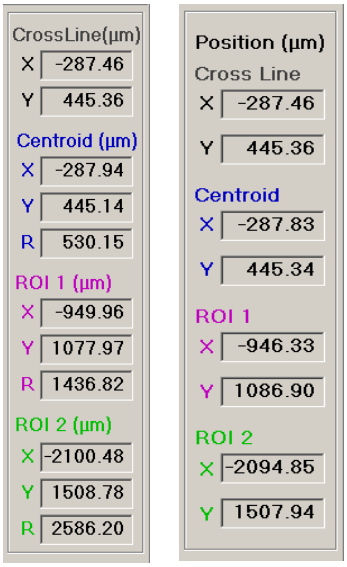
Beam centroid (X, Y), which is the beam centroid location calculated over the entire detector area.

Cross Line coordinates (X, Y) displaying either the detector center of origin (detector Center option), or the cross line coordinates at any point over the detector View Area (Free option), or the beam centroid coordinates or any offset value with respect to the centroid (Centroid option)

ROI 1: the beam centroid (X, Y) in the defined Region of Interest 1.

ROI 2: the beam centroid (X, Y) in the defined Region of Interest 2.

In each one of the above listed presentations (Centroid, ROI1 and ROI2) a third line can appear, marked as "R" and stands for the Radius calculation (squared-root of X^2+Y^2). This calculation and presentation appear when the Radius parameter is set on in the System Setup – Position tab.



Position Data Calculation

8.3 Viewing the 2D / 3D Presentations

The projection function provides either a 2D or a 3D plot of the beam intensity profile. A zooming feature enables magnification of the displayed image. It is possible to control the 3D plot wire density.

To display the 2D presentation in the view area:

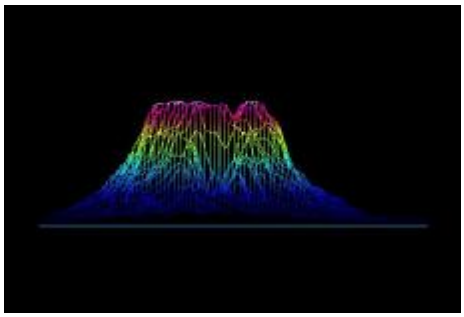
From the **Control Toolbar**, click  for a 2D display.

To display the 3D presentation in the view area:

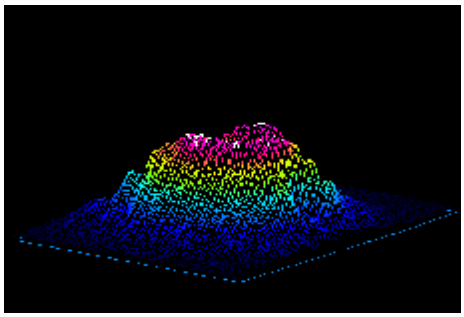
From the **Control Toolbar**, click  for a 3D display.

The 3D image can be rotated along the vertical and horizontal axes, as well as be flipped, using the following routine. This feature enables the user to view the beam image from various angles around the beam:

- Place the mouse cursor over the 3D image
- Hold the left mouse button down
- Drag the mouse while pressing the left mouse button. You can move the cursor up/down or left/right. The image will rotate accordingly.

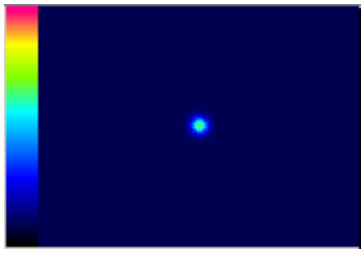


3D Plot – Side View

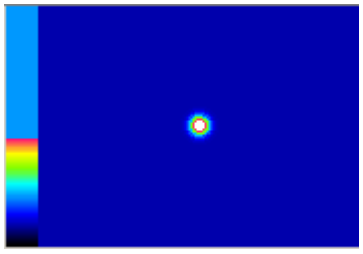


3D Plot – Top View

If beam is weak even when shutter is wide-open then increase the gain. If beam is very weak and color is dark even at the maximum shutter opening and gain, then optimize the color with the side panel. To optimize beam image place mouse cursor at the color bar and click the right mouse button. Return to default color bar press left mouse button once. (See illustrations below).



Weak beam



Weak beam with optimized color

8.4 Viewing Power .

The beam power is displayed as a digital readout (in mW) at the **Status Bar**.

A power calibration function allows the user to enter a “base” power value. In all subsequent captured images the summed intensity of all pixels will be proportional to this value. A double click on the Power value at the Status Bar opens up the Power Calibration screen.

8.5 Viewing the Beam Peak

The beam peak calculation provides the position of the peak intensity in the captured beam image.

The beam peak intensity location is found by searching all the pixels in a scanned sample for the maximum digital intensity level. The location of the pixel with maximum intensity is the peak location. It is possible that more than one pixel is found at the maximum intensity signal. In this case, the peak location will be the peak intensity pixel which is found first. The search is conducted by scanning the image from left to right, top to bottom.

The beam peak calculation is displayed in the **Statistics** window. Refer to **Viewing the Statistics** topics for more information.

The BeamOn enables you to display the beam peak in the view area when a 2D image is displayed. The beam peak is located where the two diagonal black lines cross in the view area. Two additional regions of interest (ROI) can be defined by the user and displayed at the Statistics table, thus enabling the user to monitor up to 3 beams’ beam peaks simultaneously.

To display the beam peak in the view area:

1. From the **Control Toolbar**, click  for a 2D display.
2. From the **Control Toolbar**, click  for a sum profiles display.

   Open the View menu and select **Beam Peak**.

8.6 Viewing Measurement Data

The BeamOn enables you to view real-time measurement data. The measurement data includes:

- The beam width measurements at 3 selected clip levels for measured beam and Gaussian profile
- The correlation factor to the ideal Gaussian beam

The Measurement Data window is located by default in the User area, but you can move it anywhere on the screen.

The Measurement Data window contains the following information:

Noise canceling — Noise canceling button at the Toolbar. It will cancel noise and you can turn this function On/Off

Percent of Peak — The width comparisons of measured beam and Gaussian beam are located at the current selected clip levels (µm).

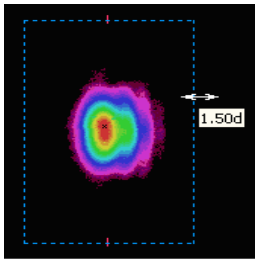
Correlation — The deformation calculation from the ideal Gaussian beam (%).

Given a theoretical curve (G) and a set of data points from a beam profile (P), where each data set is composed of points for j=0, 1, 2, … N. The correlation coefficient is derived from the following steps:

1. $S = \text{Integral } [(P-G)^2]$
   where S = the integration of the squared differences between the two curves.
2. $So = \text{Integral } [(G)^2]$
   where So = the deformation at each point from the average, Dj.
3. $C = 100 * \{ 1 - [\text{SQRT } (3/S-So)]\}$
   where C = the fit coefficient percentage.

16/84% Knife-edge — The 16/84% criteria simulate the moving knife-edge method. In this case the total beam power on the detector is integrated and represents 100% of beam energy, and the two levels 16% and 84% represents two imaginary knife-edge scanning position: one abstracting 16% of energy, other 84% of energy. The corrected beam width is given by twice the distance, between the two imaginary knife-edge locations.

4Sigma — The 4 Sigma is the second moment method of beam measuring device. 4 Sigma criteria – flexible ROI. This function is activated by mouse operation, and its value is indicated upon touching ROI border. The size is also displayed at Toolbar:



The second moment is calculated and performed according to ISO Standard 11146.

The beam column displays the laser beam's readings. The Gaussian column displays the data of the ideal Gaussian profile.

These measurement results are calculated and displayed for both the Horizontal and the Vertical profile.

The Measurement Data window can be viewed off-line in stored snapshot images for further analysis. Refer to **Creating / Viewing Snapshot Files**.

To view the Measurement Data window:

1. If the **Statistics** window is displayed, open the View menu and select **Statistics**. Or,

   From the **Control Toolbar**, click Σ_n.
   The **Statistics** window is not displayed.

NOTE: When the Statistics window displays, the Measurement Data window is hidden.

To move the Measurement Data window:

1. Position the cursor on the blank area on the top corner of the Measurement Data window.
2. Press the left mouse button and drag the Measurement Data window to the desired location.

8.7 Saving and Viewing the numerical data of the profiles

The BeamOn allows you to save, view and print the numerical values of the X and Y profiles for later analysis.

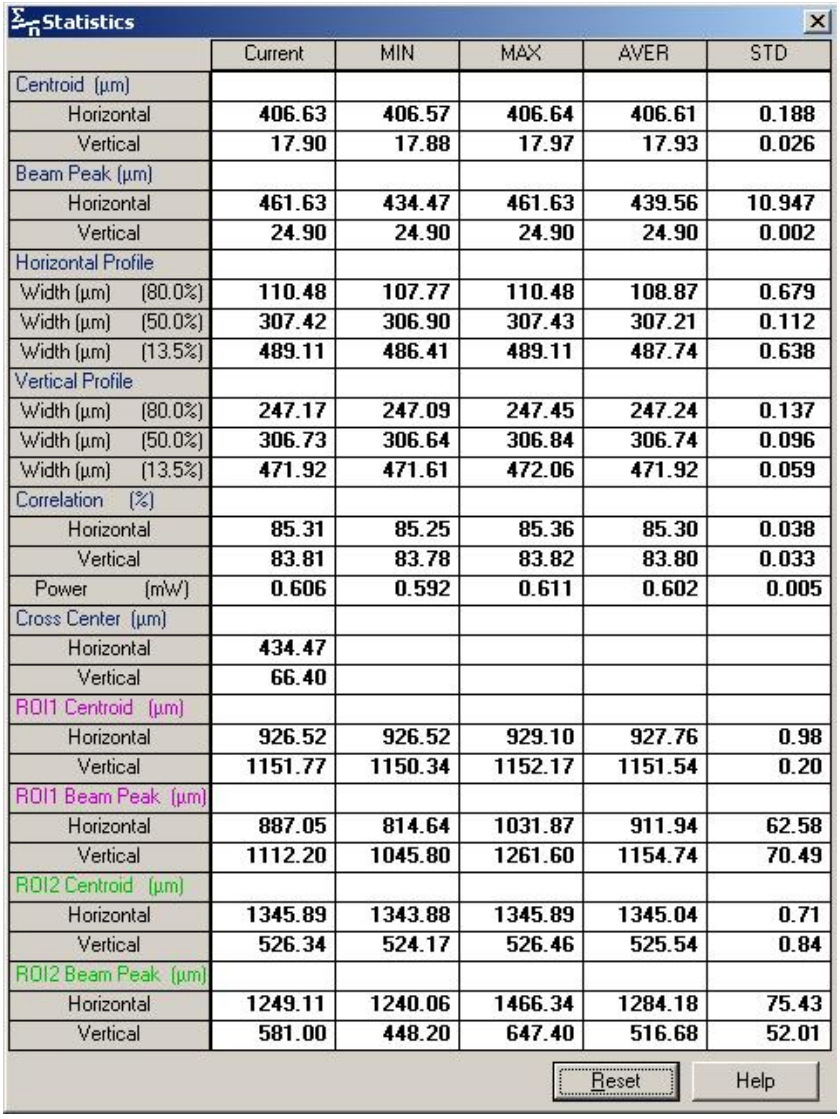
To View the numerical data of the X and Y profiles:

3. Place the X and Y crosshairs at the angle and position you desire.
4. Press **Options** menu, **Save data in text file**, **Profiles** option.
5. Name the text file and save with the TXT extension. The data will be saved as a text file with the relative X and Y intensity vs. pixel number. The setup data will be saved at the same time.
6. To view the data, press **File** menu, **View file** option and the view file window will open. Under Files of type select snapshot files and double click on the desired TXT file. If you want to print the file when open, press **Print**.

8.8 Viewing the Statistics

The information in the Statistics window is useful for analyzing beam stability related characteristics. The statistics can help you monitor fluctuations and beam stability of the images captured and stored in the data buffer or analyze the warm-up characteristics when measuring beam-pointing stability.

- Current - the actual measurement values
- MIN - the minimum measured value
- MAX - the maximum measured value
- AVER - the average value
- STD - the standard deviation



Statistics Window

To view the Statistics window:

1. Open the View menu and select **Statistics.** Or,

   From the **Control Toolbar**, click Σn.

You can reset the parameters in the statistics window to initiate a new statistics calculation session. To reset the parameters in the Statistics window, press the **Reset** button.

☞ ***NOTE:*** *When the Statistics window displays, the Measurement Data window is hidden.*

8.9 Freezing Screen Graphics

It is possible to freeze the last image display and its measured data for further analysis using the Analysis function. You can perform the following functions on the frozen data:

- Calculating a beam footprint (refer to page 64)
- Measuring distances between two points (refer to page 65)
- Viewing the measurement data (refer to page 57)
- Viewing the Statistics (refer to page 59)

When the BeamOn is in freeze mode, a message displays on the top left-hand side of the screen, which reads: **Freeze Mode**.

To freeze the screen graphics:

1. Open the Options menu and select **Freeze Mode**. Or,

   Click  on the **Control Toolbar**. A Freeze Mode message appears on the menu bar.

To return to real-time measurement mode:

1. Open the Options menu and select **Freeze Mode**. Or,

   Click  on the **Control Toolbar**. The Freeze Mode message disappears from the menu bar.

8.10 Printing Screen Displays

This section describes how to print:

- The BeamOn window
- The view area (2D/3D image only)

To print the BeamOn window, open the File menu and select **Print Screen**.

To print the view area, open the File menu and select **Print Frame**.

8.11 Saving Screen Graphics

The BeamOn's screen graphics are saved as image files, which you can view, edit or print at a later time.

To save screen graphics:

1. Open the Options menu and select **Save Image File**. A sub-menu displays.

2. Select the screen section to be saved: Frame (view area), Profiles, Statistics or Full Screen. The **Save Image File** window displays.
3. Enter a filename and file extension (BMP or JPG) for the saved screen graphic.
4. Click **OK**.

☞ *NOTE: You can only save graphics, which appear in the BeamOn window. For example, if the Statistics window is not displayed, the Statistics option is disabled.*

8.12 Working with saved Files

You can view or print stored BeamOn files.

Viewing Files

To view a file:

1. Open the File menu and select **View File**, Or

   Click  , from the **Control Toolbar**.

   The **View File** window displays.
2. In the **Files of Type** field, select the file type.
3. Select the file. Click **OK**.

Printing Files

BeamOn provides you with the ability to print a saved text or image file.

To print a text or bitmap file:

1. Open the File menu and select **Print**, Or

   From the **Control Toolbar**, click  .
2. Select the file type for the file you want to print **Text** or **Image**. If you select Text, the **Print Text File** window displays. If you select Image, a menu appears for selecting **Print Image File** window (select BMP or JPG file).
3. Select the file you want to print. Click **OK.**

9.0 Analysis Functions

This chapter includes the following:

- Testing the beam
- Calculating a beam elliptical footprint
- Measuring distances
- Power in the Bucket
- Report

9.1 Test

BeamOn provides a test routine, which allows you to test a laser beam based on user defined pass/fail criteria. The test results are calculated for any one of the following user-selected parameters:

- Centroid Horizontal (µm)
- Centroid Vertical (µm)
- Width Horizontal (µm) at the lowest clip level
- Width Vertical (µm) at the lowest clip level
- Gaussian Width Horizontal (µm) at the lowest clip level
- Gaussian Width Vertical (µm) at the lowest clip level
- Correlation Horizontal (%)
- Correlation Vertical (%)
- Power (mW)

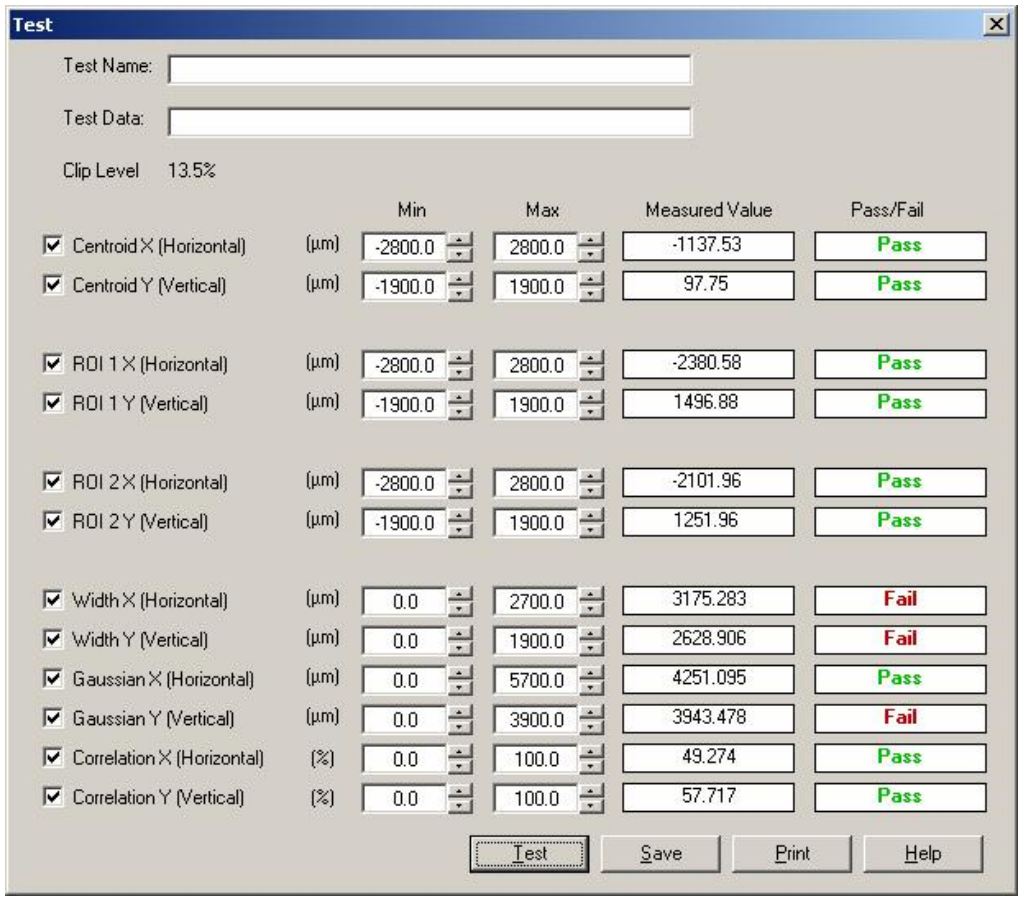
To test a laser beam:

1. Open the **View** menu and select Toolbars u **Analysis**. Or,

   From the **Control Toolbar**, click  .

   The **Analysis Toolbar** displays.

2. To run the test, click  on the **Analysis Toolbar**.
3. Select the parameters to include in the test and set the minimum and maximum values for these parameters.
4. Enter your test related information.
5. Click **Test** button to perform a test routine.



Test Window

The test window displays the beam's test results based on the parameters entered in the Test window.

To save the current test results in a bitmap or test file, click **Save** in the Test window.

To print the current test results, click **Print** in the Test window.

To close Test window click PF on the **Analysis Toolbar**.

9.2 Calculating a Beam Footprint

Analyzing a laser beam frequently requires a definition of beam elliptical footprint in the profile cross-section plane, and beam angular orientation with respect to the camera axis. The ellipse function calculates the best-fit ellipsoid for the examined beam. The major and minor axes of the fit ellipse are calculated by determining the distance from the centroid (center of the beam) to the ellipse. Also, the orientation (Theta θ) is a measure of the orientation of the major axes of the fit. Theta is measured from the positive X-axis and varies between +90° and –90°.

To use the ellipse function the image must be frozen. The BeamOn can now calculate the best-fit ellipse and display it as a dotted white ellipse just around the edges of the measured ellipse. The best-fit ellipse parameters are also calculated and displayed.

To calculate a beam elliptical footprint:

1. Open the Options menu and select **Freeze Mode**. Or,

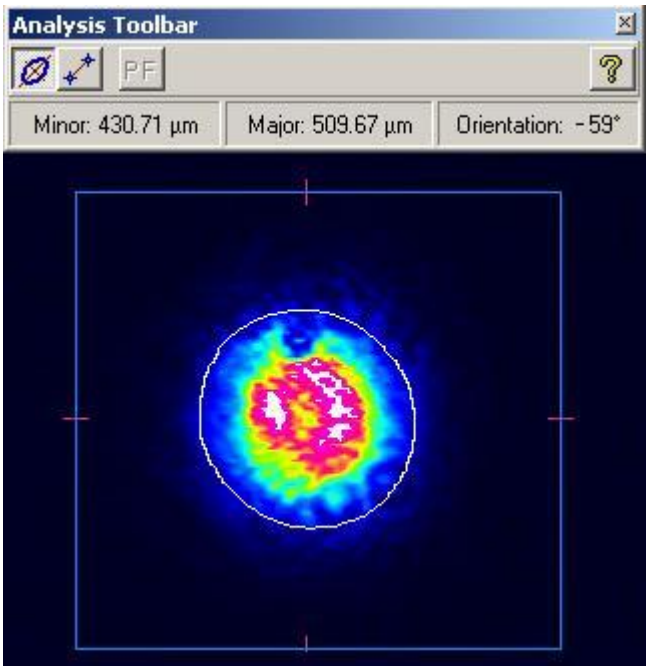
   From the **Control Toolbar**, click  .

2. Open the View menu and select Toolbars u **Analysis**. Or,

   Click  from the **Control Toolbar**.

   The **Analysis Toolbar** displays.

3. From the **Analysis Toolbar**, click  . The BeamOn calculates the best-fit ellipse and displays it as a dotted white ellipse just around the edges of the measured ellipse. The best-fit ellipse parameters are displayed below the Analysis Toolbar (see below).



Best fit Ellipse

9.3 Measuring Distances

The BeamOn can accurately measure distances between any two points on the beam image. You select the end points and the BeamOn calculates and displays the results.

To measure the distance between two points on the beam image:

1. Open the Options menu and select **Freeze Mode**. Or,

   From the **Control Toolbar**, click  .

2. Open the View menu and select Toolbars u **Analysis**. Or,

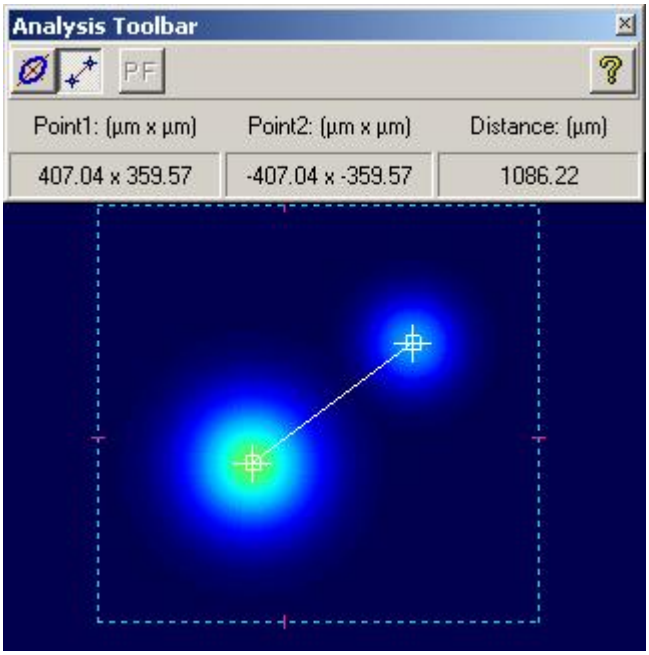
   From the **Control** Toolbar, click  .

   The **Analysis Toolbar** displays.

3. From the **Analysis Toolbar**, click  .

4. Select the first point by placing the cursor on the beam image and click the left mouse button.

5. Drag the mouse to the second point on the beam image and click the left mouse button. A straight line is drawn between these two points and the line distance calculation is displayed below the Analysis toolbar.



Measuring Distances Between two Points

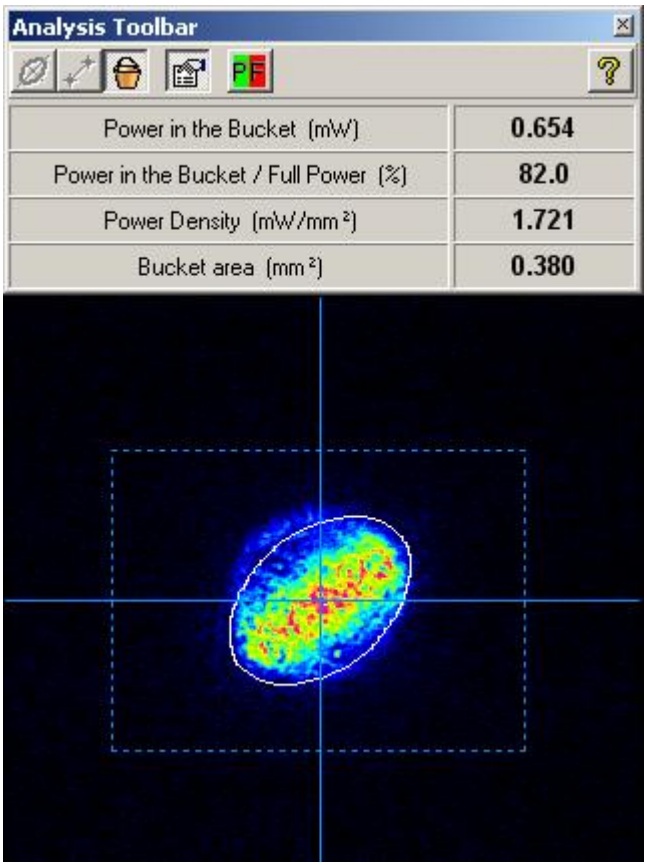
9.4 Power in the Bucket

The BeamOn can accurately measure the power in a specific area, defined by user on the beam image. The results are displayed on the following screen and are self-explanatory. Please note in order to get full results the system should be calibrated for power.

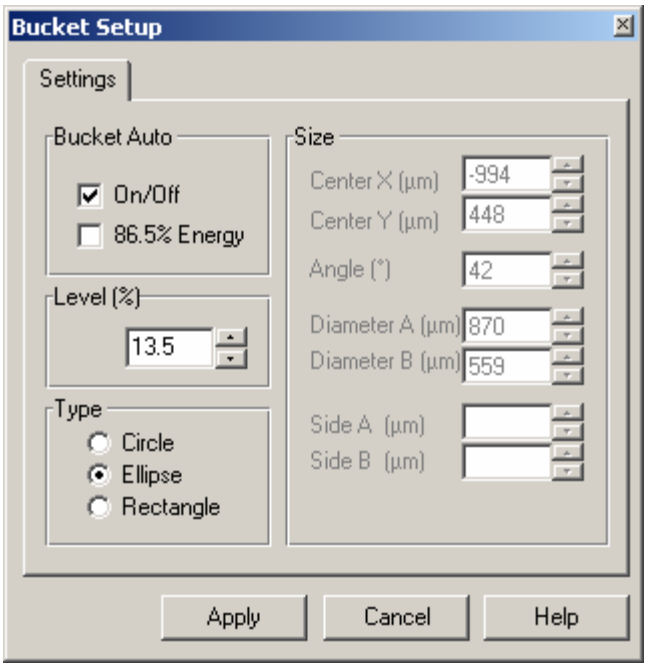
To calculate a Power in the Bucket:

1. From the **Control Toolbar**, click  , or
2. From the **Control Toolbar**, click  .

   The **Analysis Toolbar** displays.
3. From the **Analysis Toolbar**, click  , and click bucket setup  .



Measuring Bucket power



Bucket Setup

Bucket Setup will adjust the bucket size and location for Power in the Bucket calculation.

To configure the Bucket features:

7. Enter your information according to the descriptions below.
8. Click **Apply** button.

Bucket Auto	Bucket will be automatically defined according to the center of the beam and accepted profile level.
Type	Defined type of the Bucket: Circle, Ellipse or Rectangle.
Size	Enable user selectable bucket size and location, where you can chose: center location, orientation (**Angle** in use), and diameter (for ellipse use different **Diameter A** and **Diameter B**). For rectangle use **Side A** and **Side B.**

9.5 Report

BeamOn provides a report routine, which allows you to save all application screens and setup parameters to the *.xls file.

To save report file, please do following:

1. Open the View menu and select Toolbars u **Analysis**. Or,

   From the **Control** Toolbar, click  .

   The **Analysis Toolbar** displays.

2. From the **Analysis Toolbar**, click  .

The Report function enables saving a momentary display and its related setup. Setup parameters are saved, including time & date, System SN, shutter and gain setup, etc. Below the Setup data, various screen displays are recorded, including

Projection and Position screens as well as all related Setup screens.

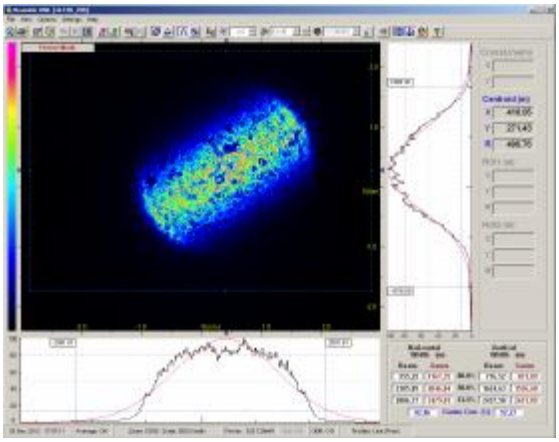
Example of the "Report.xls" file:

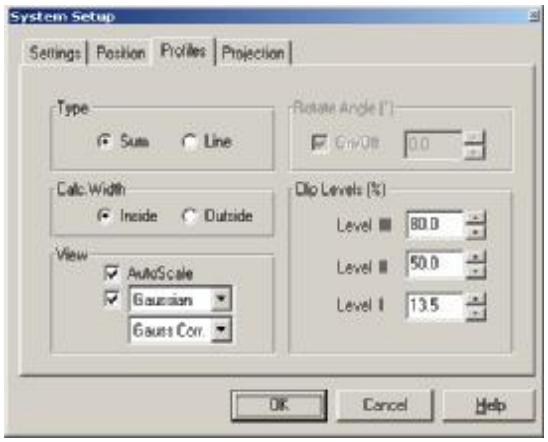
*** BeamOn Series USB Measurement system, Version 1.02 ***

User Data:

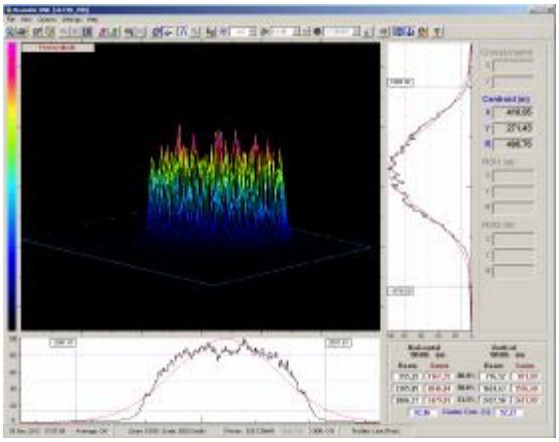
Date:	5 Dec 2014
Time:	14:40:43
System N:	000-013
Detector S/N:	4127
Size:	720x576
Average:	Off
Level I:	13.50%
Level II:	50.00%
Level III:	80.00%
ProfAngle:	Off
Zoom:	Off
Gain:	6.0 dB
Shutter:	1/500 sec
Optical Factor:	x1.00

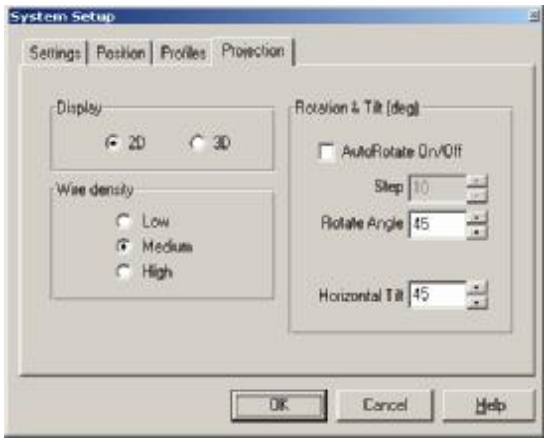
2D Projection



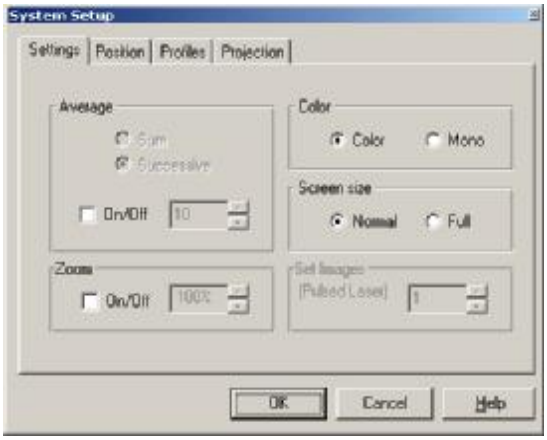


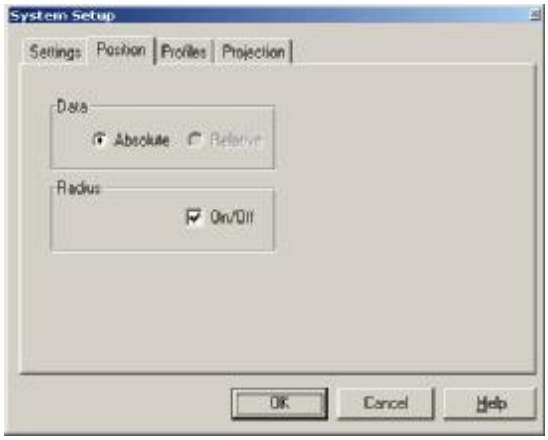
3D Projection



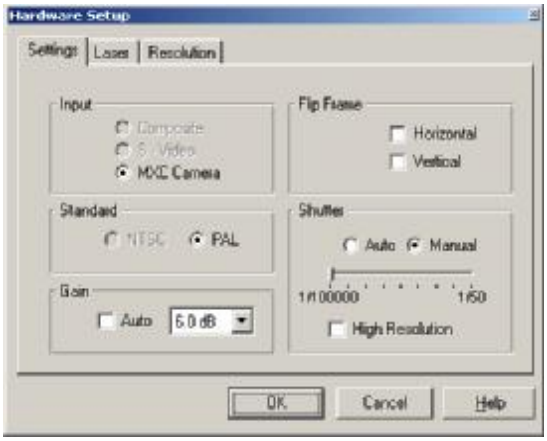


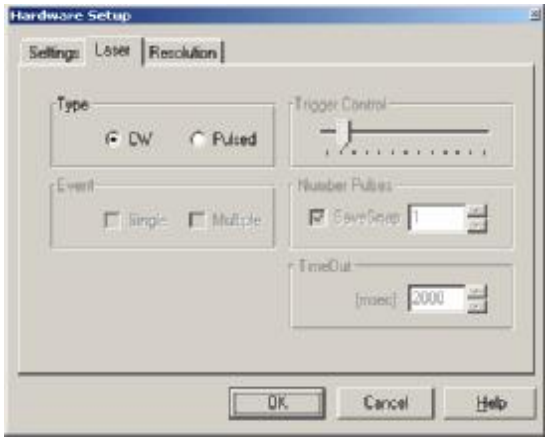
System setup

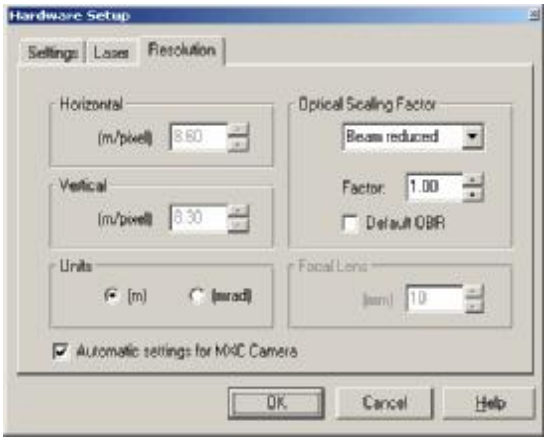




Hardware setup







10.0 Saving Data Log files

This chapter describes how to create a data log.

All the data collected by the BeamOn can be saved in a file with a .LOG extension. The data log files are stored in ASCII format so they can be easily printed, viewed, and analyzed by other programs. Refer to an example of the contents of a data log file (below).

The data log file contains general information including system parameters at the time of the log operation, such as the amount of averaging used, shutter level, Null (Offset) indication, zooming parameter and the size of the picture frame.

Additionally, at the lowest selected clip level beam width measurements for the horizontal and vertical profiles, centroid indication, as well as the power level value are displayed.

The end of the data log file contains a statistics summary of all the measured parameters, including the minimum measured value, maximum measured value, average measured value, as well as the standard deviation for each parameter.

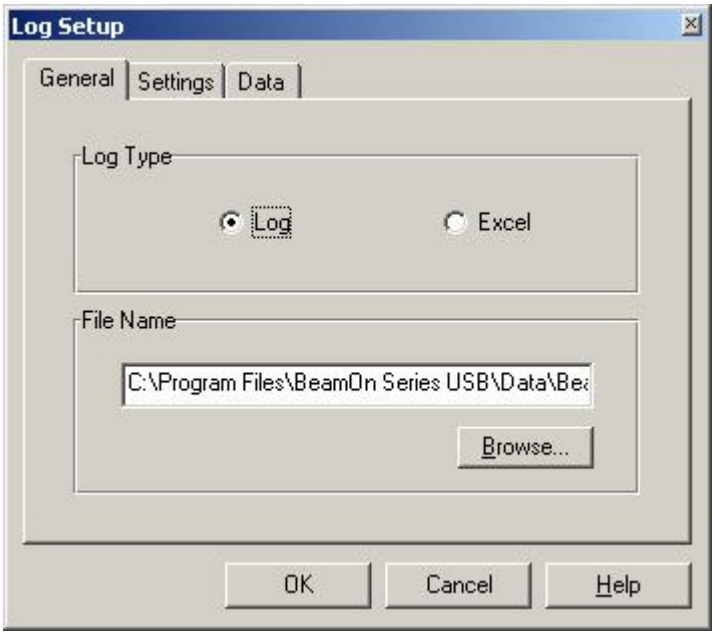
10.1 Setting Up the Data Log Function

This setup screen allows the user to customize the Log operation to suit a particular need: the duration of an experiment, the rate of data saving into file, and the Log filename can be input by this setup screen. Also, data can be saved either to a Log file or to Excel file for further analysis at a later stage**.**

To setup the data log function:

1. Open the File menu and select **Log Setup**. Or,

   From the **Control Toolbar**, click  . The **Log Setup** window displays

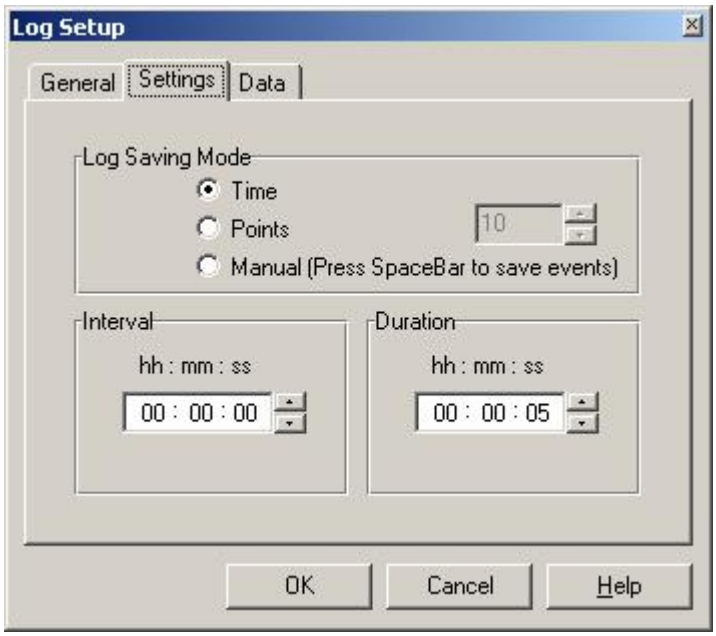


Log Setup

1. **Logtype:** LOG file or Excel file

2. **File Name:** Providing the system with a filename where Log data will be saved. Activate Button Browse... in order to provide the system with a filename via the standard Windows File Input interface box.

Note: When LOG file type was selected, all data collected will be saved in a file name ***.LOG**, which is a text file and can be imported into other programs. When Excel file type was selected, all data collected will be saved in a file name ***.XLS**.



Log Setup – Settings Tab

Interval Configures the time interval between consecutive measurements.

To configure the time interval between consecutive measurements, enter the time. The number of hours, minutes and seconds must each be entered separately.

Duration Defines the duration of the data log function. The data log function ends automatically at the end of the duration; however, you can stop the data log function prematurely (refer to **Stop Data Logging**).

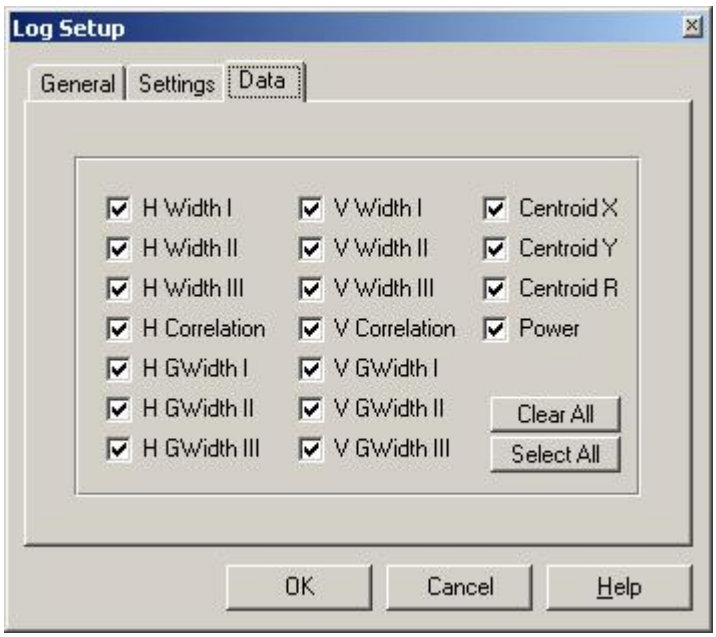
To configure the duration of the data log function, enter the amount of time. The number of hours, minutes and seconds must each be entered separately.

Log Type Provide the system with a method to control the data logging operation:

Time: Save measurements for a pre-defined duration, the interval between the saved measurements is also defined prior to saving.

Points: Save a certain amount of measurements taken at the system's data capturing rate, the exact figure is entered at the points field to the right of this option.

Manual: Save a certain measurement to the file by pressing the SpaceBar. This method is called "Event oriented", meaning once the user observes a certain measurement on the screen he can control the system to save this exact measurement data to the file, rather than other methods of stream data saving.



Log Setup – Data Tab

Data Allows mark that the data will be stored in a Log/Excel 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.

10.2 Start Data Logging

The BeamOn collects the laser beam's data in the configured data log. While the data log function is in progress, a message displays on the top left side of the screen, which reads: **Log in Progress.**

To start the data log function:

1. Open the File menu and select **Start Log**. Or,

   From the **Control Toolbar**, click  .

10.3 Stop Data Logging

The data log function automatically terminates after the user-preset time is reached. However, you can stop the function at any time.

To stop the data log function:

1. Open the File menu and select **Stop Log**. Or,

   From the **Control Toolbar**, click  .

10.4 Viewing Data Log Files

To view the data log file:

1. Open the File menu and select **View File**.
2. Select the data log file you want to view.
3. Click **Open**. The **Data Log** displays.

*** BeamOn Measurement system, Version 1.0 ***

UserData:

Date: 22 Dec 2003
Time: 16:26:47

System number: 0013
CCD S/N: 0013L

Size: 640x480
Average: Off
ClipLevel I : 13.5%
ClipLevel II : 50.0%
ClipLevel III: 80.0%
ProfAngle: 0 Deg
Zoom: Off
Gain: 17 dB
Shutter: 1/500 sec

Time (sec)	Centr. X (µm)	Centr. Y (µm)	H_Width I (µm)	H_Width II (µm)	H_Width III (µm)	V_Width I (µm)	V_Width II (µm)	V_Width III (µm)	Power (mw)
0	653.605	106.088	524.649	321.671	167.166	534.561	331.963	214.360	1.149
1	653.606	106.011	521.919	322.752	168.866	533.505	330.755	214.297	1.159
2	653.637	105.853	526.127	323.780	168.556	535.677	331.585	214.393	1.152
3	653.803	106.017	519.244	323.181	167.723	537.305	331.426	214.630	1.173
4	653.724	105.915	522.742	324.403	168.544	532.661	329.786	214.651	1.167
5	653.692	106.056	526.946	323.062	168.149	532.631	330.903	213.965	1.153
********** Statistics **********									
Min	653.605	105.853	519.244	321.671	167.166	532.631	329.786	213.965	1.149
Max	653.803	106.088	526.946	324.403	168.866	537.305	331.963	214.651	1.173
Aver	653.678	105.990	523.604	323.141	168.167	534.390	331.070	214.383	1.158
STD	0.294	0.085	2.873	0.924	0.630	1.844	0.765	0.251	0.009

Data Log File example

11.0 Creating / Viewing a Video

This chapter describes how to create and view a video file. The recording program enables recording and saving a continuous set of images from a single BeamOn camera source. The video is saved in a file with the extension .AVI.

11.1 Initializing the Video Parameters

To initialize the video parameters:

1. Open the Settings menu and select **Video Properties…**. The Video Properties window displays.

Video Properties

2. Enter your information according to the descriptions below.
3. Click **OK**.

Video Time Limit

Sets a time limit for the video recording.

To set the video time limit:

1. Select **Enable Time Limit.**
2. Enter the time limit in minutes and seconds.

Permanent Video File

This setting allows you to specify the filename and path, where the recorded video is saved. For best results, if you have multiple hard drives, this file should be located on the fastest hard disk drive or the disk drive with the most available free space.

You can also use this setting to limit the video to a selected amount of memory.

To specify a location for the video file, enter the file name and path.

To limit the video to a selected amount of memory:

1. Deselect **Enable Time Limit** check box in the **Video Time Limit** field.
2. Enter memory size (in Mbytes) in the **Size** field.

11.2 Record a Video file

When you record a video, the video is saved in the file you specified in the Video Properties window. If you don't want to overwrite this file, you must change the file name before recording a new video.

During video recording, a message at the top of the screen indicates the recording operation. When the BeamOn is recording a video, a message displays on the top left side of the screen, which reads: 

, and during recording the **Status Bar** presents the following pattern: 

You can change the setup parameters while recording your video (refer to **Initializing the Video Parameters**).

To record a video:

1. Open the Options menu and select **Record Video**. A checkmark is placed beside this option. Or,

   Click  from the **Control Toolbar**.

11.3 Stop the Video Recording

The video recording automatically terminates after the user-preset time is reached. However, you can stop recording at any time. When recording terminates, it is automatically saved in the file you specified during video setup.

To stop the video recording:

1. Open the Options menu and select **Record Video**. The checkmark is removed from this option. Or,

   Click  from the **Control Toolbar**.

When video recording is terminated the following message is displayed:

Stop video recording

11.4 Play a Video File

During a video playback routine, the BeamOn displays a digital presentation of the time elapsed since the video began, as well as the number of the frame being displayed.

To play a video, open the video file you want to see and use the following buttons on the Playback Toolbar to play your video:

	Play	Plays the recorded video file.
	Stop	Stops the playback of the video file once it is started.
	Rewind	Rewinds the current video one frame backwards.
	Forward	Fast-forwards the current video one frame.
	Open	Opens a video file.
	Close	Closes an open video file.

There is a slide bar in the middle of the Playback Toolbar, which moves in accordance with the video's progress. It is also possible to use this slide bar to rewind the video to its starting point, or to bring it to the end of the video.

To play a video file:

1. Open the View menu and select Toolbars u **Playback**. Or,

   Click  from the **Control Toolbar**.

   The **Playback Toolbar** displays.
2. Click  on the **Playback Toolbar**. The **Open Video File** dialog displays.
3. From the Open Video File dialog, select the video file you want to view.
4. Click **Open**. The video file displays.
5. Use the **Playback Toolbar** buttons as defined above to play the video.
6. Click  to close the video file.

12.0 Saving / Viewing Still Images

This chapter describes how to capture and view high quality digital images with BeamOn system. A still image is captured by digitizing a single video frame. The still images can be saved as bitmaps.

The captured image is displayed as an icon on the Status Bar with a number assigned to it. If you are using a pulsed laser, you can set the number of bitmap files that the system captures when performing a still image operation. The BeamOn can capture up to 12 still images during one session.

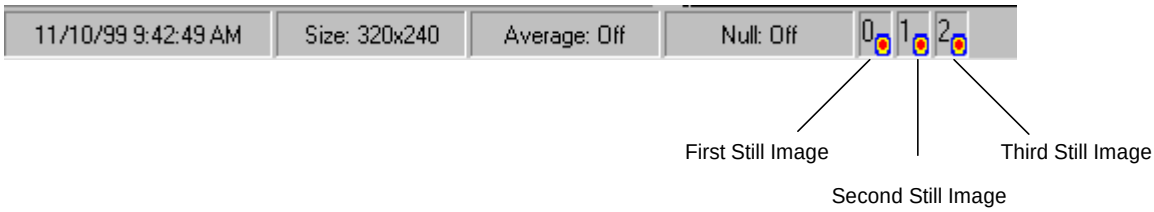
12.1 Capturing a Still Image

To capture a still image:

1. Open the Options menu and select **Still Images**. Or,

   Click  on the **Control Toolbar**.

   The image is captured and an icon is placed on the Status Bar.



Status Bar with Still Image Icons

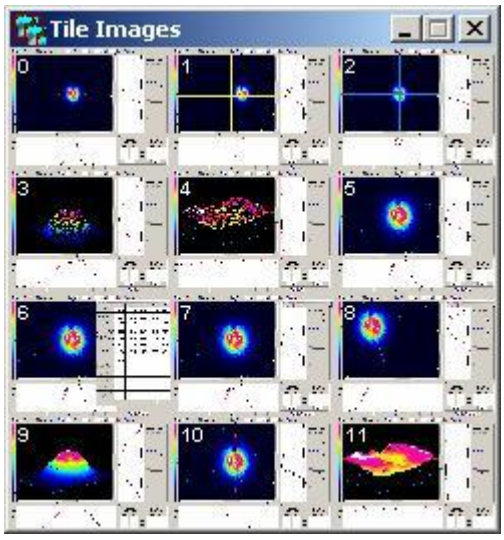
12.2 Viewing a Still Image

To view a single still image, click the still image icon on the **Status Bar**.

To close the magnified still image, click  in the upper right corner of the image window.

12.3 Tile Images

You can view a single still image or all your still images in a matrix (refer to the following figure). When viewing the still images in a matrix, you can select a single still image to magnify for details.



Tile Images window

To view a single still image, click the still image icon on the Status Bar, as explained in previous section.

To view the still images in a matrix, open the **Options** menu and select **Tile Images**.

To magnify a still image in a matrix, click one of the tile images. To close the magnified still image, click in the upper right corner of the image window. The still image remains in the matrix.

12.4 Saving / Closing Still Images

When you close a still image you must either save it or discard it. If you close a still image matrix and choose to save it, each of the images in the matrix are saved as separate bitmap files. The bitmap filenames are created by the BeamOn and consist of the image number, day, hour, minutes and seconds (n_ddhhmmss.bmp).

To close an opened still image or still image matrix:

1. Click in the upper right corner of the image window. The **Still Image** window displays.
2. If you want to save the still image, click **Yes** in the Still Image window.

To close all captured images at once, open the Options menu and select **Close All Images**.

13.0 Creating / Viewing Snapshot Files

Snapshot files enable you to create and view a pre-saved snapshot image for analysis and in-depth study of a beam measurement frame stored in the system's memory.

When you view a saved snapshot file you can analyze the measured results by activating system tools, such as:

- Viewing measurement data – refer to page 56.
- Change profiles clip levels – refer to page 37.
- Explore 2D contour or 3D isometric plots – refer to page 55.
- Perform Beam Analysis – refer to page 63.

When the BeamOn displays the snapshot file, a message displays on the top left side of the screen, which reads: **Snapshot in progress**. The BeamOn does not display real-time measurements and the screen is frozen.

13.1 Creating a Snapshot File

The snapshot image is captured as soon as you select the Save Snapshot option. You then save the snapshot image as an .SNP file. The snapshot file is saved in binary format and can only be processed by this application.

To create a snapshot file:

1. Open the Options menu and select **Save Snapshot**. The Save Snapshot File window displays.
2. Enter a filename for the snapshot file.
3. Click **OK**.

13.2 Viewing a Snapshot File

To view a snapshot file:

1. Open the View menu and select **Snapshot**. The Load Snapshot File window displays.
2. Select a snapshot file.
3. Click **Open**. The snapshot file displays.

13.3 Closing a Snapshot File

To close a Snapshot file, open the View menu and select **Snapshot**. The BeamOn restores real-time measurement displays, or click  in the upper right corner of the image window.

14.0 RS232 Communication

The BeamOn enables you to operate an RS-232 communication link for serial data transmission.

Any displayed data or pre-saved log file can be transmitted via the RS-232 communication link. Another computer can receive the data using a program that can communicate over a COM Port like Windows Hyper Terminal program.

While the link function is in progress, a Link in progress message displays on the top right corner of the Menu Bar.

Transmitting serial data requires the following steps:

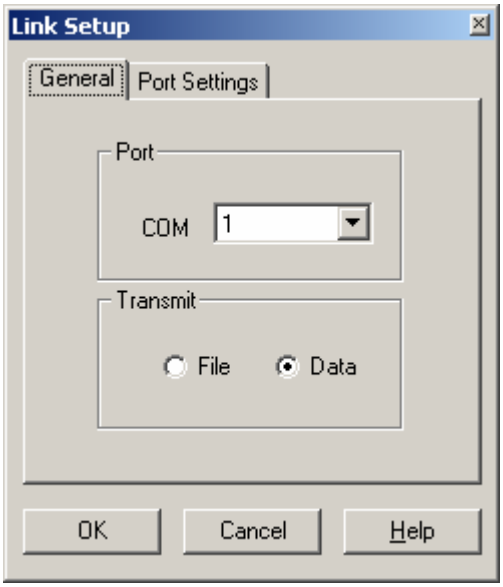
- Setting up the parameters needed for the link transmission.
- Making a null modem cable for connecting the two computers.
- Starting the link transmission.
- Terminating the link transmission.

14.1 Setting Up for RS232

The BeamOn allows you to configure a particular set of parameters needed for the RS-232 transmission.

To configure the RS-232 link:

1. Open the File menu and select **Link Setup**. The Link Setup window displays.
2. Click the **General** tab.

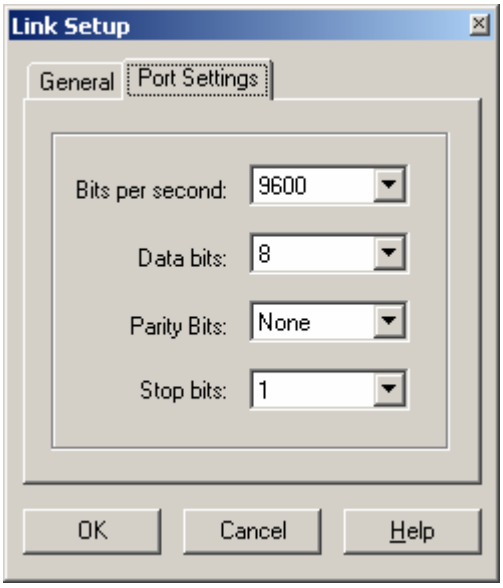


Link Setup - General Tab Selected

3. Complete the information as described below.

Port	Sets the computer communication port through which the data is transmitted over the RS-232 link. The possible values for Port are 1 through 4, for COM1 through COM4 respectively.
Transmit	Select one of the radio buttons: • **File** - transmits a pre-saved text file. • **Data** - transmits real-time measurements. The data is sent in the sequence and format of the saved data in the text (ASCII) file.

4. Click the **Port Settings** tab.



Link Setup - Port Settings Tab Selected

5. Complete the information as described below. These settings must match the settings on the receiving computer.

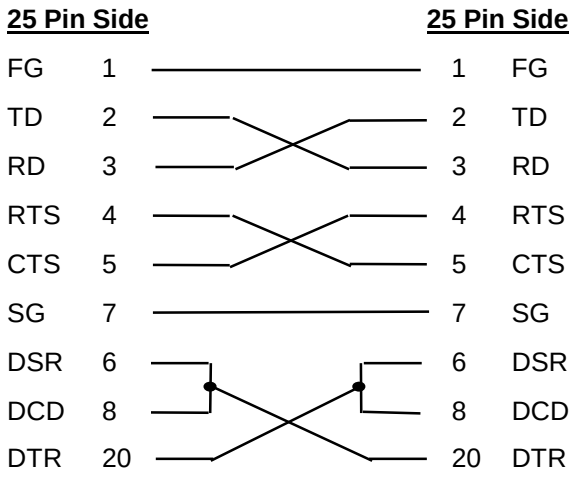
Frequency	Sets the transmission rate for the RS-232 link. The possible values for Frequency are: 110, 300, 600, 1200, 2400, 9600, 14400, 19200, 38400, 57600, 115200.
Data Bit	Determines the number of bits used for the RS-232 transmission. The possible values are: 4, 5, 6, 7, and 8.
Parity Bit	Determines whether or not a parity bit is transmitted. The possible values are: None, Odd, Even, Space, Mark.
Stop Bit	Determines the number of stop bits transmitted. The possible values are: 1 or 2.

6. Click **OK**.

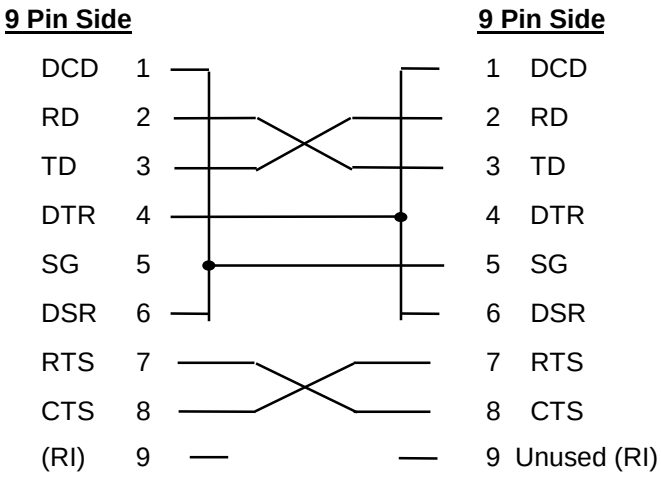
14.2 Making a Null Modem Cable

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 below.

Null modem cable with 25 pins on both sides:



Null modem cable with 9 pins on both sides:



Null Modem cable

14.3 Starting an RS-232 Link Transmission

The file (or measured data) is transmitted in the background while the system continues to capture data. When the BeamOn is transmitting data, a message displays on the top left side of the screen, which reads: **Link in progress**.

If you transmit a file, the contents of the file are sent.

If you transmit real time data, the following information is sent:

- Time of measurement
- Beam Centroid (H)
- Beam Centroid (V)
- Beam Peak (H)
- Beam Peak (V)
- Width (H)
- Width (V)
- Power

To transmit files over an RS-232 link:

1. Connect the BeamOn computer to another computer using a null modem cable.
2. Enable the receiving program to receive the file/data.
3. Open the File menu and select **Start Link**.
4. If you are transmitting data the BeamOn immediately starts sending measured data via the RS-232 link. A “link in progress” message displays on the Menu Bar. Proceed to **Terminating an RS232 link.**
5. If you are transmitting a file, the **Link File** window displays. Select the file you want to send. A 

message displays on the Menu Bar.
6. Click **OK**.

14.4 Terminating an RS-232 Link Transmission

When transmitting a file, the RS-232 link transmission is automatically terminated upon completion of the transmission. However, if you are transmitting data, or you want to terminate your file transmission, you can manually terminate a transmission in progress.

To stop a transmission in progress, open the **File** menu and select **Stop Link**.

15.0 Troubleshooting

If, after reading this chapter and reviewing relevant portions of the user manual or on-line help, you still have a question, refer to **Customer Support** on page 88.

15.1 Common Operating Problems

The following are some common problems and possible solutions:

Problem	Possible Solution
Display Problems:	
• No picture appears on the screen	• Check the Settings parameters (refer to **Setting Up the BeamOn**). If this does not correct the problem: • Refer to **Windows XP/Vista/7/8 Installation**
• Scrambled Image	Verify the NTSC/PAL setting is correct (refer to Standard option in **Hardware Setup**). If this does not correct the problem: • Refer to **Windows XP/Vista/7/8 Installation**
Other Windows applications run slowly, or appear to be interrupted	Because the BeamOn System must constantly collect and analyze data, it might not work well with all Windows applications. If you want to use another application while the BeamOn System is running, select **About** from the Help menu. This will cause the BeamOn to pause the data collection. Now run your other application.
System Locks-up During Software Startup	• Refer to **Windows XP/Vista/7/8 Installation**.
The following error message displays: ”The Device is Not Ready or Busy, OK”	After receiving this error message, system operation is halted. Reboot you computer and restart the BeamOn program. This message is due to an internal problem, such as the drivers are not able to find the video card. Before rebooting your computer, verify that: • The card is firmly seated in the Chassis. • The drivers were correctly installed. • The slot is working correctly by installing the board in another slot. BE SURE TO TURN OFF THE COMPUTER BEFORE ADJUSTING THE HARDWARE.

Problem	Possible Solution
The following error message displays: "Hardware error #1: Cannot find the USB Capture Box"	Possible problems include: • Check proper connection of USB video device • Unsuccessful installation of the video device – check installation via Windows Device Manager. See more details at the **Software Installation**. • Problem with video card hardware – contact your provider
The following error message displays: "Not enough power from USB port."	• Try operation at another USB2.0 port. This is applicable only for revision "D".
The following error message displays: "Video Device Error"	• Contact factory for Service
Display does not update fast enough	The display update rate of a particular computer is influenced by a variety of factors: • CPU Speed • Computer RAM • Video Card • Video RAM • Screen resolution • Screen color depth • Other applications open at the same time Refer to **Hardware Requirements** to see if your computer meets minimum requirements. Upgrade your computer hardware or close other opened applications.
The power value in the Measurement Data window is not correct	Verify that: • The Power Calibration is set (refer to **Configuring Hardware** topic). • The Null Calibration is performed (refer to **Setting the Ambient Light Suppression (CW lasers)**. • The BeamOn camera is not saturated (refer to **Using Filters**).
Image is seen, but appears faint (weak intensity)	• Try setting a smaller shutter speed or Gain value in order to improve the image presentation (refer to **Configuring the Hardware**, Shutter option or Gain. • Use the Zoom option to magnify the image display (refer to **Configuring the Software**, option Zoom).

Problem	Possible Solution
Screen image is frozen, no real-time measurements	• Verify that the Freeze option is not activated, by checking the menu bar for a “freeze” message (refer to **Freezing Screen Graphics**). • Verify that the Snapshot option is not activated, by checking the menu bar for a “snapshot” message (refer to **Creating / Viewing Snapshot files**.
The image in the view area does not fully display	If the Zoom option is greater than 100%: • Use the scroll bars to reach the main image presentation display. • Reduce the Zoom value to 100%.
The Control Toolbar is not complete	You must use a 1024 x 768 resolution screen in order to fully view all the graphics. You can still operate the system using the menu commands for activating the hidden **Control Toolbar** icons.

16.0 Customer Support

Support Inside Israel

Please have your serial number and software version number available before you call, and include it on your faxes! This will greatly assist our technical service personnel in helping you solve your difficulty!

By Phone

Please call the Duma Optronics Ltd. at 972-4-8200577 and ask for "CUSTOMER SERVICE ". Our Support Hours are from 9:0 AM to 5:0 PM.

By Fax

If you wish to fax your question, our fax number is available 24 hours a day at 972-4-8204190. Please put "ATTENTION: Customer Service", on the cover sheet of the Fax.

By Internet

Email: sales@duma.co.il
Web: http://www.duma.co.il

Support Outside of Israel

Please call the Representative Company from which you purchased the BeamOn Series.

BeamOn Repair

We will try to answer your questions, and help solve the problem over the phone. The BeamOn has been designed to be robust and trouble free. If however, it appears that the system, or a portion of the system needs to be sent back for repair please make sure that you have first called in and received a Return of Materials Authorization Number, (RMA#).

The address for the Duma Optronics Ltd. is given below:

Duma Optronics Ltd.
Attn.: Customer Service.

17.0 DOVideoWCL.DLL - Windows Control Library.

Introduction

As mentioned in previous chapters, the BeamOn Series USB is a full capture and analysis application with sophisticated capabilities. However, many customers have special analysis demands and tools, yet are lacking data collection capabilities.

> The DOVideoWCL.dll control contains easy-to-operate functions and properties that enable measuring beam parameters and creating your own application under Windows XP, Windows Vista, or Windows 7 environment. The DOVideoWCL.dll control was written using Microsoft .Net C#.

This has been tested in LabVIEW 8.6 (National Instruments) as well as C# (Microsoft).

Examples

Examples of a LabVIEW and a C# application are provided with the installation CD disk. All examples assume a rudimentary knowledge of the respective development platforms.

Windows Control Library

Types

1) **DrawLine** { eNone, ePosition, eCursor };
    a. Enumerate of measuring line types.
2) **TypeProfile** { eSum, eCross };
    a. Enumerate of measuring profiles types.
3) **PositionUnits** { eMilimetr, eRad };
    a. Enumerate of measuring data units types.
4) **Dimension** { d2D, d3D };
    a. Enumerate of viewing picture types.
5) **Auto** { eOff, eOn };
    a. Enumerate of auto rotate 3D projection value.

Events

1) **OnNewDataReceved**: BeamOn has made a new measurement

Properties

1) **ShutterTable -** get the shutter table values, used by the camera hardware.
2) **Shutter -** get or set the shutter value from ShutterTable array.
3) **GainTable -** get the gain table value, used by the camera hardware.
4) **Gain -** get the gain value from GainTable array.
5) **GainIndex -** get or set the index of gain used by the camera hardware.
6) **ShiftGainIndex -** get or set the shift index of gain used by the camera hardware.
7) **AveragePictureEnable -** enable or disable averaging pictures.
8) **AveragePicture -** set or get of number pictures to averaging.
9) **Average -** set or get number of measured data for averaging.
10) **NumDevices -** set or get number of BeamOn devices connected to you computer.
11) **CurrentDraw -** set or get type of cross line.
12) **CurrentProfile -** get or set type of mesuring profiles.
13) **ActiveDevice -** get or set active BeamOn device.
14) **Unit -** get or set type of measuring data units.
15) **FocalLens -** get or set focal lens value.
16) **Levels** - get or set profile measure levels array.
17) **Position** - get measured positions array.
18) **Peak** - get measured peaks array.
19) **ProfileWidth** - get measured profiles width array.
20) **GaussWidth** - get measured gaussian width array.
21) **GaussCorrelation** - get measured gaussian corelations array.
22) **ProfileV** - get measured Vertical profile data array.
23) **ProfileH** - get measured Horizontal profile data array.
24) **Projection** - get measured projection data array.
25) **CurrentDimension** - get or set view type of picture.
26) **ProjectionWireDensity** - get or set projection wire density.
27) **ProjectionAngleTilt** - get or set projection angle tilt.
28) **ProjectionStepRotation -** get or set projection step auto rotation.

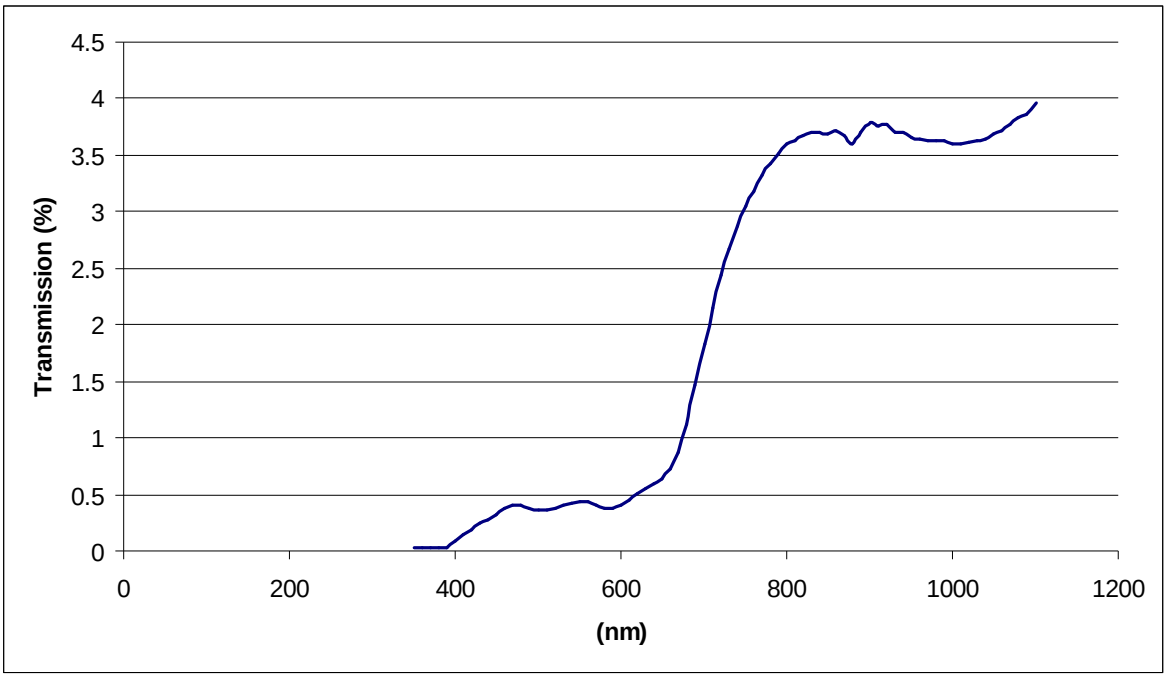
29) **ProjectionAngleRotation** - get or set projection angle rotation.
30) **ProjectionAutoRotation** - enable or disable projection auto rotation.
31) **Zoom** - get current zoom value.
32) **IndexZoom** - get or set current zoom index.

Methods

1) **GetVideoDeviceArray** - returns array list of the connected BeamOn devices.
2) **StopVideo** - stop BeamOn video device.
3) **StartVideo** - start BeamOn video device.
4) **SetLevel** - set clip level.
5) **GetCurrentPosition** - returns current measuring position.
6) **GetCurrentPeak** - returns current measuring peak.
7) **GetGaussCorrelation** - returns gaussian correlation.

18.0 A P P E N D I X

ND64 filter transmission and curve

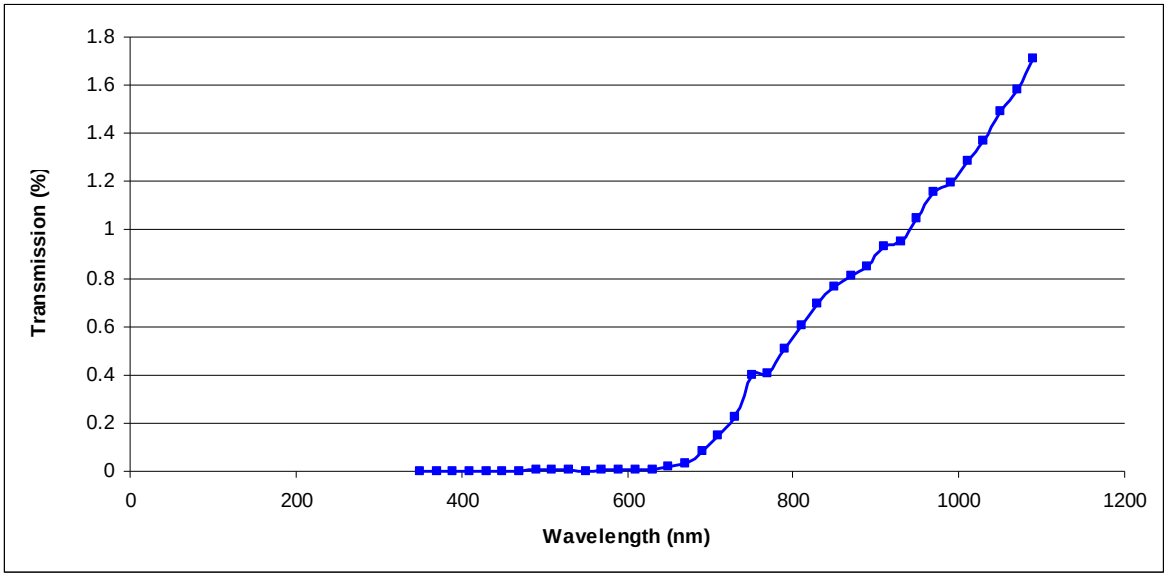


Wavelength-nm	Transmission-%
350	0.0272
360	0.0272
370	0.0272
380	0.0272
390	0.0272
400	0.0920
410	0.1446
420	0.1910
430	0.2418
440	0.2770
450	0.3208
460	0.3836
470	0.4098
480	0.3996

490	0.3830
500	0.3668
510	0.3616
520	0.3730
530	0.4014
540	0.4260
550	0.4376
560	0.4332
570	0.4110
580	0.3828
590	0.3792
600	0.4038
610	0.4532
620	0.5048
630	0.5538
640	0.5944
650	0.6430
660	0.7240
670	0.8760
680	1.1250
690	1.4678
700	1.8312
710	2.1552
720	2.4356
730	2.6712
740	2.8700
750	3.0450
760	3.1840
770	3.3238
780	3.4292
790	3.5102

800	3.5940
810	3.6322
820	3.6770
830	3.7026
840	3.7030
850	3.6930
860	3.7132
870	3.6784
880	3.6068
890	3.6958
900	3.7898
910	3.7658
920	3.7744
930	3.7086
940	3.7016
950	3.6616
960	3.6404
970	3.6224
980	3.6352
990	3.6284
1000	3.6000
1010	3.6024
1020	3.6154
1030	3.6322
1040	3.6420
1050	3.6828
1060	3.7218
1070	3.7682
1080	3.8268
1090	3.8560
1100	3.9662

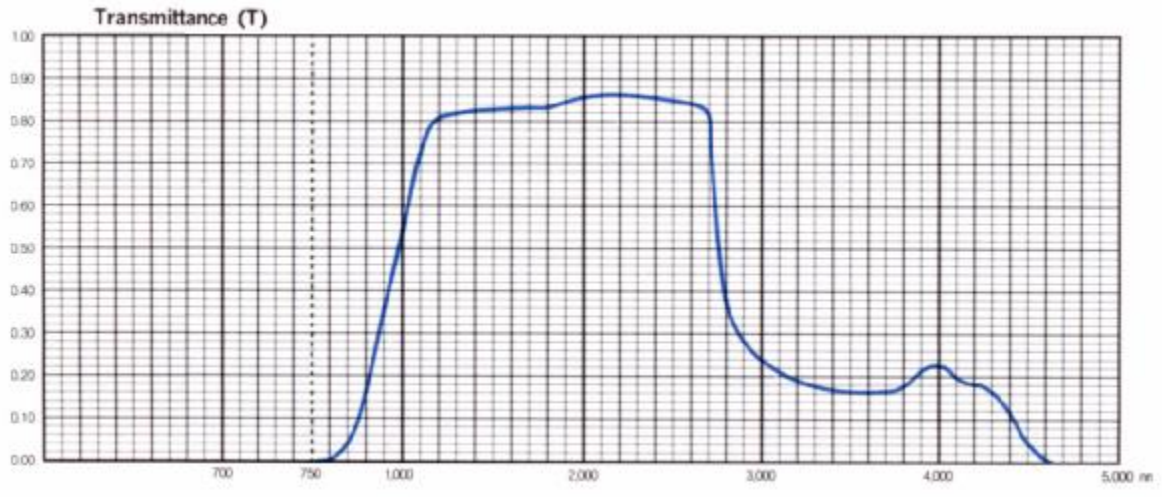
ND1000 filter transmission and curve



Wavelength-nm	Transmission-%
350	0.001
370	0.002
390	0.002
410	0.002
430	0.002
450	0.002
470	0.003
490	0.008
510	0.009
530	0.005
550	0.003
570	0.006
590	0.009
610	0.008
630	0.008
650	0.017
670	0.032
690	0.081
710	0.148

730	0.227
750	0.397
770	0.407
790	0.510
810	0.603
830	0.693
850	0.764
870	0.813
890	0.850
910	0.932
930	0.952
950	1.045
970	1.160
990	1.193
1010	1.286
1030	1.367
1050	1.494
1070	1.584
1090	1.712

IR filter transmittance & curve:



λ_{nm}	700	710	720	730	740	750	800	850	900	950	1,000	1,100	1,200
T					$1 \cdot 10^{-3}$	$5 \cdot 10^{-3}$	.35	3.8	16.5	35.9	53.8	74.7	80.8

1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000	2,100	2,200	2,300	2,400
80.8	82.1	82.4	82.7	82.9	83.0	83.0	84.5	86.0	86.0	86.0	85.8	85.7