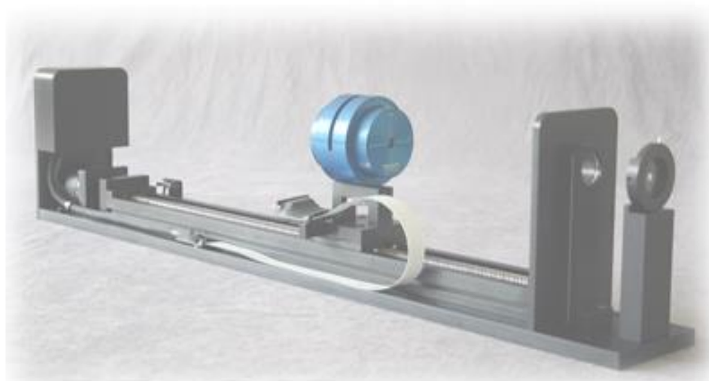

NanoModeScan™

Installation
And Operation Manual

Model #____________________________
Serial #____________________________
Date ____________________________

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Obtain the latest version of this manual at *http://www.ophiropt.com/laser-measurement-instruments/beam-profilers/services/manuals*.

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SYSTEM SPECIFICATIONS

Scan head Travel	500mm
Optical Axis Height	140–170mm
Horizontal Fine Adjustment	19mm
Angular Fine Adjustment	±2º vertical, ±1.4º horizontal
Standard Lens	200mm EFL, BK-7 plano-convex, broadband AR coated
Compatible Scan heads[1]	NanoScan2, NanoScan2s
Minimum Spot Size	See scan head specifications
Source Power	See scan head specifications
Parameters Measured	M^2 (Times Diffraction Limit Factor) K (Beam Propagation Factor) d (Beam Waist Size) Z_0 (Beam Waist Location) θ (Divergence) Z_r (Rayleigh Length)
File Saving and Data Logging	Data Files, ASCII Files
Software Operating System	Microsoft Windows 7 or Windows 10 32- or 64-bit Operating System
Dimensions	ModeScan Linear Stage: 812×102×78mm Photon Motion Controller: 273×89×57mm Alignment Channel: 940×247×72mm Removable Light Shield: 787×777×110mm
Weight	ModeScan Linear Stage: 8.4kg Photon Motion Controller: 1.5kg Alignment Channel: 4.8kg Removable Light Shield: 4.3kg
AC Power	110V 60Hz standard, 220V 50Hz optional

[1] ***Note: Ophir-Spiricon no longer verifies or certifies operation with legacy NanoScan I scan heads.***

1 Introduction

1.1. System Overview

NanoModeScan is an accessory to the NanoScan family of laser beam profilers. It is a computer driven automated linear stage and data acquisition and analysis system. It is designed to measure the beam propagation parameters of paraxial laser sources using the method defined in the ISO/DIS 11146 Laser Standard or the Rayleigh method. From measurements of the beam profile at multiple locations, the NanoModeScan analysis determines the laser beam propagation parameters, including the laser source diameter, divergence, and the propagation factor (K-factor or M^2) for orthogonal axes.

The ISO/DIS Standard 11146 defines the M^2 testing procedure. The beam is measured at ten or more locations, allowing determination of M^2 and other laser beam parameters. Half of the total measurement locations must be located within one Rayleigh range of an artificial waist (created by a lens inserted in the beam path) and five or more test points must be located more than two Rayleigh ranges from the waist. The NanoModeScan Acquisition and Analysis Software automates the measurement process, controlling the scan head motion and computing the results.

Spiricon has implemented a second method called the Rayleigh Method to determine M^2. This method is fully automated, and unlike the ISO method does not require selecting ten specific data points along the propagation path. Experience has taught us that selecting the ten points requires both time and a reasonably high degree of knowledge; once one finds the correct ten points, the ISO measurement will be the fastest of the two methods. Having both methods within the same instrument makes it possible now to verify the ISO method. Chapter 6 discusses both methods in greater detail.

M^2 measure-to-measure repeatability can be only as good as your laser's repeatability. The measurement takes one to a few minutes. A good measurement will be when the laser stays the same (little or no mode-hopping) during that time. Since the results are calculated from beam diameters along the propagation axis, a changing laser during the measurement can produce an indeterminate M^2.

NanoModeScan provides an ActiveX automation interface. As an automation server NanoModeScan can be controlled by an automation client. See chapter 7 for more information about the ActiveX interface provide by NanoModeScan.

1.2. Product Description

The Model 1740 NanoModeScan consists of:

1. The ModeScan Linear Stage.
2. Lens Mount with a 200 or 400mm focal length lens.
3. Entrance Aperture Iris.
4. Photon Motion Controller.
5. Mechanical Alignment Fixture.
6. NanoScan System.

2 SYSTEM INSPECTION

2.1. Inspection

Your NanoModeScan has been carefully tested, inspected and packaged before shipment. Spiricon performs extensive testing to ensure that the unit is in proper working order.

Please do the following:

- Inspect the shipping container. Please note any damage to the container. Please report any damage found immediately to the shipping company. ***Spiricon does not warrant damage that occurs during shipment.***
- Check the contents of your shipment against the packing slip attached to the shipping box. Please note any discrepancy.

2.2. Packing List NanoModeScan System

NanoModeScan System for NanoScan2 Scan Heads

1. NanoModeScan Linear Stage
2. Lens Mounts with 200mm and 400mm focal length lenses
3. Entrance Aperture Iris
4. Photon Motion Controller
5. One 3-meter white RS-232 Communication Cable, 9-pin D-subminiature male to 9-pin D-subminiature female
6. One 1.25-meter black Motor Power Cable, 9-pin D-subminiature male to 9-pin D-subminiature female
7. One 2-meter USB to Serial Adapter Cable
8. Motion Controller AC Power Cable
9. NanoScan2 scan head
10. One 2-meter USB 2.0 A to USB mini-B cable
11. DVD w/NanoScan v2 Acquisition and Analysis Software
12. DVD w/NanoModeScan Acquisition and Analysis Software
13. NanoScan v2 Installation and Operation Manual and Automation Developers Guide
14. NanoModeScan Operation Manual

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3 SYSTEM SETUP

Setup of the NanoScan system involves configuration of the system hardware and installation of the system software.

3.1. Recommended PC Requirements

To take full advantage of your NanoModeScan System capabilities, the following minimum PC requirements are **recommended:**

- A dual core processor CPU, 2GHz or better
- Microsoft Windows 7 or Windows 10 Operating System[1]
- 2GB of RAM[2]
- 2 USB 2.0 ports available, depending on controller version
- At least 250MB of free HDD space
- 1400 x 900 display resolution or better
- Add-in PCI/PCI-Express graphics card w/hardware accelerator
- DVD-ROM drive
- Microsoft compatible pointing device (e.g., mouse, trackball, etc.)

[1] A business/professional version of Windows is recommended, the NanoScan v2 system has not been tested with home versions of Windows. Both 64-bit and 32-bit versions of Windows 7 and Windows 10 are supported.

[2] The computer memory (RAM) affects the performance of the software in the Data Recorder. Refer to the NanoScan v2 Operation Manual for more information on the Data Recorder.

IMPORTANT WARNING!

Do *not* expose a NanoScan to a laser beam if the drum is not spinning!

Scan head damage thresholds are reduced below specifications when the drum is not spinning, increasing the possibility of damage to the scan head.

ESPECIALLY IMPORTANT

When measuring High Power CW or High Energy Pulsed lasers, do *not* expose a NanoScan to a laser beam if the drum is not spinning!

The NanoScan drum will not spin unless the power is ON and the software is launched. The laser beams incident on the aperture may cause damage to the slits/pinholes and detector when the drum is NOT spinning. The slits/pinhole substrates are thin membranes which can be damaged if stopped in the beam, and if this occurs, the detector may also be damaged. Use of a beam dump is recommended until the drum is spinning!

When running long-term tests with NanoScan, Configure the PC Power Management to NEVER go off, and to NOT ALLOW Automatic Updates. These cause the computer to reboot, closing the NanoScan program and stopping the NanoScan drum, potentially subjecting it to the same type of damage.

3.2. NanoScan v2 Installation

To properly install and configure the software you will need Administrative Rights. (Please contact your system administrator for details regarding the Administrative Rights.) Refer to the NanoScan v2 Installation and Operation Manual supplied separately. It is recommended that you install this software first.

3.3. *NanoModeScan* Software Installation

To properly install and configure the software you will need Administrative Rights. (Please contact your system administrator for details regarding the Administrative Rights.)

After your computer has started, insert the NanoModeScan Acquisition and Analysis Software CD in the CD-drive. The setup program should run automatically. Select **Software Install**. Follow the directions of the installation program.

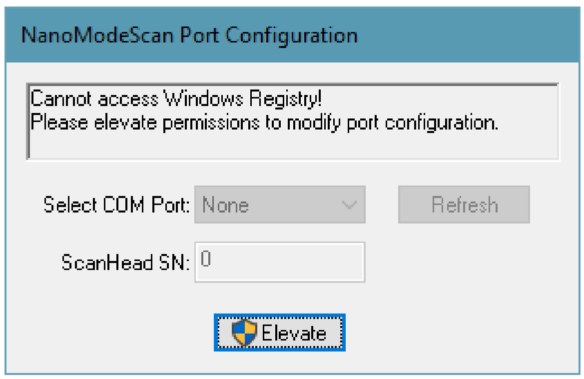
3.3.1. COM Port Configuration for Motion Controller

At the end of the software installation, the NanoModeScan Port Configuration utility will be displayed. This utility configures the serial COM port to which the Photon Motion Controller is connected.

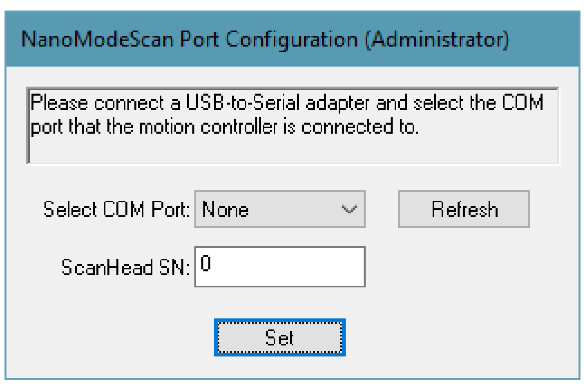
NOTE: This utility requires the current user to have administrative privileges to configure the COM port settings.

The software settings must coincide with the correct PC hardware settings or the NanoModeScan system cannot communicate with the motion controller.

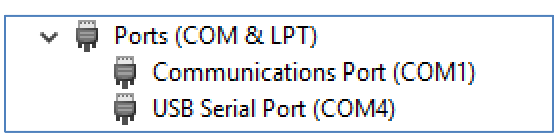
If the current user does not have sufficient user privileges the utility will ask the user to authorize elevation of the utility. Consult your system administrator for assistance.



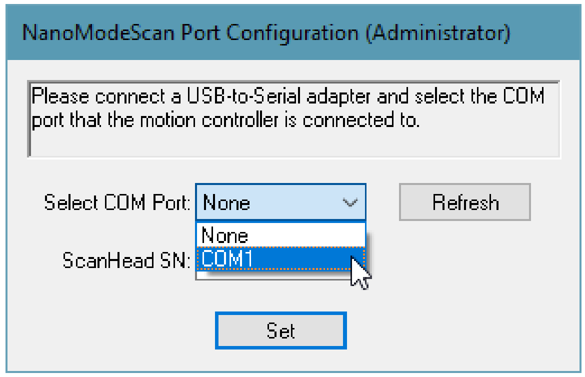
Once elevated, use the COM Port dropdown to select the appropriate COM port from the available options and enter the scan head serial number.



If the correct serial COM port is unknown, check the Windows Device Manager for the COM port assigned to the serial interface in the **Ports (COM & LPT)** category. If using the supplied USB-to-Serial adapter cable, it will be displayed like the image below.

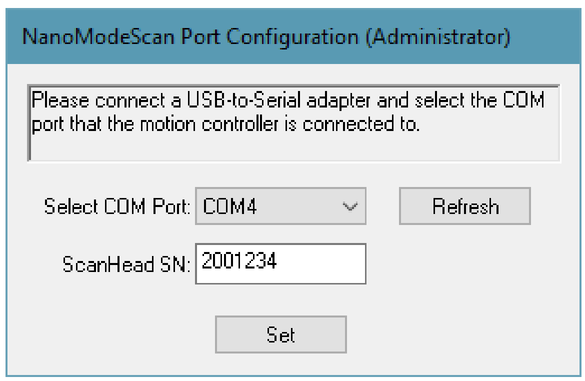


If the USB-to-serial adapter was not connected when the utility was launched, and the correct port is not displayed, click the **Refresh** button to enumerate the available COM ports and check the dropdown menu again.



Enter the scan head serial number. Press the Set button to confirm the settings and exit the utility.

The NanoScan serial number can be identified on the bottom Status Bar in the NanoScan v2 software or on the product label on the rear I/O panel of the scan head.



If the COM port settings need to be changed later, run the NanoModeScan Port Configuration utility via the **ModeScan Configuration** Start Menu shortcut.

Warning

If other software that uses COM ports is installed on the system, extra care must be taken to ensure that those do not communicate over the assigned NanoModeScan COM port. Doing so may damage or corrupt the NanoModeScan motion controller embedded program.

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4 NanoModeScan Alignment

4.1. Introduction

Alignment of the NanoModeScan to the laser source under test is important for two main reasons. First, proper alignment is necessary to obtain the utmost accuracy in measured beam widths and hence in the computed laser beam propagation parameters. Second, it is important in the installation and configuration of tooling fixtures in manufacturing environments to enable rapid testing of laser sources.

For the M^2 measurement, the Model 1740 NanoModeScan lens and scan head can be considered as components in the optical system under test. This system includes the laser source under test and any associated optics, the NanoModeScan lens and scan head, and the surface it is mounted on. The laboratory environment can also be a factor: for example, the ambient temperature, external ambient light, mechanical and acoustic vibration, and electromagnetic sources could also cause adverse effects. These factors and others are discussed in the ISO/DIS 11146-1, -3 standards.

Prior to performing alignment verify that the position of the laser beam waist imaged by the test lens falls centrally within the measurement range of the NanoModeScan. Failure to do this initially will require that the system be repositioned.

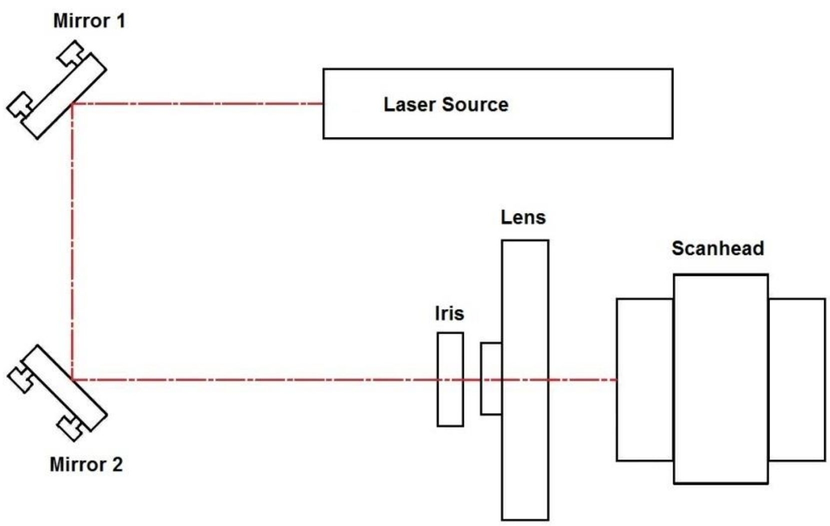
When aligning the NanoModeScan it is important to remember that it is part of a system and that changing one component in the system can affect the whole. For example, the laser source and the NanoModeScan could be positioned such that the NanoModeScan lens back reflection feeds back to the laser cavity and corrupts the beam quality. In general, care must be taken to avoid systematic errors due to reflections, interference effects, and external ambient light. Similarly, if dust or fingerprints contaminate the lens, the beam quality will be affected, and the true source characteristics will not be measured. If the NanoModeScan is not rigidly mounted to a surface, mechanical and acoustical vibration can produce errors in the measurement. Adherence to the ISO standard and to common optical and laser practices and procedures at all times will ensure the highest achievable measurement accuracy.

4.2. Optical/Mechanical Alignment

Accurate measurements of the laser beam propagation parameters require precision alignment of your laser source to the optical axis of the NanoModeScan. The Model 1740 NanoModeScan should be mounted to an optical table or other suitable rigid surface. The optical axis of the NanoModeScan is horizontal and cannot be adjusted once mounted.

The motion of the linear stage and the entrance aperture iris defines the NanoModeScan optical axis. Specifically, it is the line parallel to the direction of linear motion that passes through the center of the iris. The NanoModeScan test lens is mechanically centered on this axis to a nominal tolerance of 0.010 inch (0.25mm). The NanoScan scan head is centered on the optical axis to a nominal tolerance of 0.020 inch (0.51mm).

a)



b)

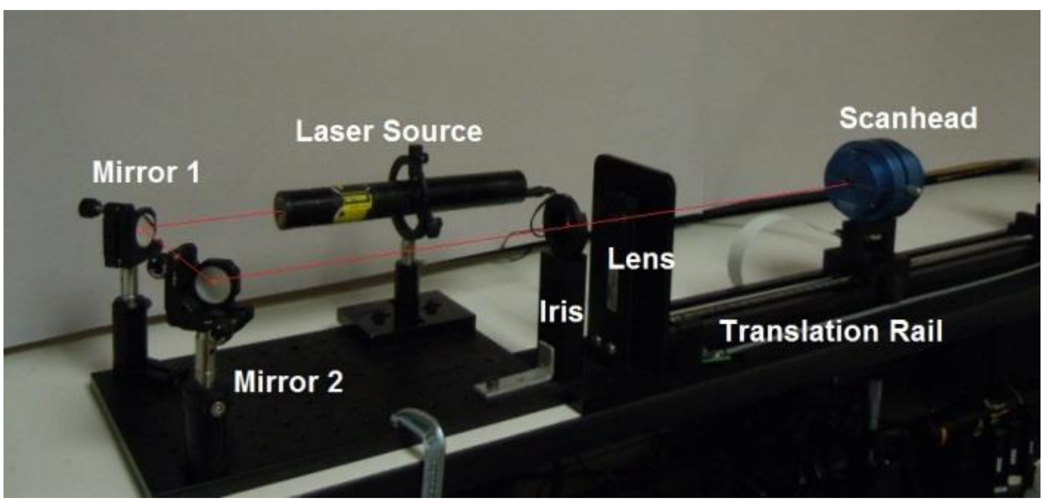


Figure 4.1. a) and b) Alignment features of the NanoModeScan

Aligning the NanoModeScan is very straightforward. With minimum effort, the NanoModeScan optical axis can be aligned to the beam axis to within 50 microradians or better.

Two steering mirrors should be used to control the alignment of the laser, as shown in Figure 4.1. The two mirrors can be adjusted to control the vertical position, the horizontal position, and the angular tilt of the laser beam. Position the laser so the beam can be reflected off both mirrors and align with the optical axis.

If the laser power/energy exceeds the scan head's operating range, apply external attenuation. In some cases, this can be done by replacing one or both steering mirrors with front surface reflecting wedges. Suitable ND filters can also be employed. With absorbing ND filters, use care to not distort the beam with thermal lensing effects.

4.3. Alignment Procedures

The following procedures are recommended for "coarse" and "fine" alignment of the NanoModeScan for laser testing. These procedures assume the NanoModeScan has already been approximately aligned to the laser such that the nominal beam propagation axis and the NanoModeScan optical axis are coaxial along the vertical and horizontal axes.

This preliminary alignment is easily achieved using standard laser beam visualization techniques and mechanical system positioning procedures. For **High-Power** lasers, the preliminary alignment should be performed without exposing the NanoModeScan to the laser beam to avoid possibly dangerous reflections and damage to the NanoModeScan components.

***Caution!* Always practice laser safety and use proper protective gear whenever you or anyone is near the path of a laser beam.**

4.3.1. Coarse Alignment

1. Launch the NanoModeScan program.
2. Using the Alignment Mode in the software (see Chapter 5), move the scan head near the far end of the rail.
3. Close the iris, located at the front of the NanoModeScan, down to the size of a pinhole. For HIGH POWER beams it may be necessary to attenuate the beam. Refer to the operating space chart of your scan head to determine the appropriate power range.
4. Adjust the steering mirrors to position the beam so it is incident on the mechanical center of the iris. While also observing the beam position in the scan head aperture. (For approximately Gaussian beams with M² value near unity, adjust the position until maximum brightness of the beam

passing through the pinhole is obtained. For higher order non-Gaussian beams, iterate between opening the iris and positioning the steering mirrors until the beam passes unobstructed through the iris aperture and the NanoScan aperture.)

5. Alternately adjust Mirror 1 and 2 to place the beam spot at the nominal center of the scan head aperture while also keeping it centered in the reduced iris opening.

4.3.2. Fine Alignment

1. Open the iris.
2. Using the Alignment Mode, position the scan head at the home or “0” position.
3. Click the **Zero** button on the Beam Pointing display to set the Home position centroid as the center or “zero” reference.
4. Move the scan head to 100mm.
5. Adjust Mirror 2 to return the red crosshair to the center of the targeting window.
6. Return the scan head to the home position and note the movement of the crosshair. Click the **Zero** button to re-center the display.
7. Continue moving the scan head forward and backward, fine tuning the alignment with Mirrors 1 & 2. As you get the NanoModeScan better aligned, you can send the scan head farther toward the rear of the stage. In many situations alignment to within 500µm over the NanoModeScan’s 500mm range is satisfactory (equivalent to 1mrad), but it is possible to align the NanoModeScan to within 25µrad of the propagation axis of the laser beam under test.

4.3.3. Angular Alignment of the Scan head

Measurement of Elliptical beams requires angular alignment of the scan head aperture axes to the major and minor axes of the laser beam. This is done by rotating the scan head in the rotation mount while observing the beam diameters until one diameter is maximized and the other is minimized. The Alignment screen includes a Beam Information display that aids in alignment of the scan head to elliptical beams (See section 5.2.6).

5 NanoModeScan Acquisition and Analysis Software

5.1. Getting Started

1. Turn on the PC.
2. Wait for the system to boot up.
3. Start the **NanoModeScan Acquisition and Analysis Software** by double-clicking on the program icon  on your monitor screen, or from the Windows Start Menu select **Programs**, then **Photon**, and then **NanoModeScan**. The software will not open unless the rail is in the home position.

NOTE: The NanoScan software must be run once prior to the first launch of the NanoModeScan software!

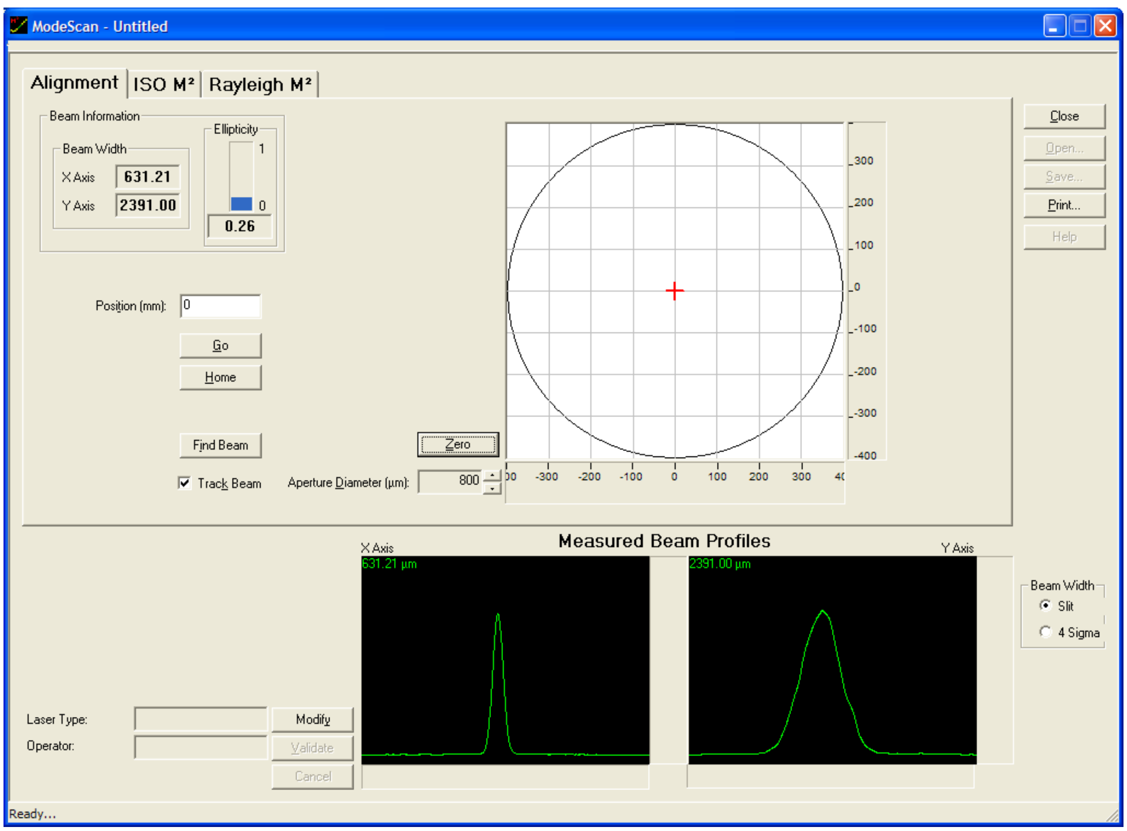
4. The program has 3 operating modes: one for Alignment and two for Measurement, each with a specific function and interface screen. A “Tab” control is used to toggle between the modes.
5. When the program first starts, it will be in the Measurement mode, and the **ISO M²** interface screen will appear.

5.2. Alignment Mode

Accurate measurements of M^2 require precision alignment of your laser source to the optical axis of the NanoModeScan. The Alignment Mode provides all the functionality necessary to perform this critical alignment in a straightforward and simple manner. The alignment procedure is discussed in Chapter 4. The features of the software are discussed below.

Selecting the **Alignment** tab puts the system in Alignment Mode and displays the Alignment screen, shown below. The screen includes:

- Notes
- Controls for moving the NanoScan scan head to specified positions along the NanoModeScan Linear Stage
- Beam Pointing display for observing the position of the laser beam in the aperture of the NanoScan scan head
- Beam Profile display that shows the profile data and the $1/e^2$ or ISO Standard 11146 $d_{4\sigma}$ beam width
- Controls for finding and tracking the beam
- Beam Information display to aid in the angular alignment of the NanoScan scan head to the major and minor axes of elliptical beams



5.2.1. Notes

Laser Type

Use the **Laser Type** filed to enter relevant data about the tested laser.

Operator

Use this edit text box for entering operator information.

5.2.2. Data Entry Controls

Modify

Use the **Modify** button to open the fields for editing.

Validate

Use the **Validate** button to update the modified parameter/notes fields. Validating the new entries clears all computed data from the measurement screens.

Cancel

The **Cancel** button cancels the **Modify** operation and restores all parameter values and notes to the previous entries.

5.2.3. Alignment Controls

Position

Enter the position in millimeters where the scan head will be moved to perform a measurement. The scan head can move to any position within the range from 0 to 500 mm.

Go

Use the **Go** button to initiate motion control and send the scan head to the position entered in the Position Field.

Home

Use the **Home** button to return the scan head to the home position. This is the closest position to the lens.

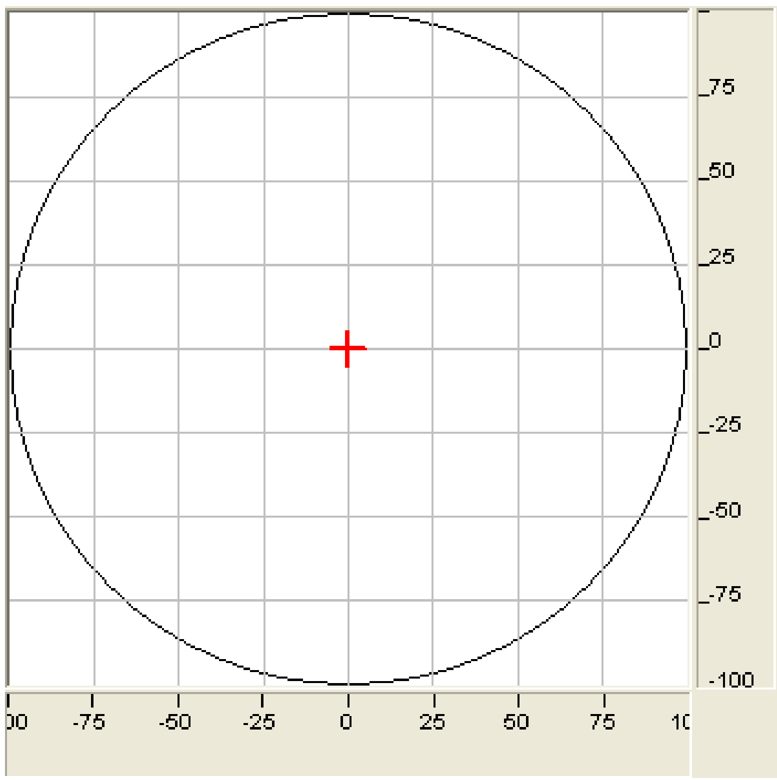
Find Beam

When the **Find Beam** feature is initiated, the software looks for the beam within the scan head aperture. When the NanoModeScan program is opened, Find Beam must be initiated to acquire the beam and display its profile.

Track Beam

Enables filter and gain tracking for both apertures. This feature is useful during beam alignment to keep the gain and filter at an optimum level for any position of the scan head along the rail. Gain and filter tracking are automatically disabled when the software is toggled to one of the Measurement modes.

5.2.4. Beam Pointing Display



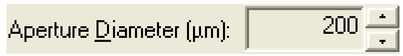
The Beam Pointing display shows the position of the centroid of the beam within the aperture of the scan head, indicated by the red crosshair. This position can be observed in real-time as you align the NanoModeScan to the laser beam. When the NanoModeScan is perfectly aligned to the laser beam, the crosshair will remain stationary (within the jitter limits of the NanoScan scan head) as the scan head traverses forward and back. The center of the display is relative and is set by using the **Zero** button.

Zero

Use the **Zero** button to reset the zero-reference position of the Beam Pointing display to the current beam position.

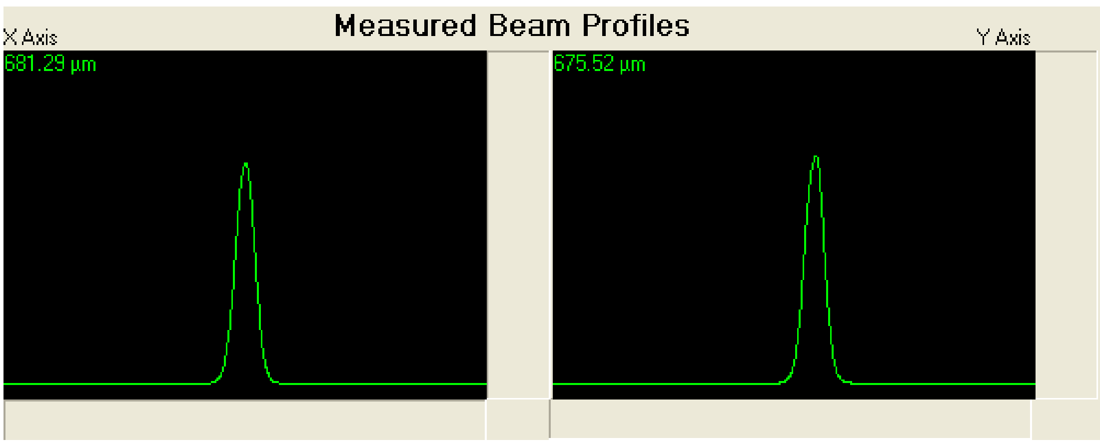
Aperture Diameter

The **Aperture Diameter** control is used to scale the diameter of the Beam Pointing display in 2× increments from 200 µm to 6400 µm.



Note: **Make sure that the "Rotation" checkbox is unchecked in the Analysis toolbox in the NanoScan software. This will ensure the accuracy of the pointing display.**

5.2.5. Measured Beam Profiles Display

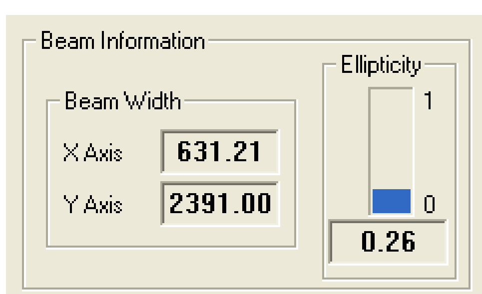


The Measured Beam Profiles windows display the shape and width of the beam at the scan head position. If **Track Beam** is selected, the profile will be scaled automatically to keep the beam maximized, even if it changes in intensity.

When satisfactory alignment is obtained, the system is ready to perform measurements. Select the one of the Measurement tabs to put the system in either ISO M² or Rayleigh M² Measurement Mode and to display the appropriate screen. The scan head will return to the home position if not already there.

Note: With the release of NanoModeScan v2.60 the Profiles display will scale for both legacy NanoScan I scan heads and NanoScan II scan heads. A sudden jump in scaling may be observed at low intensities using a NanoScan II scan head where the sensor depth of the two devices differs.

5.2.6. Ellipticity Beam Information



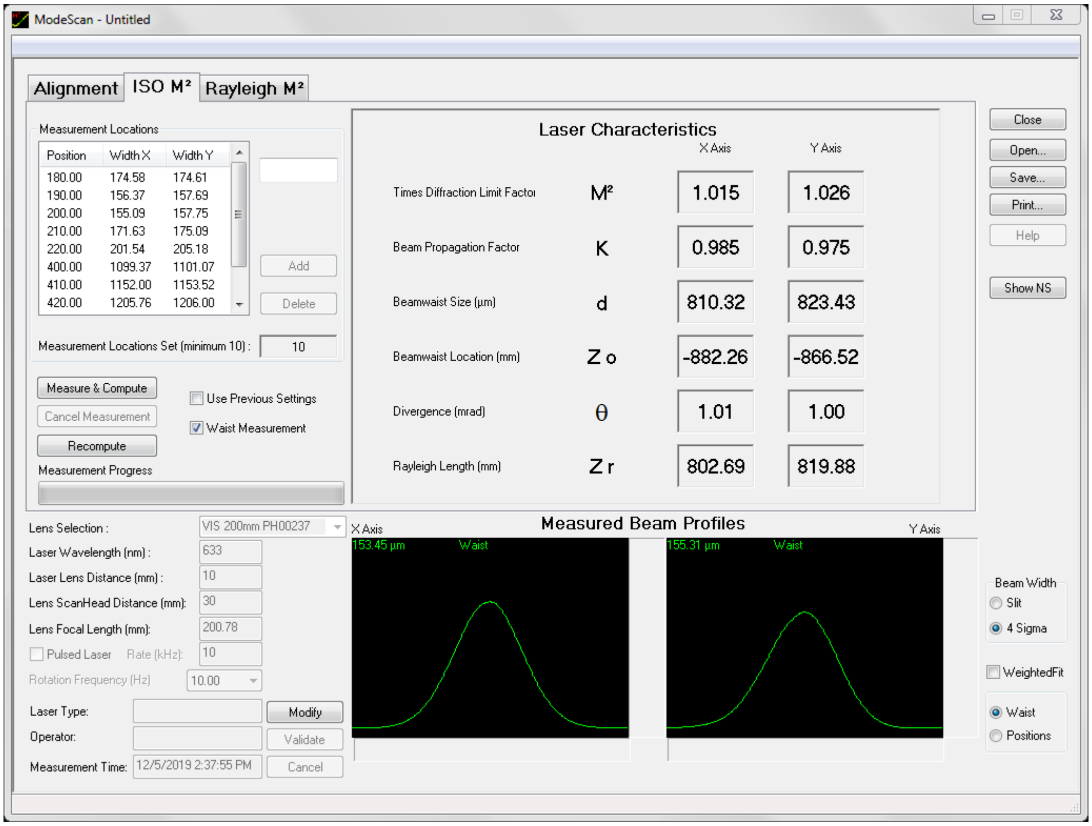
Ellipticity Beam Information is displayed to aid in the angular alignment of the NanoScan scan head to the major and minor axes of elliptical beams. The display includes an **Ellipticity** progress bar with range from 0 to 1 for visual feedback while rotating the scan head during angular alignment. Proper angular alignment is achieved when the progress bar is minimized. Also shown in the display are the current measured values of the beam diameter for the “X” axis (Aperture 1) and the “Y” axis (Aperture 2), together with the computed Ellipticity parameter, i.e., the ratio of minor axis to major axis beam diameters.

5.3. ISO M² Measurement Mode

The Measurement screen on the next page includes:

- Measurement Locations Table for entering the positions to perform the ISO/DIS 11146 M² measurement
- Measurement controls and progress group
- Data Entry Fields for Laser Parameters used in the M² analysis, Data Acquisition Parameters, Notes, and a Date &Time Stamp Field
- Beam Profile/Width vs. Position Display
- Selections for Beam Diameter computation, either D_{slit} or D_{4sigma}, a selection for Weighted or Unweighted Fit, and selection for either Profiles at the beam waist or beam caustic diameters for display in the Measured Beam Profiles windows.
- Laser Characteristics Display.

Before conducting a measurement, it is first necessary to input the data acquisition parameters, the measurement locations (for ISO method), and the laser parameters and M² analysis parameters.



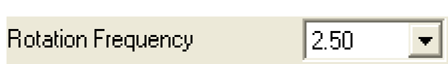
5.3.1. Data Acquisition Parameters

Pulsed Laser

For continuous lasers, leave the **Pulsed Laser** checkbox unchecked. For pulsed lasers, check the **Pulsed Laser** checkbox.

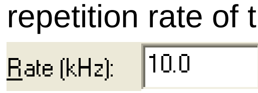
Rotation Frequency

The default rotation frequency is 10Hz. Lower head rotation frequencies should be used in pulsed beam analysis. For pulsed lasers operation and proper head rotation frequency selection, please refer to the NanoScan v2 Operation Manual.



Pulsed Laser Rate

For pulsed lasers use the **Rate** field to enter the repetition rate of the laser in kHz.

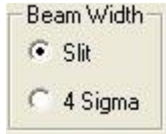


Beam Width

Selects the beam-width computation method:

Slit - 13.5% of peak clip level

4 Sigma - ISO Standard 11146 $d_{4\sigma}$ beam width

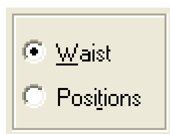


Weighted Fit

Selects the Weighted Fit option, in which case the data is weighted by the inverse square of the beam diameter.

Waist/Positions

Selects either the Measured Beam Profiles window, which displays the measured profiles at the waist in the test space, or the Measured Width vs. Position window, which displays the beam caustic measured at the positions specified in the ISO M^2 Measurement Locations Table. See section 5.3.7



5.3.2. M² Analysis Parameters

These fields allow you to enter important test parameters used in M² analysis. They are available only in Measurement Modes. The parameters that must be specified are the Laser Wavelength, and system geometry parameters including the Laser Lens Distance, Lens Scanhead Distance, and the Lens Focal Length. Figure 5.1 shows the system geometry and defines the geometrical parameters and their relations. Distances relative to the lens are measured from the principal plane of the lens.

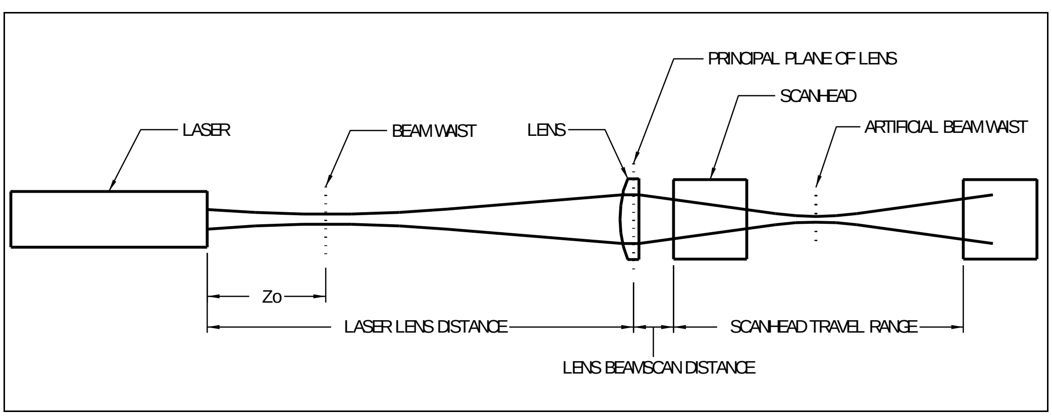
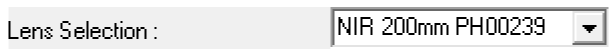


Figure 5.1 NanoModeScan system geometry

Note: **Be sure your source beam waist is positioned with respect to the test lens, so it forms an artificial beam waist in the scan head travel range. Refer to Section 4.1.**

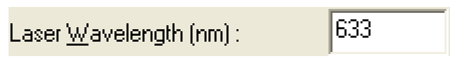
Lens Selection

Use this field to select the lens in use. If a catalog lens is selected, the **Lens Focal Length** field will be locked, and update automatically based on the entered **Laser Wavelength** and the manufacturer's lens data. If the lens in use is not a catalog lens, select **User Defined**.



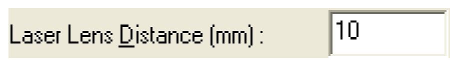
Laser Wavelength

Use this field to enter the wavelength of the beam in nanometers.



Laser Lens Distance

Use this field to enter the distance from the NanoModeScan lens to the reference plane of the laser in millimeters.

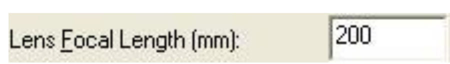


Lens Scanhead Distance

Use this field to enter the distance in millimeters from the lens to the reference surface of the scan head in its home position.

Lens Focal Length

Use this field to enter the focal length of the lens, in millimeters. If a catalog lens is selected from the **Lens Selection** dropdown, this field is locked and updated automatically based on the entered wavelength.



5.3.3. Notes

Laser Type

Use the **Laser Type** field to enter relevant data about the laser under test.

Operator

Use this edit text box for entering operator information.

Measurement Date/Time

This field updates automatically with the date and time of the last measurement or when **Recompute** is performed.

5.3.4. Data Entry Controls

Modify

Use the **Modify** button to open the fields for editing.

Validate

Use the **Validate** button to update the modified parameter/notes fields. Validating the new entries clears all computed data from the measurement screens.

Cancel

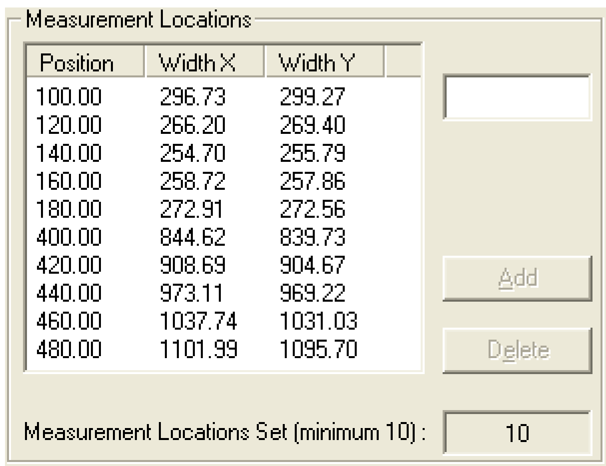
The **Cancel** button cancels the **Modify** operation and restores all parameter values and notes to the previous entries.

5.3.5. Measurement Locations Table

Use the Measurement Locations table to enter the positions at which beam width measurements will be performed. The ISO standard M² measurement procedure requires a minimum of 10 test measurement positions with five test points located within one Rayleigh range of the artificial waist created by the lens and five test points located beyond two Rayleigh ranges from the waist. As such, **at least** 10 positions must be entered in the table. Refer to Chapter 4 on guidelines for selecting the measurement positions.

Type the position values into the text entry field at the right of the table and click the **Add** button to add them to the table. If you need to delete a position value from the table, select it and click the **Delete** button, or use the delete key on the keyboard. The **Measurement Locations Set** text box displays the number of positions you have entered.

The measurement locations are saved when a file is saved.



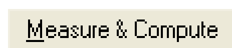
Position	Width X	Width Y
100.00	296.73	299.27
120.00	266.20	269.40
140.00	254.70	255.79
160.00	258.72	257.86
180.00	272.91	272.56
400.00	844.62	839.73
420.00	908.69	904.67
440.00	973.11	969.22
460.00	1037.74	1031.03
480.00	1101.99	1095.70

The Measurement progress bar indicates the status of the acquisition sequence in progress. If you want to cancel the current acquisition, use the **Cancel Measurement** button.

5.3.6. Measurement Controls

Measure & Compute

After the test parameters and Measurement Locations have been entered the system is ready to perform a measurement. Click **Measure & Compute** to measure your beam. The NanoModeScan will move to the points in the Measurement Locations table and measure the beam. As the beam is measured, the beam profiles will be displayed in the Measured Beam Profiles windows. After all the points have been measured, the NanoModeScan will return to its home position, then move again to measure the artificial waist, in X and Y axes, created by the lens at the positions determined from M^2 analysis.



Cancel Measurement

Use the **Cancel Measurement** button to abort a measurement before it is completed. The scan head will return to the home position and no measurements will be reported.

Recompute

Use the **Recompute** button to recalculate the laser propagation parameters after modifying the M^2 Analysis parameters. It is possible to change one or more of the test parameters after a measurement is completed. **Modify** the parameters as desired then **Recompute** to recalculate laser propagation parameters.

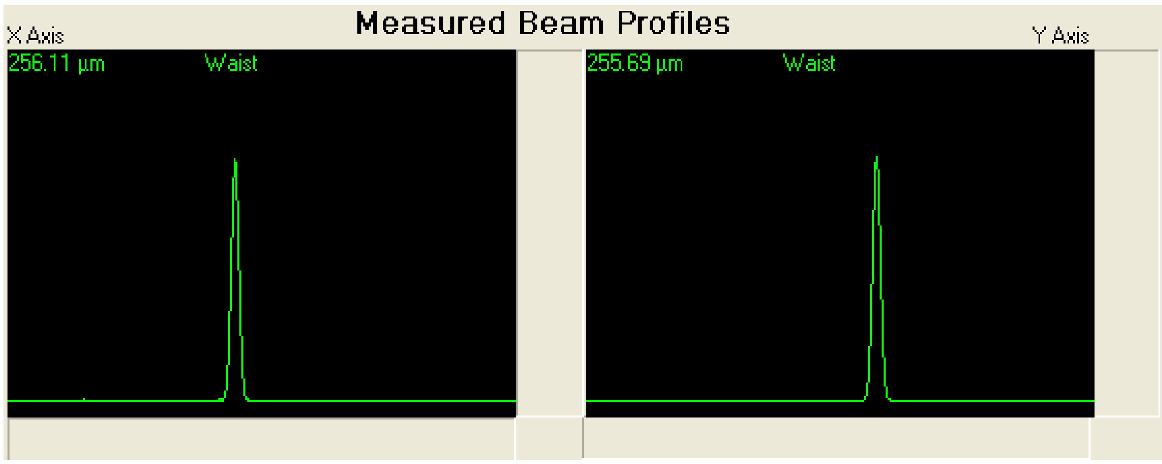
Use Previous Settings

When selected, the system will perform M^2 measurements using the gain and filter settings determined previously using the **Auto Find** feature. This speeds up the measurement by eliminating the **Auto Find** procedure.

Waist Measurement

When selected, the measurement of the beam diameter at the calculated position of the artificial beam waist generated by the test lens will be measured after the M^2 measurement is complete.

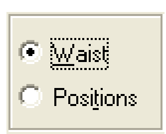
5.3.7. Measured Beam Profiles/Measured Width vs. Position Display



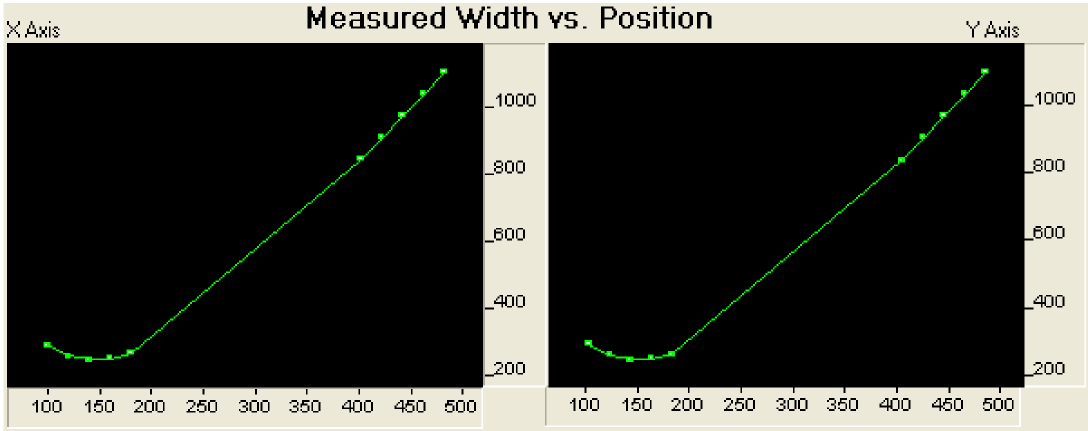
As the NanoModeScan is performing measurements, the beam profiles and the $1/e^2$ d_{slit} or $d_{4\sigma}$ beam widths are displayed in the **Measured Beam Profiles**/**Measured Width vs. Position** windows.

Note: With the release of NanoModeScan v2.60 the Profiles display will scale for both legacy NanoScan I scan heads and NanoScan II scan heads. A sudden jump in scaling may be observed at low intensities using a NanoScan II scan head where the sensor depth of the two devices differs.

After the test is completed, the windows can display either the profiles of the beam at the computed artificial waist position created by the lens, or the beam caustic measured at each position selected in the Measurement Locations Table, as set using the **Waist** and **Positions** radio button control.



By default, the **Waist** mode is selected, displaying the artificial waist beam profiles. If **Positions** is selected, the window title changes to **Measured Width vs. Position** and displays the measured beam diameter for each position selected in the Measurement Location Table. This display can be useful for determining proper measurement locations in accordance with ISO/DIS 11146, or for pinpointing locations where optical aberrations may be influencing your measurements.



5.3.8. Laser Characteristics

After the measurements are completed, the computed ISO/DIS 11146 beam propagation values are displayed in the **Laser Characteristics** table. The laser beam propagation parameters will be reported in red if M^2 is smaller than 0.96. Theoretically, the lowest possible value of M^2 is 1. The value 0.96 is the lowest allowable value of M^2 considering the 2% accuracy of the NanoScan beam width measurements.

Laser Characteristics

		X Axis	Y Axis
Times Diffraction Limit Factor	M^2	1.013	1.014
Beam Propagation Factor	K	0.987	0.986
Beamwaist Size (µm)	d	227.06	227.89
Beamwaist Location (mm)	Z_o	-425.43	-424.78
Divergence (mrad)	θ	3.59	3.59
Rayleigh Length (mm)	Z_r	63.17	63.57

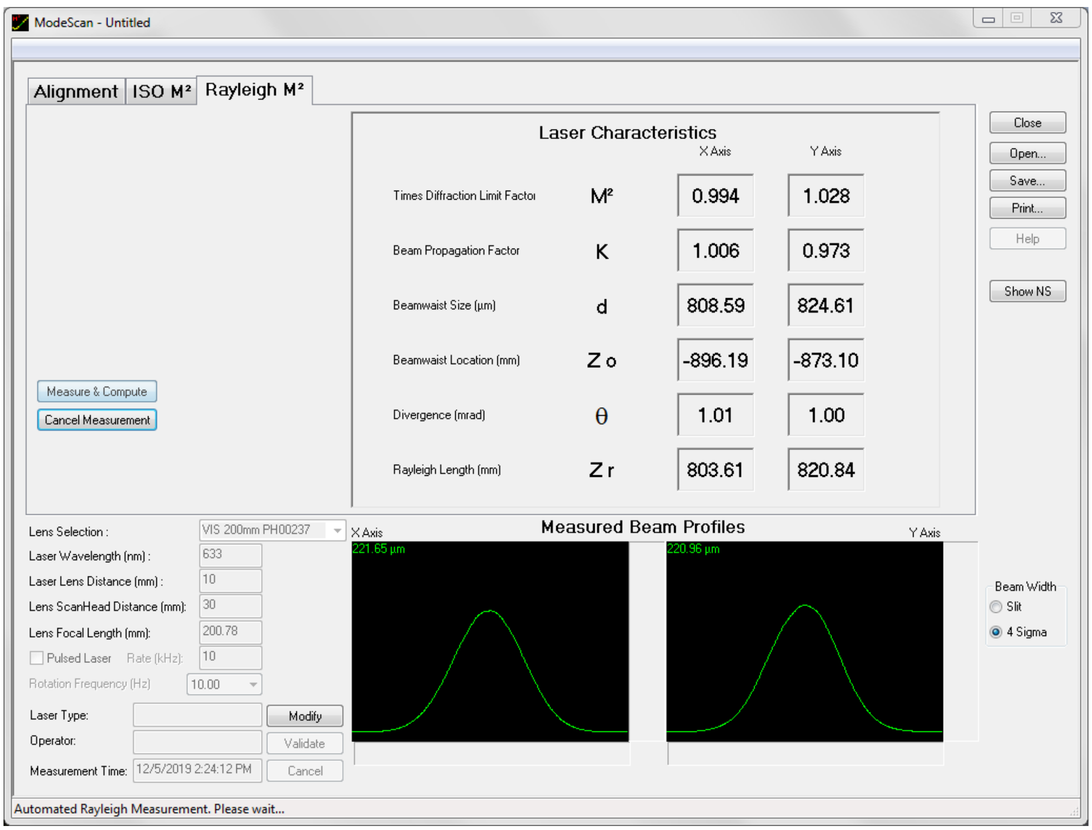
The measured beam sizes used in the computation will be displayed in the Measurement Locations table.

5.4. Rayleigh M² Measurement Mode

The Measurement screen is shown below, and it includes:

- The Measurement controls
- Data Entry Fields for Laser Parameters used in the M² analysis, Data Acquisition Parameters, Notes, and a Date &Time Stamp Field
- The Beam Profile
- The Laser Characteristics Display

Before conducting a measurement, it is first necessary to input the data acquisition parameters, the laser parameters and M² analysis parameters.



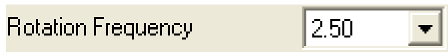
5.4.1. Data Acquisition Parameters

Pulsed Laser

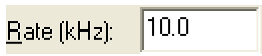
For continuous lasers, leave the **Pulsed Laser** checkbox unchecked. For pulsed lasers, check the **Pulsed Laser** checkbox.

Rotation Frequency

The default rotation frequency is 10Hz. Lower head rotation frequencies should be used in pulsed beam analysis. For pulsed lasers operation and proper head rotation frequency selection, please refer to the NanoScan v2 Operation Manual.



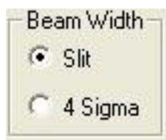
Pulsed Laser Rate For pulsed lasers use the **Rate** field to enter the repetition rate of the laser in kHz.



Beam Width Selects the beam-width computation method:

Slit - 13.5% ($1/e^2$) clip level d_{slit} - width

4 Sigma - ISO Standard 11146 $d_{4\sigma}$ beam width



5.4.2. M² Analysis Parameters

These fields allow you to enter important test parameters used in M² analysis. They are available only in Measurement Modes. The parameters that must be specified are the Laser Wavelength, and system geometry parameters including the Laser Lens Distance, Lens Scanhead Distance, and the Lens Focal Length. Figure 5.2 shows the system geometry and defines the geometrical parameters and their relations. Distances relative to the lens are measured from the principal plane of the lens.

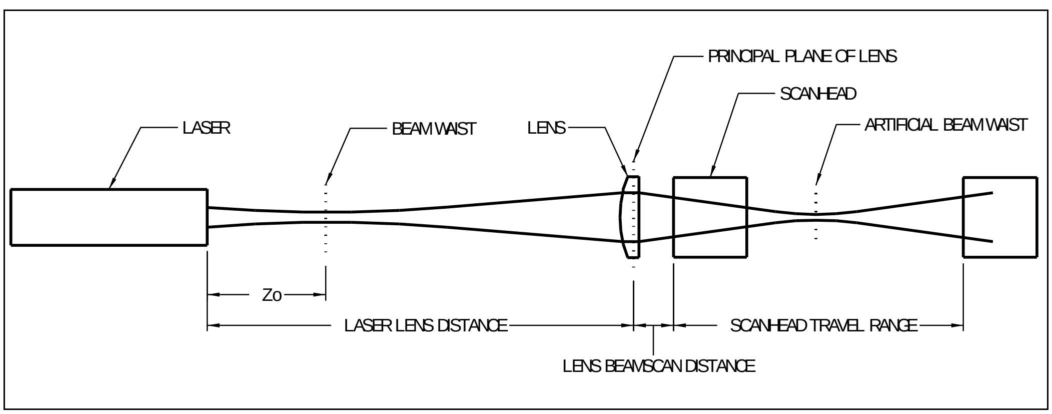
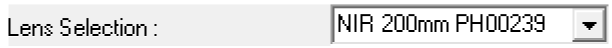


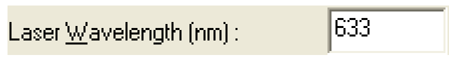
Figure 5.2 NanoModeScan system geometry

Note: **Be sure your source beam waist is positioned with respect to the test lens, so it forms an artificial beam waist in the scan head travel range. Refer to Section 4.1.**

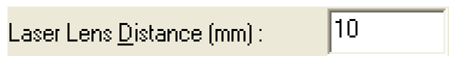
Lens Selection Use this field to select the lens in use. If a catalog lens is selected, the **Lens Focal Length** field will be locked, and update automatically based on the entered **Laser Wavelength** and the manufacturer's lens data. If the lens in use is not a catalog lens, select **User Defined**.



Laser Wavelength Use this field to enter the wavelength of the beam in nanometers.

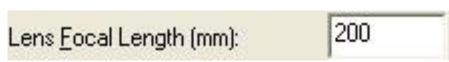


Laser Lens Distance Use this field to enter the distance from the NanoModeScan lens to the reference plane of the laser in millimeters.



Lens Scanhead Distance Use this field to enter the distance in millimeters from the lens to the reference surface of the scan head in its home position.

Lens Focal Length Use this field to enter the focal length of the lens, in millimeters. If a catalog lens is selected from the **Lens Selection** dropdown, this field is locked and updated automatically based on the entered wavelength.

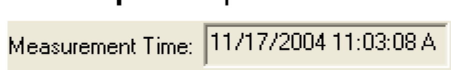


5.4.3. Notes

Laser Type Use the **Laser Type** field to enter relevant data about the laser under test.

Operator Use this edit text box for entering operator information.

Measurement Date/Time This field is automatically updated with the date and time of the last measurement or when **Recompute** is performed.



5.4.4. Data Entry Controls

Modify

Use the **Modify** button to open the fields for editing.

Validate

Use the **Validate** button to update the modified parameter/notes fields. Validating the new entries clears all computed data from the measurement screens.

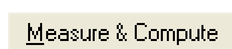
Cancel

The **Cancel** button cancels the **Modify** operation and restores all parameter values and notes to the previous entries.

5.4.5. Measurement Controls

Measure & Compute

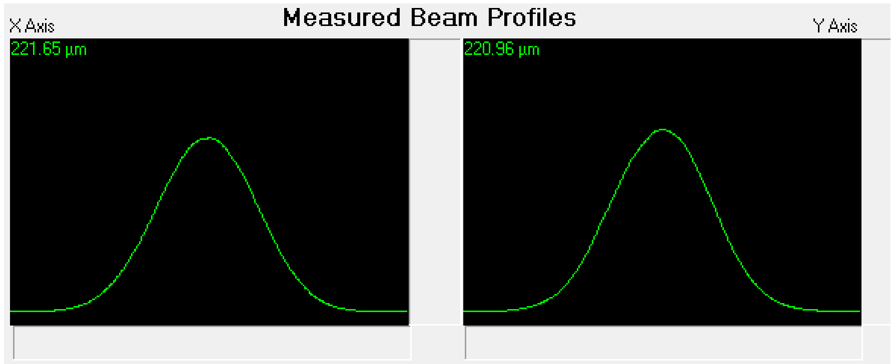
Click **Measure & Compute** to start the automated Rayleigh method. The NanoModeScan will scan for the waist and Rayleigh points. As the beam is measured, the beam profiles will be displayed in the Measured Beam Profiles windows. After all the points have been measured, the NanoModeScan will return to its home position and display the laser characteristics.



Cancel Measurement

Use the **Cancel Measurement** button to abort a measurement before it is completed. The scan head will return to the home position and no measurements will be reported.

5.4.6. Measured Beam Profiles



As the NanoModeScan is performing Rayleigh Mode measurements, the beam profiles and the $1/e^2$ d_{slit} or $d_{4\sigma}$ beam widths are displayed in the **Measured Beam Profiles** window.

Note: With the release of NanoModeScan v2.60 the Profiles display will scale for both legacy NanoScan I scan heads and NanoScan II scan heads. A sudden jump in scaling may be observed at low intensities using a NanoScan II scan head where the sensor depth of the two devices differs.

5.4.7. Laser Characteristics

After the measurements are completed, the computed beam propagation values are displayed in the **Laser Characteristics** table. The laser beam propagation parameters will be reported in red if M^2 is smaller than 0.96. Theoretically, the lowest possible value of M^2 is 1. The value 0.96 is the lowest allowable value of M^2 considering the 2% accuracy of the NanoScan beam width measurements.

Laser Characteristics

		X Axis	Y Axis
Times Diffraction Limit Factoı	M^2	1.013	1.014
Beam Propagation Factor	K	0.987	0.986
Beamwaist Size (µm)	d	227.06	227.89
Beamwaist Location (mm)	Z o	-425.43	-424.78
Divergence (mrad)	θ	3.59	3.59
Rayleigh Length (mm)	Z r	63.17	63.57

5.5. Program Management

Opening Files

Files can be opened using the **Open…** button. The **Open** dialog box will appear for selecting files.

This is available only in Measurement Modes (ISO M² or Rayleigh M²).

Saving Files

Files can be saved using the **Save…** button. The **Save As** dialog box will appear for saving files. Files can be saved as:

M2K File (.m2k)* NanoModeScan Acquisition and Analysis Software Data File. This file type can only be used by the NanoModeScan Software. The system settings, parameters, measurement locations and widths are saved.

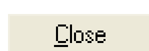
ASCII File (.asc)* The test parameters, calculated parameters and all measured positions (user entered locations and computed waist positions) and corresponding widths are saved in an ASCII format file.

This is available only in Measurement Modes (ISO M² or Rayleigh M²).

Printing

The program screen can be printed using the **Print…** button. The **Print** dialog box will appear for selecting and configuring printers, and for printing.

Close



To exit the program, use the **Close** button or the  icon in the upper right corner of the screen.

NanoScan GUI

The NanoScan program GUI can be displayed using the Show NS button. **Caution!** This is intended for ***observation*** of the NanoScan GUI only. Changing settings in the NanoScan GUI can cause the software to crash!

5.6. Motion Controller Messages

5.6.1. No communication with Motion Controller. Check the configuration. Program aborted.

If this message appears when the NanoModeScan software is starting it means that the software cannot open the motion controller port. Try running the configuration program again and select the COM port. If the message appears during a measurement in the NanoModeScan software, it means that the program sent a command to the Motion Controller and did not receive a response within the defined time-out period. After the program exits, turn off the motion controller, move the head to the “home” position and turn the motion controller back on. Start the NanoModeScan software.

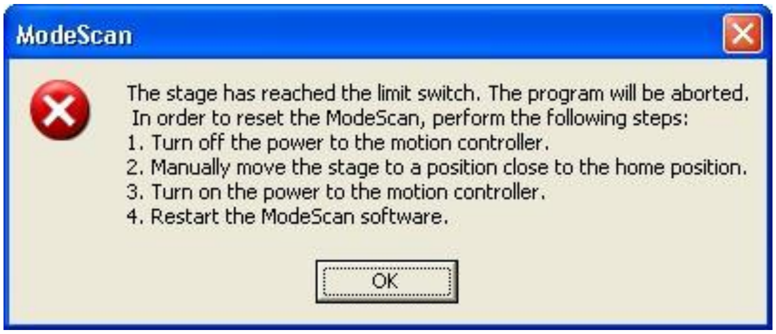
5.6.2. Check the port configuration for the motion controller. Program aborted.

NanoModeScan software uses COM ports for communication with the motion controller. After the program exits, turn off the motion controller, run the configuration program to select the correct serial port. See section 3.3.1 COM Port Configuration for Motion Controller.

5.6.3. Motion controller failed!

Motion controller tried to send the head to the “home” position and failed. Redo the measurement.

5.6.4. **The stage has reached the limit switch.**



The motion stage has reached one of the two limit switches. Follow the procedure described in the message. Verify that the measurement positions are not beyond the limits of the motion stage.

5.7. ActiveX Status Messages

5.7.1. OLE initialization failed!

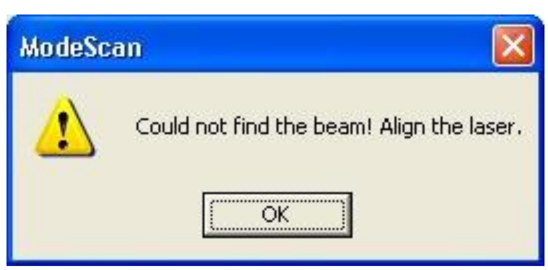
NanoModeScan software could not initialize the OLE (COM) mechanism on the host computer. Without the OLE mechanism NanoModeScan software cannot run. If the message keeps appearing upon starting NanoModeScan software, the Operating System installed on the computer is faulty. Try installing NanoModeScan and NanoScan software on a different computer or reinstall the operating system and the Spiricon provided software.

5.7.2. Cannot connect to NanoScan Server!

The error message indicates that the NanoModeScan software couldn't start the NanoScan ActiveX server (program). NanoModeScan software will exit if it encounters this problem. The NanoScan software must be run once before using the NanoModeScan, to enable the NanoScan to register the ActiveX server and type library. If the message comes up every time the NanoModeScan software is launched, try reinstalling the NanoScan software and run it once before launching the NanoModeScan software again.

5.8. NanoScan/NanoModeScan Status Messages

5.8.1. Could not find the beam! Align the laser.

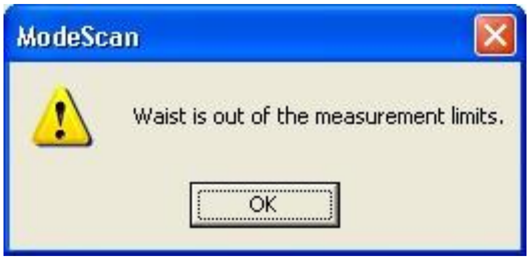


The software couldn't retrieve beam results. Verify that the beam is in the scan head aperture at current position. If not, refer to the stage alignment section of the manual for system alignment. Check if the beam power at current position is within scan head operating space. Try using the "Track beam" instead of "Find Beam".

5.8.2. Could not acquire profiles at waist!

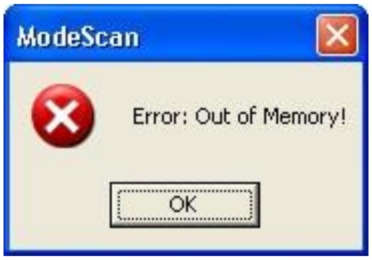
The software could not retrieve the beam results at computed waist position. Redo the measurement.

5.8.3. Waist is out of the measurement limits.



The computed waist position for the current set of data points is outside the travel length of the motion stage. Verify the measurement points are picked correctly and redo the measurement.

5.8.4. Error: Out of Memory!



NanoModeScan internal buffers could not be created. This error message usually indicates that the computer has limited resources. Increase system resources and restart the software.

5.8.5. Cannot read data!

An error occurred while reading the data from the NanoScan PCI controller card. Check the NanoScan PCI controller card is properly seated in the PCI slot. Check all cable connections from NanoScan PCI controller card to the NanoScan scan head. Redo the measurement.

5.8.6. Data array and Position array are different.

Indicates an internal software error while transferring data from NanoScan to NanoModeScan software. Redo the measurement.

5.8.7. AutoFind Failed

NanoScan could not find the beam at current position. Verify the laser is in the scan head entrance aperture. Verify the laser power and spot size at current position are in the NanoScan scan head operating chart. Redo the measurement.

5.8.8. Cannot get scan head capabilities

Indicates a communication error between NanoScan PCI controller card and the NanoScan scan head. Check all cable connections between scan head and PCI card.

5.8.9. Cannot start DAQ timer

NanoModeScan internal error that indicates the operating system is low on resources. Increase system resources and restart the software.

5.8.10. Cannot get the aperture limits!

Indicates an error while transferring data from NanoScan ActiveX server to NanoModeScan software. Redo the measurement. If the software is in alignment mode and the profiles freeze up after the message is displayed, switch to measurement mode and back to alignment to reinitialize the data collection. If the message appears during a measurement, redo the measurement.

5.8.11. Could not compute M2 parameters!

Indicates the least square fit algorithm could not compute a fit for the selected measurement points. Verify the measurement points are according to the M^2 standard and redo the measurement.

5.8.12. File version not supported.

The file was saved with an old software version and is not supported in the current software package.

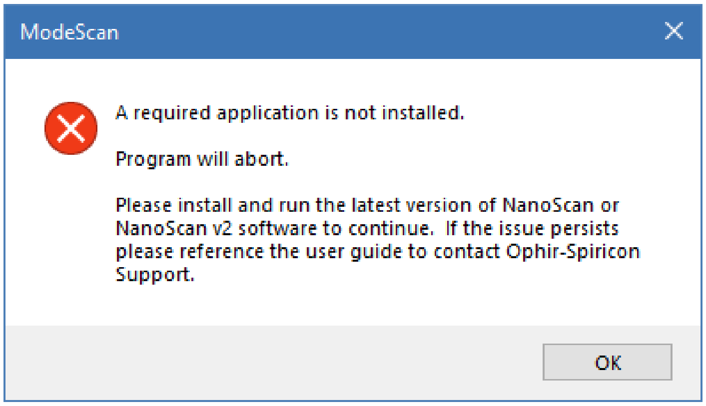
5.8.13. Not enough memory to run the program

Indicates the operating system is low on resources. Program will exit. Increase system resources and restart the software.

5.8.14. No timers available!

Indicates the operating system is low on resources. Program will exit. Increase system resources and restart the software.

5.8.15. NanoScan or NanoScan v2 not installed



NanoScan v1.x or NanoScan v2.x must be installed and run at least once before NanoModeScan will operate correctly. Program will exit. Install and run the latest version of NanoScan v1.x or NanoScan v2.x, then run NanoModeScan again.

6 MEASURING M2 USING THE ISO 11146 METHOD OR THE RAYLEIGH METHOD

6.1. Introduction

The measurement of M^2 according to the ISO 11146 Method is a complex operation that makes a number of assumptions about the laser to be measured. To obtain meaningful M^2 values it is necessary to understand how the measurement is made and what laser properties can dramatically affect the results. The NanoModeScan is designed to make these measurements according to the standard, but the laser properties must be compatible with the method for the system to work properly.

The laser must be stable in both power and modal quality *during the full measurement time* (one to a few minutes) to obtain consistent results with the NanoModeScan. If the laser is not, it will be very difficult for the program to apply a fit to the data obtained.

The laser must also propagate without truncation caused by apertures. Any limiting apertures in the laser optics may create nonsense values for M^2. It is possible to measure laser-lens combinations for M^2, but they must not introduce other features into the beam. It is also important that the beam have a pure wavelength; this is especially important when measuring DPSS or YAG laser harmonics, which should be filtered to remove pump laser or fundamental wavelengths. Mixed wavelength beams will result in erroneous values for M^2.

Before attempting to make the M^2 measurements, be sure that you have properly aligned the NanoModeScan per the instructions found in Chapter 4.

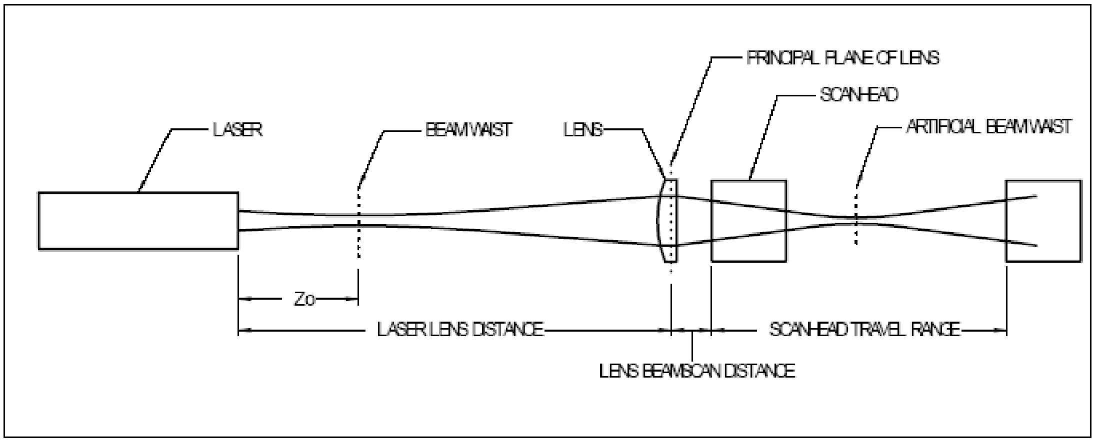


Figure 5.3 Basic NanoModeScan setup

Note: Be sure your source beam waist is positioned with respect to the test lens, so it forms an artificial beam waist in the scan head travel range. Refer to Section 4.1.

M^2 may be indeterminate or non-repeatable if the laser beam is not reasonably steady during the time it takes to complete a measurement, since it fits beam diameter data points along the propagation path.

The NanoModeScan is available with different focal length test lenses. Select a lens that will not generate a waist that is too small. Also, be aware of the power density of the laser at the waist so as not to damage the NanoScan aperture with too high a power. Remember the smaller the beam waist the higher the power density and refer to the appropriate operating space charts for the scan head. If you are measuring a pulsed laser, be aware of the effect of frequency on the energy per pulse (joules). It is possible that a laser that will not damage the slits at 80kHz will have sufficiently higher energy to damage them at 60kHz.

6.2. The ISO 11146 Method

The ISO method calls for a minimum of ten beam measurements to be made, with five in the Rayleigh zone of the artificial waist, and five at least two Rayleigh distances away from the waist. These latter five must be on the distal side of the waist. The Rayleigh zone is defined as that area where the beam diameter d is less than or equal to the square root of 2 times the waist diameter, d_{min}.

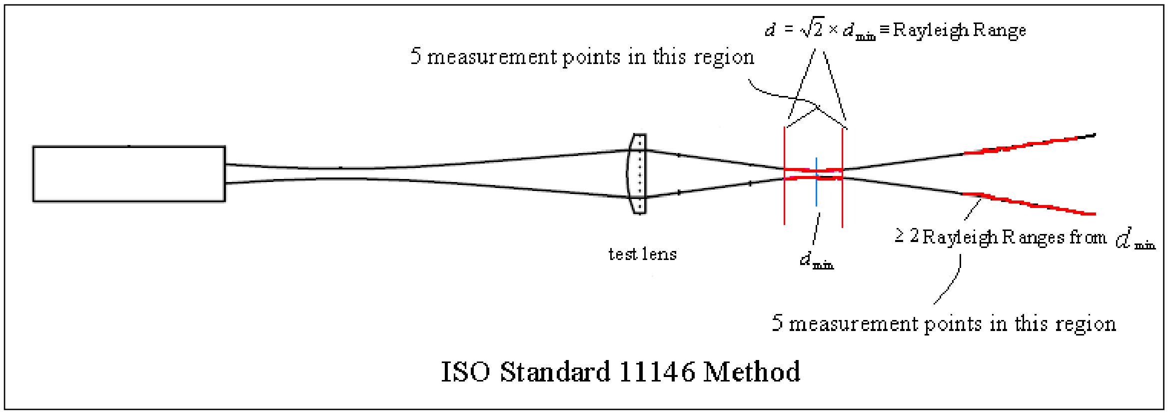


Figure 5.4 ISO 11146 Method

It is often a matter of trial-and-error to select the proper locations for these measurements. We have found that selecting measurement points proximal to the test lens outside the Rayleigh zone will lead to either erroneous M^2 or complete failure of the fit algorithm. Failure of the algorithm may result in theoretically impossible values for M^2 that are less than 1.

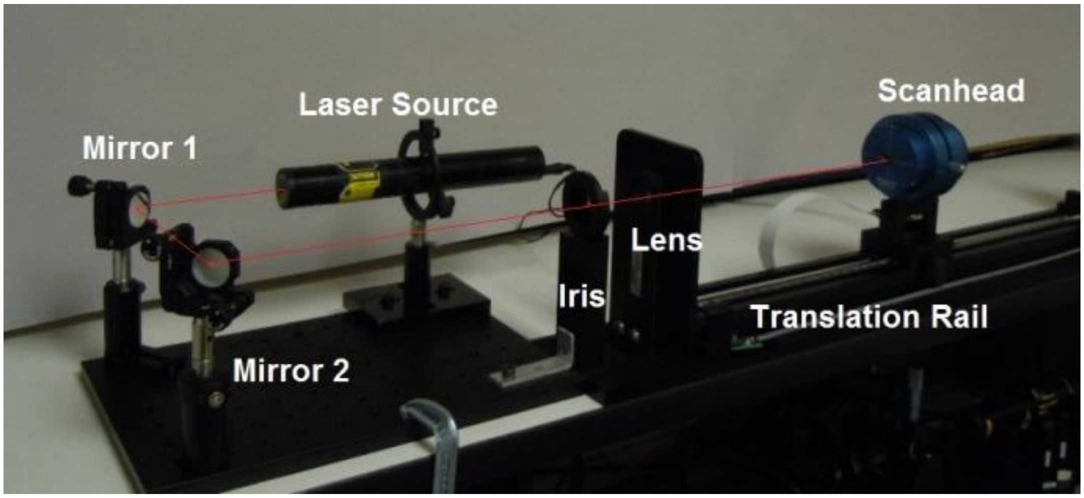
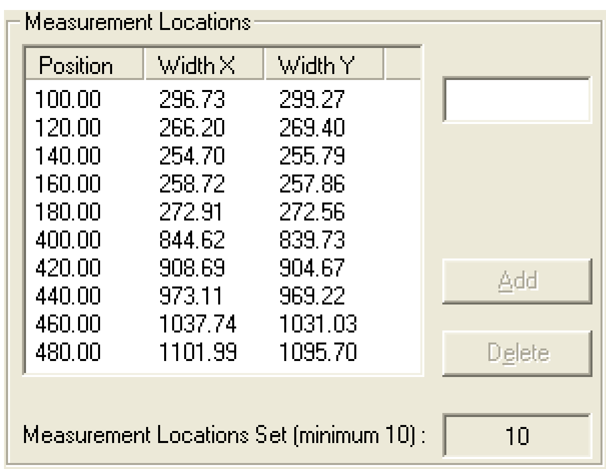


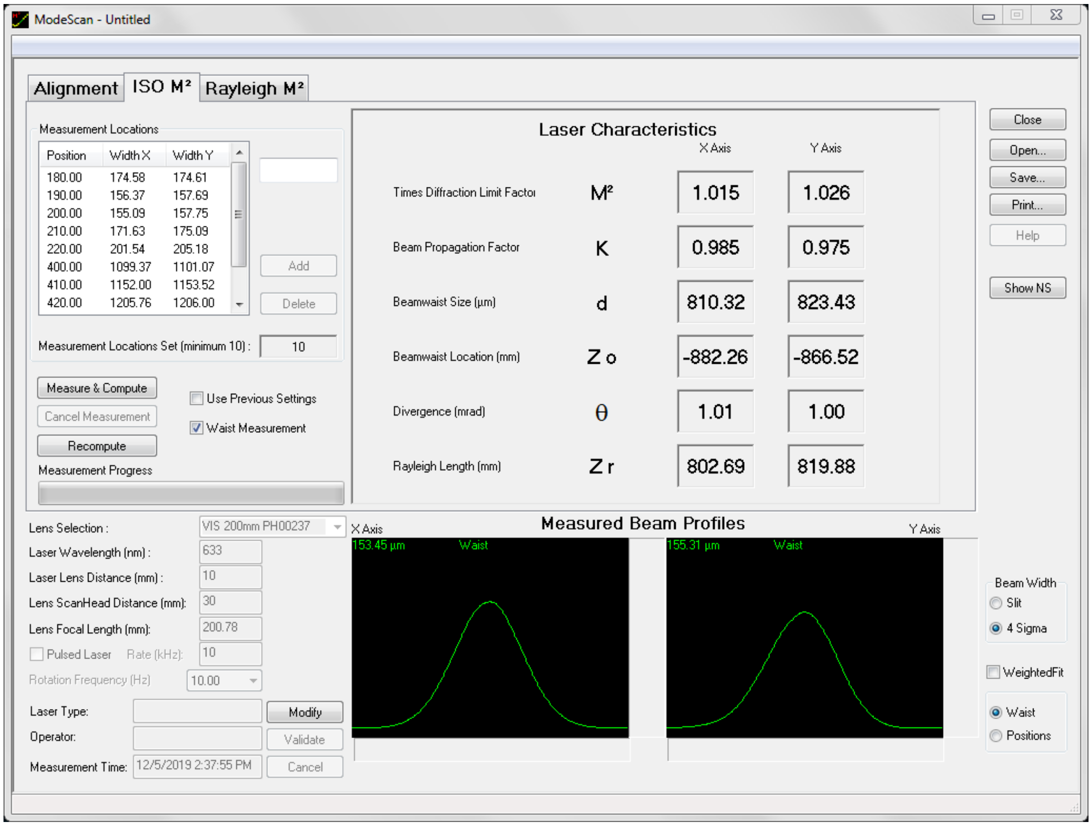
Figure 5.5 Alignment features of the NanoModeScan

To determine the proper location of the measurement points, it is necessary to map the waist of the laser. Start by having the system measure at points every few cm along the rail. This will give an indication of the general location of the waist. Once the waist area is found, have the system make measurements in much shorter steps in the waist region and determine the d_{min}. After the waist, d_{min}, is located, find the locations of the Rayleigh zone where the beam diameter increases to $\sqrt{2}$ x d_{min}. Now select five measurement points inside this range and five more distal to the waist and enter them into the NanoModeScan measurement screen using the **Add** button. Refer to Chapter 5 for detailed descriptions of the Measurement Screen and the available commands.

At this point enter the parameters describing the laser in the lower left corner of the NanoModeScan Measurement Screen. These include the wavelength of the laser, the distance from the front of the laser to the test lens, the distance from the test lens to the home position of the scan head, and the focal length of the test lens. These values are very important to generating accurate and consistent M^2 and laser propagation values.

Note: If a catalog lens is selected from the Lens Selection dropdown list the Lens Focal Length will automatically update based on the Laser Wavelength.



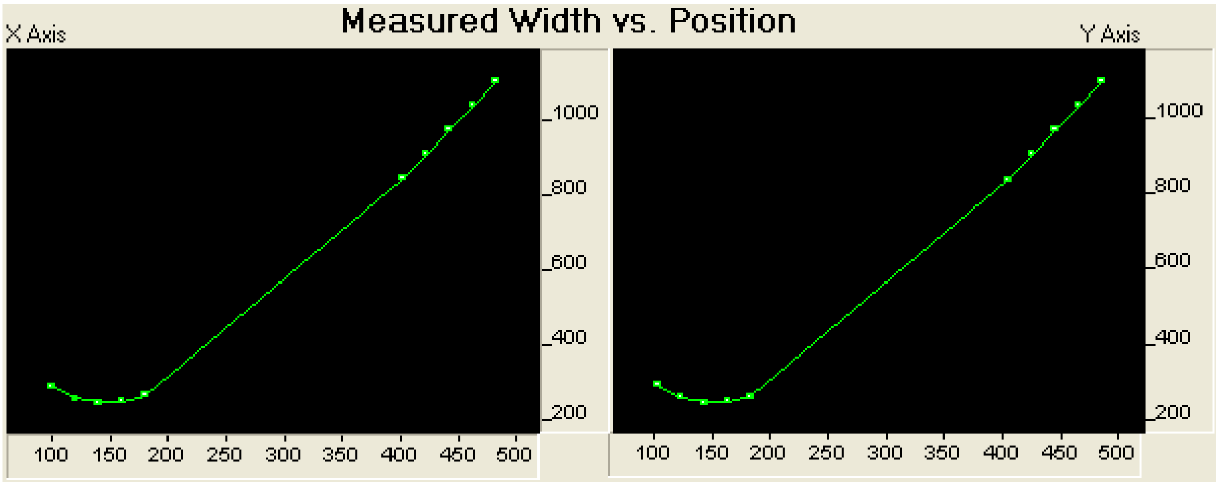


Once the measurement points and laser parameters have been selected in the NanoModeScan Measurement Screen, click on the **Measure and Compute** button. The system will automatically go to the points, make the beam diameter measurements and then calculate the propagation parameters for both the X- and Y-axes of the laser beam.

Occasionally you will get either nonsensical values or an error message stating that the parameters could not be calculated. In this case you should ensure that your laser parameter values are correct. Click on the “Positions” radio button at the lower right of the measurement screen and observe the curves. They should be relatively smooth and not show any sharp angles [see Figure 6.6 below]. If they do not look smooth, go back and select some different measurement points, taking care to delete any that seem to generate outliers on the curve.

Repeat the measurement.

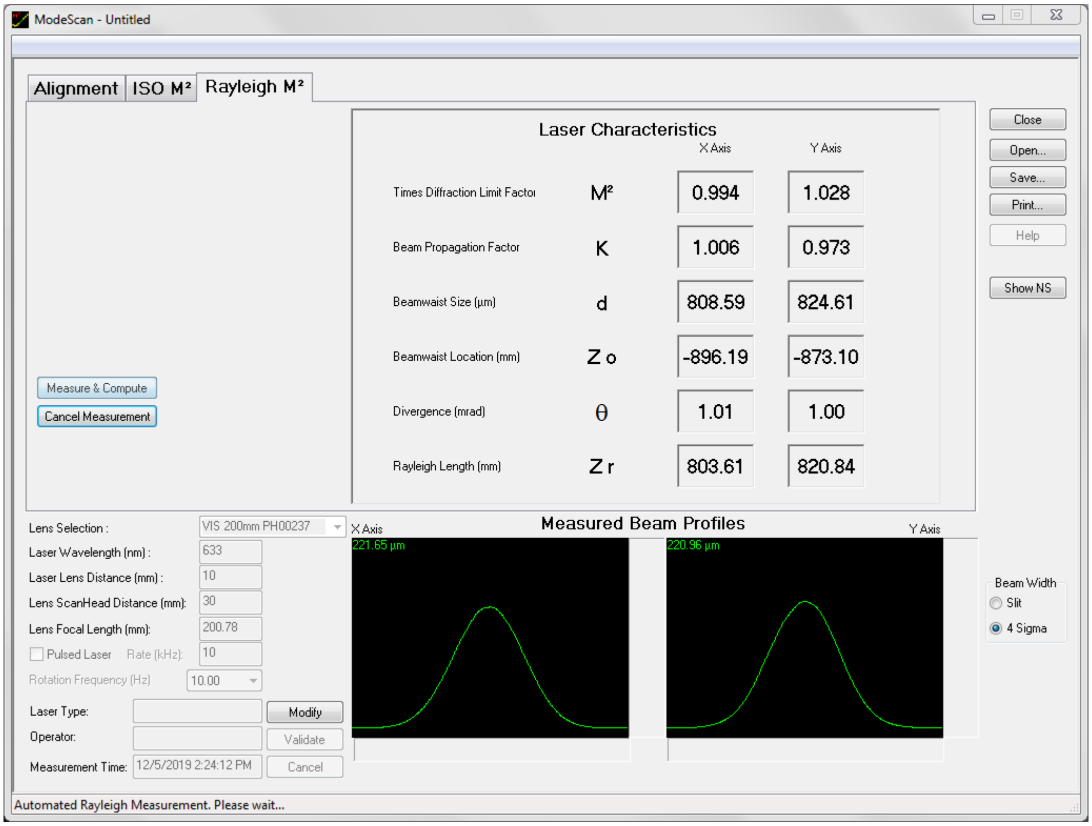
Please note that it is impossible to obtain meaningful M^2 measurements for lasers, which are unstable or are “mode-hopping”, or laser-lens optical systems that are not propagating without aberration. No amount of realignment or selection of different measurement points will make up for the fact that the laser is not sufficiently stable or has aperture induced diffraction. If you cannot obtain a repeatable M^2 value, suspect your laser system.



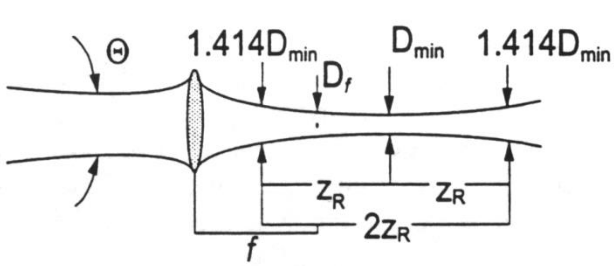
6.3. The Rayleigh Method

This method involves taking measurements exclusively through the waist of a lens like that which is specified in the ISO method. However, the method offers greater ease and potentially less error.

The Rayleigh M² method is completely automated. Select **Measure & Compute** to initiate a new measurement.



To calculate M^2, NanoModeScan will sample through the waist of the lens to determine D_{min}. Next, it will translate the scan head until the beam size increases to $1.414D_{min}$ and record this location. Then, it will translate the scan head back through the waist until the beam size measures $1.414D_{min}$ on the other side of the waist. The distance between these points is $2Z_R$, or twice the Rayleigh range.



This approach relies on the fact that the propagation factor is a constant throughout an unaberrated optical system. Thus, the product of a beam's waist size and divergence in any section of an optical path will be equal to that in any other section. Therefore, the diameter of the waist of a lens, D_{min}, and the angular spread affected by the lens, θ_L, can be substituted for D_0 and θ, respectively, within the propagation formula. Since the Rayleigh range for any beam is defined as the waist divided by the divergence, this allows you to substitute the use of D_{min}/z_R for θ_L.

$$M^2 = \frac{D_{\min}}{Z_R} D_{\min} \frac{\pi}{4\lambda}$$

$$M^2 = \frac{\pi}{2\lambda} \frac{D_{\min}^2}{2Z_R}$$

A key advantage of using $2Z_R$ in this method is the elimination of some potential sources of error in location determination. The depth of focus of a lens can provide a significant range of comparable readings of D_{min}, thus making it difficult to precisely determine the distance from the lens to this hard-to-define location. At the extent of the Rayleigh range, however, the high rate of change of beam size makes it easy to locate these points.

After scanning the D_{min} and Z_R positions and values, the software uses the lens equations to back-calculate the laser results.

The computed laser results are displayed in the **Laser Characteristics**.

Please note that it is impossible to obtain meaningful M^2 measurements for lasers, which are unstable or are "mode-hopping", or laser-lens optical systems that are not propagating without aberration. No amount of realignment will make up for the fact that the laser is not sufficiently stable or has aperture induced diffraction. If you cannot obtain a repeatable M^2 value, suspect your laser system.

6.4. Troubleshooting M^2 Measurement Errors

Failure to obtain meaningful M^2 measurements for your laser can be attributed to a variety of causes:

1. The laser beam waist must be imaged within the measurement space of the NanoModeScan Rail. Refer to section 4.1 for proper alignment.
2. The laser must be reasonably stable during the 1 to 3 minutes it takes to collect all the beam widths needed to calculate the results. Refer to section 4.1 for proper alignment.
3. The laser should not experience strong diffraction due to truncation. Diffraction will propagate differently than the underlying laser beam. Refer to section 4.1 for proper alignment.
4. The system should not experience back reflections into the laser cavity. Refer to section 4.1 for proper alignment.
5. For pulsed lasers it is essential that the true laser repetition rate is entered in the Data Acquisition Parameters. Refer to section 5.3.1 for the ISO M^2 measurement and 5.4.1 for the Rayleigh M^2 measurement.
6. For the Rayleigh method the lens selection must be such that the Rayleigh length in front and behind the beam waist is still within the rail length.
7. The NanoScan aperture should not be over filled in any position along the rail. Refer to section 4.1 for proper alignment.

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7 ActiveX Automation

7.1. Introduction

NanoModeScan provides a Microsoft Automation interface. As an automation server, NanoModeScan exposes a set of methods and properties.

Using ActiveX compatible programs such as LabVIEW or Microsoft Excel, a user can create his own automation controller, which can display and process data from NanoModeScan. The type library *"M2K.tlb"* file is located in the Automation folder where the software has been installed contains a full description of the ActiveX interface. You can open and view this file with an OLE/COM viewer program.

In addition, ActiveX compatible programs, any programming language that provides access to ActiveX can be used to write an automation client against the Interface provided by NanoModeScan.

The methods and properties exported by NanoModeScan are explained in sections 7.3 and 7.4.

7.2. General Information

An ActiveX client can only create new instances of the NanoModeScan software; it cannot connect to an already running server.

If the interface window is shown while an ActiveX client is running, users can interact with the NanoModeScan software, but this could cause some problems if the user makes changes.

Before any ActiveX clients can connect to NanoModeScan the software must have been run at least once; started and shutdown. In order for the NanoModeScan software to start, the NanoScan software must have been run at least once as well.

7.3. Properties

Properties are Read/Write values that reflect the current state and allow the state to be changed.

7.3.1. Mode

Property Type:
VT_I4 – Mode Enumeration

Remarks:

Indicates the mode the software is currently in; set to change which mode the software is in.

Available methods and their behavior depend on the current mode.

The possible options are defined by the Measurement Mode enumeration in the type library.

Measurement Mode	Value	Comments
MODE_ALIGNMENT	1	Very few methods work in this mode
MODE_MEASUREMENT	2	ISO measurement mode
MODE_RAYLEIGH	3	Rayleigh measurement mode

7.3.2. ShowWindow

Property Type:

VT_BOOL – Show Flag

Remarks:

Indicates the current visibility state of the main window; set to TRUE to show the main window or set to FALSE to hide the main window.

7.3.3. BeamWidthMethod

Property Type:

VT_I4 – Beam Width Method Enumeration

Remarks:

Indicates the beam with calculation method the software uses.

The possible options are defined by the **BeamWidthCalcMethod** enumeration in the type library.

Beam with calculation method	Value	Comments
METHOD_SLIT	0	Uses the Slit Method
METHOD_4SIGMA	1	Uses the 4σ Method

7.3.4. WeightFit

Property Type:

VT_BOOL – Fit Weighting Flag

Remarks:

Indicates if the ISO fit will be weighted or not.

7.4. Methods

7.4.1. InitializeNanoscan

Method Return Value:

VT_BOOL – TRUE if Successful; FALSE otherwise

Method Parameter List:

VTS_NONE – No Parameters

Remarks:

Initializes NanoScan ActiveX server. This must be the first method called after opening the software via ActiveX. Other calls will fail until this method is called.

If the call is unsuccessful, **GetLastMsgboxString** will return a human readable message describing the problem, but nothing else can be done, close the software.

7.4.2. Measure

Method Return Value:

VT_BOOL – TRUE if Successful; FALSE otherwise

Method Parameter List:

VTS_NONE – No Parameters

Remarks:

Starts a measurement, the type of measurement is determined by what mode the software is in. Only works in ISO or Rayleigh mode; returns FALSE otherwise.

The call will not return until the measurement is finished.

If the call is unsuccessful, **GetLastMsgboxString** will return a human readable message describing the error.

7.4.3. OpenFile

Method Return Value:

VT_BOOL– TRUE if Successful; FALSE otherwise

Method Parameter List:

VTS_BSTR – File name to open.

Remarks:

Opens a file; the file name must be a fully qualified path, the file must exist, and it must be a **.m2k* file.

If the call is unsuccessful, **GetLastMsgboxString** will return a human readable message describing the error.

7.4.4. GetLastMsgboxString

Method Return Value:

VT_BSTR – Message box string(s)

Method Parameter List:

VTS_NONE – No Parameters

Remarks:

Some of the calls made through ActiveX capture any strings that would have been shown via a Message Box during normal operation. This method returns the captured error and warning messages. Each message is separated by a single line with only “--" on it.

If the string is not empty the last line will be a line with only “--" on it.

The string will only contain the messages of the last call that set it. Changing modes will clear the string.

7.4.5. GetParams

Method Return Value:

VT_BOOL – TRUE if Successful; FALSE otherwise

Method Parameter List:

VTS_PR4 – Receives – M^2_X Times diffraction limit factor for X axis (passed by reference)

VTS_PR4 – Receives – M^2_Y Times diffraction limit factor for Y axis (passed by reference)

VTS_PR4 – Receives – D_X Beam waist (μm) for X axis (passed by reference)

VTS_PR4 – Receives – D_Y Beam waist (μm) for Y axis (passed by reference)

VTS_PR4 – Receives – Z_{0X} Beam waist location (mm) for X axis (passed by reference)

VTS_PR4 – Receives – Z_{0Y} Beam waist location (mm) for Y axis (passed by reference)

VTS_PR4 – Receives – θ_X Divergence (mrad) for X axis (passed by reference)

VTS_PR4 – Receives – θ_Y Divergence (mrad) for Y axis (passed by reference)

VTS_PR4 – Receives – Z_{RX} Rayleigh Length (mm) for X axis (passed by reference)

VTS_PR4 – Receives – Z_{RX} Rayleigh Length (mm) for Y axis (passed by reference)

Remarks:

Gets the computed parameters from the last measurement; only returns TRUE after a successful Measurement.

This method will only return TRUE once per measurement; the data cannot change until a new measurement is completed.

The data is invalidated upon changing modes and will return FALSE until a new measurement is completed.

The output parameters are not written if the return value is FALSE.

7.4.6. AddPosition

Method Return Value:

VT_EMPTY – No Return Value

Method Parameter List:

VTS_R4 – Rail measurement position to add (mm)

Remarks:

Adds a position to be used for ISO M^2 measurements; at least 10 positions are needed. Only works in ISO mode; does nothing in any of the other operating modes.

7.4.7. DeleteAllPositions

Method Return Value:

VT_EMPTY – No Return Value

Method Parameter List:

VTS_NONE – No Parameters

Remarks:

Removes all positions set. Only works in ISO mode; does nothing in any of the other operating modes.

7.4.8. GetNumPositions

Method Return Value:

VT_I4 – Number of positions currently set

Method Parameter List:

VTS_NONE – No Parameters

Remarks:

Returns the number of positions set. Only works in ISO mode; returns -1 in any other operating modes.

7.4.9. GetPosAt

Method Return Value:

VT_BOOL – TRUE if Successful; FALSE otherwise

Method Parameter List:

VTS_I4 – Index of position to get

VTS_PR4 – Receives position (mm) on rail (passed by reference)

VTS_PR4 – Receives Beam width (μm) for X axis (passed by reference)

VTS_PR4 – Receives Beam width (μm) for Y axis (passed by reference)

Remarks:

Retrieves the last measured beam width measured at a position on the rail. Only succeeds in ISO mode; returns FALSE if not in ISO mode.

Index must be an integer in the range (0, n) where "n" is the return value from **GetNumPositions**. Returns FALSE if the index is out of bounds.

If there is no last measurement, the beam width will be 0 for both axes. There are two cases when this can happen: a position was added, but the Measure method has not been called, or when the measurement did not complete.

7.4.10. SetLaserProperties

Method Return Value:

VT_EMPTY – No Return Value

Method Parameter List:

VTS_R4 – Laser wavelength (nm)

VTS_R4 – Laser-Lens Distance (mm)

VTS_R4 – Laser-Scan Head Distance (mm)

VTS_R4 – Lens focal length (mm)

VTS_BOOL – Pulsed flag (TRUE if pulsed; FALSE otherwise)

VTS_R4 – Pulse rate (kHz)

VTS_R4 – Scan head rotation frequency (Hz)

Remarks:

Sets laser properties and scan head speed. Scan head rotation frequency MUST be one of the values returned from **GetSpeed**.

7.4.11. GetLaserProperties

Method Return Value:
VT_EMPTY – No Return Value

Method Parameter List:

VTS_PR4 – Receives Laser wavelength (nm) (passed by reference)

VTS_PR4 – Receives Laser-Lens Distance (mm) (passed by reference)

VTS_PR4 – Receives Laser-Scan Head Distance (mm) (passed by reference)

VTS_PR4 – Receives Lens focal length (mm) (passed by reference)

VTS_PBOOL – Receives Pulsed flag (TRUE if pulsed; FALSE otherwise) (passed by reference)

VTS_PR4 – Receives Pulse rate (kHz) (passed by reference)

VTS_PR4 – Receives Scan head rotation frequency (Hz) (passed by reference)

Remarks:

Retrieves laser properties and scan head speed. Scan head rotation frequency will be one of the return values from **GetSpeed**.

7.4.12. GetNumSpeeds

Method Return Value:

VT_I4 – Number of scan head rotation speeds

Method Parameter List:

VTS_NONE – No Parameters

Remarks:

Returns the number of possible scan head speeds.

7.4.13. GetSpeed

Method Return Value:

VT_R4 – Possible scan head rotation frequency (Hz)

Method Parameter List:

VTS_I4 – Index.

Remarks:

The Index must be an integer in the range of (0, N) where N is the return value from **GetNumSpeeds**.

The return value is a possible rotation frequency to be used with **SetLaserProperties**.

Appendix A – Replacement Lenses

Part Number	Description
PH00090	Lens, 200mm UV
PH00091	Lens, 350mm UV
PH00093	Lens, 100mm VIS
PH00237	Lens, 200mm VIS
PH00238	Lens, 400mm VIS
PH00094	Lens, 100mm NIR
PH00239	Lens, 200mm NIR
PH00240	Lens, 400mm NIR
PH00095	Lens, 100mm LIR
PH00241	Lens, 200mm LIR
PH00242	Lens, 400mm LIR
PH00224	Lens, 400mm 2um
PH00092	Lens, 190mm (7.5in) 10.6um