KEYENCE

B54GB

3D Surface Profiler
VK-X3000 Series

Viewer Application

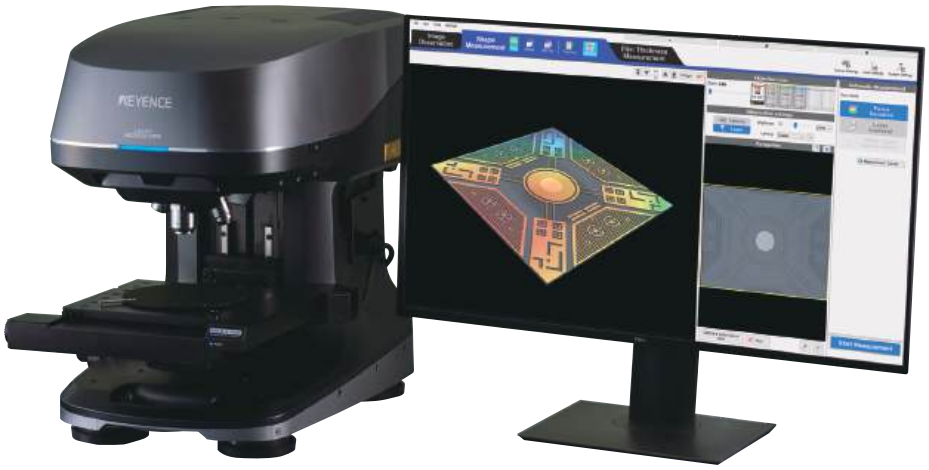
Image Stitching Module
VK-H3J

White Light Interferometry Module
VK-H3I

Spectral Film Thickness Unit
VK-T300

Reference Manual

Read this manual before use.
Keep this manual in a safe place for future reference.



Introduction

This manual describes the handling, operating procedures, and precautions for the "VK-X3000 Series Viewer Application", "VK-X3000 Series Image Stitching Module (VK-H3J)", and "VK-X3000 Series White Light Interferometry Module (VK-H3I)". Read this manual thoroughly before using the system to get the maximum performance out of the Viewer Application, Image Stitching Module, and White Light Interferometry Module.
Keep this manual at hand for reference whenever needed.

Symbols

This manual uses the following symbols to show important information at a glance.
Make sure to read this section.

DANGER	**Indicates a hazardous situation which, if not avoided, will result in death or serious injury.**
WARNING	**Indicates a hazardous situation which, if not avoided, could result in death or serious injury.**
CAUTION	**Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**
NOTICE	**Indicates a situation which, if not avoided, could result in product damage as well as property damage.**

Important **Indicates cautions and limitations that must be followed during operation.**

Point **Indicates additional information on proper operation.**

Reference Indicates tips for better understanding or useful information.

It indicates reference pages in this manual or other manual.

General Precautions

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- If there are missing or misplaced pages, we will provide a new copy of this manual.

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MEMO

Organization of This Manual

This manual describes the operation of the Viewer Application.

Chapter 1	Getting Started	This chapter gives an overview of the package details and the Viewer Application.
Chapter 2	Basic Operation	This chapter describes how to start the Viewer Application and create a 3D image by measuring the surface profile.
Chapter 3	Advanced Settings of the Head	This chapter describes how to adjust the head to optimize brightness and focus of the image before measurement and observation.
Chapter 4	Observation, Depth Composition, and HDR	This chapter describes the operation procedure to create observation images, full focus observation images (depth composition), and HDR images.
Chapter 5	2D Measurement	This chapter describes procedures for measuring length or angle of a specified area on an image being observed and a captured still image. Also, procedures for displaying a scale (auxiliary line) and entering the comment are described.
Chapter 6	Shape Measurement	This chapter describes how to use the shape measurement function to create a 3D image by measuring the surface profile.
Chapter 7	Film thickness measurement	This chapter describes the operation of measuring the film and coating thicknesses from the intensity distribution of laser or white light reflection.
Chapter 8	Stitching Measurement	This chapter describes how to assemble multiple images by using the Image Stitching Module (VK-H3J).
Chapter 9	Teaching	This chapter describes teaching, which is programming the stage to automatically move to the specified position and make a measurement.
Chapter 10	Result View Type	This chapter describes the operation to switch the display of the 3D image (measurement result) and the operation to set the profile line to measure the height or width of the part specified.
Chapter 11	Adjustment and calibration	This chapter describes procedures for correcting errors that may occur due to the measurement environment (temperature) and for inspecting the operation of the controller.
Appendix	Appendix	The appendix describes the operation required when new objective lenses are mounted on the VK-X3000 Series, and how to install and uninstall the Viewer Application and Image Stitching Module.

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Chapter 4 Observation, Depth Composition, and HDR

Chapter 5 2D Measurement

Chapter 6 Shape Measurement

Chapter 7 Film Thickness Measurement

Chapter 8 Stitching Measurement

Chapter 9 Teaching

Chapter 10 Result View Type

Chapter 11 Adjustment and calibration

Appendix

Chapter 1

Getting Started

This section gives an overview of the package details and the Viewer Application.

Operating Environment

The computer running the VK-X3000 Series application must meet the following requirements.

Operating environment

OS	Windows 10/11 Pro 64-bit version must be pre-installed.
CPU	Intel® Core™ i5-11600 or later
Memory	At least 16 GB
USB port	USB 2.0 x 2, USB 3.0 x 1
Video card	NVIDIA® T400 2GB
Display resolution	1920 x 1080 pixels

▶ Important

- **There is no guarantee that the application will run on all computers that meet the above requirements.**
- **Do not install the application on computers other than KEYENCE-specified computers or computers with an equivalent performance (preinstalled with Windows 10/11 Pro). If you install the application on an OS other than Windows 10/11, the computer's system files, installed applications, and so on may no longer function.**
- **Set all of the power settings to “None” on the Power Options Properties dialog box for the control computer.**
- **During measurement, the sleep feature in energy settings should be disables. (It is not necessary to disable the screen saver, etc.).**
- **When you perform the sleep operation from the Start Menu, the PC goes to sleep mode even if measurement is in progress. In this case, measurement is interrupted and the measurement result will not be saved.**

Application Components

The VK-X3000 Series application has the following components.

Configuration	Name	Model	Remarks
Main Applications	Viewer Application	–	This is the operation software used to obtain shape data by controlling the VK-X3000 Series. This software is used to switch the lens revolver, adjust the camera, laser, scanning optics, etc., and obtain the object shape data.
	MultiFileAnalyzer Application	–	This software can display, edit, measure and manage images and shape data obtained using the Viewer Application. Since this can process images and measurement analysis contents at once for multiple files, differences and trends between data can be obtained and analyzed very quickly.
Options Applications	Image Stitching Module	VK-H3J	This software adds the functionality to stitch captured data and the teaching feature. This is optional software.
	White Light Interferometry Module	VK-H3I	This optional software adds white light interferometry as a measurement principle to use in the Viewer software. Using this combined with the interference objective lens enables measurement by the white light interferometry. Paired with the Image Stitching Module, large samples can be measured with high vertical resolution.
	CAD Comparison Module	VK-H3CA	This application adds the comparative measurement function to the Multifile Analyzer. This allows for two parts to be compared side-by-side, or a part to be overlaid to a CAD model.

Checking the Package Contents

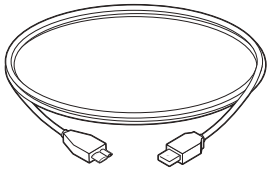
The VK-X3000 Series application package contains the following items.

Please check the contents before getting started. In the event of defective or broken items, please contact the nearest KEYENCE office.

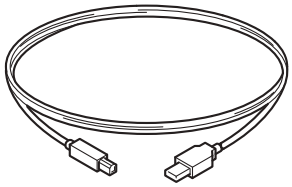
Standard Set (VK-A3E)

☐ VK-X3000 Series Application Software installation DVD
Viewer Application
Multifile Analyzer Application
(DVD-ROM)

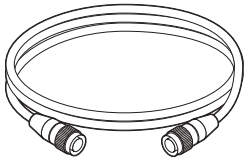
☐ USB3.0 cable
(A connector - Micro B connector)
2m: 1



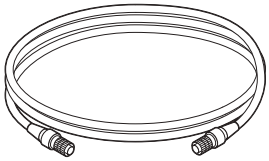
☐ USB2.0 cable 2m: 1



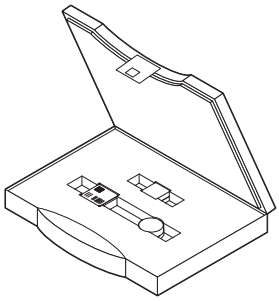
☐ Cable B 2 m: 1



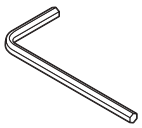
☐ Cable A 2 m: 1



☐ Maintenance kit



☐ L-shaped allen key
(for securing the measurement unit)



☐ Hexagon socket bolts
M6 length 20 mm: 6
M6 length 35mm: 2

☐ User's manual

☐ Quick Start Guide (12 types)

Image Stitching Module VK-H3J (Optional)

☐ Image Stitching Module VK-H3J
License Sheet.....1

☐ Image Stitching Module VK-H3J
License Registration Procedure.....1

☐ Image Stitching Module Installation DVD.....1

White Light Interferometry Module VK-H3I (Optional)

☐ White Light Interferometry VK-H3I
License Sheet.....1

☐ White Light Interferometry Module VK-H3I
License Registration Procedure.....1

CAD Comparison Module VK-H3CA (Optional)

☐ CAD Comparison Module VK-H3CA
License Sheet1

☐ CAD Comparison Module VK-H3CA
License Registration Procedure.....1

File Formats

The VK-X3000 Series application supports the following file formats.

File format	Extension	Description
VK-X3000 Series measurement result file	*.vk7	This is a VK-X3000 Series proprietary file format. The measurement results obtained with the VK-X3000 Series can be recorded and saved with this file type. Measurements obtained using white light interferometry or spectal film thickness mode will save as *.vk7 file type.
VK-X1000 Series measurement result file	*.vk6	The file format for the VK-X3000 and VK-X1000 Series. The measurement results obtained with the VK-X3000 Series can be recorded and saved with this file type. Measurements obtained using focus variation or laser confocal mode will save as *.vk6 file type.
VK-X250/X150 Series measurement result file	*.vk4	The file format for the VK-X3000, VK-X1000, VK-X250/X150/X120, and VK-X200/X100 Series. The measurement results obtained with the VK-X3000 Series can be recorded and saved with this file type. Measurements obtained using laser film thickness mode will save as *.vk4 file type.
Image file	*.jpg	This is a compressed image format perfect for saving still images. You can save 3D displays, measurement screens, and analysis result reports in JPEG file format.
Image file	*.tif	This is an uncompressed image format perfect for saving high resolution still images. The file size is larger than the JPEG format. You can save 3D displays, measurement screens, and analysis result reports in TIFF format.
Measurement conditions file	*.pr7	The VK-X3000 Series measurement conditions are saved in this file type. Measurement settings, light, device information, and so on are recorded in this file. It is used when you want to reproduce the same measurement conditions and you can check saved data from the measurement conditions on the display menu.
Teaching settings file*	*.vkt	Measurement points and conditions registered with the teaching function are saved in this file. You can reproduce measurement conditions by loading this file when executing teaching measurement.
Teaching settings file*	*.csv	Measurement points and conditions registered with the teaching function are saved in this file. As this file is saved in text format, you can edit the data with commercially-available software like MS Excel.
Lens data file	*.vk6lens	This is a file format for saving registered lens information (name, magnification, working distance, and so on) as a backup. You can reproduce registered lens information by loading this file.

Chapter 2

Basic Operation

This chapter describes the basic operations about how to create a 3D image by measuring the surface profile with simple measurements.

Procedure for Creating a 3D Image by Measuring the Surface Profile

Setup

Launching the Viewer Application

Start the Viewer Application.

"Launching the Viewer Application" (Page 2-3)

Place the sample on the stage

Place the sample on the stage.

"VK-X3000 Series User's Manual"

Setting of the Measurement Method

Adjusting the magnification and focus

Adjust the magnification and focus so that the image of the sample appears properly in the viewing window.

"Adjusting the Magnification and Focus" (Page 2-4)

Positioning the measurement target

Determine a measurement point for the surface profile.

"Positioning the Measurement target" (Page 2-5)

Selecting the Scan Mode

Select the scan mode.

"Selecting the Scan Mode" (Page 2-5)

Measure/Save

Executing Measurement

Capture the image to measure the surface profile.

"Measuring" (Page 2-6)

Confirming the Measurement Result

Check the 3D measurement result.

"Confirming the Measurement Result" (Page 2-6)

Saving the Measurement Result

Save the 3D measurement result.

"Saving the Measurement Result" (Page 2-6)

Exiting the Viewer Application

Exit the Viewer Application after completing the measurement.

"Exiting the Viewer Application" (Page 2-6)

Launching the Viewer Application

Launch the Viewer Application in the following way.

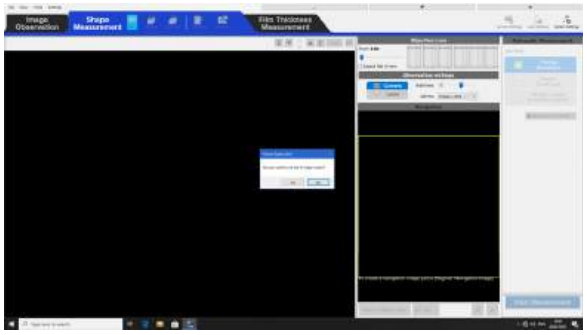
Important

After turning on the controller, it takes 10 seconds to establish communication between the controller and control computer. Wait 10 seconds before launching the Viewer Application.

1 Either double-click the [VK-X 3000 Viewer Application] icon on the desktop or click the [Start] button > [KEYENCE VK-X 3000 Series] > [VK-X 3000 Viewer Application] on the Windows task bar.

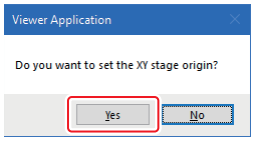
The Viewer Application starts.

If you are using the motorized XY stage, a confirmation message appears for moving to the motorized XY stage origin.



When the motorized XY stage is connected

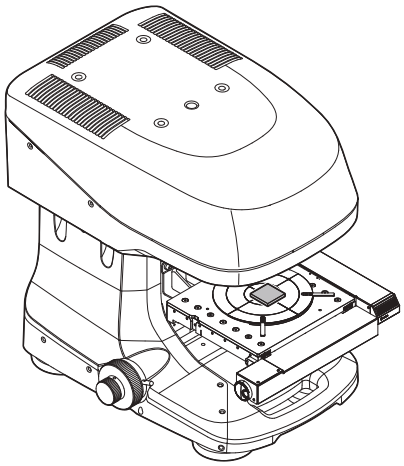
1 To return the motorized XY stage to its origin, click the [Yes] button.



Setting of the Measurement Method

Loading the Sample

1 **Place the sample to be observed on the rotating stage.**

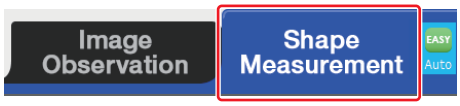


Adjusting the Magnification and Focus

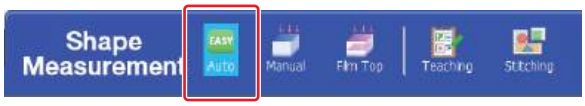
Adjust the magnification and focus so that as much as possible of the part of the sample that you want to measure appears in the viewing window.

NOTICE	**Do not bring the sample into contact with the objective lens when moving the objective lens up/down. Doing so may cause failure.**

1 **On the toolbar, select [Shape Measurement].**



2 **Click the [Auto] button.**

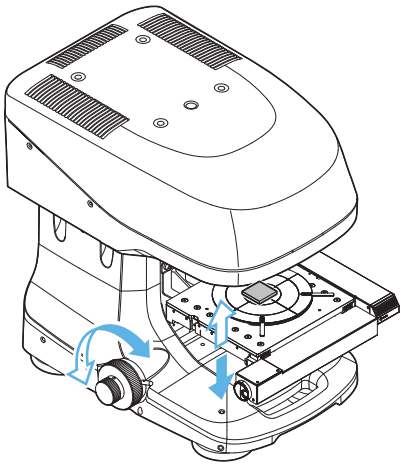


The shape measurement mode changes to automatic measurement.

3 **On the objective lens view, click a 10x or lower low magnification lens.**

The revolver rotates and the objective lens changes.

4 **Use the coarse and fine focusing handles to adjust focus on the sample. Ensure you are using a 10x or lower magnification lens.**



5 **On the objective lens view, click an objective lens to be used in measurements.**

The revolver rotates and the objective lens changes.

Important	**Adjust the sample so that the measurement position is displayed fully in the viewing window.**

6 **Click the [AF] button or move the objective lens up or down to adjust the focus.**

Reference "Adjusting Focus" (Page 3-3)

Positioning the Measurement target

Check the observation image to determine the measurement point for the surface profile.

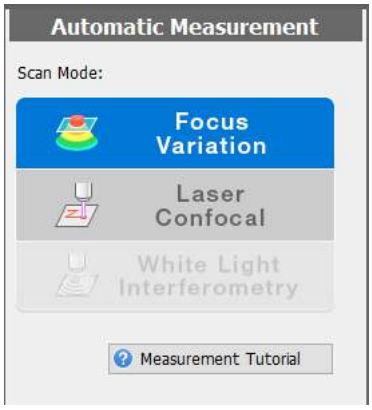
1 **Operate the XY stage to display the measurement point for the surface profile in the viewing window.**

2 **Focus on the lowest point on the surface shape.**

Selecting the Scan Mode

Select the sample scan mode.

1 **On the side panel, select the scan mode.**

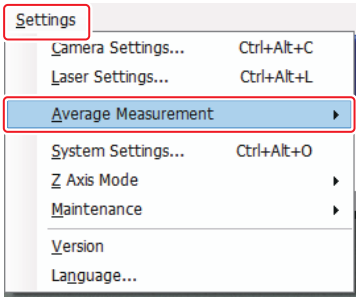


Averaging settings for Measurement Data (Average Measurement)

Measure the planes with the same height for a specified number of times, and collect the averaged information as measurement data.

By setting a higher average count, the measurement time will be longer, but the noise in the measurement data can be reduced.

1 **Select [Average Measurement] from the [Settings] menu.**



2 **Select the average count.**

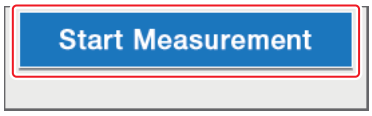
Setting range: 1, 2, 4, 8*, 16*, 32*

* Can be set if [Resolution] is [1 Line (1024 x 1)] pixels.

Measuring

Measure the shape and display the measurement result.

1 On the side panel, click the [Start Measurement] button.

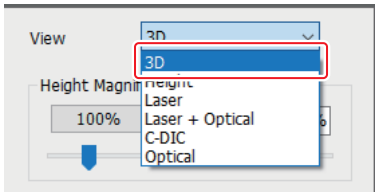


After the shape is measured, the measurement result appears in the viewing window.

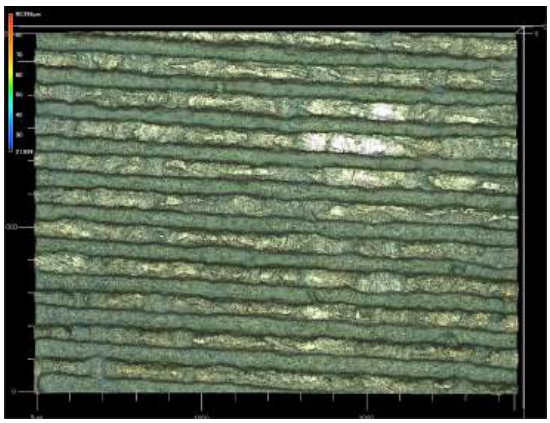
Confirming the Measurement Result

The measurement result can be viewed in different ways depending on the user's preference.

1 In the [View] selection box, select [3D].



The measurement result is switched to an image expressed in 3D based on the height information.

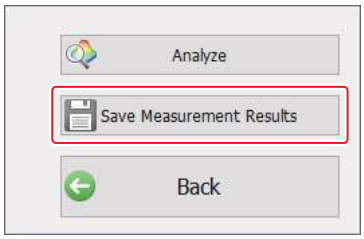


Reference A 3D image can be rotated, enlarged/reduced and moved.

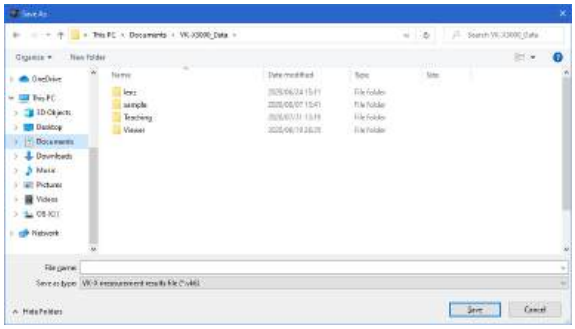
"Operating the 3D Display Image" (Page 10-10)

Saving the Measurement Result

1 Click the [Save Measurement Results] button.



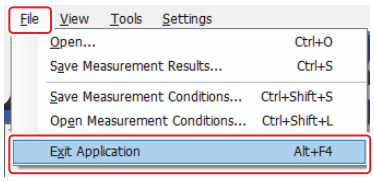
The [Save As] dialog box appears on the screen.



2 Save the measurement result with the folder and file name specified.

Exiting the Viewer Application

1 On the [File] menu, select [Exit Application]. Alternatively, click the [x] button on the top right of the screen.

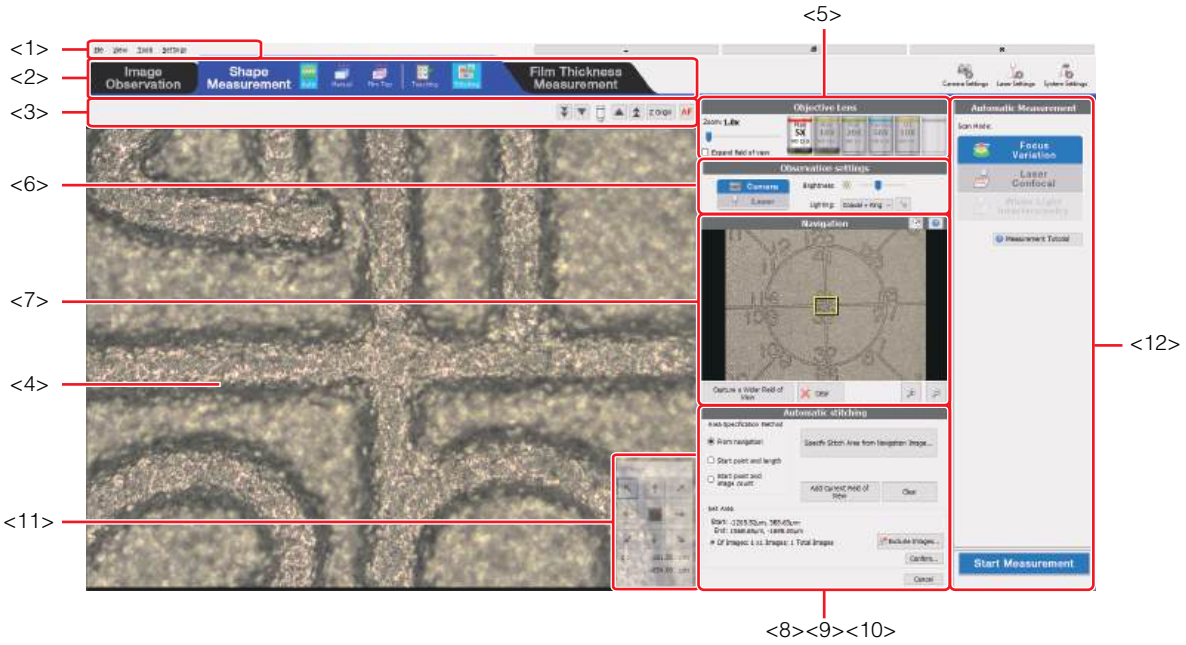


Exit the Viewer Application.

Reference After exiting the Viewer Application, the control computer, head and controller are not turned off.

Layout of the Screen

■ Shape Measurement



<1> Menu bar
Displays [File], [View], [Tools], and [Settings] menu drop-downs.

<2> Toolbar
This area contains buttons for frequently used functions. Click a button to load the corresponding function.

<3> Operation panel
This panel provides buttons for adjusting focus.

<4> Viewing window
Displays the observation image for the sample.

<5> Objective Lens view
Displays a list of objective lenses that are mounted on the VK-X3000 Series. Any objective lens not in use is shaded.
You can change the objective lens by clicking on an objective lens icon.

<6> Observation settings view
Buttons for changing lighting type and brightness of the viewer screen are displayed.

<7> Navigation view
Displays buttons for navigation and captured navigation images.

<8> Automatic stitching view
Displayed when selecting the stitching measurement.
For details, see "Stitching Measurement View Layout" (Page 8-11).

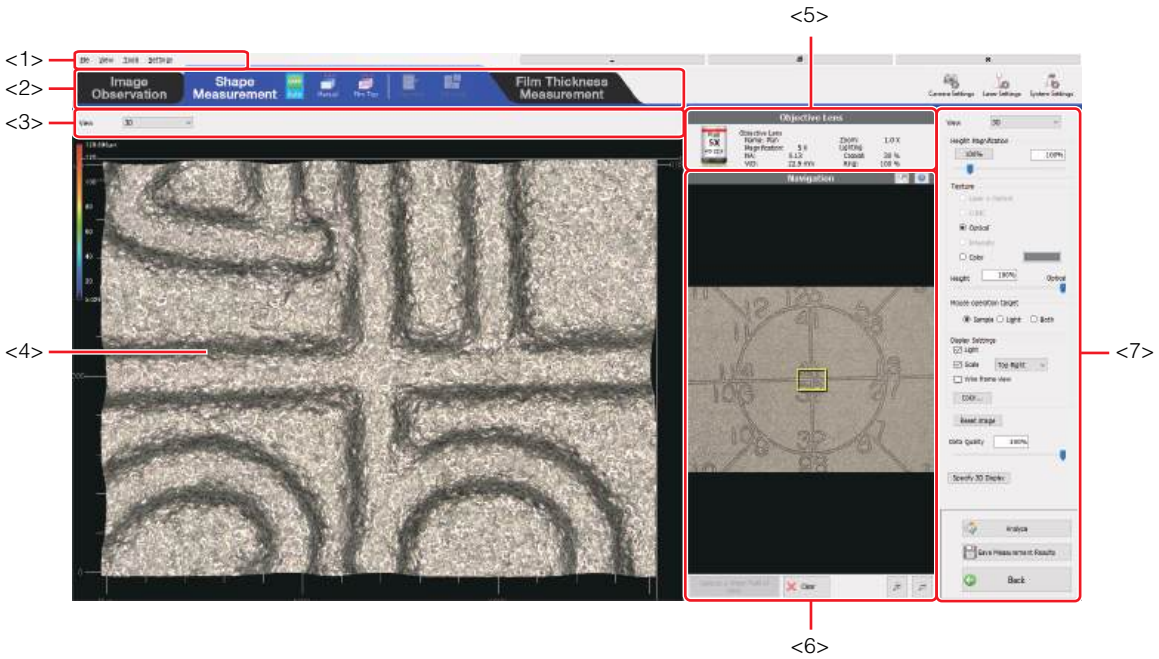
<9> Teaching view
Displayed when selecting the teaching.
For details, see "Teaching View Layout" (Page 9-14).

<10> Reflection view
Displayed when selecting the spectral film thickness measurement.
Displays the waveform of the reflection rate. If a layer and base material are selected, the film thickness value and fit degree will also be displayed.

<11> [XY Stage] dialog box
Displays buttons for operating the motorized XY stage (displayed when the motorized XY stage (VK-S2100) is attached).

<12> Side panel
Displays buttons to operate the function being used.

■ Viewing Measurement Results



<1> Menu bar
Displays [File], [View], [Tools], and [Settings] menu drop-downs.

<2> Toolbar
This area contains buttons for frequently used functions. Click a button to load the corresponding function.

<3> Measurement results operation panel
Displays buttons to operate the measurement results.

<4> Viewing window
Displays the observation image for the sample.

<5> Objective Lens view
Displays information for the objective lens that measured the sample.

<6> Navigation view
Displays captured navigation images.

<7> Side panel
Displays buttons to operate the function being used.

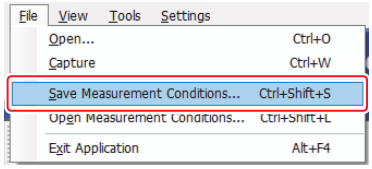
Saving and Restoring Measurement Conditions

The measurement conditions can be saved and restored from the measured data set in 3D measurement mode.

Saving Measurement Conditions

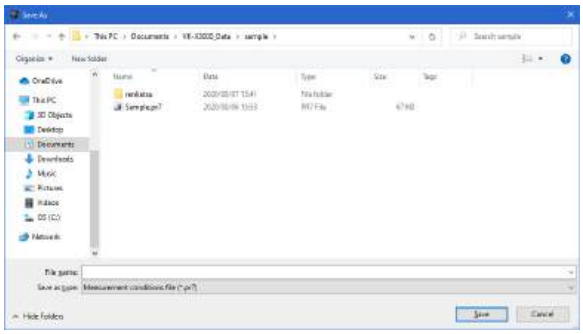
You can save the current measurement conditions.

1 On the [File] menu, select [Save Measurement Conditions].



The [Save As] dialog box appears on the screen.

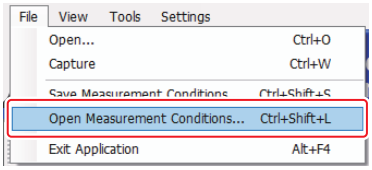
2 Save the measurement conditions with the folder and file name specified.



Restoring Measurement Conditions

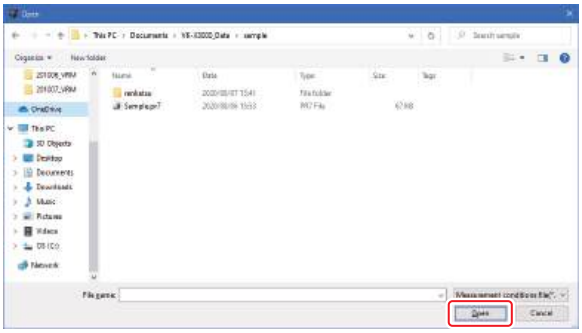
You can load the measurement conditions that have been saved.

1 On the [File] menu, select [Open Measurement Conditions].



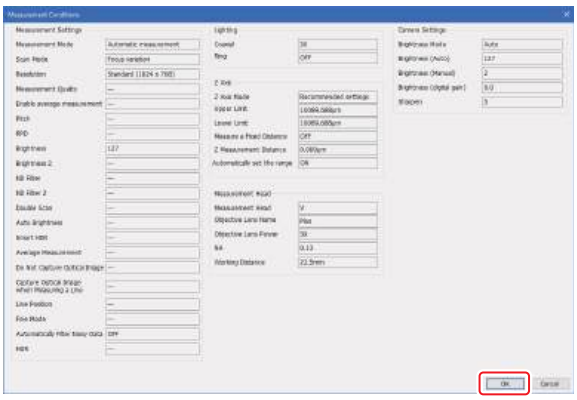
The [Open] dialog box appears.

2 Specify the folder and file name and click the [Open] button.



The [Measurement Conditions] window appears.

3 Check the loaded measurement conditions.



4 Click the [OK] button.

The measurement conditions saved in the file will be restored.

MEMO

Chapter 3

Advanced Settings for the Sensor Head

This chapter describes microscope adjustments including focus, brightness, and field of view. Configure advanced settings on the operation panel.

Selecting Magnification

Selecting an Objective Lens

Change the objective lens and select the magnification.

NOTICE	**Do not bring the sample into contact with the objective lens when moving the objective lens up/down. Doing so may cause failure.**

1 On the objective lens view, click the objective lens that you want to use.

The revolver rotates and the objective lens changes.

Objective lens magnification		5x	10x	20x	50x
Magnification in a 23" monitor		120x	240x	480x	1200x
View range	H (horizontal): µm	2700	1350	675	270
	V (vertical): µm	2025	1012	506	202

Point

The depth of field and angle characteristics differ for the objective lens depending on the magnification.
Select a lens optimal for your required measurement accuracy.

Zoom

This section describes the zoom function to enlarge a sample and observe/measure it.

As this function narrows the laser scanning range and displays the image in the same number of pixels as the normal range, you can obtain a high quality enlarged image.

Point

If the measurement quality is set to superfine, you cannot use the zoom function.

1 Select the magnification on the zoom slider bar for the objective lens view.

Setting Range: [0.7x], [1.0x], [1.2x], [1.5x], [2.0x], [2.5x], [3.0x], [4.0x], [5.0x], [6.0x], [8.0x]

Point

You can select [0.7x] only if the scan mode is set to focus variation and the [Expand field of view] check box on the objective lens view is selected.

Adjusting Focus

Move the XY stage or objective lens up and down using the following methods to adjust the focus.

- XY stage
  - Adjust with the focusing handle
- Objective lens
  - Adjusting automatically (Auto Focus)
  - Adjust with the vertical position buttons for the objective lens
  - Adjust with the Mouse Scroll Wheel

NOTICE	**Do not bring the sample into contact with the objective lens when moving the XY stage or objective lens up/down. Doing so may cause failure.**

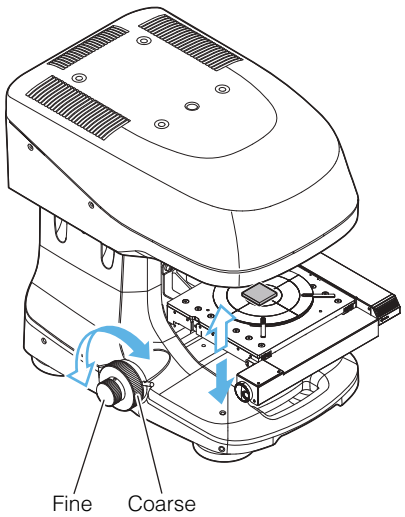
Adjusting the XY Stage

In order to focus by adjusting the objective lens, first adjust the height of the XY stage.

Adjusting with the focusing handle

Use the focusing handle to adjust the height of the XY stage.

1 Turn the focusing handle (Coarse/Fine) to adjust the focus.



Handle	Distance adjusted	Maximum movement range
Focusing handle (Coarse)	Approx. 4.0 mm/ rotation	Approx. 72 mm
Focusing handle (Fine)	Approx. 0.46 mm/ rotation	

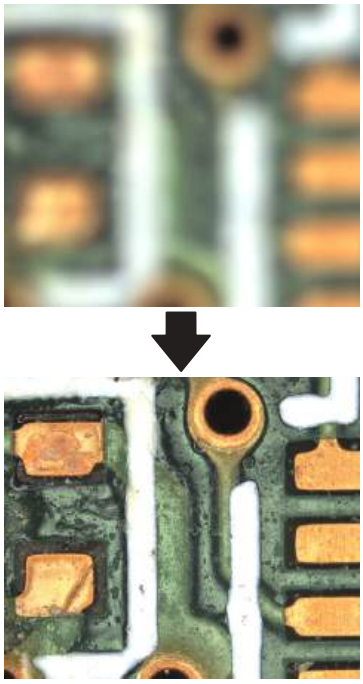
Adjusting the Objective Lens

Adjusting automatically (Auto Focus)

Adjust the focus by automatically moving the objective lens up and down.

1 On the operation panel, click the [AF] button.

The focus is adjusted.



If the image is not in focus, adjust using one of the other two methods.

Adjusting with the vertical position buttons for the objective lens

Move the objective lens up and down with the vertical position buttons to adjust the focus.

1 Click the vertical position buttons for the objective lens on the operation panel to adjust the focus.

Vertical position buttons for the objective lens

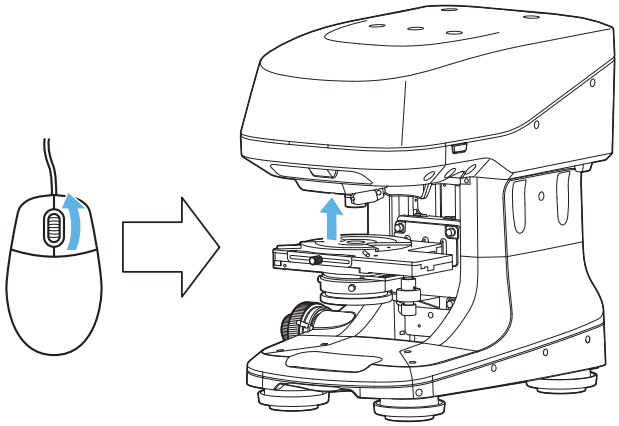
- Moves the stage downward at high speed (10x faster than standard speed).
- Moves the stage downward at standard speed.
- Moves the stage upward at standard speed.
- Moves the stage upward at high speed (10x faster than standard speed).

Reference The amount that the objective lens moves depends on the objective lens in use.

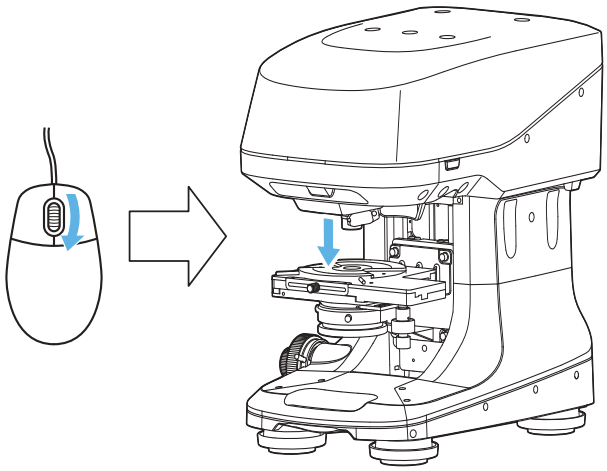
Adjusting with the Mouse Scroll Wheel

Turn the mouse scroll wheel to adjust the focus.

- Turning the mouse scroll wheel forward moves the objective lens upward.



- Turning the mouse scroll wheel backwards moves the objective lens downward.



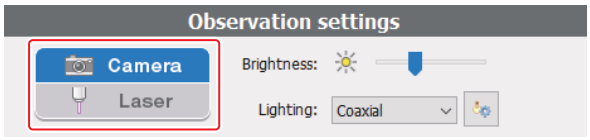
You can move the objective lens at high speed using the following methods:

- Holding down the Shift key while turning the mouse scroll wheel moves the objective lens three times faster than standard speed.
- Holding down the Ctrl key while turning the mouse scroll wheel or holding down the mouse scroll wheel while turning it moves the objective lens 10 times faster than standard speed.
- Holding down the Ctrl+Shift keys while turning the mouse scroll wheel moves the objective lens 30 times faster than standard speed.

Changing the Display Image

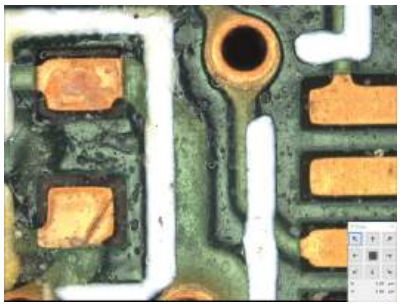
You can change the image displayed on the Viewer window by changing between the camera and laser.

1 Change the optical image/laser image from the viewer screen view.



Camera/laser selection box

- Camera



- Laser

Optical Image Brightness and Light Settings

Adjust the brightness and lighting of the optical image. Adjust the brightness each time the sample or objective lens used changes.

Adjusting the Camera Brightness

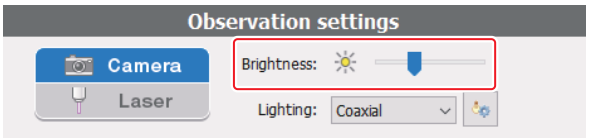
Adjust the brightness of the optical image. "Auto" mode is available for setting the brightness, and "Manual" mode is available for setting the shutter speed.

Adjusting the brightness with the slider

1 Click [Camera] in the viewer screen view.

The image displayed on the Viewer window changes to the optical image.

2 Adjust the brightness with the camera brightness slider in the viewer screen view.



The brightness changes.

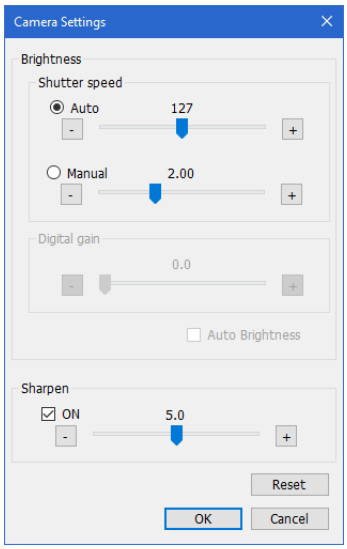
Adjusting the brightness with the camera settings

On the [Camera Settings] dialog box, you can adjust the brightness more granularly.

1 On the toolbar, click the [Camera Settings] button.

The [Camera Settings] dialog box appears.

2 Adjust the brightness.



Brightness

Select a mode for setting the brightness.

- Auto

  This is a mode for setting the brightness.
  Drag the slider or click [-]/[+] button to adjust the image brightness. The higher the value, the brighter the image.
  Setting range: 1 to 255

  Reference The shutter speed is automatically adjusted to match the brightness setting, and the shutter speed will be changed when the condition of the sample or the illumination is changed.

- Manual

  This is a mode for setting the shutter speed.
  Drag the slider or click the [-]/[+] button to adjust the shutter speed. The higher the value, the slower the shutter speed and the brighter the image will be.
  Settings Range:0.2 - 4000 ms

  Reference The shutter speed will not change if the conditions of the sample and lighting change.

  The brightness changes.

3 Click the [OK] button.

The [Camera Settings] dialog box closes.

Adjusting the Camera Lighting

Adjust the camera lighting. There are two types of lighting: "Coaxial" and "Ring".

Reference You can only set "Ring" if the ring illumination is attached to the objective lens.

Changing the lighting to be used

1 Select the lighting from the [Lighting] selection box in the viewer screen view.

- Coaxial + Ring
  This is lighting that uses "Coaxial" and "Ring".
- Coaxial
  This is lighting that uses "Coaxial".
  This enables you to view samples in a bright field.
- Ring
  This is lighting that uses "Ring".
  This enables you to view samples in a dark field.
- OFF
  Lighting is not used.

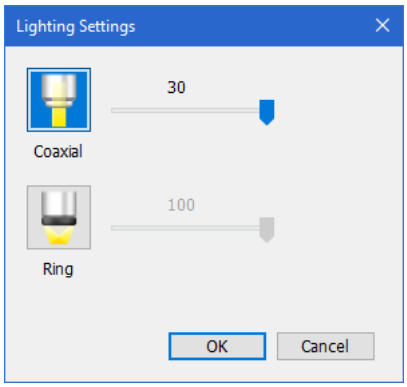
The lighting changes.

Adjusting the Brightness of the Lighting

1 On the operation panel, click .

The [Lighting Settings] dialog box appears.

2 Adjust the brightness of the lighting.



- Coaxial
  Sets the lighting to coaxial epi-illumination.
  Click the icon to switch the lighting on or off.
  Use the slider to specify the strength of the light.
- Ring
  Sets ring illumination.
  Click the icon to switch the lighting on or off.
  Use the slider to specify the strength of the light.

Reference You can adjust the strength of the light with the slider only for the lightning where [Coaxial] and [Ring] turned on.

3 Click the [OK] button.

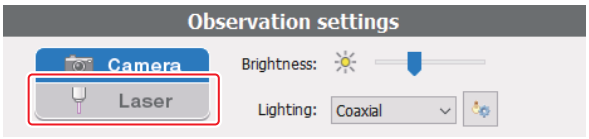
The [Lighting Settings] dialog box closes.
The lighting brightness changes.

Adjusting the Laser Images

Laser Brightness Adjustment

Adjust the laser brightness to the optimal laser intensity. Adjust the laser brightness each time the sample or objective lens used changes.

1 On the operation panel, click [Laser].

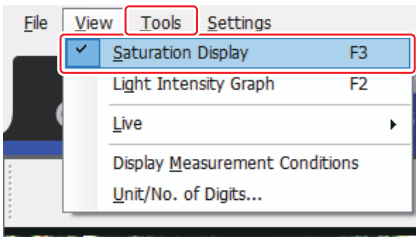


The image displayed on the Viewer window changes to the laser image.

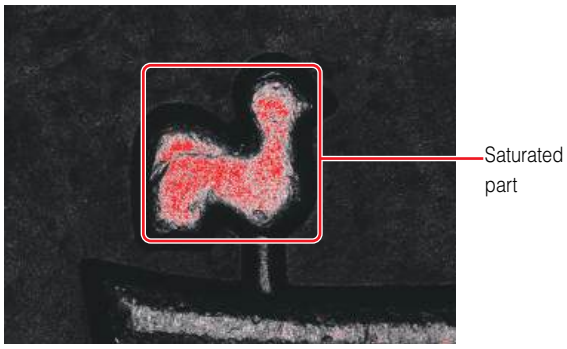
2 Turn the focusing handle to adjust the focus on the part of the sample that reflects the most laser light.

3 Find out the areas that are saturated by the laser intensity.

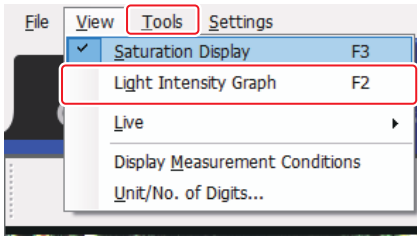
- To measure the center of a band or surface
  On the [View] menu, select [Saturation Display] to turn it on.



Areas that are saturated by the laser reflection intensity (areas that receive too much light) are displayed in red.

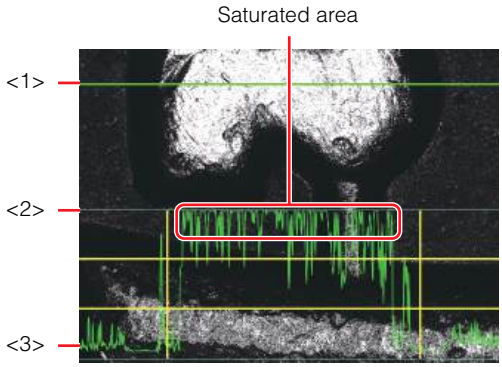


- To measure a line
  On the [View] menu, select [Light Intensity Graph] to turn it on.

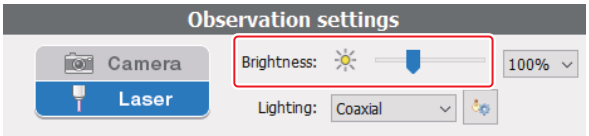


A horizontal line (<1>) and a light intensity graph on the horizontal line (<3>) are displayed in the observation image display area.

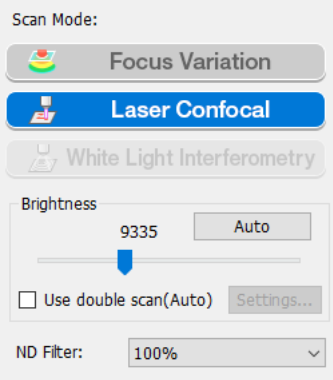
In areas that are saturated by the laser reflection intensity (areas that receive too much light), the reflection intensity graph (<3>) is displayed overlapped with the saturation line (<2>).



4 Move the [Brightness] slider in the viewer screen to manage the brightness of the image.

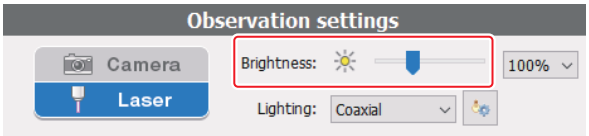


5 If there are any saturated areas, change the settings in the [ND Filter] box.



Reference The light filter physically (optically) reduces the amount of light that enters the light receiving element (photomultiplier).

6 Move the laser brightness slider to the right.



Move it as far as possible to the right without any saturated areas appearing.

7 Click the vertical position buttons for the objective lens to check the light intensity of the entire measurement range.

If there are any saturated areas, change the settings in the [ND Filter] box.

Important **When measuring surface shapes, the reliability of the data decreases if there are any dark places in the measurement range. In that case, use the double scan.**

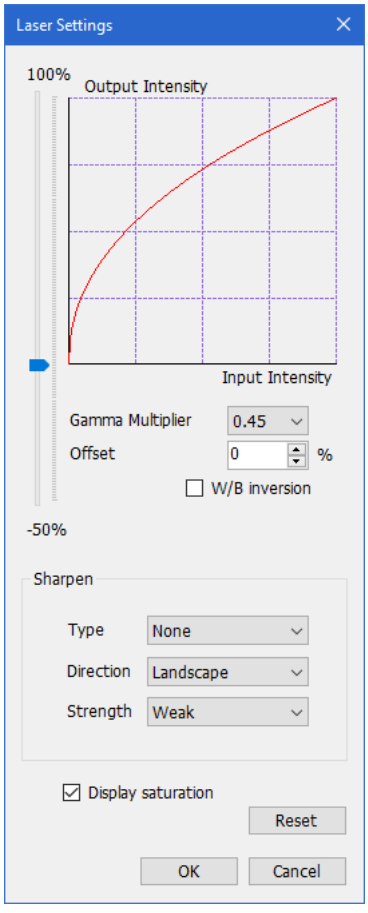
Laser Display Adjustment

Adjust the display of the laser image.

1 On the toolbar, click the [Laser Settings] button.

The [Laser Settings] dialog box appears.

2 Adjust the laser display.



Point The default [Gamma Multiplier] and [Offset] values are as follows:
[Gamma Multiplier]: 0.45
[Offset]: 0

"Laser Settings" (Page A-6)

3 Click the [OK] button.

Creating a Navigation Image

Create a navigation image with a field of view wider than the viewing window.
The created navigation image is displayed in the navigation view and you can check the sample with a wider field of view.
You can also move to the desired location quickly and specify a stitching area from a created navigation image.

Navigation Image Capturing

Capture a navigation image.

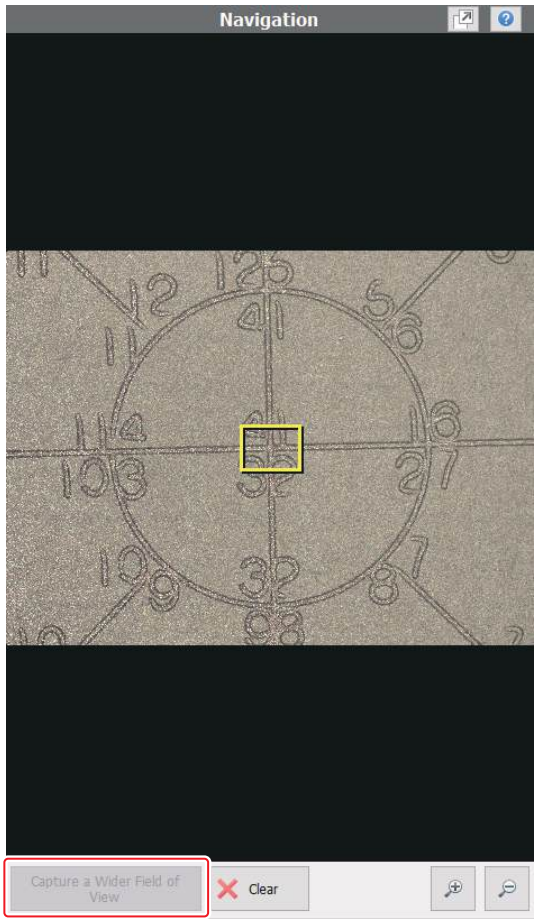
For a motorized XY stage

1 Move the XY stage to the position that you want to make the center of the navigation image.

"Adjusting the Motorized XY Stage Position" (Page 3-13)

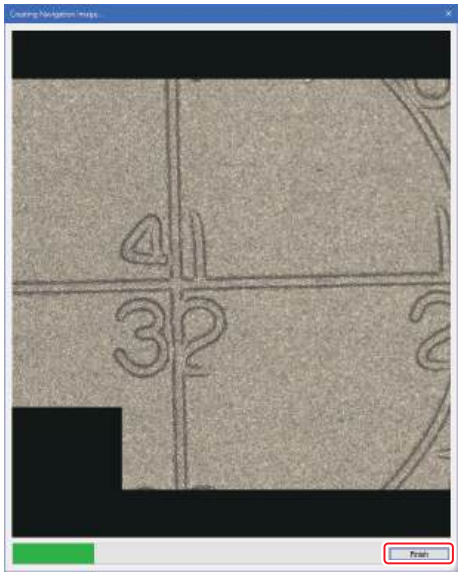
2 On the navigation view, click the [Register Navigation Image] button.

The [Creating Navigation Image] screen will appear and a navigation image will be automatically created.



Reference

To complete the creation of a navigation image, click the [Finish] button on the [Creating Navigation Image] screen.



For a standard XY stage

1 **Move the XY stage to the position that you want to make the center of the navigation image.**
"VK-X3000 Series User's Manual"

2 **On the navigation view, click the [Register Navigation Image] button.**

A navigation image will be obtained with the selected lens magnification.

Navigation Image Operation

You can perform the following operations on the navigation view:

- Move the motorized XY stage
- Set the view range
- Set a stitching region
- Add a navigation region
- Zoom in and out on the navigation image

Moving the motorized XY stage

Clicking the (left) mouse button on the navigation view moves the motorized XY stage.

- When you click the left button, the motorized XY stage will move such that the double-clicked point becomes the center of the navigation view.
- When you select [Move Here] on the right mouse context menu, the motorized XY stage will move such that the right-clicked point becomes the center of the navigation view.
- Dragging the yellow field-of-view frame with the left button moves the motorized stage to the moved location.

Setting the view range

Click and drag within the navigation view to outline the desired measurement range. Right click and select [Set This Area as the Field of View].

When you click the [OK] button, the motorized XY stage moves and the auto focus is executed.

If no other objective lens is more suited to the selected range, the motorized XY stage moves.

Setting a stitching region

By selecting [Specify the Stitching Region] on the right mouse button drag context menu on the navigation view, you can set the selected range as the stitching region.

Adding a navigation region

By performing the following operations on the navigation view, you can add a navigation image region.

- Clicking the [Capture a Wider Field of View] button enables you to add another wide range region to the center of the current navigation region.
- By selecting [Register Navigation Image] on the right mouse button drag context menu, you can add the region that contains the selected range.

Deleting a navigation region

Clicking the [Clear] button on the navigation view enables you to delete a navigation image.

Zooming in and out on the navigation image

By performing the following operations on the navigation view, you can zoom in and out on the navigation image.

- Turn the mouse wheel forward or click  to zoom in on the navigation image.
- Turn the mouse wheel backward or click  to zoom out of the navigation image.

Adjusting the Motorized XY Stage Position

If the motorized XY stage is attached, you can move the motorized XY stage with the following methods:

- Move the stage with the [XY Stage] dialog box
- Move the stage with the navigation view
- Moving via Mouse Operation

NOTICE	**When adjusting the position of the motorized XY stage, the motorized XY stage will move left and right. Check that there is no obstacle in the movable range of the motorized XY stage.**

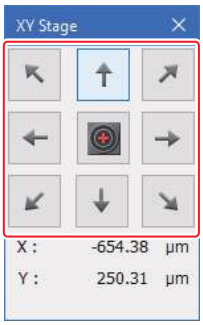
Important **You need to attach the motorized XY stage before launching the Viewer Application.**

Moving the Stage with the [XY Stage] Dialog Box

Click any of the 8 directional buttons to move the motorized XY stage.

Reference If you keep on clicking the 8-direction button, the motorized XY stage will also continue moving.

1 Click the 8-direction button on the [XY Stage] dialog box to move the motorized XY stage.

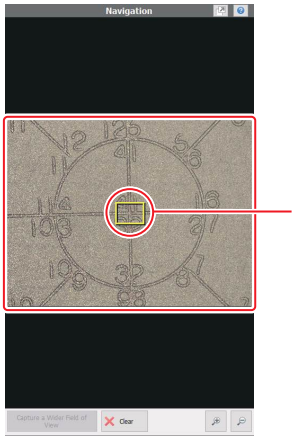


Reference
- When you click the left/right button, the motorized XY stage move in the X axis direction.
- When you click the up/down button, the motorized XY stage move in the Y axis direction.
- When you click a diagonal button, the motorized XY stage will move in X and Y axis directions at the same time.
- You can return the motorized XY stage to the origin by clicking  . Coordinates will be deviated if you cancel the return of the motorized XY stage to the origin. If you cancel the return to the origin before it was complete, perform the same operation again.
- The stage position is displayed at the bottom of the [XY Stage] dialog box.

Moving the Stage with the Navigation View

Clicking the mouse button on the navigation view moves the motorized XY stage.

1 Double-click the place that you want to move the stage to on the navigation view or select [Move Here] on the right-click context menu.



The XY stage moves to the center of the clicked location.

Moving the Stage by Using the Mouse

Click on the viewing window to move the XY stage.

- Dragging the mouse will move the motorized XY stage in the dragged direction.
- When you double-click the mouse button, the motorized XY stage will move such that the double-clicked point becomes the center of the viewing window.

Chapter 4

Observation, Depth Composition, and HDR

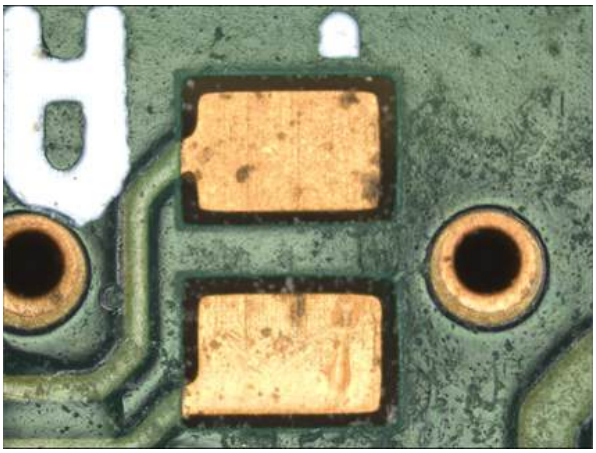
This chapter describes the operation procedure to create standard observation images, full focus observation images (Z-stack), and HDR images.

Types of Observation Methods

You can capture images with the Viewer Application using three methods.

● Standard observation

This is the observation method used in most situations.



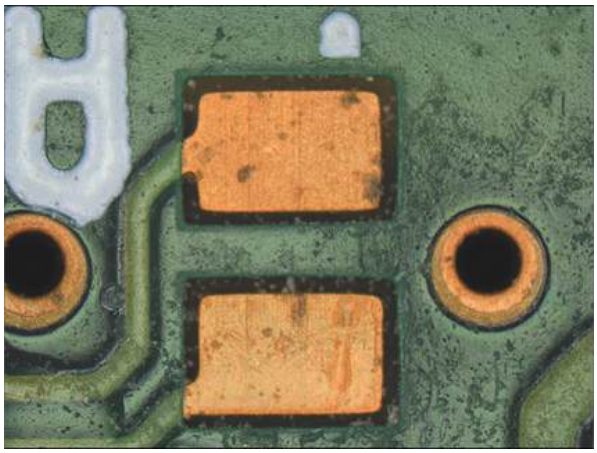
● Full focus observation (Z-stack)

An image created from multiple focus images overlapped into one image.
Use this setting when the sample is tall and unable to be focused completely.

● HDR

This setting improves the contrast and color gradation of the image. Several images are taken while varying the shutter speed to acquire a high-resolution, high-contrast picture.

Since the range of brightness that can be captured is wide, a sample causing halation (a phenomenon in which white blurring occurs around a part under intense light) or a sample with poor gradation can be expressed in high-fidelity.



Flow of Operation for Observation

Setup

Launching the Viewer Application

Start the Viewer Application.

"Launching the Viewer Application" (Page 2-3)

Switching to observation

Switch to observation mode.

"Switching to Observation" (Page 4-4)

Adjusting standard observation images

Adjusting the Magnification and Focus

Adjust the magnification and focus so that the image of the sample appears properly in the viewing window.

"Advanced Settings for the Sensor Head" (Page 3-1)

Pause/Save

Pause

Pause the observation image.

"Step 1: Pause" (Page 4-4)

Measuring dimensions

Measure the dimensions of the sample in a still observation image and add comments.

"2D Measurement" (Page 5-1)

Saving optical images

Capture (save) the observation image.

"Capture (Save)" (Page 4-10)

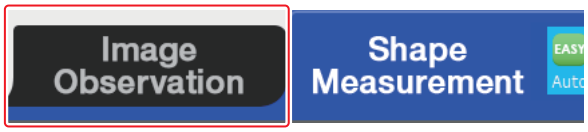
Observation

Observation is a mode that allows you to view the optical image.

Switching to Observation

Switch to the observation mode to create optical observation images.

1 On the toolbar, click [Image Observation].



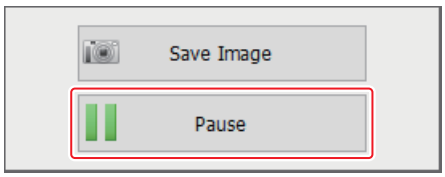
Switches to the observation mode.

Step 1: Pause

Pauses the optical image displayed in the viewing window and create a still image.

> Important **The head must be adjusted in advance.**
> **"Advanced Settings for the Sensor Head" (Page 3-1)**

1 Click the [Pause] button on the side panel.



The optical image in the viewing window is paused. Click the [Back to Live Image] button to release the pause.

Flow of Operation to Create a Full Focus Image

Setup

Launching the Viewer Application

Start the Viewer Application.

"Launching the Viewer Application" (Page 2-3)

Switching to Z-stack

Switch to Z-stack in the observation mode.

"Switching to Z-Stack" (Page 4-6)

Adjusting observation images

Adjusting the Magnification and Focus

Adjust the magnification and focus so that the image of the sample appears properly in the viewing window.

"Advanced Settings for the Sensor Head" (Page 3-1)

Z-stack/Save

Starting Z-Stack

Z-stack is started.

"Step 1: Starting Z-stack" (Page 4-6)

Measuring dimensions

As required, measure the dimensions of the sample in a depth composite observation image and add comments.

"2D Measurement" (Page 5-1)

Saving optical images

Capture (save) the observation image.

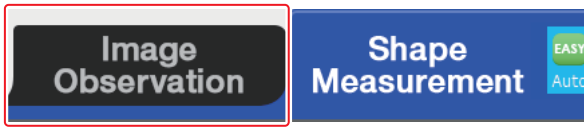
"Capture (Save)" (Page 4-10)

Z-Stack

A fully-focused image can be created through composition of captured images obtained by changing the height of the Z axis stage. This is useful when the sample has height/depth and cannot be seen in full focus.

Switching to Z-Stack

1 On the toolbar, click [Image Observation].



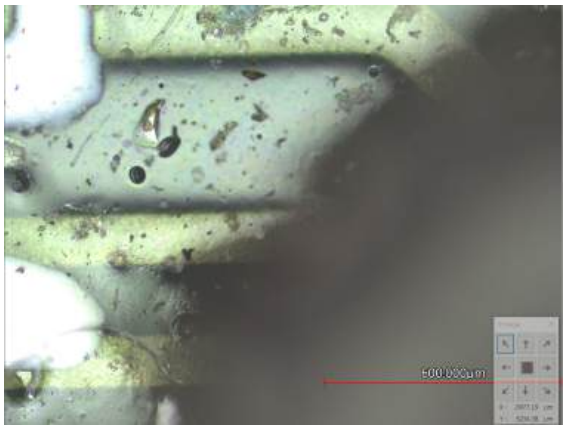
2 Click the [Z-Stack] button.

Switches to Z-stack in the observation mode.

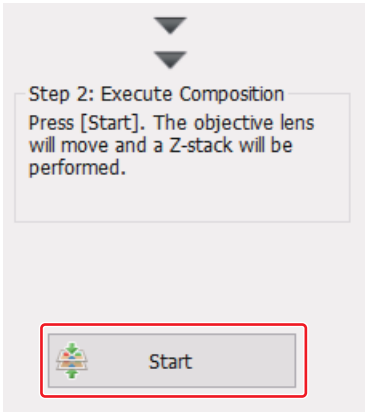
Step 1: Starting Z-stack

Important **The head must be adjusted in advance.**
"Advanced Settings for the Sensor Head" (Page 3-1)

1 Adjust the focus on the lowest part of the sample.
"Adjusting Focus" (Page 3-3)

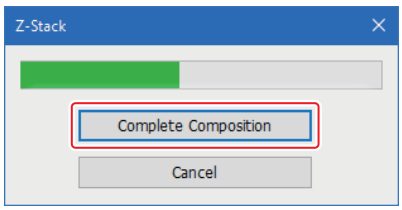


2 Click the [Start] button.



Z-stack is started.

3 Look in the viewing window and after the image reaches the highest part of the sample, click the [Complete Composition] button.



Reference In order to stop and delete the data before completing, click the [Cancel] button.

The full focus observation image (Z-stack) is displayed in the viewing window. Click the [Back to Live Image] button to release the pause.

Point Make sure the sample is not tilted.
A tilted sample due to a swing by the move of the stage causes inaccurate Z-stack.

Flow of Operation for Creating a High Dynamic Range (HDR) Image

Setup

Launching the Viewer Application

Start the Viewer Application.

"Launching the Viewer Application" (Page 2-3)

Switch to HDR

Switch the observation mode to HDR.

"Switching to HDR" (Page 4-8)

Adjusting observation images

Adjusting the Magnification and Focus

Adjust the magnification and focus so that the image of the sample appears properly in the viewing window.

"Advanced Settings for the Sensor Head" (Page 3-1)

HDR Capture/Save

Starting HDR Capture

Start HDR capture.

"Step 1: Start HDR" (Page 4-8)

Measuring dimensions

As required, measure the dimensions of the sample in a depth composite observation image and add comments.

"2D Measurement" (Page 5-1)

Saving optical images

Capture (save) the observation image.

"Capture (Save)" (Page 4-10)

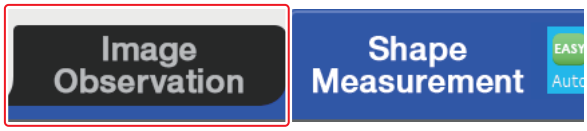
High Dynamic Range (HDR)

HDR captures several images with varying brightness to achieve a final image with higher gradation.

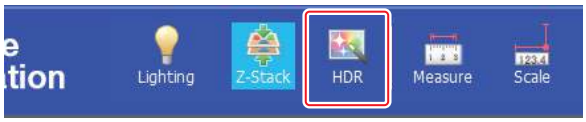
Since the range of brightness that can be captured is wide, a sample causing halation (a phenomenon in which white blurring occurs around a part under intense light) or a sample with poor gradation can be expressed in high-fidelity.

Switching to HDR

1 **On the toolbar, click [Image Observation].**



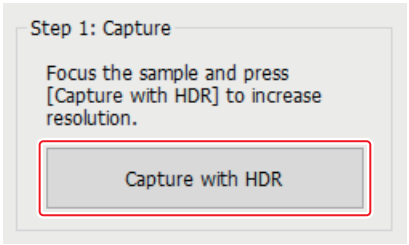
2 **Click the [HDR] button.**



The observation mode changes to HDR.

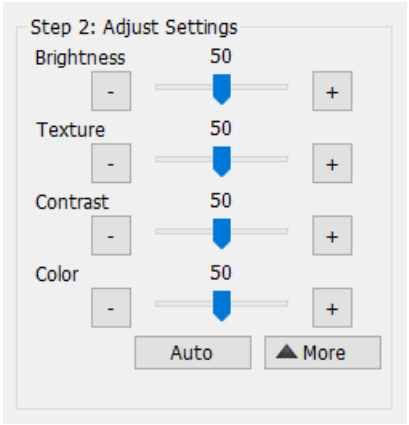
Step 1: Start HDR

1 **Click the [Capture with HDR] button.**



An image is captured.

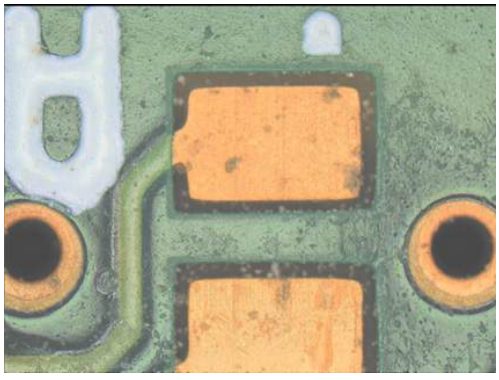
2 **Adjust the image.**



<1> Brightness

Drag the slider or click [-]/[+] button to adjust the image brightness. The larger the value, the brighter.

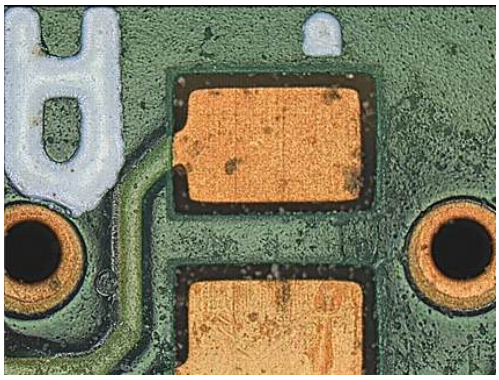
Settings range: 0 - 100



<2> Texture

Drag the slider or click [-]/[+] button to enhance the fine patterns on the surface. The larger the value, the more enhanced the image.

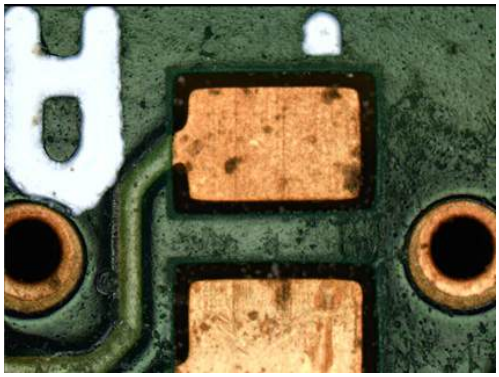
Settings range: 0 - 100



<3> Contrast

Drag the slider or click [-]/[+] button to adjust the tone of the image contrast. The larger the value, the larger the difference between the bright and dark parts.

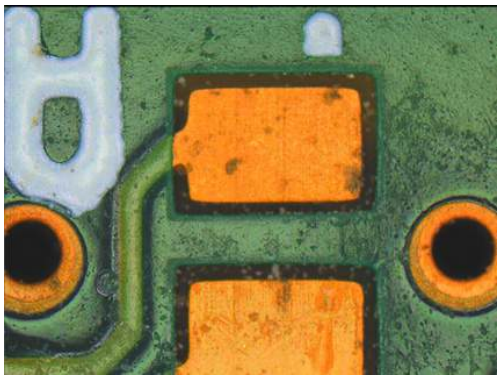
Settings Range: 0 - 100



<4> Color

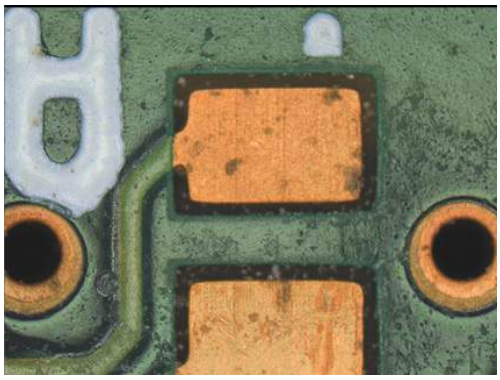
Drag the slider or click [-]/[+] button to adjust the color saturation (color intensity) of the image. The larger the value, the more vivid the color.

Settings Range: 0 - 100



<5> [Auto] button

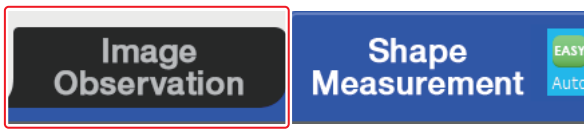
Adjusts HDR setting automatically.



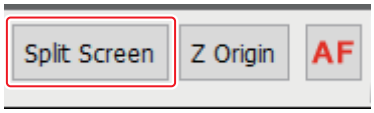
Useful Functions in Observation and Z-stack

Split Screen

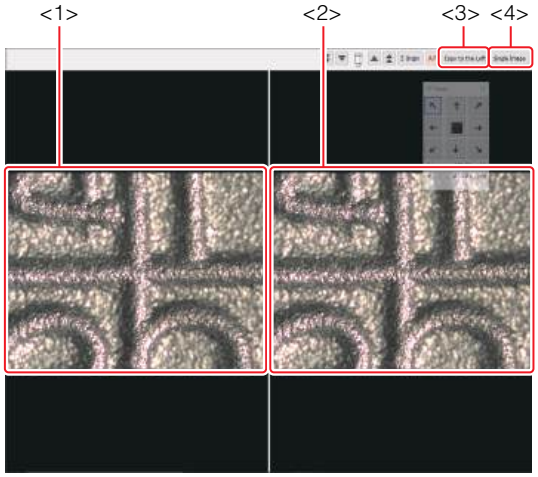
1 **On the toolbar, click [Image Observation].**



2 **On the operation panel, click the [Split Screen] button.**



The window splits into two.



<1> Left-side viewing window

Displays the image that was displayed when split screen was clicked.

<2> Right-side viewing window

Displays the image being captured.

<3> [Copy to the Left] button

Copies the image displayed in the right-side viewing window to the left window.

<4> [Single Image] button

Cancels split screen.

Capture (Save)

Capture (save) the image displayed in the viewing window.

1 **Click the [Save Image] button on the side panel.**

The [Save As] dialog box appears on the screen.

"Saving the Measurement Result" (Page 2-6)

2 **Specify the save destination folder and file name and save the image.**

Chapter 5

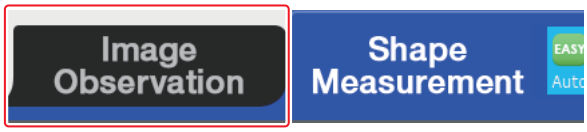
2D Measurement

Measure length or angle on an image being observed or on a captured still image. Also, you can display a scale (auxiliary line) and enter your comments.

Opening file

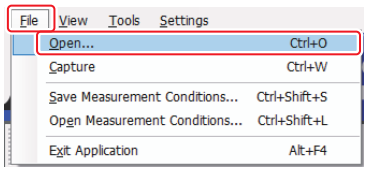
Open the file you captured (saved) to measure the length or angle of the image. Also, you can display a scale (auxiliary line) and enter your comments.

1 **On the toolbar, click [Image Observation].**



Switches to the observation mode.

2 **On the [File] menu, select [Open].**



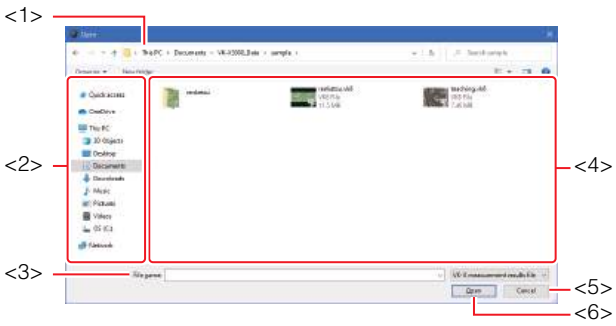
The [Open] dialog box appears.

"[Open] Dialog Box" (Page 5-2)

3 **Specify the folder and file name of the saved image.**

The image appears in the viewing window.

[Open] Dialog Box



<1> Folder location

Displays the folder that contains the files displayed in the file list.

<2> Folder list

Displays the folder structure in a tree.

<3> [File name] box

Enter the file name of the data to be opened.

<4> File list

Displays the files contained in the folder selected from the folder list.

<5> [Cancel] button

Closes the [Open] dialog box without opening the data.

<6> [Open] button

Opens the data and closes the [Open] dialog box.

Plane Measurements

In observation mode, distances between two points, lines, a distance from center to center, angles, the number of samples, etc. in the viewing window can be measured. The viewing window displays the measurement results.

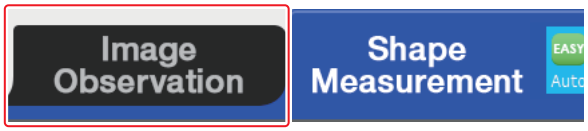
Important **Measure data obtained in 3D measurement mode by using the Analyzer Application. For details, see "VK-X3000 Series Analyzer Application Reference Manual".**

Plane Measurement Procedure

Paused images as well as images captured via Z-stack can be easily measured.

Reference
- Although you can similarly measure an image without pausing it in observation, displacements between the measurement result and image can result if the magnification is changed or the sample is moved.
- After the start point of measurement points is clicked, right-click to specify the start point again.

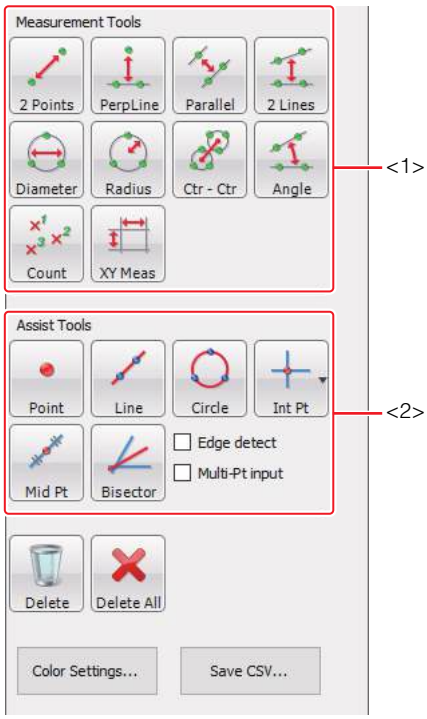
1 On the toolbar, click [Image Observation].



Switches to the observation mode.

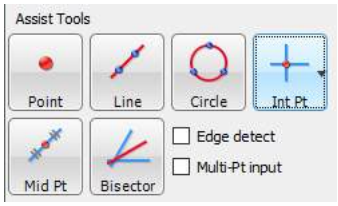
2 On the toolbar, click the [Measure] button.

The measurement tool (<1>) and the assist tool (<2>) are displayed on the side panel.



3 Click a button in the assist tool (<2>) as needed.

The button displays as selected.



4 Specify measurement points in the viewing window.

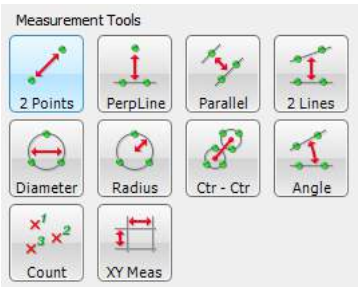
"Assist Tool" (Page 5-6)

Point

When required measurement items can be set with the measurement tool, it is unnecessary to use the assist tool.

5 Click a button in the measurement tool (<1>).

The button displays as selected.



6 Specify measurement points in the viewing window.

For the details of the operation, refer to each item about measurement.

"Measurement tool" (Page 5-11)

After specifying the measurement points, the measurement result appears. You can specify the colors of lines and points of the measurement tool, dimension auxiliary line, count, XY measurement line, and lines and points of the helper tool to be displayed in the viewing window individually.

"Color Settings" (Page 5-5)

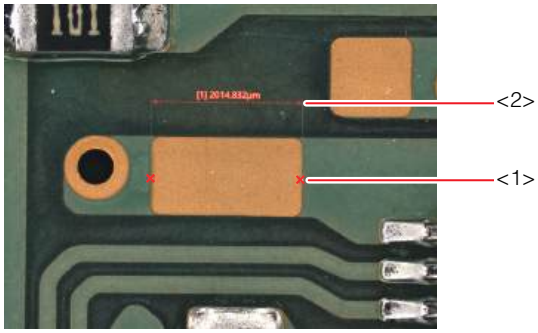
Reference

- Measurement by specifying points or lines arranged in the viewing window beforehand is also available.
- You can measure a total of 30 measurement and assist elements.
- [Count] can be counted up to 1000.

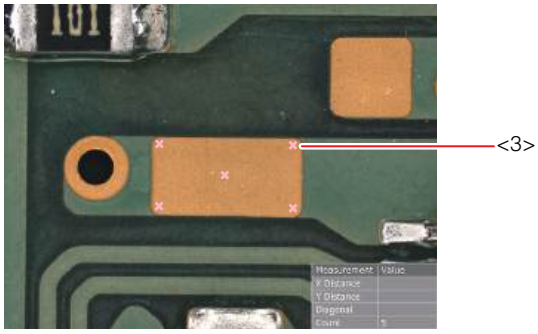
Color Settings

The colors of lines and points of the measurement tool (<1>), dimension auxiliary line (<2>), count (<3>), XY measurement line (<4>), and lines and points of the helper tool (<5>) in the viewing window can be specified.

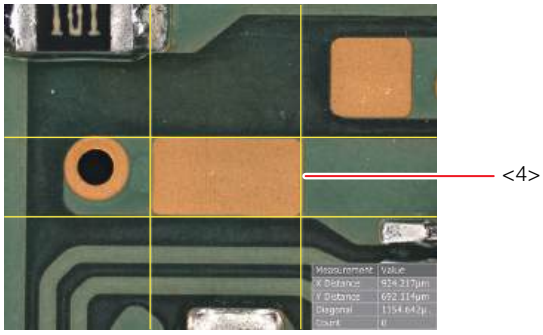
[2 Points]



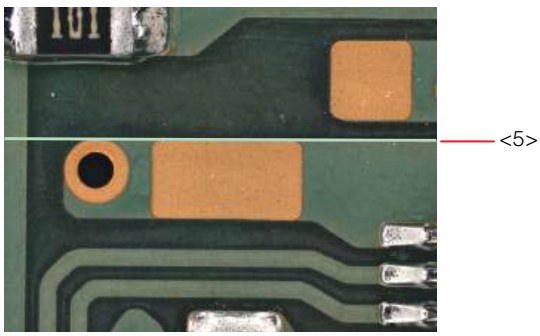
[Count]



[XY Meas]



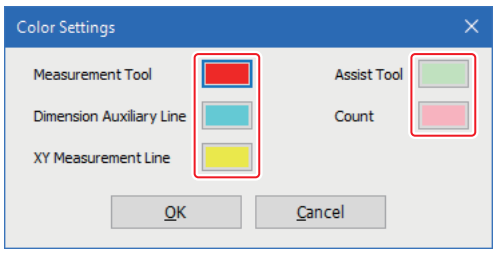
[Assist Tools (Line)]



1 Click the [Color Settings] button on the side panel.

The [Color Settings] dialog box appears.

2 Click a color palette.



Measurement Tool

Sets the point and line colors for the measurement tool.

Assist Tool

Sets the point and line colors for the assist tool.

Dimension Auxiliary Line

Sets the color for the dimension auxiliary line.

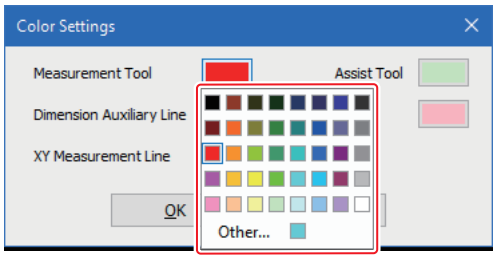
Count

Sets the color for the counts.

XY Measurement Line

Sets the line color for the XY measurement.

3 Select the color to be used.

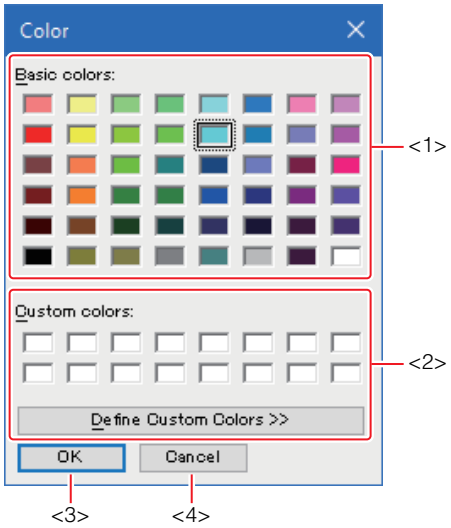


Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

■ [Color] dialog box

Select a color from Basic colors, or specify RGB values to create a color.



<1> [Basic colors]

Select the color to be used.

<2> [Custom colors] and [Define Custom Colors] button

Specify RGB values to create a color. However, after the [Color] dialog box is closed, all the colors displayed in [Custom colors] return to white.

<3> [OK] button

Sets the color and closes the [Color] dialog box.

<4> [Cancel] button

Closes the [Color] dialog box without setting the color.

Assist Tool

Elements placed by means of the assist tool can be used as auxiliary points and lines for setting measurement lines in the measurement tool.

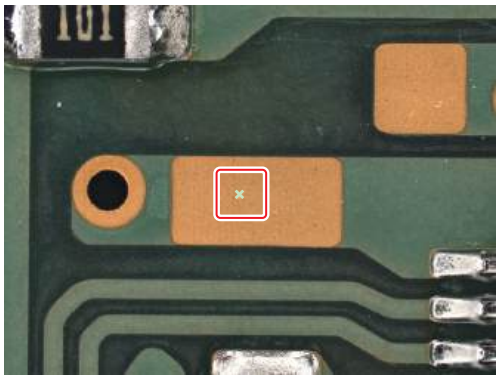
Arranging auxiliary points and lines at locations to be measured in advance enables efficient setting of measurement lines.

Placing a point

Place a point at a specified position.

1 Click the [Point] button on the side panel and click a desired position in the viewing window.

A point is displayed at the clicked position.

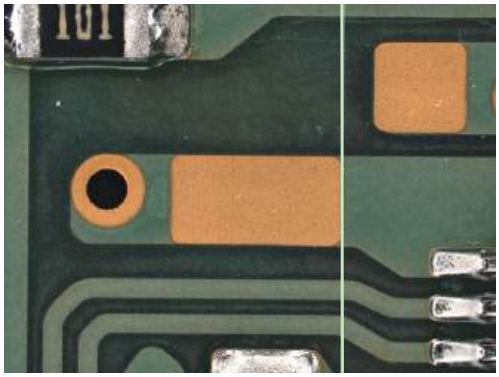


Placing a line

This places a straight line that runs through two user specified points.

1 Click the [Line] button on the side panel and click two points on a line in the viewing window.

A straight line running through the two clicked points is displayed.

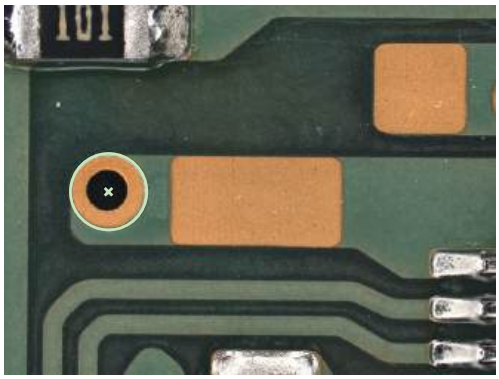


Placing a circle

This places a circle that runs through three user specified points.

1 Click the [Circle] button on the side panel and click three points on the circumference of the circle in the viewing window.

A circle running through the three clicked points is displayed.



Placing an intersection

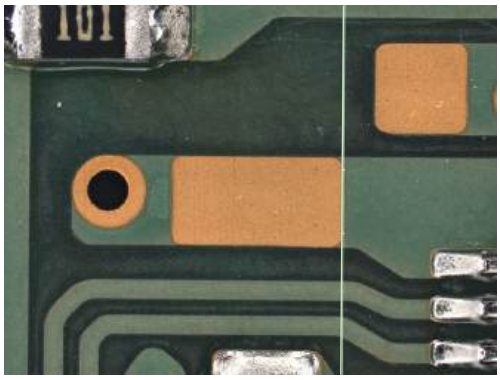
This places intersections of specified lines or circles.

■ Intersection of line and line

1 Click the [Int pt] button on the side panel and click [Line - Line].

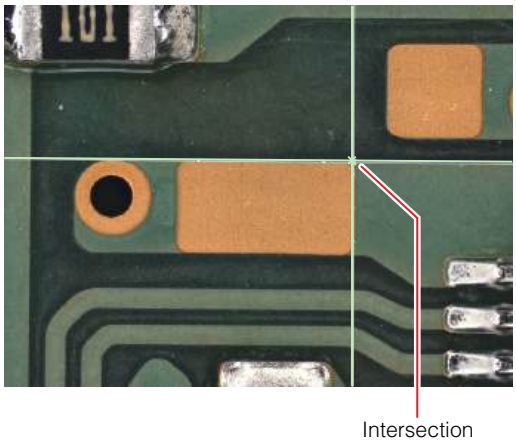
2 Click two points one by one on the first line in the viewing window.

A straight line appears.



3 Click two points one by one on the second line.

A straight line running through the two clicked points and an intersection of the lines are displayed.



■ Intersection of circle and line

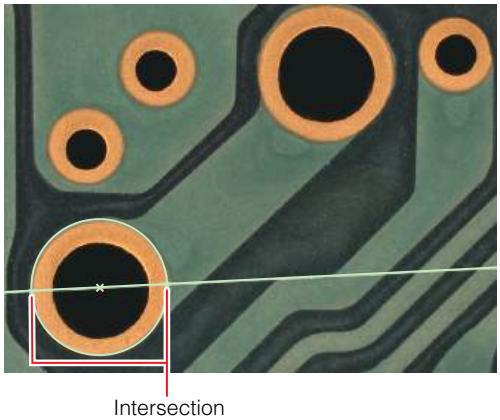
1 Click the [Int pt] button on the side panel and click [Circle - Line].

2 Click three points on the circumference of the circle in the viewing window.

A circle running through the three clicked points is displayed.

3 Click two points one by one on the line.

A straight line running through the two clicked points and an intersection of the lines are displayed.



Point

If there is no intersection of the circle and line, a midpoint between the center of the circle and line is displayed. However, no measurement can be carried out with the midpoint.

■ Intersection of circle and circle

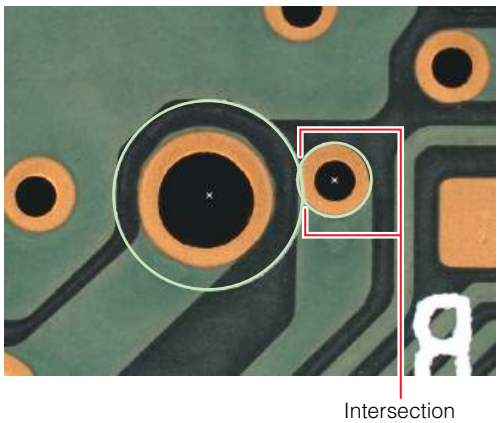
1 Click the [Int pt] button on the side panel and click [Circle - Circle].

2 Click three points on the circumference of the 1st circle in the viewing window.

A circle running through the three clicked points is displayed.

3 Click three points one by one on the circumference of the 2nd circle.

A circle running through the three clicked points and intersections of the circles are displayed.



Point

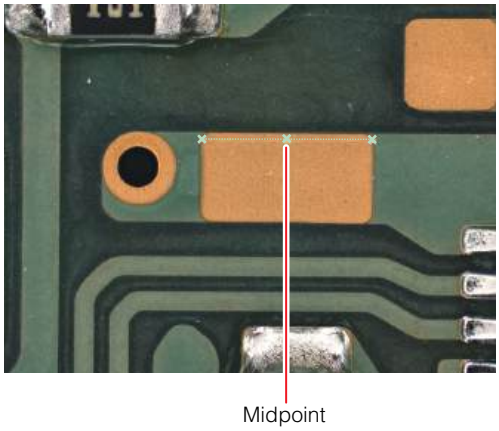
If there is no intersection of the circles, a midpoint between the centers of the circles is displayed. However, no measurement can be carried out with the midpoint.

Placing a midpoint

This places a midpoint between two user specified points.

1 Click the [Mid pt] button on the side panel and click two points in the viewing window.

A dashed line connecting the two clicked points and a midpoint between the two clicked points are displayed.



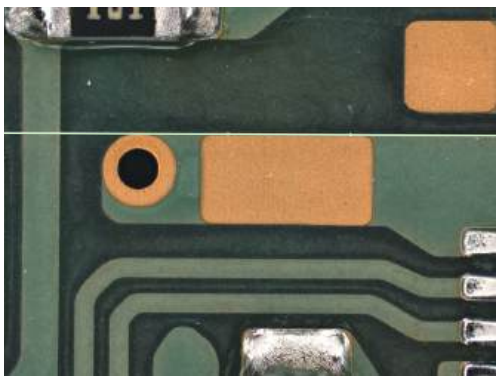
Placing a bisector

This places the bisector in relation to the interior angle (or the exterior angle) that intersects the two straight lines that were specified arbitrarily.

1 Click the [Bisector] button on the side panel.

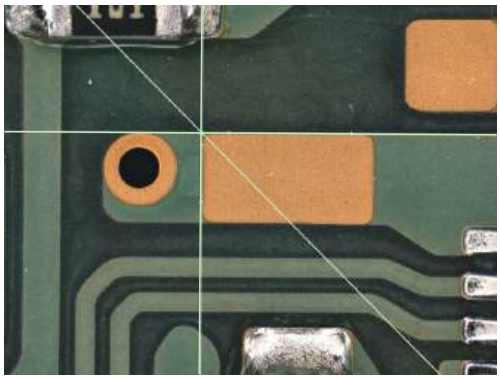
2 Click two points one by one on the first line in the viewing window.

A straight line running through the two clicked points is displayed.



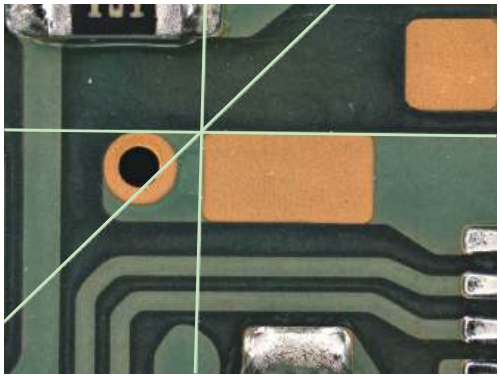
3 Click two points one by one on the second line.

The straight line that passes through the clicked two points, and the interior angle (or the exterior angle) that intersects the two straight lines is displayed.



4 Click the interior angle (or exterior angle) intersected by the two specified lines.

The bisector of the interior angles (or the exterior angle) that intersects the two specified straight lines is displayed.



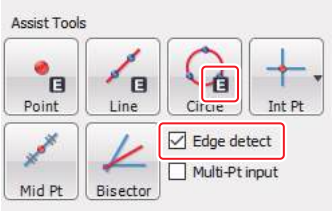
Edge detect

This function detects the edge of the sample and automatically corrects the measurement line.
It minimizes human errors. Auto extract edge is designed to minimize user error and is available for "2 Points", "PerpLine", "Parallel", "2 Lines", "Diameter", "Radius", "Ctr - Ctr", "Angle", "Point", "Line", and "Circle".

Reference When the image is not paused in observation, the [Edge detect] check box is not displayed.

1 Select the [Edge detect] check box on the side panel.

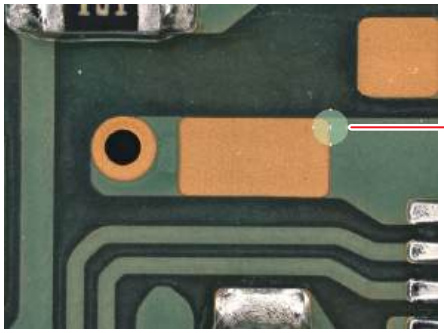
An 'E' is displayed on the bottom right of the icons for measurement and assist tools that have Auto extract edge available.



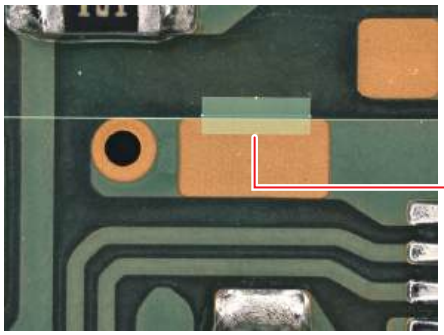
2 Place the target in the viewing window so that the Auto extract edge range contains the desired points or lines.

Click 1 point for Point, 2 points for Straight line, and 3 points for Circle.

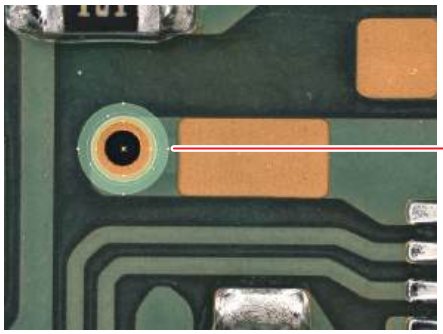
[Point]



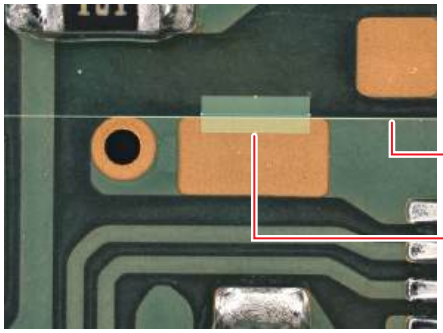
[Line]



[Circle]



Extracts the edge in the Auto extract edge range to determine the line.



Reference Drag the mouse pointer to change the range of auto extract edge.

For the procedure hereafter, operate according to the procedure for the measurement item you select.

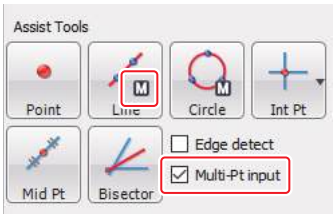
Multi-Pt input

Multi-pt input allow you to specify multiple measurement points and display a measurement line approximated by the least squares method. This function is designed to minimize user or measurement errors due to deformation, etc. of the sample. Multi-pt input is available for a reference line in "PerpLine", a reference line in "Parallel", "2 Lines", "Diameter", "Radius", "Ctr - Ctr", "Angle", "Line", and "Circle".

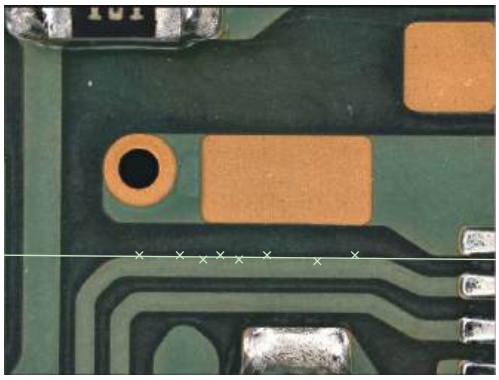
Reference Up to 99 measurement points can be specified in Multi-pt input.

1 Select the [Multi-Pt input] check box on the side panel.

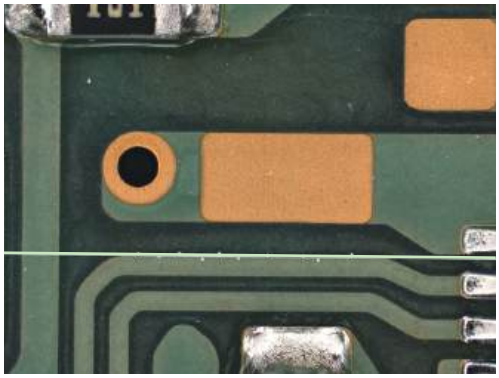
An “M” is displayed in the bottom right corner of the icons of the measurement and assist tools that the Multi-pt input function is available.



2 Select multiple points along the line (or circle) that you wish to measure.



3 To finish Multi-pt input, double-click the last measurement point.



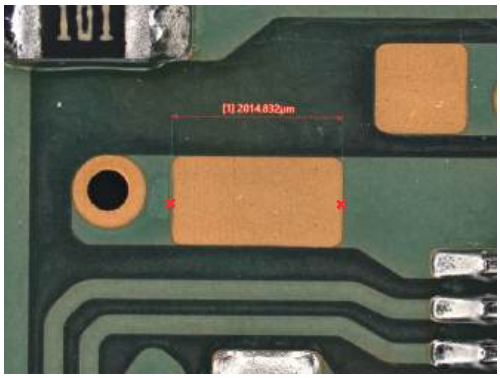
Measurement tool

Measurement of the distance between two points

Measures the distance between any two specified points.

1 Click the [2 Points] button on the side panel and click the start point and the end point in the viewing window.

The dimension line and measured value are displayed.



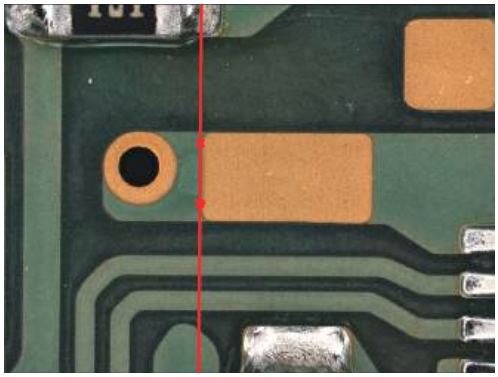
2 Click a location on the image to display the measured value.

Measurement of the length of a vertical line

Measures a length of a line perpendicular from any point to a reference line.

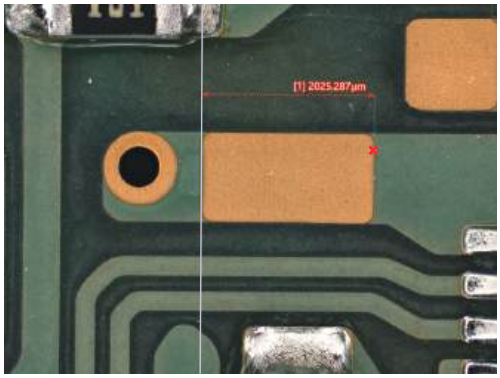
1 Click the [PerpLine] button on the side panel and click two points one by one on the line to be a reference line in the viewing window.

A reference line appears.



2 Click the position to be measured.

A vertical line from the clicked point to the reference line, and the measured value are displayed.



3 Click a location on the image to display the measured value.

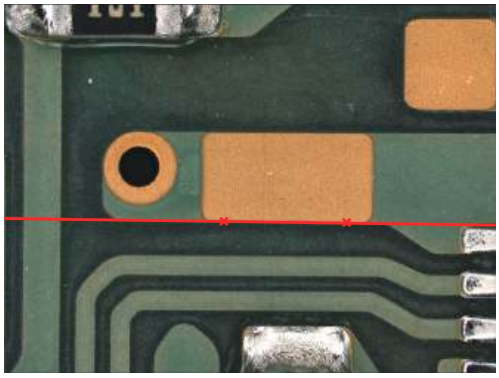
To specify multiple measurement points from the same reference line, click the [PerpLine] button on the side panel in step 1, and then click the reference line in the viewing window. Repeat the procedure described above for step 2 and so on.

Measurement of the distance between parallel lines

Measures the distance between a reference line and any parallel line.

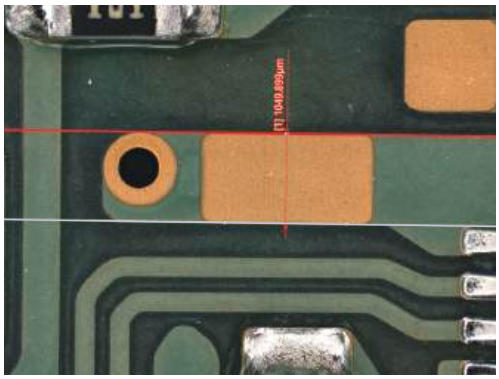
1 Click the [Parallel] button on the side panel and click two points on the line to be a reference line in the viewing window.

A reference line appears.

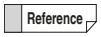


2 Click the position to be measured.

A parallel line running through the clicked point, a vertical line from the reference line to the parallel line, and the measured value are displayed.



3 Click a location on the image to display the measured value.



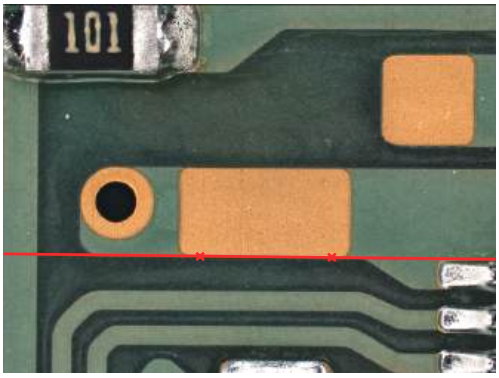
To specify multiple measurement points from the same reference line, click the [Parallel] button on the side panel in step 1, and then click the reference line in the viewing window. Repeat the procedure described above for step 2 and so on.

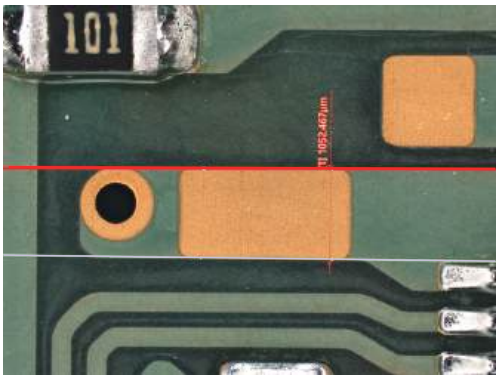
Measurement of the distance between lines

Measures the distance between a reference line and any line (a midpoint between the two points that define the line).

Point

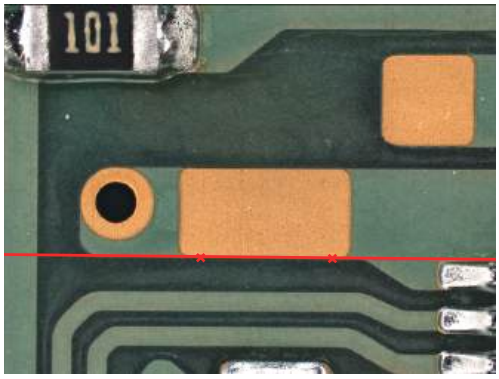
Although the distance between a reference line and a line that are not parallel can be measured, the distance varies with the positions of the two points that define the line.





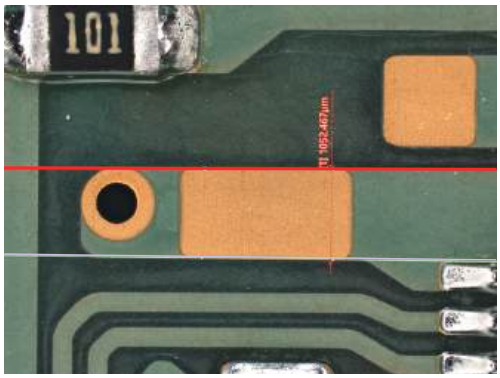
1 Click the [2 Lines] button on the side panel and click two points on the line to be a reference line in the viewing window.

A reference line appears.



2 Click two points one by one on the second line.

A vertical line from a line running through the two clicked points to the reference line, and the measured value are displayed.



3 Click a location on the image to display the measured value.

Reference

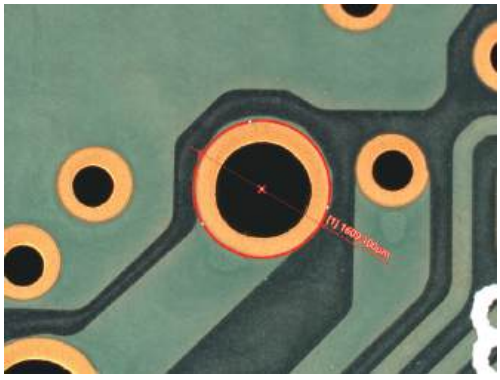
To specify multiple lines from the same reference line, click the [2 Lines] button on the side panel in step 1, and then click the reference line in the viewing window. Repeat the procedure described above for step 2 and so on.

Measurement of the diameter of a circle (radius)

This measures a diameter (a radius) of the circle that runs through three arbitrarily selected points.

1 Click the [Diameter] button ([Radius] button) on the side panel and click three points on the circumference of the circle in the viewing window.

A circle running through the three clicked points, diameter (radius), center point, and the measured value are displayed.



2 Click a location on the image to display the measured value.

Distance between the centers of circles

This measures the distance between the centers of two circles.

1 Click the [Ctr - Ctr] button on the side panel and click three points on the circumference of the 1st circle in the viewing window.

A circle running through the three clicked points is displayed. The 1st circle represents a reference circle.

2 Click three points on the circumference of the 2nd circle.

A circle running through the three clicked points, a straight line connecting the centers of the two circles, and the measured value are displayed.

3 Click a location on the image to display the measured value.

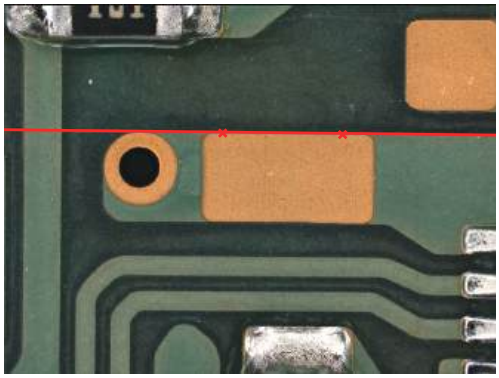
To specify multiple circles from the same reference circle, click the [Ctr - Ctr] button on the side panel in step 1, and then click the reference circle in the viewing window. Repeat the procedure described above for step 2 and so on.

Measuring an angle

By specifying two arbitrary straight lines, the interior angle of the two sides formed by those points is measured.

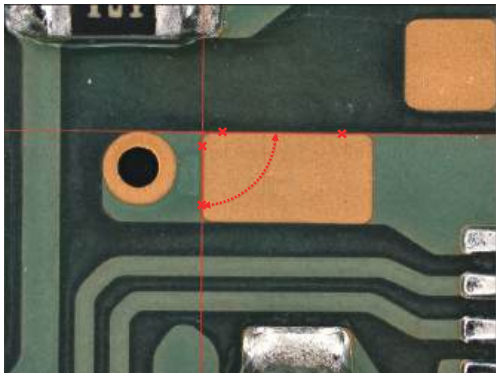
1 Click the [Angle] button on the side panel and click two points on the 1st side in the viewing window.

A straight line running through the two clicked points is displayed.



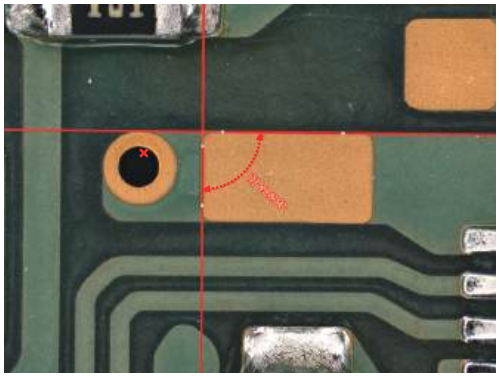
2 Click two points on the 2nd side.

The dotted arrow shows the angle to be measured.



3 Click the angle you want to measure.

Displays the measured value.



4 Click a location on the image to display the measured value.

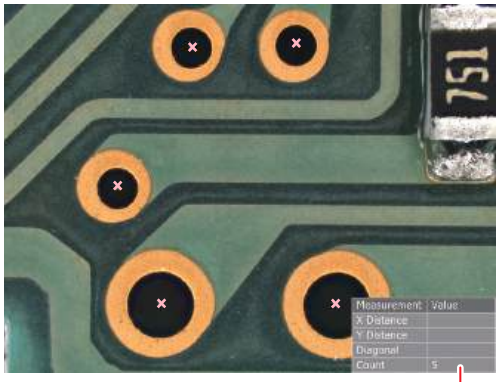
Reference To specify multiple lines from the same reference line, click the [Angle] button on the side panel in step 1, and then click the reference line in the viewing window. Repeat the procedure described above for step 2 and so on.

Counting the number of points

Count Specify any points on the image and count them.

1 Click the [Count] button on the side panel and click measurement points one by one in the viewing window.

The clicked points are marked with x, and [Count] appears in the viewing window.



Count

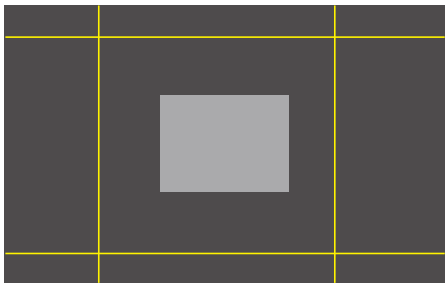
Measuring the size of rectangles and length of diagonal lines

Reference When moving XY measurement result, after clicking the [Count] button to deselect, click the [XY meas] button to display [XY measurement result], and drag XY measurement result.

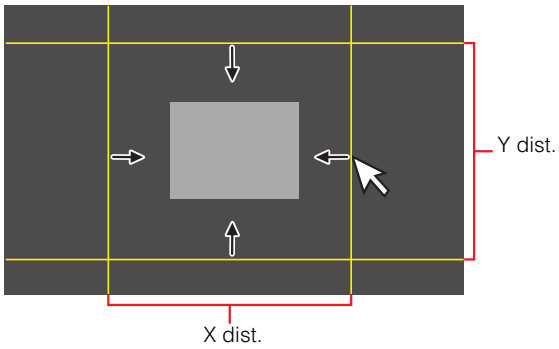
XY meas Encircling a sample by lines in horizontal (X axis) and vertical (Y axis) directions, this measures distances of the sample in the horizontal and vertical directions and the length of the diagonal line of the rectangle that consists of the lines encircling the sample.

1 Click the [XY meas] button on the side panel.

The X axis (horizontal axis) and the Y axis (vertical axis) are displayed in the viewing window.



2 Drag the X axis and the Y axis individually in the viewing window to encircle the object you want to measure by the X axis and the Y axis.



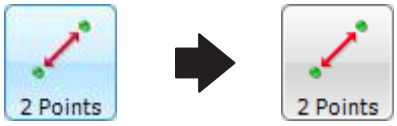
The X dist. (horizontal distance) and the Y dist. (vertical distance) across the object and the length of the diagonal line are displayed in the viewing window.

Measurement	Value
X Distance	966.382µm
Y Distance	723.690µm
Diagonal	1207.320µ...
Count	0

Moving and Correcting a Measurement Point

Point

If icons in the measurement tool or assist tool are selected, the points cannot be moved and corrected. Click the icon to deselect it.



Moving a measurement point, measured value, line and circle

1 Drag the measurement result (point, line, measured value, etc.) that you want to move and drop it at the appropriate position.

Deleting measurement results

■ Delete

Deletes measurement results (points, lines, measured values, etc.) displayed in the viewing window individually.

1 Click the measurement result (point, line, measured value, etc.) that you want to delete in the viewing window.

2 Click the [Delete] button.

Reference

In [PerpLine] or [Parallel], measurement points can be deleted one by one. Also, if a reference line is deleted, all the measurement points for the line will be deleted.

■ Delete all

Measurement results, reference lines, X axis and Y axis of XY measurement, which are measured in the Plane, will all be deleted.

1 Click the [Delete all] button.

The confirm dialog box appears.

2 Click the [Yes] button.

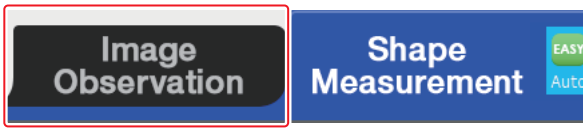
All the measurement results are deleted.

Scale (Auxiliary Line)

Displaying the Scale

Displays the scale (auxiliary lines) for size estimation in the viewing window.

1 **On the toolbar, click [Image Observation].**

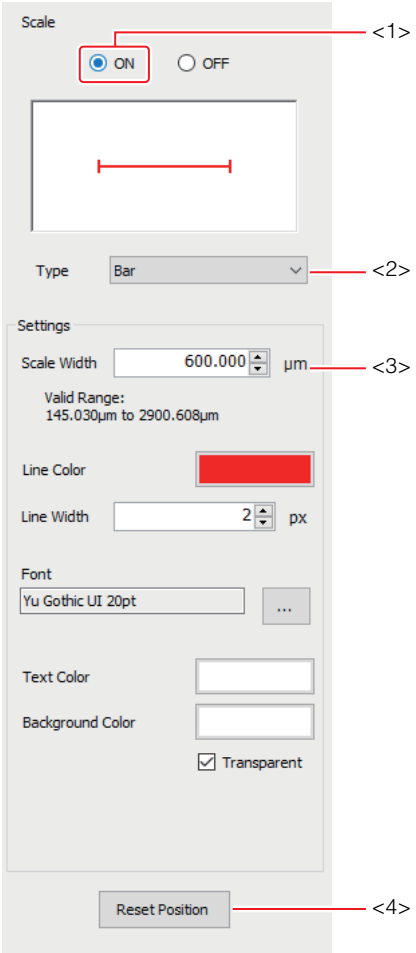


Switches to the observation mode.

2 **On the toolbar, click the [Scale] button.**

[Scale] is displayed on the side panel.

3 **Click the [ON] radio button (<1>) in [Scale].**

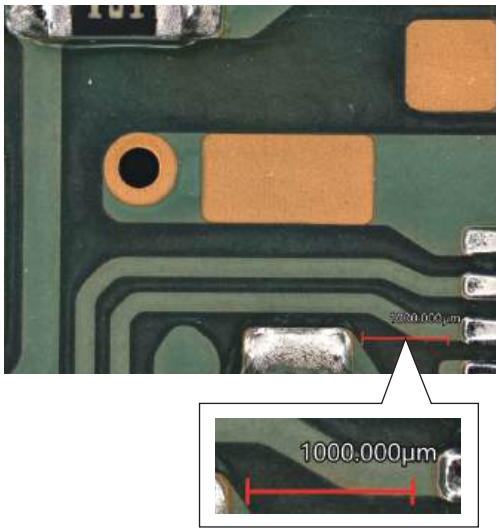


The viewing window displays the scale.

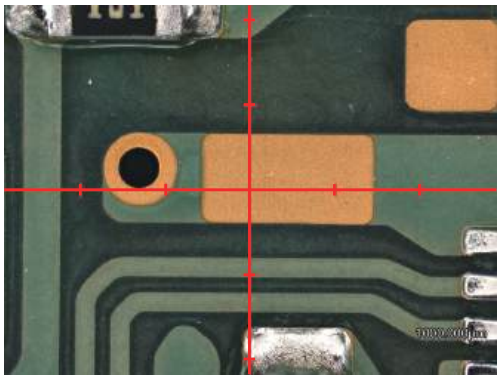
4 **Select a type of the scale in the [Type] box (<2>).**

The available types of scales are as follows.

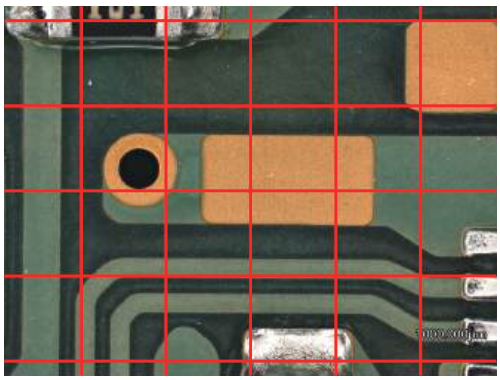
- Bar



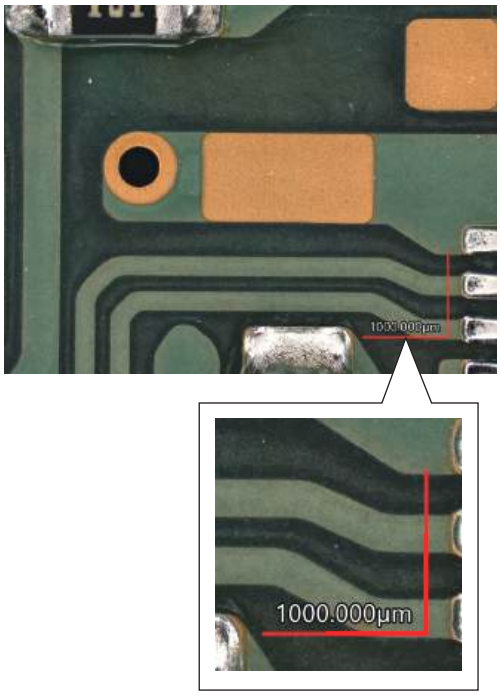
- Cross



- Mesh



- XY Bar



Reference The number of decimals for the dimensions can be changed.

"Setting the Display Units and Number of Decimal Places in Numerical Values" (Page A-5)

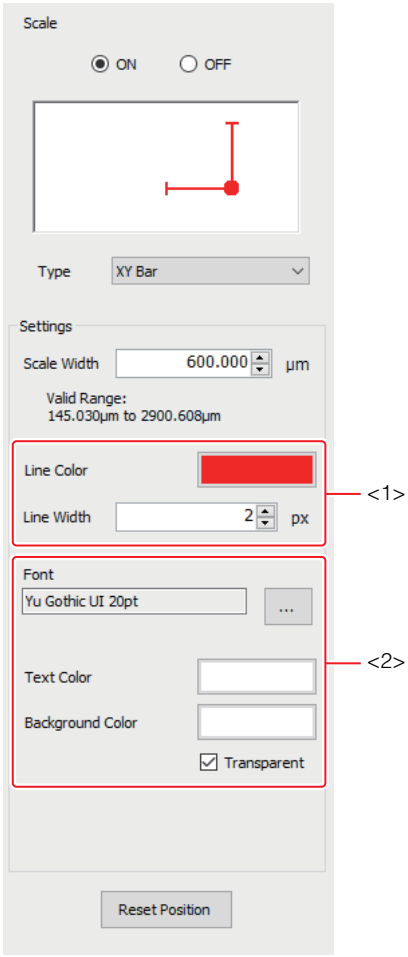
5 Enter the reference length of the scale to display in the [Scale Width] box (<3>).

Point The scale width that can be entered depends on the camera and the magnification being used.

Reference
- Move a scale and a scale width (value) displayed in the viewing window by dragging them.
- Clicking the [Reset Position] button (<4>) resets the scale and the scale width (value) to their initial positions.

Display Settings

Configures the display settings of a scale and a scale width (value) in the viewing window.



<1> Show scale

[Line Color] color palette

Sets the line color of the scale.

Click the color palette to select a desired color. Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

[Line Width] box

Sets the width of the line.

The higher the value, the thicker the line.

Settings Range: 1 - 4 px

<2> Scale width (value) display

Sets the display of the scale width (value).

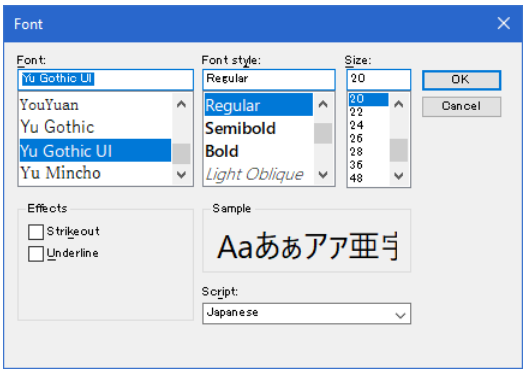
[Font] box

The current font type is displayed.

- [...] button

  Sets the font type.

  Clicking this displays the [Font] dialog box.



  Set [Font], [Font style], [Size], and [Effects] and click the [OK] button.

[Text Color] color palette

Sets the color of the characters.

Click the color palette to select a desired color. Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

[Background color] color palette

Sets the background color of the text.

Click the color palette to select a desired color. Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

[Transparent] check box

Select this check box to make the background transparent.

Comment (Text and Graphics)

In observation mode, comments (texts and graphics) can be displayed in the viewing window. The image can be captured (saved) with these comments displayed directly on the image.

There are two types of comments: [Normal comment] and [Fixed comment].

- Normal comment

  This is the comment where the character or the figure can be entered arbitrarily.

- Residual comment

  This type of comment has a predetermined content.

Reference In 3D measurement mode, comments are not permitted. Edit comments in observation mode and then switch to 3D measurement mode.

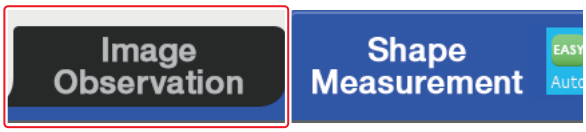
Point **Comments cannot be edited on a saved image that is opened.**

Procedure for Adding a Comment

Pausing or depth-compositing an image in observation enables you to enter comments with the viewing window paused.

Reference Comments can also be entered using the same procedures for images that are not paused. The comments remain fixed to their locations even if the sample is moved.

1 On the toolbar, click [Image Observation].

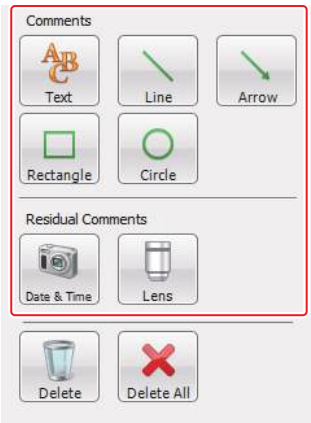


Switches to the observation mode.

2 On the toolbar, click the [Comment] button.

Normal comment and Fixed comment are displayed on the side panel.

3 Click the button for the comment that you want to enter.



The button displays as selected.

4 Add a comment in the viewing window.

Refer to each comment item for details.

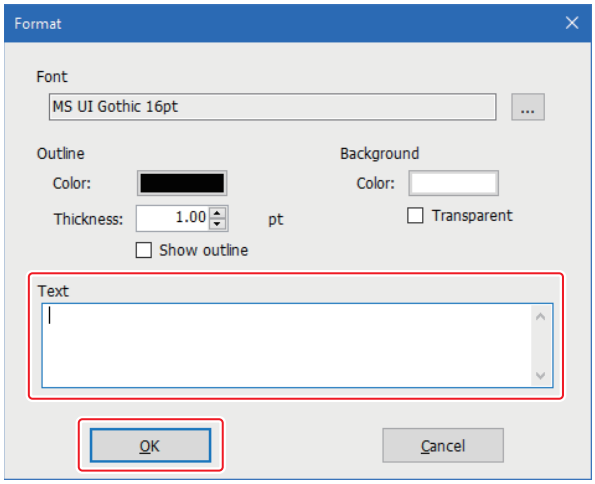
Entering Normal Comments

Entering text

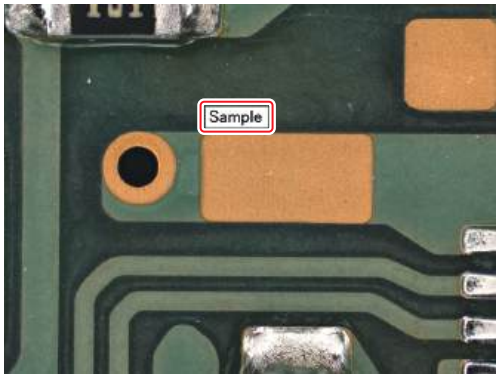
Enters text.

1 **Click the [Text] button on the side panel.**
The [Format] dialog box appears.

2 **Enter text in the [Text] box and click the [OK] button.**



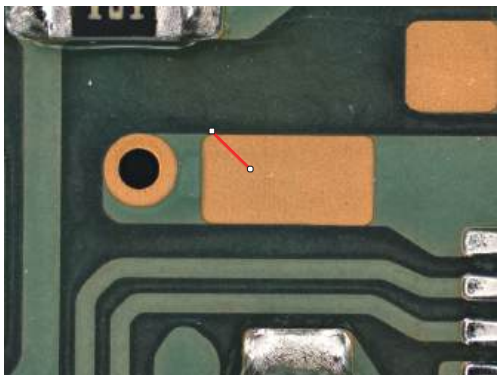
3 **Click the position where you want to display the text in the viewing window.**



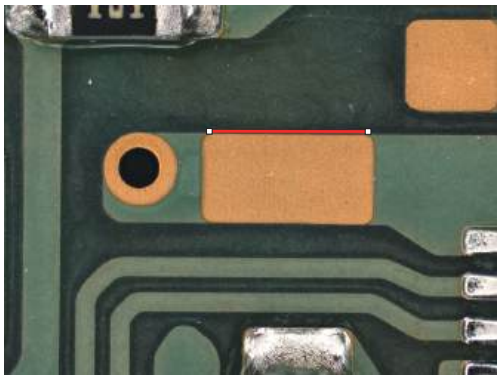
Drawing a line

Draws a line.

1 **Click the [Line] button on the side panel and click the start point in the viewing window.**



2 **Drag the line or either end of the line to move the line.**



Reference

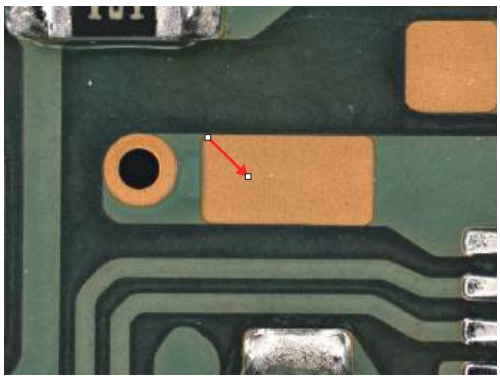
Dragging either end of the line with the Shift key pressed enables you to change the length of the line while the alteration of the line angle is restricted.

Drawing an arrow

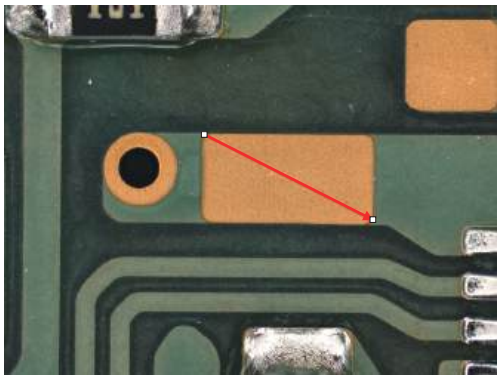
Draws an arrow.

1 Click the [Arrow] button on the side panel and click the start point in the viewing window.

The arrow whose head is on the end point is displayed.



2 Drag the line or either end of the arrow to move the arrow.



Reference

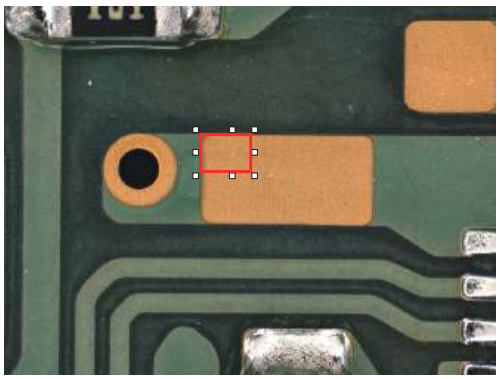
Dragging either end of the line with the Shift key pressed enables you to change the length of the line while the alteration of the line angle is restricted.

Drawing a rectangle

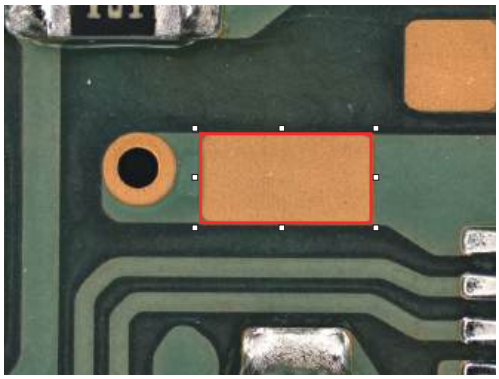
Draws a rectangle.

1 Click the [Rectangle] button on the side panel and click a desired position in the viewing window.

A rectangle is displayed.



2 Drag the rectangle or the □ on the four corners or the sides to move the rectangle.



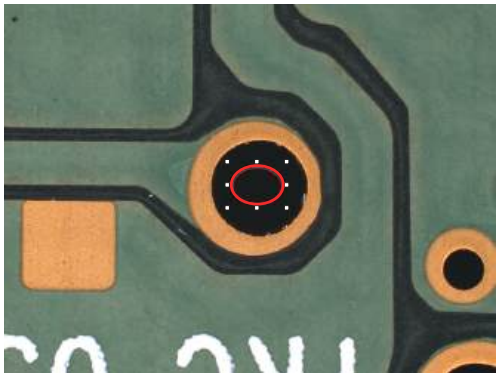
Reference

Dragging □ on the four corners while holding down the Shift key enables you to change the size of the graphic while the aspect ratio is maintained.

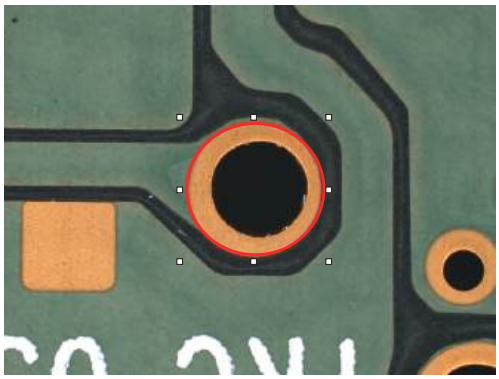
Drawing a circle

Draws a circle.

1 Click the [Circle] button on the side panel and click a desired position in the viewing window.
The circle is displayed.



2 Drag the circle or the □ on the circumference to move the circle.



Reference Dragging □ on the four corners while holding down the Shift key enables you to change the size of the graphic while the aspect ratio is maintained.

Displaying Residual Comments

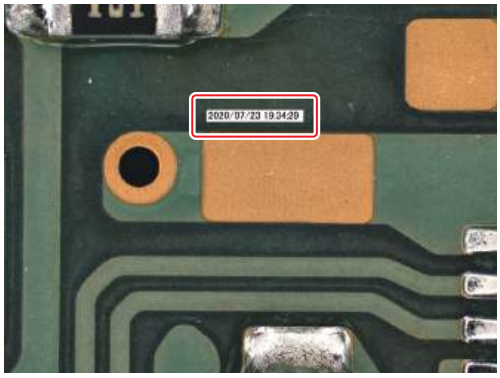
Point Fixed comments cannot be displayed on the left side of the screen in split screen.

Displaying capture date and time

Displays the capture date and time.

Reference When the image is not paused in observation, the current date and time is displayed.

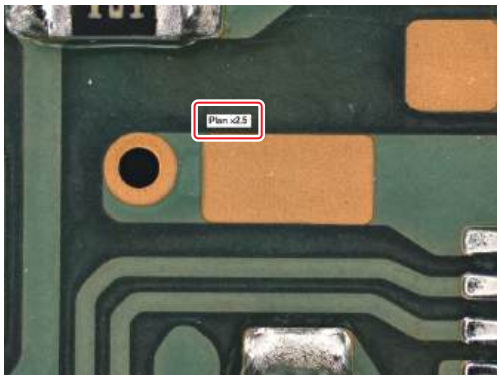
1 Click the [Date & time] button on the side panel and click a desired position in the viewing window.
The capture date and time is displayed.



Displaying the Lens Registration Name and Magnification

Display the registration name and magnification of the objective lens in use.

1 Click the [Lens] button on the side panel and click a desired position in the viewing window.
The objective lens registration name and magnification is displayed.



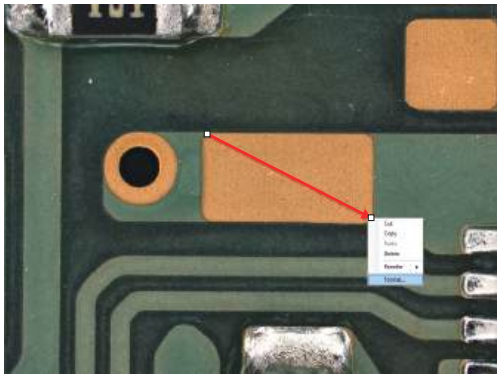
Setting the Display Method for the Comment

Specifies the display method for comments and graphics in the viewing window.

Setting the line color and the line width of the figure

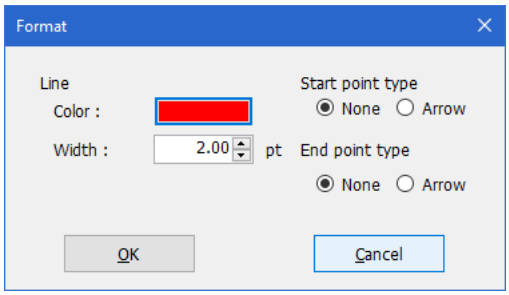
The line color and line width can be changed for any graphics that are added. The procedures below use an arrow as an example for changing the line color and line width.

1 Double-click the line of the graphic to change the line color or width, or right-click and select [Format] in the viewing window.



The [Format] dialog box appears.

2 Change the settings.



● Line

[Color] color palette

Sets the line color of the graphics.

Click the color palette to select a desired color. Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

[Width] box

Changes the line width of graphics.

The higher the value, the thicker the line.

Setting range: 0.10 - 6.00 pt

● Start point type

Sets the shape of the start point.

Setting range: None, Arrow

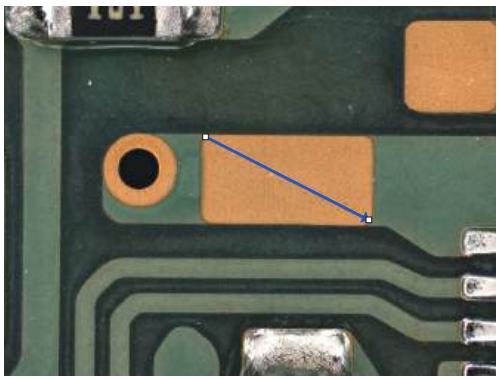
● End point type

Sets the shape of the end point.

Setting range: None, Arrow

3 Click the [OK] button.

The line color and line width are changed and the [Format] dialog box closes.

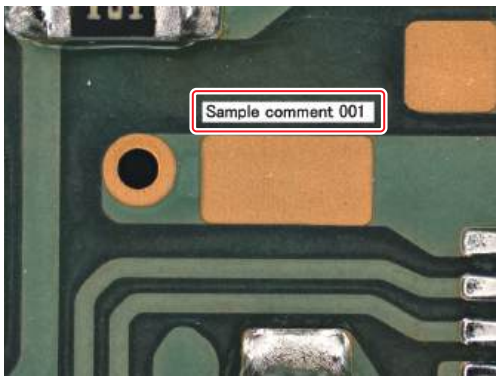


Reference Click the [Cancel] button to close the [Format] dialog box without changing the line color and line width.

Setting font type, frame line color, and background of the character

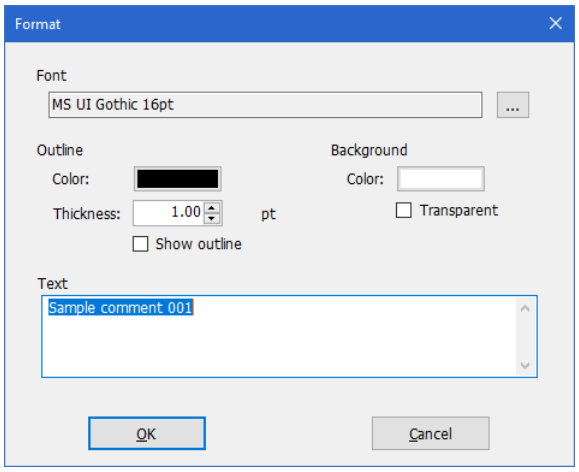
You can change the font type, frame line color, line width and background color of characters or text in a fixed comment added in the viewing window.

1 Double-click the target character, or right-click and select [Format] in the viewing window.



The [Format] dialog box appears.

2 Change the settings.



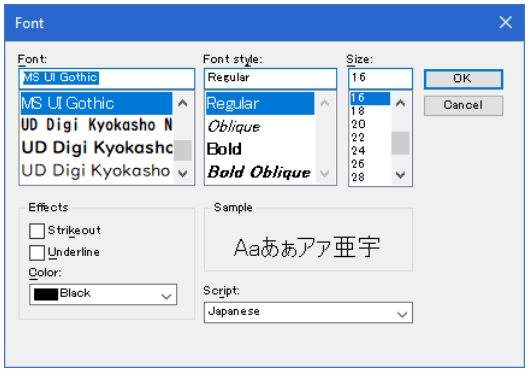
● [Font] box

The current font type is displayed.

[...] button

Sets the font type.

Clicking this displays the [Font] dialog box.



Set [Font], [Font style], [Size], [Effects] and [Color] and click the [OK] button.

● Outline

Sets the format of the frame line encircling the text.

[Color] color palette

Sets the color of the frame line.

Click the color palette to select a desired color. Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

[Thickness] box

Changes the frame line width.

The higher the value, the thicker the line.

Setting range: 0.10 - 6.00 pt

[Show outline] check box

When checked, the frame line is displayed.

● Background

[Color] color palette

Sets the background color of the text.

Click the color palette to select a desired color. Click the [Other] button to open the [Color] dialog box.

"[Color] dialog box" (Page 5-6)

[Transparent] check box

Select this check box to make the background transparent.

● Text

Enter text you want to add in the viewing window. Press the Enter key to insert a line feed.

Point Text of fixed comments cannot be changed.

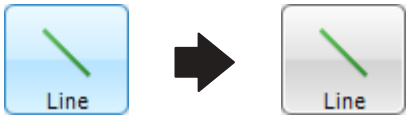
3 Click the [OK] button.

The line color and line width are changed and the [Format] dialog box closes.

Reference Click the [Cancel] button to close the [Format] dialog box without changing the line color and line width.

Moving and Deleting a Comment

Point If the icon for normal comments is selected, the comment cannot be moved and deleted. Click the icon to deselect it.



Moving a comment

1 Drag the comment that you want to move, and drop it at a proper position.

Deleting a comment

■ Delete

Deletes comments displayed in the viewing window, individually.

1 Click the comment you want to delete in the viewing window.

Reference Clicking while holding down the Shift key on the keyboard enables you to select multiple comments at the same time.

2 Click the [Delete] button.

Reference
- You can also delete the comment by clicking the [Delete] key on the keyboard.
- Right-clicking the comment enables Cut, Copy, Paste and Reorder.

■ Delete all

Deletes all comments displayed in the viewing window.

1 Click the [Delete all] button.

The confirm dialog box appears.

2 Click the [Yes] button.

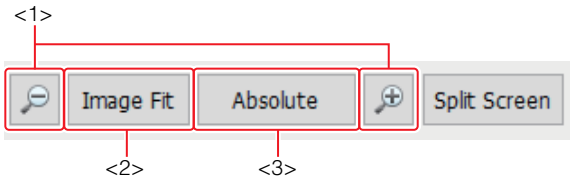
All comments are deleted.

Useful Functions in Measuring Dimensions

Changing the Display Magnification

The display magnification of a captured still image can be changed. You can also observe the image by enlarging it.

1 On the operation panel, select a display magnification.



<1> Zoom In/Out buttons

The displayed image can be magnified or reduced as desired.

<2> [Image Fit] button

Changes the display magnification so that the entire image is displayed in the viewing window.

<3> [Absolute] button

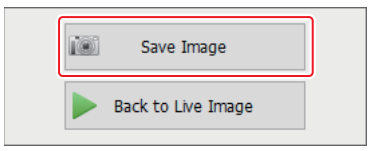
The image is displayed in actual size.

Reference The display magnification can also be changed by turning the mouse scroll wheel.

Capture (save)

Capture (save) the image displayed in the viewing window.

1 Click the [Save Image] button on the side panel.



The [Save As] dialog box appears on the screen.

"Saving the Measurement Result" (Page 2-6)

2 Specify the save destination folder and file name and save the image.

MEMO

Chapter 6

Shape Measurement

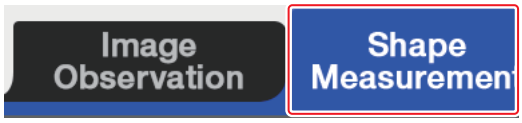
This chapter describes how to obtain a new 3D image (height information). Shapes can be measured by automatically adjusting the settings or individually adjusting the settings according to the sample or application.

Automatic Measurement

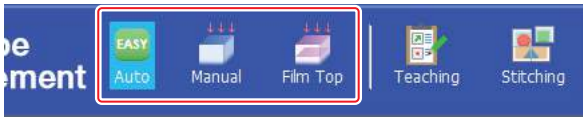
Automatic measurement is an easy measurement mode that enables shapes to be measured with minimal settings. This is ideal for new users or parts with simple geometry and features.

Switching to Automatic Measurement

1 **On the toolbar, click [Shape Measurement].**

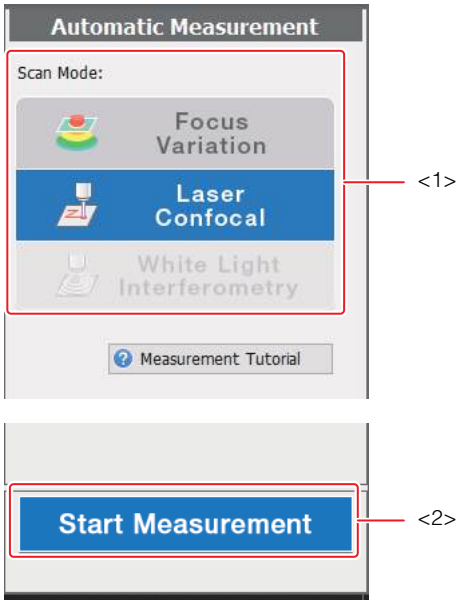


2 **Click the [Auto] button.**



The shape measurement mode changes to automatic measurement.

Side Panel for Automatic Measurement



<1> Scan Mode

Select the sample scan method from the following. The item with blue background is the current scan mode.

- Focus variation
- Laser confocal
- White light interferometry

"Scan Mode" (Page 6-17)

Point

The scan modes which can be selected depend on the lens being used.

- Plan, Plan Apo: focus variation, laser confocal
- DI: white light interferometry (fixed)

<2> [Start Measurement] button

Measure the shape based on the current settings. After the shape measurement is completed, the measurement result (3D image) is displayed.

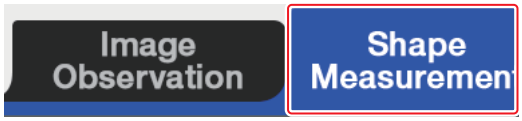
"2D Measurement" (Page 5-1)

Manual Measurement

Manual measurement is the measurement mode for advanced users who want to adjust the advanced measurement settings such as scan mode, image brightness, and lens moving pitch.

Switching to Manual Measurement

1 On the toolbar, click [Shape Measurement].

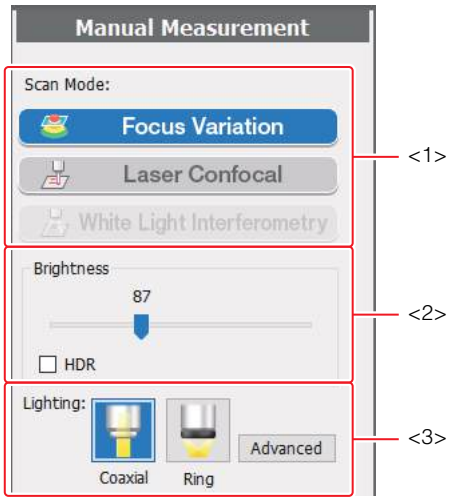


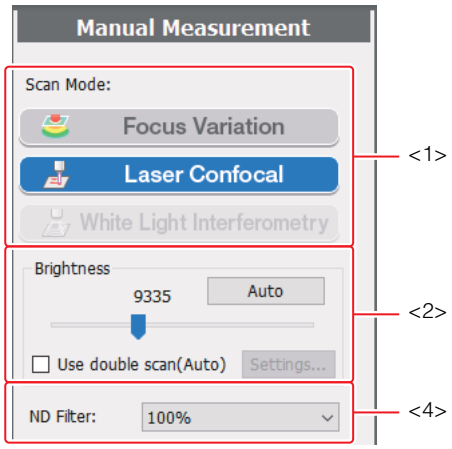
2 Click the [Manual] button.

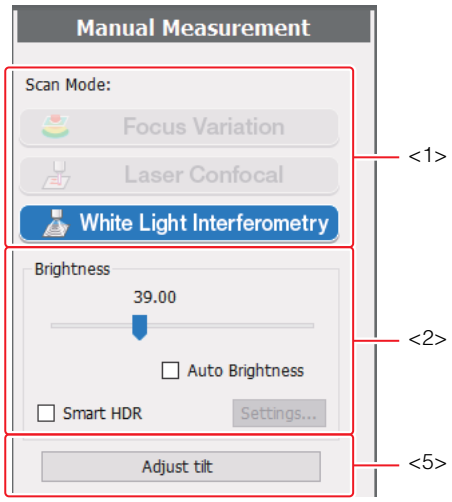
The shape measurement mode changes to manual measurement.

Side Panel for Manual Measurement

■Top of the screen







<1> Scan Mode

Select the sample scan method from the following. The item with blue background is the current scan mode.

- Focus variation
- Laser confocal
- White light interferometry

"Scan Mode" (Page 6-17)

Point

The scan modes which can be selected depend on the lens being used.

- Plan, Plan Apo: focus variation, laser confocal
- DI: white light interferometry (fixed)

<2> Brightness

Move the slide bar to adjust the brightness.

Point

The advanced settings depend on the scan mode.

- For focus variation
  Selecting the [HDR] check box performs the measurement using HDR.
- For laser confocal
  Click the [Auto] button to adjust the brightness automatically.
  Selecting the [Use double scan(Auto)] check box performs the measurement using double scan. In addition, clicking the [Settings] button displays the [Double Scan Settings] dialog box.
- For white light interferometry
  Selecting the [Auto Brightness] check box automatically sets the brightness.
  Selecting the [Smart HDR] check box performs the measurement using smart HDR. In addition, clicking the [Settings] button displays the [Smart HDR setting] dialog box.

<3> Lighting

Select the lighting to be used.

Click this to switch on or off.

Click the [Advanced] button to display the [Lighting Settings] dialog box.

"Adjusting the Brightness of the Lighting" (Page 3-7)

Reference

- This appears only when the scan mode is focus variation.
- To use ring illumination, you need to mount the ring illumination adaptor on the lens.

<4> [ND Filter] box

Physically (optically) adjust the amount of light that enters the light receiving element (photomultiplier).

Reference

This appears only when the scan mode is laser confocal.

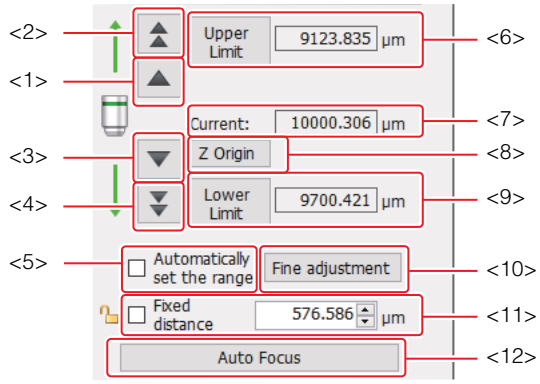
<5> [Adjust tilt] button

Click the [Adjust tilt] button to open the [Adjust tilt] dialog box.

Reference

This is displayed only when the scan mode the white light interferometry.

■Middle of the screen



<1>

The objective lens moves upward.

<2>

The objective lens moves upward. This button moves the lens ten times more than ▲ .

<3>

The objective lens moves downward.

<4>

The objective lens moves downward. This button moves the lens ten times more than ▼ .

<5> [Automatically set the range] check box

Selecting the check box automatically sets the maximum and minimum limits as well as the brightness during measurement.

Important

- **When laser confocal is set, the laser is emitted before measurement and maximum and minimum limits are set according to the laser intensity.**
- **When focus variation is set, lower the objective lens to a position where the image is blurred and start measurement. If necessary, adjust the shutter speed. If the updating of the focus variation image stops for a certain amount of time while executing measurement, end measurement.**
- **When white light interferometry is set, the maximum and minimum limits are determined from the change in the interference stripes to the lens movement after executing the laser auto focus.**

Point

When focus variation and white light interferometry are set, the name will be [Automatically set the range], and the brightness will be out of the target of the auto settings.

<6> [Upper Limit] button

Set the upper limit of the measurement range.

Setting this displays the value in the box in the right side.

<7> Current

The current position of the objective lens is displayed.

<8> [Z Origin] button

Selecting this returns the position of the objective lens to the origin.

<9> [Lower Limit] button

Set the lower limit of the measurement range.

Setting this displays the value in the box in the right side.

<10> [Fine adjustment] button

Selecting this sets the movement of the objective lens to a small, minute amount.

Reference

This is displayed only when the scan mode is white light interferometry.

<11> [Fixed distance] check box

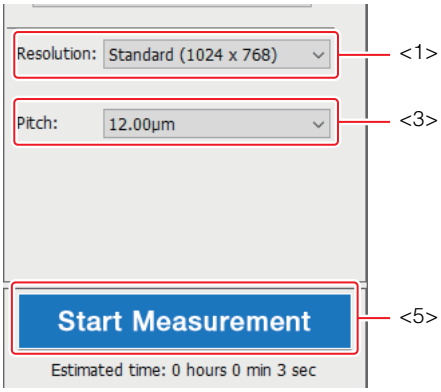
Selecting this check box maintains the value displayed in the box in the right side as a measurement range.

<12> [Auto Focus] button

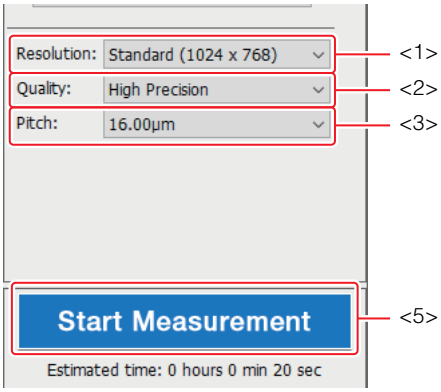
Execute the auto focus.

■Bottom of the screen

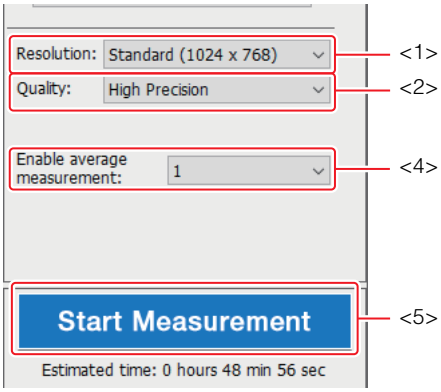
For focus variation



For laser confocal



For white light interferometry



<1> [Resolution] box

Select the size of the measurement result.

"Measurement Setting" (Page 6-21)

<2> [Quality] box

Select the quality for measurement.

Reference This does not appear when the scan mode is focus variation.

<3> [Pitch] box

Select the movement distance for the objective lens.

Reference This does not appear when the scan mode is white light interferometry.

<4> [Enable average measurement] box

Obtain the light interference images with the same lens position for a specified number of times, and acquire 3D images based on the averaged brightness information.

By setting a higher average count, the measurement time will be longer, but the noise in the height data can be reduced.

Reference This is displayed only when the scan mode is the white light interferometry.

<5> [Start Measurement] button

Measure the shape based on the current settings.

After the shape measurement is completed, the measurement result (3D image) is displayed.

"2D Measurement" (Page 5-1)

Top Surface Measurement

You can measure the film shape of the top surface (by layer) of the transparent part of the sample with a line, band, or surface.

Reference The approximate thicknesses of transparent targets/film thickness shapes that can be measured are as follows.

Model	Objective lens	Measurable film thickness value
VK-X3100	150x	1.5μ -
	50x	2μ -
	20x	12μ -
	10x	50μ -
VK-X3050	50x	3.5μ -
	20x	20μ -
	10x	80μ -

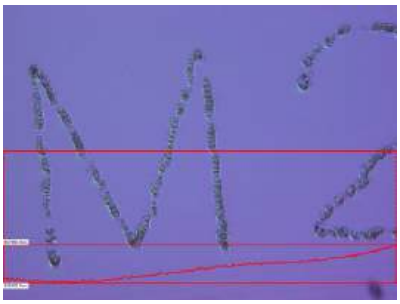
The values above are only approximate values, and the results will vary depending on the reflection rate of the surface and bottom surface of the film, its material, etc.

Important **The preview feature of the top surface measurement, which is displayed when the scan mode is laser confocal, supports the following lenses.**

VK-X3100	**10x**	**VK-X3050**	**10x**
	20x		**20x**
	50x		**50x**
	150x		

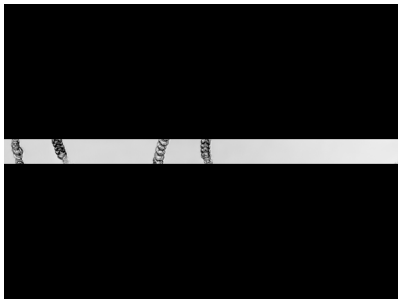
■ Measurement: Line

Measure a profile (cross section) of the straight line part specified arbitrarily.



■ Measurement: Band

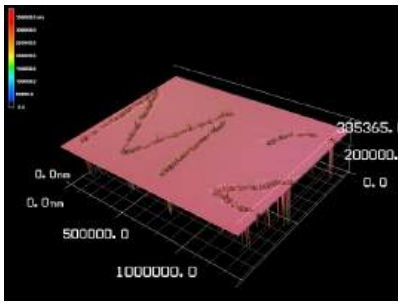
Measure a part which appears in the middle of the observation image display area.



■ Measurement: Plane

Measure a part which appears in the observation image display area.

Note that the switching between the laser confocal and white light interference scan mode can be done by selecting the objective lens to be used.



Flow of Top Surface Measurement

Setup

Launching the Viewer Application

Start the Viewer Application.

"Setup" (Page 2-3)

Switching to the top surface measurement

Switch to the top surface measurement mode.

"Switching to Top Surface Measurement" (Page 6-9)

Adjusting observation images

Adjusting the Magnification and Focus

Adjust the magnification and focus so that the image of the sample appears properly in the viewing window.

"Advanced Settings for the Sensor Head" (Page 3-1)

Measuring the top surface/Saving

For laser confocal

Laser Settings

Make the laser image optimum for observation.

"Laser Settings" (Page A-6)

Averaging settings

Perform measurement for a specified number of times, and collect the averaged information as measurement data.

"Averaging settings for Measurement Data (Average Measurement)" (Page 2-5)

For white light interferometry

Adjustment of the screen brightness

Optimizes interference fringes displayed in the optical image to the best brightness.

"Adjusting the Camera Lighting" (Page 3-7)

Tilt adjustment

Adjust the tilt stage so that the interference fringes in the optical image are minimized.

Film surface measurement

Measure the film shape of the top surface for the transparent target.

"Executing Top Surface Measurement" (Page 6-9)

Saving the measurement result

Save the measurement result.

"Saving the Measurement Result" (Page 2-6)

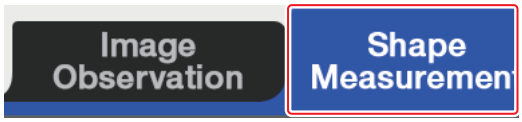
Measurement result display

Display the measurement result.

"Result View Type" (Page 10-1)

Switching to Top Surface Measurement

1 **On the toolbar, click [Shape Measurement].**



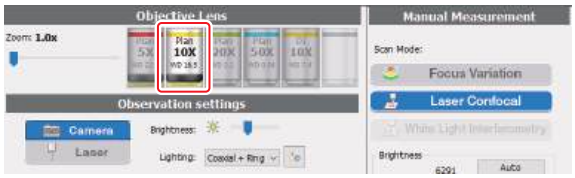
2 **Click the [Film Top] button.**

The shape measurement mode changes to the top surface measurement.

Switching the scan mode

1 **Select the objective lens to be used.**
Change the scan mode.

■ For laser confocal

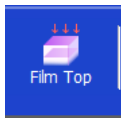


■ For white light interferometry

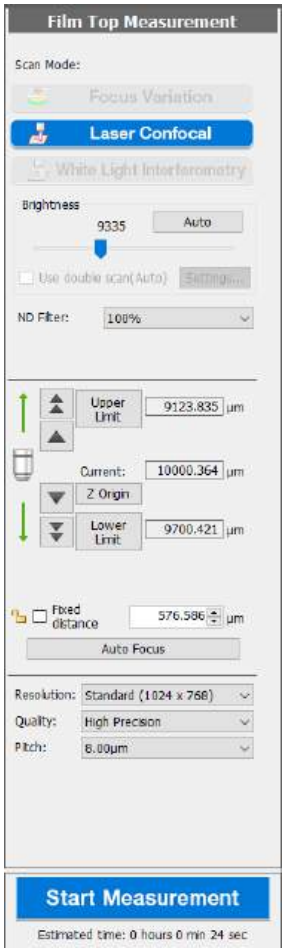
Executing Top Surface Measurement

You can measure the film surface shape of the outermost surface (first layer) in a transparent coating part of a sample.

1 **Click the [Film Top] button.**

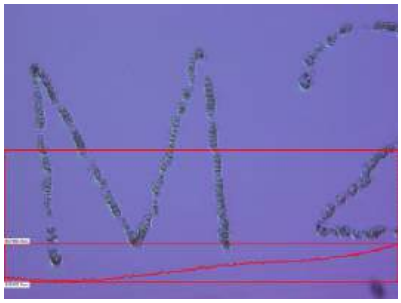


The top surface measurement in shape measurement mode appears.



Measuring the Top Surface (for laser confocal)

Measure a part which appears in the observation image display area.



■ Adjusting the Laser Brightness

If the scan mode is set to laser confocal, adjust the laser brightness to optimize intensity within the selected region of interest.

Reference For details, see "Laser Brightness Adjustment" (Page 3-8).

1 Click the [Camera] button (<1>).

The camera image appears in the observation image display area.

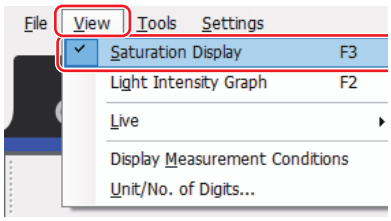
2 Switch the lens depending on the film thickness you want to measure.

3 Click the [Laser] button (<2>).

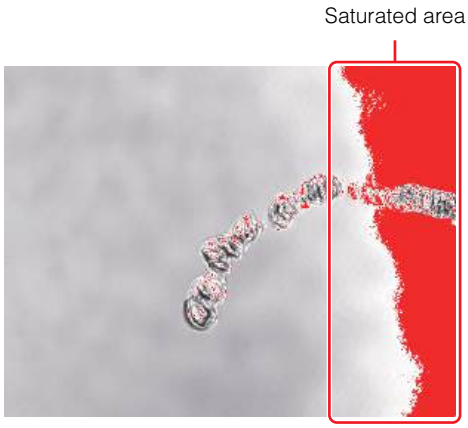
The laser image appears in the observation image display area.

4 Turn the focusing handle to adjust the focus on the part of the sample that reflects the most laser light.

5 On the [View] menu, select [Saturation Display] to turn it on.



Areas that are saturated by the laser reflection intensity (areas that receive too much light) are displayed in red.



6 Move the [Brightness] slider to the left to reduce the brightness and limit oversaturation.

7 **If there are any saturated areas remained, change the settings in the [ND Filter] box.**

Change the settings in the following order until no more saturated places exist.
100%→30%→10%→3%→1%

Reference The light filter physically (optically) reduces the amount of light that enters the light receiving element (photomultiplier).

8 **Move the [Brightness] slider to the right.**

Move it as far as possible to the right without any saturated areas appearing.

9 **Click the vertical position buttons for the objective lens to check the light intensity of the entire measurement range.**

If there are any saturated areas, change the settings in the [ND Filter] box.

■Setting the upper and lower limits of the measurement range (height)

Set the height range for the shape measurement (upper and lower limits).

Important **Set the layer you want to measure so that it falls within the height range for the shape measurement.**

Reference The laser reflected light is received from the surface and bottom surface of the transparent target (where the refractive index changes), while it is not received from the transparent part (where the refractive index does not change). Set the upper/lower limit based on the image turning brighter or darker depending on the number of layers of the transparent target.

1 **Click the vertical position buttons for the objective lens to move the objective lens upward.**
Move it upward past the top surface of the film to be measured, until the laser image turns black and disappears.

2 **Click the [Upper Limit] button.**

Set the upper limit value of the range to be measured.

3 **Click the vertical position buttons for the objective lens to move the objective lens downward.**

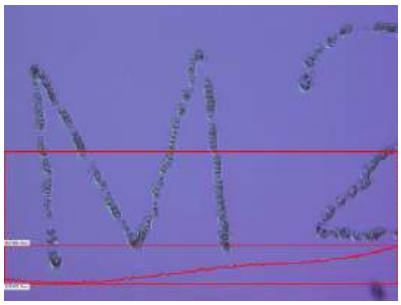
Move it downward past the bottom surface of the film to be measured, until the laser image turns black and disappears again.

4 **Click the [Lower Limit] button.**

Set the lower limit value of the range to be measured.

Measuring the Top Surface (for white light interferometry)

Measure a part which appears in the observation image display area.



■ Adjust the tilt of a sample

Adjust the tilt of a sample to perform the shape measurement by the scan mode [White light interference].

1 Move the focusing handle and objective lens so that the optical image is brought into focus.

2 Adjust the stage tilt so that interference fringes displayed in the optical image are minimized.

■ Adjusting the screen brightness

1 Move the focusing handle and objective lens so that the optical image is brought into focus.

2 Adjust the brightness by the [Auto] button when interference fringes displayed in the optical image are saturated.
Alternatively, move the [Brightness] slider to the right.

■ Setting the upper and lower limits of the measurement range (height)

Set the height range for the shape measurement (upper and lower limits).

Important **Set the layer you want to measure so that it falls within the height range for the shape measurement.**

1 Click the vertical position buttons for the objective lens to move the objective lens upward.
Move it upward past the top surface of the film to be measured by interference fringes, until the interference fringes are no longer visible in the optical image.

2 Click the [Upper Limit] button.

Set the upper limit value of the range to be measured.

3 Click the vertical position buttons for the objective lens to move the objective lens downward.

Move it downward past the bottom surface of the film to be measured by interference fringes, until the interference fringes are no longer visible again in the optical image.

4 Click the [Lower Limit] button.

Set the lower limit value of the range to be measured.

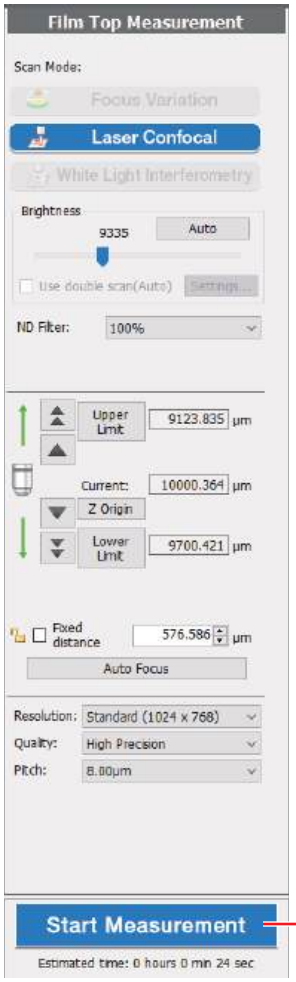
■ Starting measurement

1 **Select [Standard (1024 x 768)] or [Super Fine (2048 x 1536)] in the [Resolution] box.**

2 **Select one from [High Precision], [High Speed]* or [Ultra High Speed]* in the [Quality] box.**

*These can be selected when selecting [Standard (1024 x 768)] in the [Resolution] box.

3 **Click the [Start Measurement] button (<1>).**

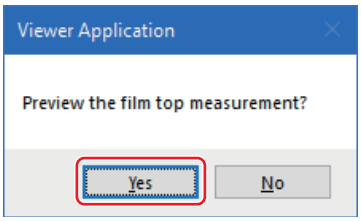


A confirmation message appears asking whether to perform a preview measurement.

Reference You can set whether or not to perform the preview measurement in the [System Settings] dialog box.

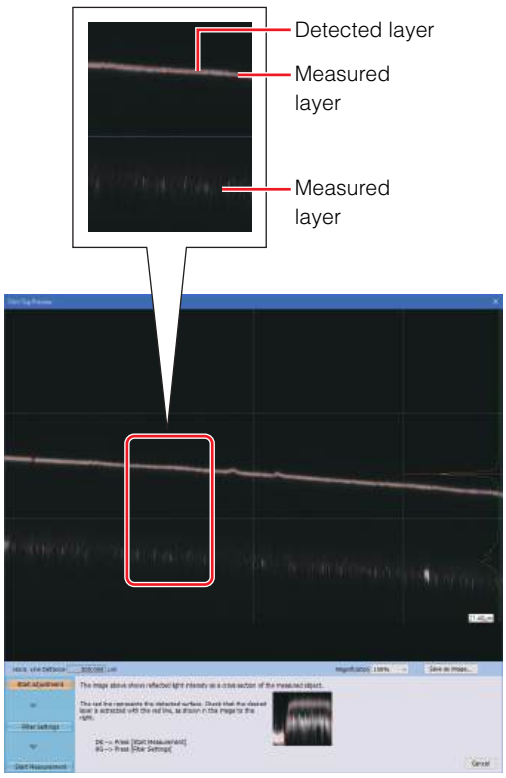
"Laser confocal mode" (Page A-10)

4 **To perform the preview measurement, click the [Yes] button.**



The preview measurement starts, and the [Film Top Preview] window appears. Make sure that the measured layer (white signal) matches the detected layer (red line) before performing the shape measurement.

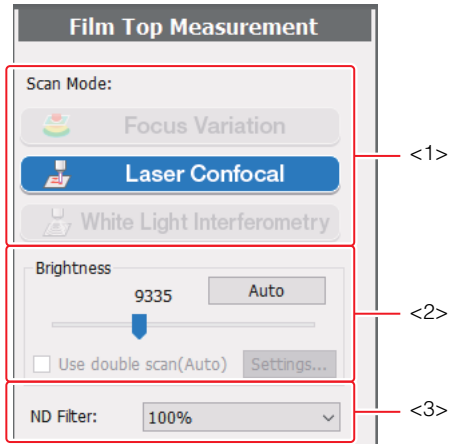
"Film Top Preview" (Page 6-15)



Reference Clicking the [No] button starts the shape measurement without performing the preview measurement. After the shape measurement is completed, the measurement result appears in the observation image display area.

Side Panel for Top Surface Measurement

■Top of the screen



<1> Scan Mode

The item with blue background is the current scan mode.

> Point
> The scan mode of the top surface measurement is fixed to the laser confocal.

<2> Brightness

Move the slide bar to adjust the brightness.

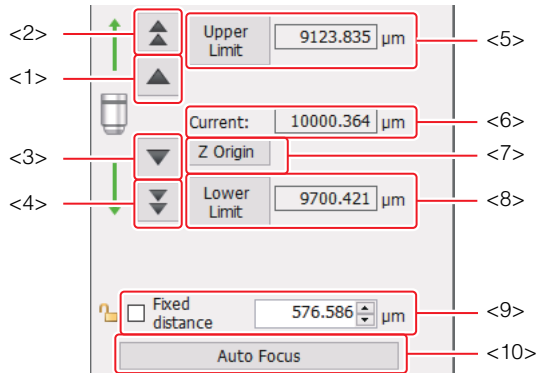
Click the [Auto] button to adjust the brightness automatically.

Double scan cannot be used.

<3> [ND Filter] box

Adjust the amount of light that enters the light receiving element (photomultiplier) using the light-reducing filter.

■Middle of the screen



<1>

The objective lens moves upward.

<2>

The objective lens moves upward. This button moves the lens ten times more than ▲ .

<3>

The objective lens moves downward.

<4>

The objective lens moves downward. This button moves the lens ten times more than ▼ .

<5> [Upper Limit] button

Set the upper limit of the measurement range.

Setting this displays the value in the box in the right side.

<6> Current

The current position of the objective lens is displayed.

<7> [Z Origin] button

Selecting this returns the position of the objective lens to the origin.

<8> [Lower Limit] button

Set the lower limit of the measurement range.

Setting this displays the value in the box in the right side.

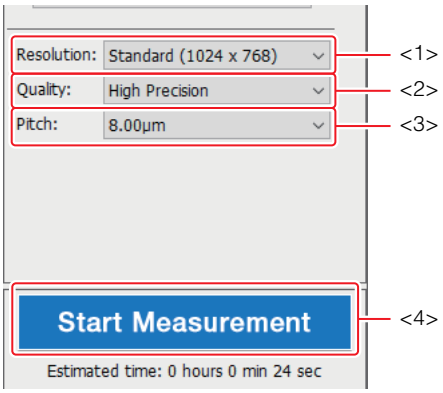
<9> [Fixed distance] check box

Selecting this check box maintains the value displayed in the box in the right side as a measurement range.

<10> [Auto Focus] button

Execute the auto focus.

■Bottom of the screen



<1> [Resolution] box

Select the size of the measurement result.

<2> [Quality] box

Select the quality for measurement.

<3> [Pitch] box

Select the movement distance for the objective lens.

<4> [Start Measurement] button

Measure the shape based on the current settings.

After the shape measurement is completed, the [Film Top Preview] screen appears.

Film Top Preview

<1> Horiz. Line Distance

Displays the height difference of two horizontal cursors (blue dotted lines).

<2> Preview flowchart

Shows the operation flow on the preview window. Click this button to proceed with the operation.

- [Start Adjustment] button
  The top surface preview guide appears.
- [Filter Settings] button
  You can set the detection sensitivity, dark cut, and inter-layer adjustment filter so that the top surface reflective layer and the red line match.
- [Start Measurement] button
  The shape measurement starts. After the shape measurement is completed, the measurement resultappears in the observation image display area.

<3> Vertical cursor (green dotted line)

When dragging the cursor left/right to move it, the Z-I graph (the intensity graph of the green line) on the vertical cursor is displayed.

<4> Saturated line (green line)

In areas that are saturated by the laser intensity (areas that receive too much light), the reflection intensity graph (green line) are displayed overlapped with the saturation line.

<5> Horizontal cursor (blue dotted line)

There are 2 horizontal cursors. When dragging the respective cursors up/down to move them, the height difference is displayed in [Horiz. Line Distance].

<6> Measured laser reflection layer (white signal)

The layer measured in the preview measurement.

<7> Reflective layer

Indicates the location detected as the top layer. If the measured laser reflective layer (white signal) and red line do not match, set the filter.

<8> Z-I graph (green line)

The intensity graph on the vertical cursor.

<9> [Save as image] button

The details displayed on the [Film Top Preview] window will be saved as an image.

<10> [Magnification] box

Sets the axial magnification.

Setting range: 25%, 50%, 100%, 200%, and 400%

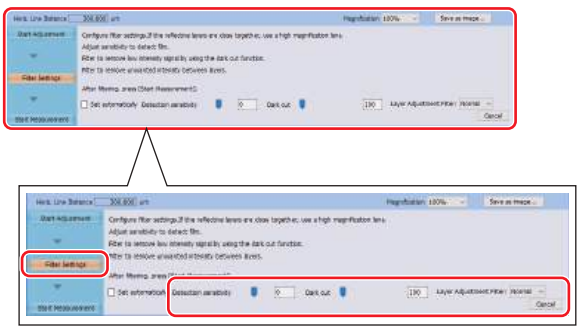
<11> [Cancel] button

Closes the preview window without measuring the top surface.

■ Setting Filter

Set the filter so that the measured laser reflective layer (white signal) and red line match.

1 Set the filter by clicking the [Filter settings] button of [Film top preview flowchart].



Point

Initially, perform the measurement by turning on [Set automatically].
When the measurement cannot be performed properly, turn it off and adjust various parameters manually.

[Set automatically] check box

Turning it on sets the [Layer Adjustment Filter] box and [Clear unneed.peak] box automatically.

Turning it off can set the [Layer Adjustment Filter] box and [Clear unneed.peak] box.

[Detection sensitivity] track bar

Moving it to the right detects a weaker reflective layer. On the contrary, moving it to the left can remove noise with only a strong reflective layer remained.

[Dark cut] track bar

Moving it to the right prevents a dark reflective layer from being detected. As the result of moving the [Detection sensitivity] track bar to the right, unintentional noise in a dark area can be removed if detected as a reflective layer.

[Layer Adjustment Filter] box

When a part of the reflective layer is obscured by flaws or debris, the height of this pixel will be interpolated from the heights of the remaining pixels.

- None, Weak
  Select this when the laser intensity of the reflective layer is low, and the red line appears in an unneeded area.
- Normal
  Select this at normal measurement.
- Strong
  Select this when the red line is displayed below the top surface.

2 Click the [Start Measurement] button.

Selecting the Measurement Mode

Measurement Mode

The measurement mode determines whether new data will be gathered automatically or manually. The mode can be selected depending on the sample in question.

Automatic measurement

A mode that automatically adjusts the settings. This measurement mode is the one used in most situations. It is mainly selected to measure the surface shape of the sample.

You can only specify the scan mode (Focus Variation or Laser Confocal).

Manual measurement

This measurement mode is for advanced users who want to adjust the advanced measurement settings such as scan mode, image brightness, and lens moving pitch.

Film top measurement

This mode is for measuring the thickness of transparent film and glass, and the film shape of the top three layers of multi-layered structures.

Scan Mode

Scan mode is a function for setting the sample scan method.

Focus variation

This scan method measures shapes by capturing multiple optical images while moving the lens up and down, and combining the height of the focus position.

In comparison to laser confocal, samples can be measured in a short amount of time.

Reference Focus variation cannot be selected when the measurement mode is set to “Film Top”.

Laser confocal

This scan method measures shapes by reflecting light emitted from the laser off the sample surface and detecting the focal point position from the strength of that reflected light.

In comparison to focus variation, samples can be measured in greater detail.

White light interferometry

The scan method by using the principle of the white light interferometry.

Since the resolution of height measurement is high regardless of lens magnification, it is more suited for measuring minute steps with low magnification lenses than the laser confocal.

It is suited for measuring flat samples with a wide field of view, such as glass and film.

Reference

- The white light interferometry is an optional function.
  To use this, it is required to purchase the white light interferometry module (VK-H3I) and enable the function by activating the license online.
- White light interferometry cannot be selected when the measurement mode is set to “Film Top”.

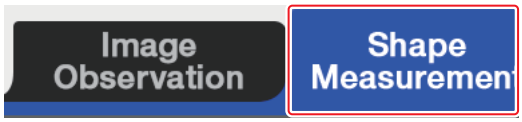
Zoom

You can select the field of view for the shape measurement. Enlarging the field of view can narrow the sampling interval in the XY direction.

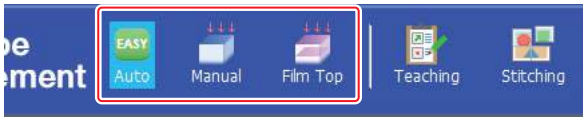
Scan Mode	Function
Focal variation White light interferometry	Magnifies the image on display using the digital processing.
Laser confocal	Enlarges the image with maintaining a high quality by narrowing the laser scanning range and displaying the image in the same number of pixels as the normal range.

Selecting the Measurement Mode

1 **On the toolbar, click [Shape Measurement].**



2 **Click the [Auto]/[Manual]/[Film Top] button.**



The measurement mode changes.

Adjusting the Laser Brightness Manually

For laser confocal

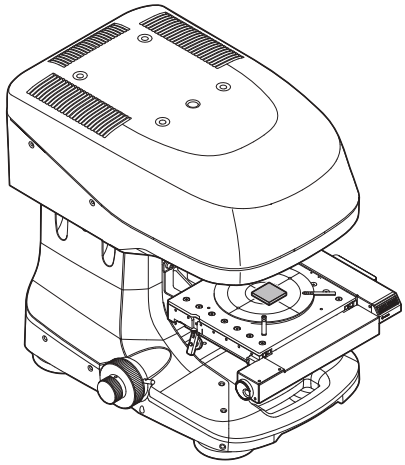
Adjust the laser brightness to the optimal laser intensity. Adjust the laser brightness each time the sample or objective lens used changes.

Point

In the following cases, the reliability of height data decreases.

- Laser reflection intensity is low
  It may be affected by extraneous light and noise.
- Laser reflection intensity is saturated (too high)
  The focal point cannot be detected accurately.

1 **Place the sample on the stage, and adjust the focus.**



2 Click the [Laser] button.

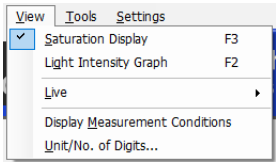
The laser image appears in the observation image display area.

3 Turn the focusing handle or move the lens revolver up and down to adjust the focus on the part of the sample that reflects the most laser light.

Point

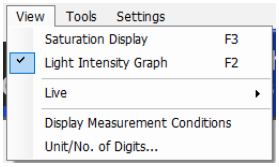
Find out the areas that are saturated by the laser intensity.

- On the [View] menu, select [Saturation Display] to turn it on, when measuring the measurement size with “Standard” or “Super Fine”, or “Partial”.

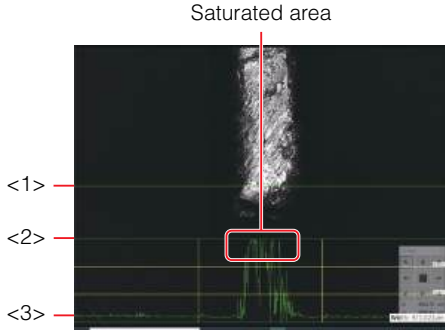


Areas that are saturated by the laser reflection intensity (areas that receive too much light) are displayed in red.

- On the [View] menu, select [Light Intensity Graph] to turn it on when measuring the measurement size with “1 Line”.



A horizontal line (<1>) and a light intensity graph on the horizontal line (<3>) are displayed in the observation image display area.
In areas that are saturated by the laser reflection intensity (areas that receive too much light), the reflection intensity graph (<3>) is displayed overlapped with the saturation line (<2>).



4 Move the [Brightness] slider to the left edge.

5 If there are any saturated areas remained, change the settings in the [ND Filter] box.

Point

The light filter reduces the amount of light that enters the light receiving element (photomultiplier) using the light-reducing filter.

6 Move the [Brightness] slider to the right.

Move it as far as possible to the right without any saturated areas appearing.

7 Click the vertical position buttons for the objective lens to check the light intensity of the entire measurement range.

If there are any saturated areas, change the settings in the [ND Filter] box.

Important

When measuring surface shapes, the reliability of the data decreases if there are any dark places in the measurement range. In that case, use the double scan.

When Double Scan is Used

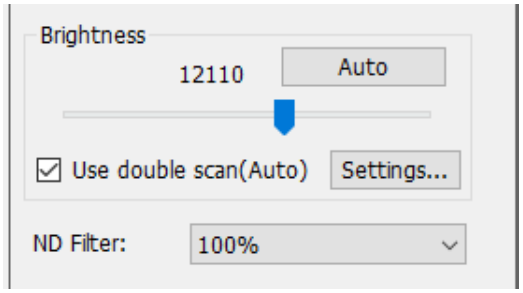
Double scan is used to measure surface shapes, if there are any dark places in the measurement range.

Point If double scan is to be used, it is recommended that auto setting is enabled.

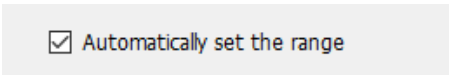
1 Click the vertical position buttons for the objective lens to move the lens, and take note of any dark places in entire measurement range.

Change the double scan settings so that the dark area becomes brighter.

2 Select the [Use double scan(Auto)] check box.



Point The [Use double scan(Auto)] check box cannot be chosen when the [Automatically set the range] check box is selected.



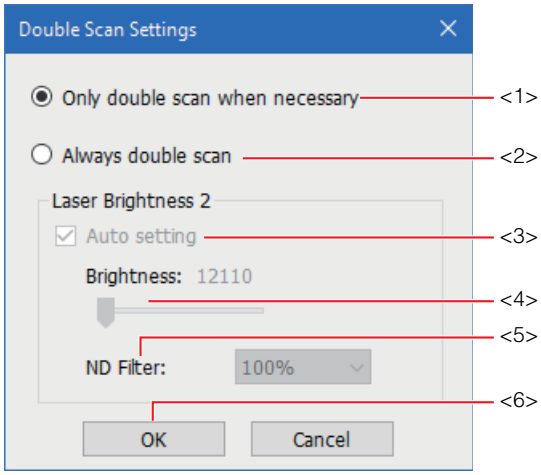
3 Click the [Settings...] button.

The [Double Scan Settings] dialog box appears.

4 Normally, select the [Only double scan when necessary] radio button (<1>). If there are many dark areas by the first scan, a second scan will be done automatically.

Select the [Always double scan] radio button (<2>) to perform measurement by always using double scan (when using a low magnification lens etc.).

Normally, select the [Auto setting] checkbox (<3>). When turning it on, then click the [OK] button (<6>). No further operations are needed from step 5 and later.



Reference Selecting the [Auto setting] check box (<3>) determines whether to use the double scan during measurement. If it is determined to be used, the laser brightness 2 will automatically be set.

5 When clearing the [Auto setting] check box (<3>), move the [Brightness] slider (<4>) to the right end.

6 If the place you remembered is still dark, change the settings in the [ND Filter] box (<5>).

Change the settings in the following order until the place you remembered becomes bright.

1%→3%→10%→30%→100%

Reference In the [ND Filter] box (<5>), you cannot select a setting with a lower value than that of the [ND Filter] box in [Measurement: Expert].

7 Move the [Brightness] slider (<4>) to the left.

Move it as far as possible to the left within the range where the place you remember is not saturated.

8 Click the [OK] button (<6>).

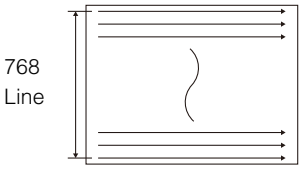
Measurement Setting

[Resolution] box

Set the measurement size.

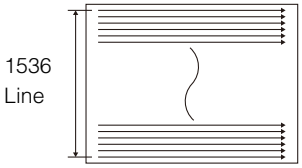
Standard (1024 x 768)

Measure the entire observation image display area by one line at a time.



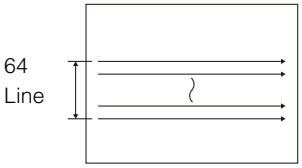
Super Fine (2048 x 1536)

Measure the entire observation image display area by a double density of the "Standard (1024 x 768)".



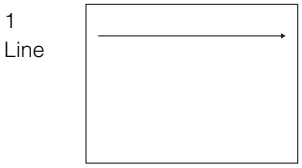
Partial (1024 x 64)

Measure 64 lines at the center of the observation image display area.



1 Line (1024 x 1)

Measure 1 line only. The measurement position can be specified.

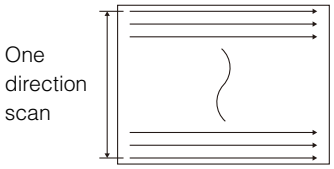


[Quality] Box

Set the measurement quality.

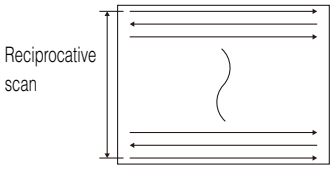
High Precision

This is the standard measurement quality.



High Speed

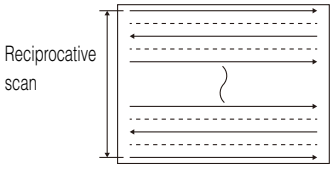
This is a measurement quality with which the measurement is done quicker than that of “High Precision”. All lines are scanned in a reciprocative manner.



Ultra High Speed

This is a measurement quality with which the measurement is done quicker than that of “High Speed”.

Measure every other line in the reciprocative way. An unmeasured line is interpolated by the data above and below.



[Pitch] Box

Select an interval (pitch) to move the objective lens.

■ For VK-X3100

Objective lens	VK-X3100	
CF IC EPI Plan 5xA	8.0	16.0
CF IC EPI Plan 10xA	2.0	4.0
CF IC EPI Plan 20xA	0.50	1.00
CF IC EPI Plan Apo 50xA	0.10	0.20

■ For VK-X3050

Objective lens	VK-X3050	
CF IC EPI Plan 5xA	12.00	24.00
CF IC EPI Plan 10xA	3.00	6.00
CF IC EPI Plan 20xA	0.75	1.50
CF IC EPI Plan 50xA	0.13	0.26

Chapter 7

Film Thickness Measurement

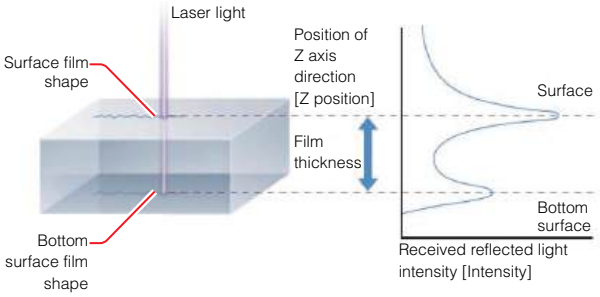
Measure the film thickness of a film or coating from the intensity distribution of the reflection of laser or white light.

Reference The spectroscopy film thickness is an optional function.
To use it, it is required to purchase the light interference film thickness set VK-T300.

Measurement Principle

■ Laser film thickness

If the object is a transparent target, the transmitted light exceeds the focal point on the surface to detect the focal point of the substrate as well. As a result, the thickness of the transparent body can be determined by calculating the difference between the two surfaces.



You can measure the thickness and film shape of the top three layers of the transparent part of the sample with a line, band, or surface.

Important

The preview measurement of the laser film thickness supports the following lenses.

VK-X3100	**10x**	**VK-X3050**	**10x**
	20x		**20x**
	50x		**50x**

Reference

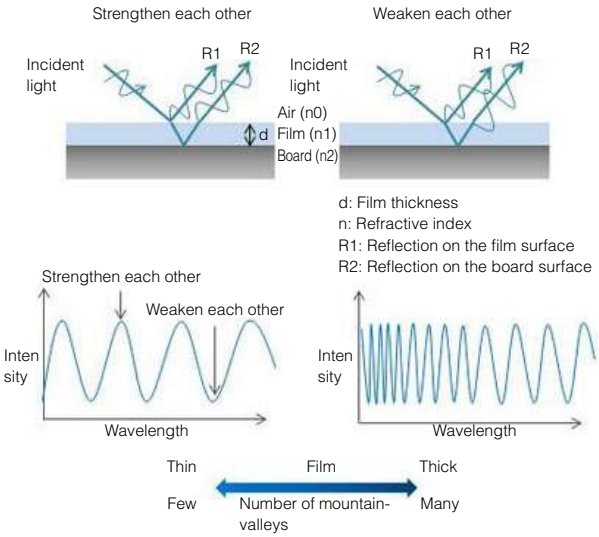
The approximate thicknesses of transparent targets/film thickness that can be measured are as follows.

Model	Objective lens	Measurable film thickness value
VK-X3100	50x	2μ -
	20x	12μ -
	10x	50μ -
VK-X3050	50x	3.5μ -
	20x	20μ -
	10x	80μ -

The values above are only approximate values, and the results will vary depending on the reflection rate of the surface and bottom surface of the film, its material, etc.

■ Spectroscopy film thickness

Illuminating light to the transparent film makes the light be reflected both of the top and bottom of the film. For the reflected light intensity, the light to reflect on the surface of the film (R1) and light to refract inside the film and reflect on the surface of the board (R2) overlap to strengthen or weaken the light.



This is called “light interference”.

The light reflection from the top and bottom of a thin film can be expressed by the following equation.

$$R \approx A + B\cos\left(\frac{2\pi}{\lambda} nd\right)$$

This shows that the reflection of the film periodically changes by 1/λ.

The spectral film thickness measurement calculates the film thickness utilizing the phenomena that the reflection of the film periodically changes depending on the wavelength.

Reference

When the film thickness is approximately 0.1 to 5.0 μm, use the spectral interference film thickness.

Flow of the Laser Film Thickness Measurement

Setup

Launching the Viewer Application

Start the Viewer Application.

"Setup" (Page 2-3)

Switching to the laser film thickness measurement

Switch to the top surface measurement mode.

"Switching to the Laser Film Thickness Measurement" (Page 7-4)

Adjusting observation images

Adjusting the Magnification and Focus

Adjust the magnification and focus so that the image of the sample appears properly in the viewing window.

"Advanced Settings for the Sensor Head" (Page 3-1)

Laser film thickness measurement/saving

Laser Settings

Make the laser image optimum for observation.

"Laser Settings" (Page A-6)

Averaging settings

Perform measurement a specified number of times, and collect the averaged information as measurement data.

"Averaging settings for Measurement Data (Average Measurement)" (Page 2-5)

Laser film thickness measurement

Measure the film shape of the top three layers for the transparent target.

"Executing the Laser Film Thickness Measurement" (Page 7-4)

Saving the measurement result

Save the measurement result.

"Saving the Measurement Result" (Page 2-6)

Measurement result display

Display the measurement result.

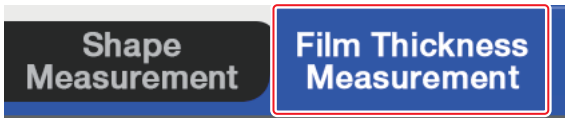
"Result View Type" (Page 10-1)

Laser Film Thickness

The laser film thickness is the mode for measuring the thickness of transparent film and glass, and the film shape of the top three layers of multi-layered structures from the intensity of the laser light reflected from the sample.

Switching to the Laser Film Thickness Measurement

1 On the toolbar, click [Film Thickness Measurement].



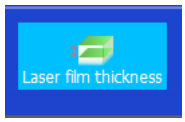
2 Click the [Laser film thickness] button.

It will switch to the laser film thickness of the film thickness measurement mode.

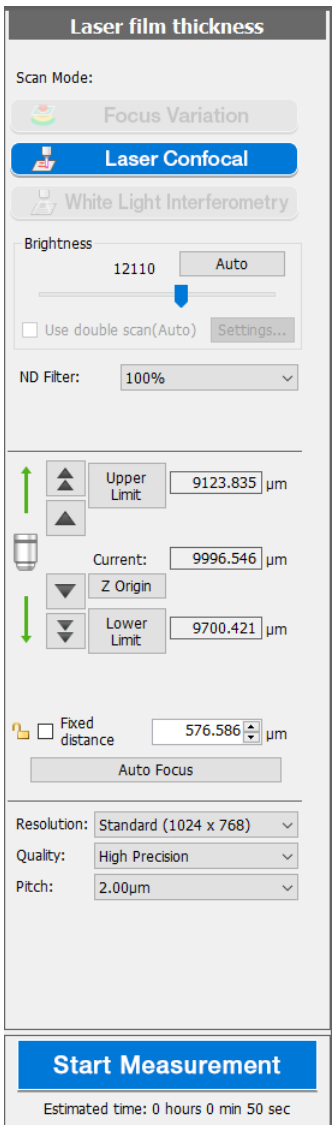
Executing the Laser Film Thickness Measurement

Measure the thickness (film thickness of more than 2 µm) and the film shape of the top three layers of the top surface of the transparent part of the sample.

1 On the toolbar, click the [Laser film thickness] button.



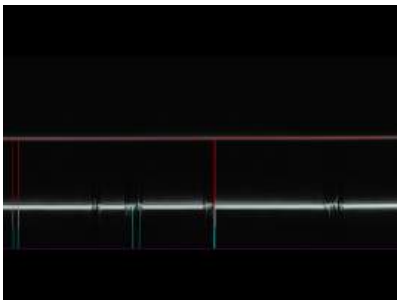
The laser film thickness measurement in the film thickness measurement mode appears.



Measuring the Transparent Target (Film Thickness) by Line

Measure a profile (cross section) of the straight line part specified arbitrarily.

Measurement: Line



■ Adjusting the Laser Brightness

Adjust the laser brightness to the optimal laser intensity within the range of the height at the point of measurement.

Reference For details, see "Laser Brightness Adjustment" (Page 3-8).

1 Click the [Camera] button (<1>).

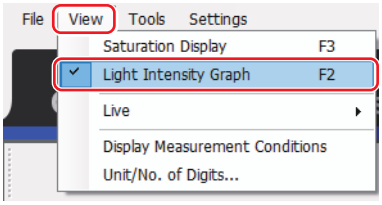
The camera image appears in the observation image display area.

2 Click the [Laser] button (<2>).

The laser image appears in the observation image display area.

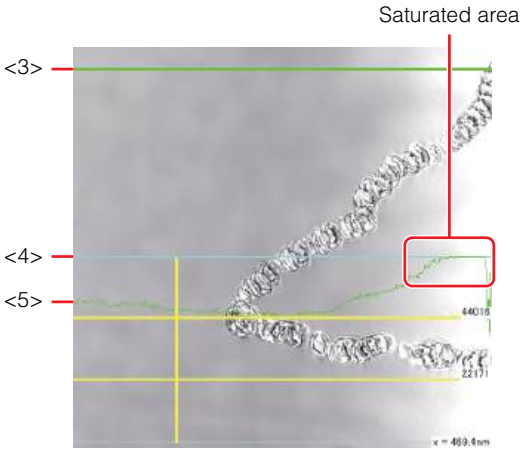
3 Turn the focusing handle to adjust the focus on the part of the sample that reflects the most laser light.

4 On the [View] menu, select [Light Intensity Graph] to turn it on.



A horizontal line (<3>) and a light intensity graph on the horizontal line (<5>) are displayed in the observation image display area.

In areas that are saturated by the laser reflection intensity (areas that receive too much light), the reflection intensity graph (<5>) is displayed overlapped with the saturation line (<4>).



5 Move the [Brightness] slider to the left edge.

6 **If there are any saturated areas remained, change the settings in the [ND Filter] box.**

Change the settings in the following order until no more saturated places exist.
100%→30%→10%→3%→1%

Reference The light filter physically (optically) reduces the amount of light that enters the light receiving element (photomultiplier).

7 **Move the [Brightness] slider to the right.**

Move it as far as possible to the right without any saturated areas appearing.

8 **Click the vertical position buttons for the objective lens to check the light intensity of the entire measurement range.**

If there are any saturated areas, change the settings in the [ND Filter] box.

■ Setting the upper and lower limits of the measurement range (height)

Set the height range for the shape measurement (upper and lower limits).

Important **Set the layer you want to measure so that it falls within the height range for the shape measurement.**

Reference The laser reflected light is received from the surface and bottom surface of the transparent target (where the refractive index changes), while it is not received from the transparent part (where the refractive index does not change). Set the upper/lower limit based on the image turning brighter or darker depending on the number of layers of the transparent target.

1 **Click the vertical position buttons for the objective lens to move the objective lens upward.**
Move it upward past the top surface of the film to be measured, until the laser image turns black and disappears.

2 **Click the [Upper Limit] button.**

Set the upper limit value of the range to be measured.

3 **Click the vertical position buttons for the objective lens to move the objective lens downward.**

Move it downward past the bottom surface of the film to be measured, until the laser image turns black and disappears again.

4 **Click the [Lower Limit] button.**

Set the lower limit value of the range to be measured.

■ Starting measurement

1 **Select [1 Line (1024 x 1)] in the [Resolution] box.**

2 **Specify the position you want to measure by dragging the horizontal line up and down.**

3 **Select an interval (measurement pitch) to move the objective lens in the Z axis direction using the [Pitch] box.**

4 **Click the vertical position buttons for the objective lens to adjust the focus.**

The color image displayed on the measurement result view is obtained at the position of the objective lens when measurement starts.

Move the objective lens to the appropriate position before starting the measurement.

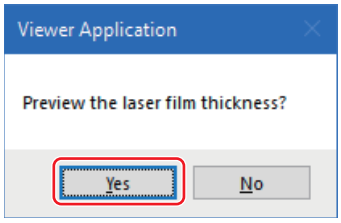
5 **Click the [Start Measurement] button.**

A confirmation message appears when using a lens which supports the preview measurement.

Reference You can set whether or not to perform the preview measurement in the [System Settings] dialog box.

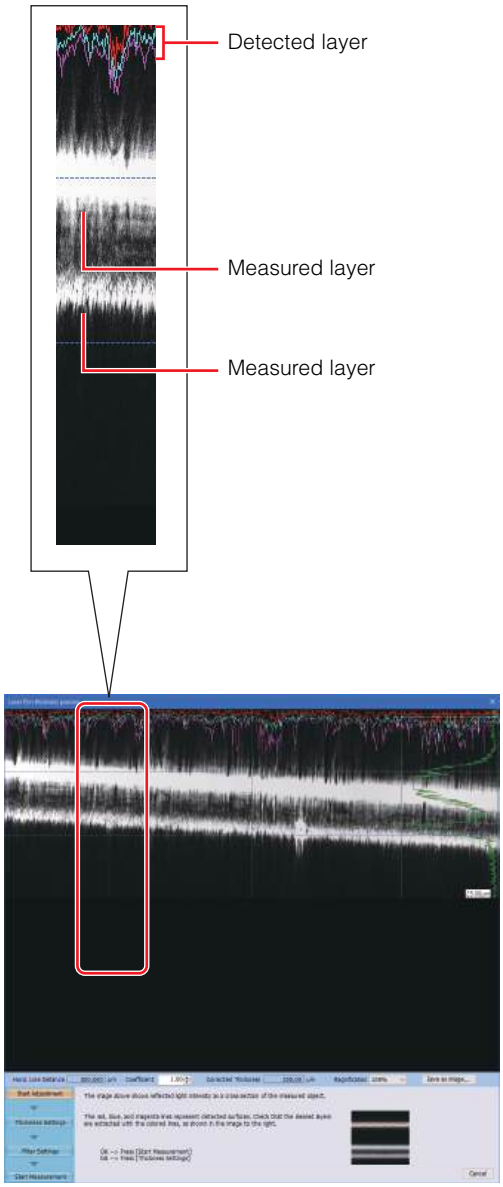
"Laser confocal mode" (Page A-10)

6 **To perform the preview measurement, click the [Yes] button.**



The preview measurement starts, and the [Laser film thickness preview] window appears. Make sure that the measured layer (white signal) matches the detected layer (red, light blue, and magenta lines) before performing the shape measurement.

"Laser Film Thickness Preview" (Page 7-12)

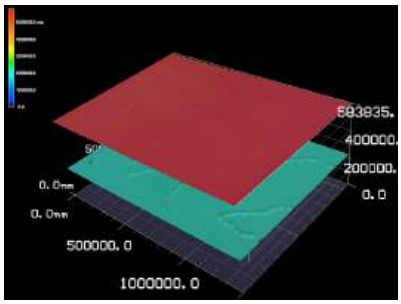


Reference Clicking the [No] button starts the shape measurement without performing the preview measurement. After the shape measurement is completed, the measurement result appears in the observation image display area.

Measuring the Transparent Target (Film Thickness) by Plane

Measure a part which appears in the observation image display area.

[Measurement: Plane]



■ Adjusting the Laser Brightness

Adjust the laser brightness to the optimal laser intensity within the range of the height at the point of measurement.

Reference For details, see "Laser Brightness Adjustment" (Page 3-8).

1 Click the [Camera] button (<1>).

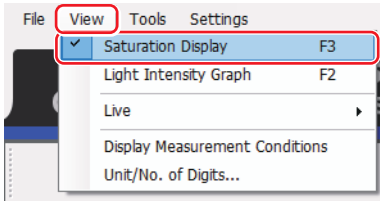
The camera image appears in the observation image display area.

2 Click the [Laser] button (<2>).

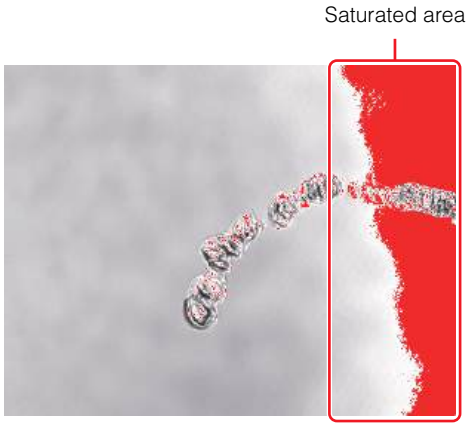
The laser image appears in the observation image display area.

3 Turn the focusing handle to adjust the focus on the part of the sample that reflects the most laser light.

4 On the [View] menu, select [Saturation Display] to turn it on.



Areas that are saturated by the laser reflection intensity (areas that receive too much light) are displayed in red.



5 Move the [Brightness] slider to the left edge.

6 **If there are any saturated areas remaining, change the settings in the [ND Filter] box.**

Change the settings in the following order until no more saturated places exist.
100%→30%→10%→3%→1%

Reference The light filter physically (optically) reduces the amount of light that enters the light receiving element (photomultiplier).

7 **Move the [Brightness] slider to the right.**

Move it as far as possible to the right without any saturated areas appearing.

8 **Click the vertical position buttons for the objective lens to check the light intensity of the entire measurement range.**

If there are any saturated areas, change the settings in the [ND Filter] box.

■Setting the upper and lower limits of the measurement range (height)

Set the height range for the shape measurement (upper and lower limits).

Important **Set the layer you want to measure so that it falls within the height range for the shape measurement.**

Reference
- The laser reflected light is received from the surface and bottom surface of the transparent target (where the refractive index changes), while it is not received from the transparent part (where the refractive index does not change). Set the upper/lower limit based on the image turning brighter or darker depending on the number of layers of the transparent target.

1 **Click the vertical position buttons for the objective lens to move the objective lens upward.**
Move it upward past the top surface of the film to be measured, until the laser image turns black and disappears.

2 **Click the [Upper Limit] button.**

Set the upper limit value of the range to be measured.

3 **Click the vertical position buttons for the objective lens to move the objective lens downward.**

Move it downward past the bottom surface of the film to be measured, until the laser image turns black and disappears again.

4 **Click the [Lower Limit] button.**

Set the lower limit value of the range to be measured.

■Starting measurement

1 Select [Standard (1024 x 768)] or [Super Fine (2048 x 1536)] in the [Resolution] box.

2 Select a speed from [High Precision], [High Speed]* or [Ultra High Speed]* in the [Quality] box.

* These can be selected when selecting [Standard (1024 x 768)] in the [Resolution] box.

3 Select a pitch as needed.

- Normally, the RPD (Real Peak Detection) method is used to detect the focal point position.
- To detect the focal point position with the peak holding method, select an interval (measurement pitch) to move the objective lens in the Z axis direction using the [Pitch] box.

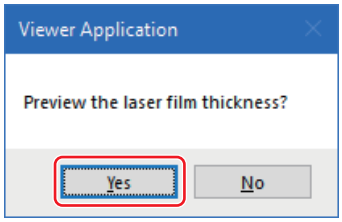
4 Click the [Start Measurement] button.

A confirmation message appears asking whether to perform a preview measurement.

Reference You can set whether or not to perform the preview measurement in the [System Settings] dialog box.

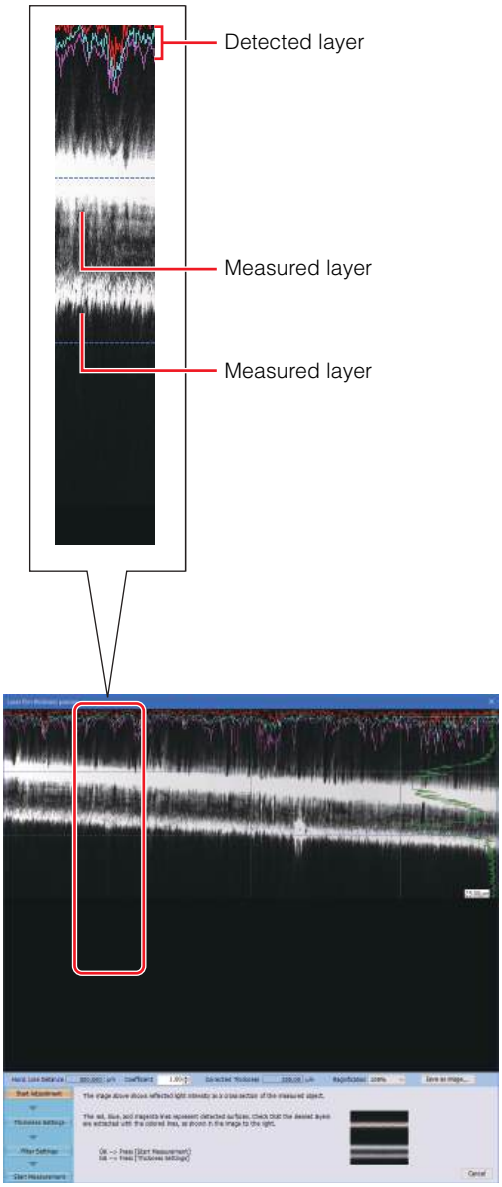
"Laser confocal mode" (Page A-10)

5 To perform the preview measurement, click the [Yes] button.



The preview measurement starts, and the [Laser film thickness preview] window appears. Make sure that the measured layer (white signal) matches the detected layer (red, light blue, and magenta lines) before performing the shape measurement.

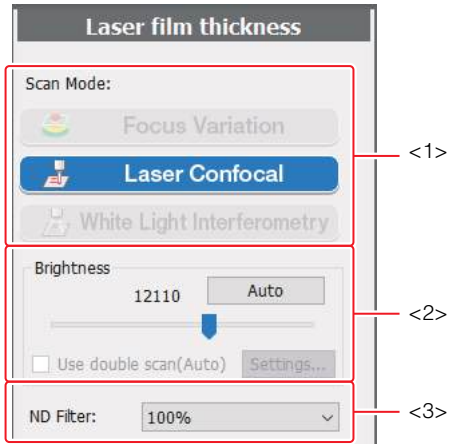
"Laser Film Thickness Preview" (Page 7-12)



Reference Clicking the [No] button starts the shape measurement without performing the preview measurement. After the shape measurement is completed, the measurement resultappears in the observation image display area.

Side Panel for the Laser Film Thickness

■Top of the screen



<1> Scan Mode

The button with the blue background is the current scan mode.

> Point The scan mode for laser film thickness measurement is set to laser confocal.

<2> Brightness

Move the slide bar to adjust the brightness.

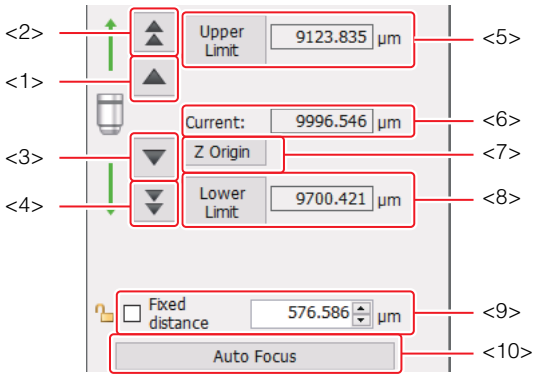
Click the [Auto] button to adjust the brightness automatically.

Selecting the [Use double scan(Auto)] check box performs the measurement using the double scan. In addition, clicking the [Settings] button displays the [Double Scan Settings] dialog box.

<3> [ND Filter] box

Physically (optically) adjust the amount of light that enters the light receiving element (photomultiplier).

■Middle of the screen



<1> ▲

The objective lens moves upward.

<2> ▲▲

The objective lens moves upward. This button moves the lens ten times more than ▲.

<3> ▼

The objective lens moves downward.

<4> ▼▼

The objective lens moves downward. This button moves the lens ten times more than ▼.

<5> [Upper Limit] button

Set the upper limit of the measurement range.

Setting this displays the value in the box in the right side.

<6> Current

The current position of the objective lens is displayed.

<7> [Z Origin] button

Selecting this returns the position of the objective lens to the origin.

<8> [Lower Limit] button

Set the lower limit of the measurement range.

Setting this displays the value in the box in the right side.

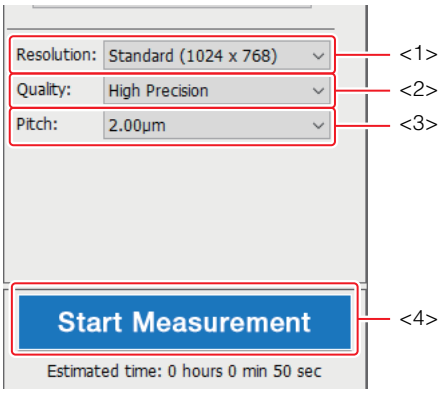
<9> [Fixed distance] check box

Selecting this check box maintains the value displayed in the box in the right side as a measurement range.

<10> [Auto Focus] button

Execute auto focus.

■Bottom of the screen



<1> [Resolution] box

Select the size of the measurement result.

<2> [Quality] box

Select the quality for measurement.

<3> [Pitch] box

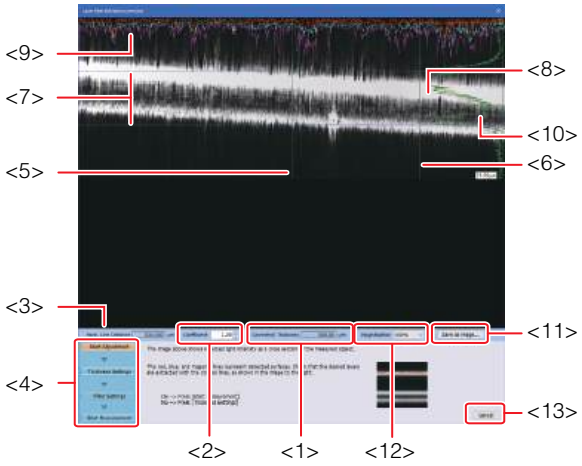
Select the movement distance for the objective lens.

<4> [Start Measurement] button

Measure the shape based on the current settings.

After the shape measurement is completed, the [Laser film thickness preview] screen appears.

Laser Film Thickness Preview



<1> Correction film thickness

Displays the value (corrected film thickness) of the height difference of two horizontal cursors (blue dotted line) multiplied by the correction factor.

<2> [Coefficient] box

Enter the correction factor (usually the refractive index of the film).

Setting range: 0.01 - 9.99

<3> Horiz. Line Distance

Displays the height difference of two horizontal cursors (blue dotted lines).

<4> Preview flowchart

Shows the operation flow on the preview window. Click this button to proceed with the operation.

- [Start Adjustment] button
  The laser film thickness preview guide appears.
- [Thickness Settings] button
  To prevent misdetections, the approximate thickness of the transparent object can be specified.
- [Filter Settings] button
  You can set the detection sensitivity, dark cut, and inter-layer adjustment filter so that the top surface reflective layer and the red line match.
- [Start Measurement] button
  The shape measurement starts. After the shape measurement is completed, the measurement resultappears in the observation image display area.

<5> Vertical cursor (green dotted line)
When dragging the cursor left/right to move it, the Z-I graph (the intensity graph of the green line) on the vertical cursor is displayed.

<6> Saturated line (green line)
In areas that are saturated by the laser intensity (areas that receive too much light), the reflection intensity graph (green line) are displayed overlapped with the saturation line.

<7> Horizontal cursor (blue dotted line)
There are 2 horizontal cursors. When dragging the respective cursors up/down to move them, the height difference is displayed in [Horiz. Line Distance].

<8> Measured laser reflection layer (white signal)
The layer measured in the preview measurement.

<9> Reflective layer
Indicates the location detected as the top three layers. If the measured laser reflective layer (white signal) and each line do not match, set the filter.
The colors for the respective lines of the top three layers are, from the top layer, red, light blue, and magenta.

Reference When only two layers exist, the third layer is not displayed.
For example, in the case of thin glass, the first layer is the top surface of the glass, the second layer is the bottom surface, and the third layer is not displayed.

<10> Z-I graph (green line)
The intensity graph on the vertical cursor.

<11> [Save as image] button
The details displayed on the [Laser film thickness preview] window will be saved as an image.

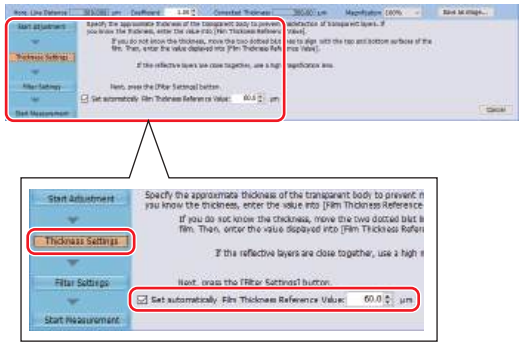
<12> [Magnification] box
Sets the axial magnification.
Setting range: 25%, 50%, 100%, 200%, and 400%

<13> [Cancel] button
Closes the preview window without measuring the film thickness.

■ Setting Thickness

To prevent misdetections, the approximate thickness of the transparent object can be specified.

1 Set the film thickness reference value by clicking the [Thickness Settings] button in the [Laser film thickness preview] window.



[Set automatically] check box
Set the film thickness reference value automatically.
Turning it off can change the film thickness reference value.

Reference Normally, use it with the setting turned on.

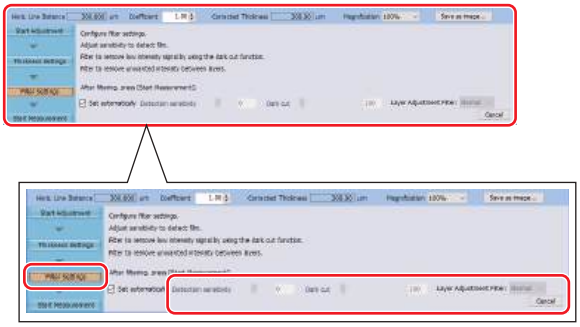
[Film Thickness Reference Value] box
If you know the true value of the film thickness, enter the film thickness reference value.
Settings range: 0.1 - 999.9

2 Click the [Filter Settings] button of [Preview flowchart].

■ Setting Filter

Set the filter so that the measured laser reflective layer (white signal) and red line match.

1 Set the filter by clicking the [Filter Settings] button of [Laser film thickness preview flowchart].



Point

Initially, perform the measurement by turning on [Set automatically].
When the measurement cannot be performed properly, turn it off and adjust various parameters.

[Set automatically] check box

Turning it on sets the [Layer Adjustment Filter] box and [Clear unneed.peak] box automatically.

Turning it off allows the [Layer Adjustment Filter] box and [Clear unneed.peak] box to be modified manually.

[Detection sensitivity] track bar

Moving it to the right detects a weaker reflective layer. On the contrary, moving it to the left can remove noise with only a strong reflective layer remained.

[Dark cut] track bar

Moving it to the right prevents a dark reflective layer from being detected. As the result of moving the detection sensitivity track bar to the right, when unintentional noise in a dark area is detected as a reflective layer, it can be removed.

[Layer Adjustment Filter] box

When a part of the reflective layer is obscured by flaws or debris, the height of this pixel will be interpolated from the heights of the surrounding pixels.

- None, Weak
  Select this when the laser intensity of the reflective layer is low, and the red line appears in an unneeded area.
- Normal
  Select this at normal measurement.
- Strong
  Select this when the red line is displayed below the top surface.

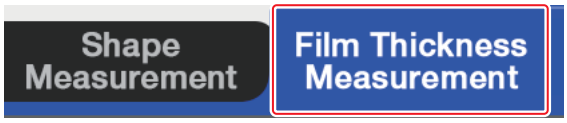
2 Click the [Start Measurement] button.

Spectral Film Thickness

Spectral film thickness is a mode to measure the thickness of a film from the intensity distribution of reflected light in the visible light range by using an external spectroscope. This mode can measure very thin film thicknesses between.1 and 5 um.

Switching to the Spectral Film Thickness

1 **On the toolbar, click [Film Thickness Measurement].**

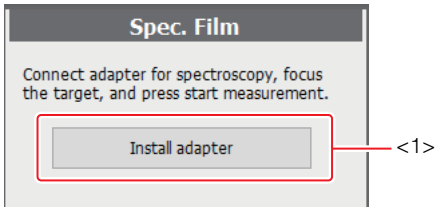


2 **Click the [Laser film thickness] button.**

It will switch to the spectroscopy film thickness of the film thickness measurement mode.

Side Panel for the Spectral Film Thickness

■Top of the screen

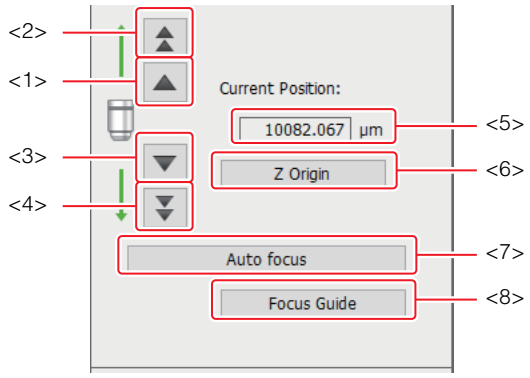


<1> Install adapter

Mount and remove the spectral film thickness unit.

"Use Settings of VK-T300 Spectral Film Thickness Unit" (Page 11-26)

■Middle of the screen



<1> ▲

The objective lens moves upward.

<2> ▲▲

The objective lens moves upward. This button moves the lens ten times more than ▲ .

<3> ▼

The objective lens moves downward.

<4> ▼▼

The objective lens moves downward. This button moves the lens ten times more than ▼ .

<5> Current

The current position of the objective lens is displayed.

<6> [Z Origin] button

Selecting this returns the position of the objective lens to the origin.

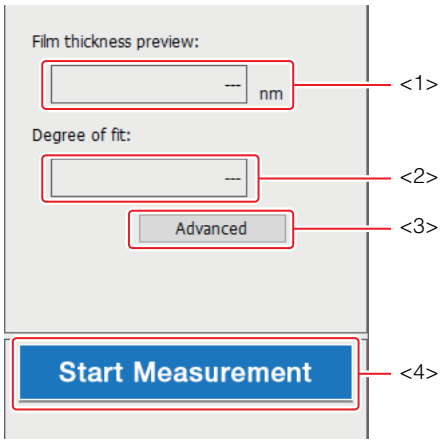
<7> [Auto focus] button

Execute the auto focus.

<8> [Focus Guide] button

The [Focus] dialog box appears.

■Bottom of the screen



<1> [Film thickness preview]

The film thickness preview appears.

<2> [Degree of fit]

The fit degree appears.

<3> [Advanced] button

The [Advanced] dialog box appears.

On the [Advanced] dialog box, select the layer and base material.

<4> [Start Measurement] button

Measure the shape based on the current settings.

After the shape measurement is completed, the measurement result (waveform of the reflection) is displayed.

Chapter 8

Stitching Measurement

This chapter describes how to stitch and measure multiple images.

Important

- **Stitching measurement is an enhanced function that becomes available by installing the Image Stitching Module (VK-H3J). The Image Stitching Module (VK-H3J) must be installed beforehand.**
- **Perform stitching measurement under constant temperature and humidity. Temperature and humidity fluctuations during the stitching process may affect the measurement values.**
- **When performing stitching measurement, use a KEYENCE-specified XY stage. XY stages other than KEYENCE-specified models have not been tested for correct operation.**

What is Auto Image Stitching?

"Automatic image stitching" is a measurement method that automatically performs a series of operations, such as collecting multiple images of data while moving the measurement range and stitching the collected data into one image.

The motorized XY stage automatically moves the sample according to the setting of the stitching area. This moves the measurement range, automatically collecting the series of images sequentially. Positioning and alignment of the obtained original image are performed automatically.

Number and Types of Images that can be Stitched

The number and types of images that can be stitched are as follows.

Viewer Application settings		Max. No. of stitching screens (Vertical)	Max. No. of stitching screens (Horizontal)	Max. total No. of stitching screens
Measurement mode	Resolution			
Surface shape	Standard	100	100	1000 (560)*
	Partial	1	100	100
	Super Fine	50	50	100
Transparent target (Top surface)	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100
Transparent target (Film thickness)	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100

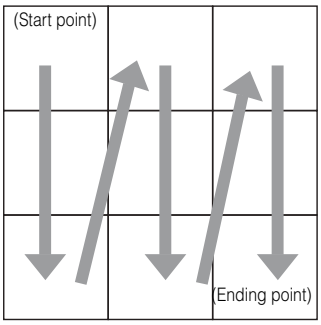
* The maximum number of stitching images increases to 1000 when scanning with focus variation and white light interference. Maximum of 560 can be stitched when the scan mode is the laser confocal.

Point

- If the stitched image size (width x height) exceeds 25,160,256 pixels (the size that allows for smooth automatic processing) for the surface shape and transparent target (top surface) data, the size is reduced by compressing the result file down and skipping lines.
- If the stitched image size (width x height) exceeds 6,290,064 pixels for transparent target (film thickness) data, the size is adjusted to be less than that by skipping the data automatically.

Image Stitching Sequence

During automatic image stitching, the system will start measuring in the upper left corner and move toward the lower right corner.

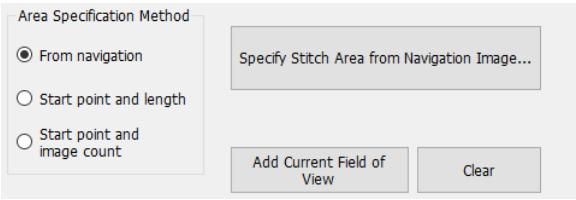


The measurement range of a single image depends on the selected objective lens.

Stitching Area Specification Method

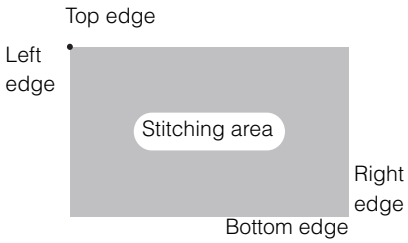
There are three methods for specifying the stitching area.

1. Specifying "from navigation"
2. Specifying the "Start point and length"
3. Specifying the "Start point and image count"



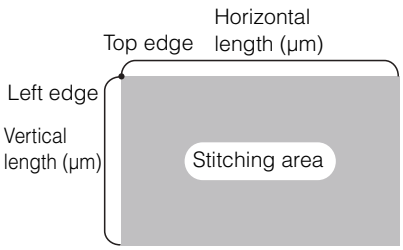
■ Specifying "from navigation"

Specify the start points (left edge/top edge) and end points (right edge/bottom edge) of the stitching area, while checking the images displayed on the navigation screen.



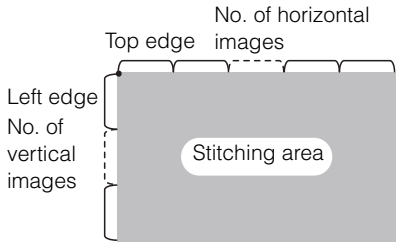
■ Specifying the "start point" and "length"

Specify the start points (left edge/top edge) of the stitching area, and then specify the vertical and horizontal lengths of the area.



■ Specifying the "start point" and "image count"

Determine the start points (left edge/top edge) of the stitching area, and then specify how many images should be measured/stitched vertically and horizontally.



Precautions for automatic image stitching

- If you wish to perform auto image stitching, use a motorized XY stage (VK-D3 or VK-S2100). Motorized XY stages other than our specified models have not been tested for correct operation.
- If the number of acquired images is different from the number of images to be stitched in automatic image stitching, or if the stitching is not performed correctly, check the movement of the motorized XY stage and the XY calibration of the objective lens.
  "Motorized XY Stage Adjustment" (Page 11-38)
  "XY calibration" (Page 11-22)
- When performing alignment on measurement results, switch [Show image] to [Laser image], [R element], [G element] or [B element]. Automatic position alignment is not available in [Laser + Optical image].

Flow of Auto Image Stitching

The flow of automatic image stitching is the same for surface shape, transparent target (top surface) and transparent target (film thickness) measurements. The operation flow will be the same for the scan modes (Focus variation, Laser confocal, and White light interferometry).

Startup

Starting the automatic image stitching function

Start the automatic image stitching function in the Viewer Application.

"Starting the Automatic Image Stitching Function" (Page 8-5)

Configuring the automatic image stitching function

Specifying a stitching area

Select the method for specifying the area for automatic image stitching, and set the start points (top and left edges) and end point of the stitching area.

"Specifying a Stitching Area" (Page 8-5)

Specifying an exclusion area

Re-adjust the measurement conditions as needed to ensure that your desired measurement range is entirely within the stitching area.

"Specifying an Exclusion Area" (Page 8-8)

Measure/stitch

Starting measurement

Start the measurement and enter the file name of the data to be saved.

"Starting Measurement" (Page 8-8)

Executing stitching

Check the alignment of the placed images and execute image stitching.

"Executing Stitching" (Page 8-9)

Checking and saving the stitched image

Select the display format and size of the image and save the stitching result.

"Checking and Saving the Stitched Image" (Page 8-9)

Operation Procedure for Automatic Image Stitching

Starting the Automatic Image Stitching Function

1 **You can select automatic measurement, manual measurement, or film surface measurement in the [Shape Measurement] tab. Alternatively, select the laser film thickness in the [Film Thickness Measurement] tab.**

Reference "Chapter 6 Shape Measurement" (Page 6-1), "Chapter 7 Film Thickness Measurement" (Page 7-1)

2 **Adjust the measurement unit to adjust the measurement conditions such as height range and measurement mode.**

Reference
- "VK-X3000 Series User's Manual"
- "Chapter 6 Shape Measurement" (Page 6-1), "Chapter 7 Film Thickness Measurement" (Page 7-1)

3 **Click the [Stitching] button on the toolbar.**

A dialog box to confirm the creation of navigation image appears.

4 **Click the [Yes] button.**

The stitching measurement menu appears.

Reference You can perform the same operation by selecting [Stitching] from the [Tools] menu.

Specifying a Stitching Area

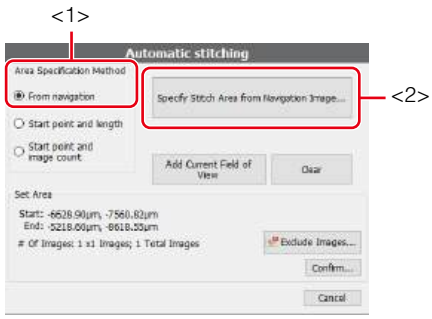
There are three methods for specifying the stitching area.

1. Specifying "from navigation"
2. Specifying the "start point and length"
3. Specifying the "start point and image count"

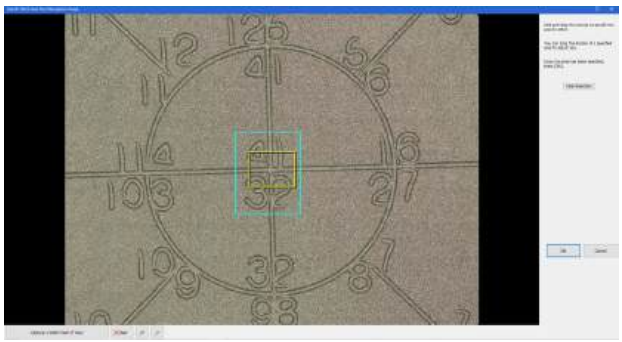
How to specify from navigation

1 **For the stitching area specification method, select the [From navigation] radio button (<1>), then click the [Specify Stitch Area from Navigation Image...] button (<2>).**

Click and drag in the [Specify Stitch Area from Navigation Image] window to specify the area to be stitched.



2 **Click and drag in the [Specify Stitch Area from Navigation Image] window to specify the area to be stitched.**



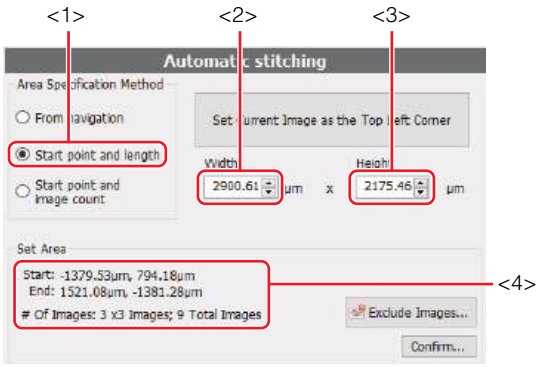
3 **Once you have finished specifying the stitching area, click the [OK] button.**

The start point, end point, and No. of images <1> for the stitched image are determined.

4 **After specifying the stitching area, click the [Start Measurement] button.**

How to specify in [Start point and length]

1 **Click the [Start point and length] radio button (<1>).**



2 **Move the view range in the viewing window, and click the [Set Current Image as the Top Left Corner] button to specify the "start point" of the stitching area.**

The view range of the currently displayed viewing window will be the start point of the stitching area.

3 **Enter the horizontal length (<2>) and vertical length (<3>) of the stitching area.**

The end point of the stitching area and the number of measured images (<4>) are determined.

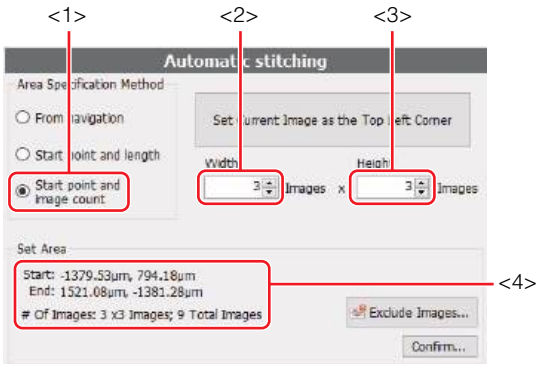
Reference

- When specifying in [Start point and length], the number of measured images will be calculated automatically to measure the specified length (numeric value) as stitching area.
- The relationship between the length of the stitching area and the number of images to be measured depends on the selected objective lens. If the stitching area is specified by length, changing the objective lens will update the number of images accordingly.
- If the stitching area is specified using [Start point and length], the area may become slightly larger than specified due to image stitching adjustments.

4 **After specifying the stitching area, click the [Start Measurement] button.**

How to specify in [Start point and image count]

1 **Select [Start point and image count] (<1>).**



2 **Move the view range in the viewing window, and click the [Set Current Image as the Top Left Corner] button to specify the "start point" of the stitching area.**

The displayed observation window will be the start point of the stitching area.

3 **Enter the No. of horizontal images (<2>) and vertical images (<3>) of the stitching area.**

The end point of the stitching area (<4>) is determined.

Reference The relationship between the number of images to be measured and the length of the stitching area (end point) depends on the selected objective lens. If the stitching area is specified by the number of images, changing the objective lens will update the value of the end point accordingly.

4 **After specifying the stitching area, click the [Start Measurement] button.**

Specifying an Exclusion Area

Some samples, such as a ring-shaped sample or L-shaped sample, may benefit from excluding unnecessary images from the stitch.

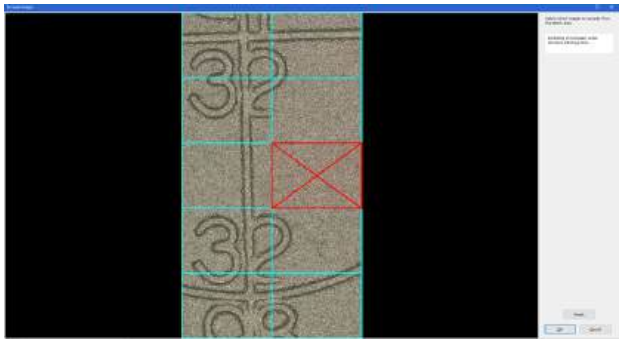
Exclusion areas are removed from the measurement and image stitching correction processes, which reduces measurement time and improves the stitching precision.

1 **Click the [Exclude Images] button.**

The [Exclude Images] dialog box appears.

2 **Click to specify the area to be excluded.**

The x symbol is displayed in the area.



3 **Once the setting is completed, click the [OK] button.**

Starting Measurement

1 **Once you have confirmed the measurement conditions and the stitching area, click the [Start Measurement] button.**

The measurement will start. When the measurement of the set number of images is completed, the [VK Image Stitching] window appears.

▶ Important

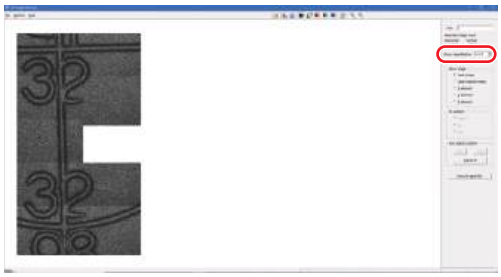
- **Adjust the shutter speed beforehand when the scan mode is set to focus variation mode and the shutter speed is set to Auto.**
- **If the scan mode is set to white light interferometry, adjust the brightness to the darkest position so that the brightness is uniform in all measurement positions.**

Executing Stitching

When the measurement is completed, the Image Stitching Module starts up and the main window is displayed.

The main window will populate with images aligned.

1 Adjust the magnification in the [Show magnification] box so that the placed images can be confirmed.



2 Adjust the image alignment as needed.

"Manual Position Alignment" (Page 8-24)

"Auto Position Adjustment" (Page 8-25)

"Fixing Adjacent Images" (Page 8-27)

"Changing the Image Display Format" (Page 8-28)

3 Click the [Execute assembly] button.

Important

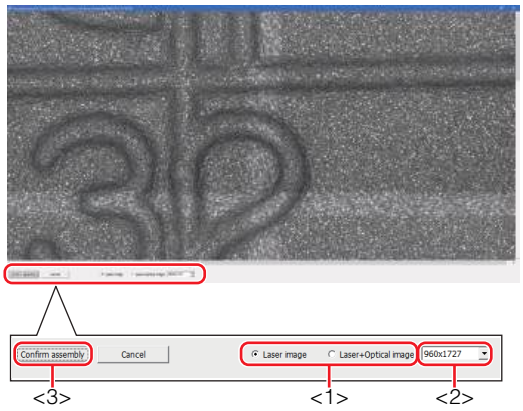
"Exclusion areas" during automatic stitching and [Perform trimming with inscribed rectangle that does not include invalid area] cannot be used together.
If "exclusion areas" are present, de-select the [Perform trimming with inscribed rectangle that does not include invalid area] checkbox in the dialog box that appears when you select [Options] in the [Options] menu of the Image Stitching Module.

"Executing Stitching" (Page 8-29)

Multiple images are stitched into a single image, which is displayed in the [Assembly result] window.

Checking and Saving the Stitched Image

You can check and save the stitched image in the [Assembly result] window.



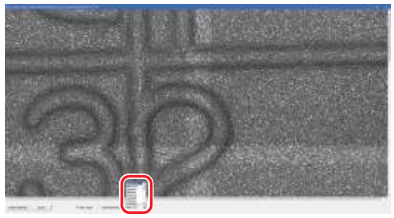
1 Click the [Laser image] or [Laser + Optical image] radio button (<1>).

The image is displayed in the selected format, allowing you to check the stitching results.

2 Select the image size after stitching in the image size selection box (<2>).

Point

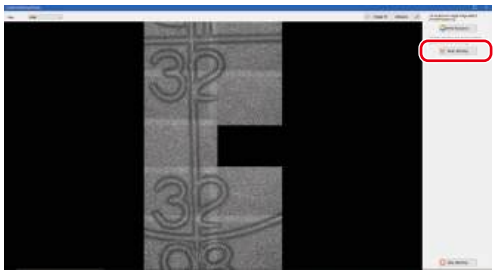
If you wish to save data that have not been skipped or whose skip amount is small, select a larger image size than the current size in the image size selection box.



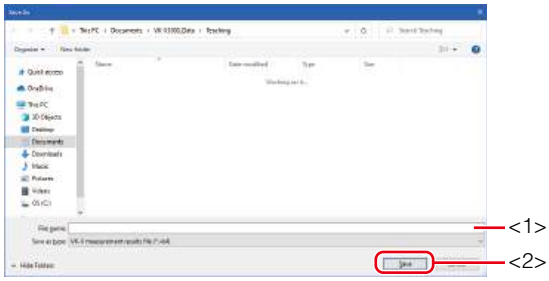
3 Click the [Confirm assembly] button (<3>).

The [Confirm Stitching Results] window appears.

4 **Click the [Finish Stitching] button.**



5 **Select a destination folder to save the file, and enter the [File name] (<1>).**



Point

- The stitched image file will be named as specified in [File name].
- The file name of each measured image (source images) will be YYYYMMDDhhmmss followed by a sequential number in the order of measurement.
  Example:
  If the file is saved at 12:34:56 on 9/1/2020, the measurement result file names will be "20200901123456_Y1_X1" (1st image from top, 1st image from left), "20200901123456_Y1_X2" (1st image from top, 2nd image from left), and so on.

6 **Select the [Save] button (<2>).**

The stitching result image is saved and displayed in the observation image display area of the Viewer Application.

Important

Do not operate the Viewer Application or Image Stitching Module during a stitching measurement. Images cannot be stitched correctly.

Point

To stop the stitching measurement or to change the measurement conditions and perform the measurement again, click the [Stop Stitching] button in the [Confirm Stitching Results] window.

Reference

Click the [Cancel] button to return to the main window without saving the image.

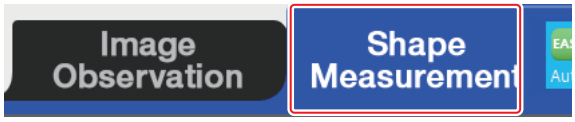
7 **Perform measurement and analysis as required.**

Stitching Settings

Displaying the Stitching Measurement View

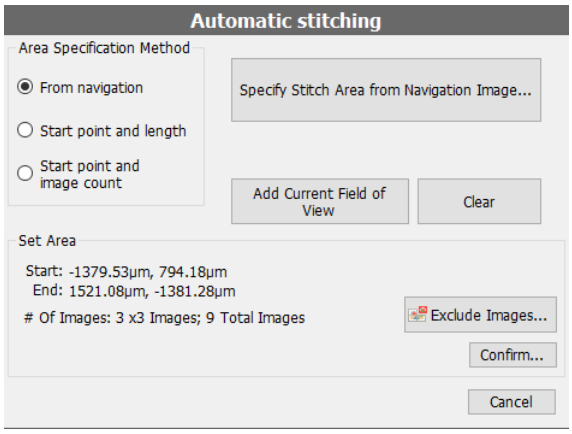
Display the view to perform stitching measurement.

1 On the toolbar, click [Shape Measurement] or [Film Thickness Measurement].



2 Click the [Stitching] button.

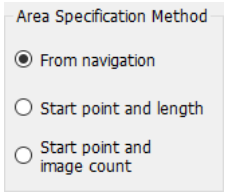
The [Automatic stitching] view appears.



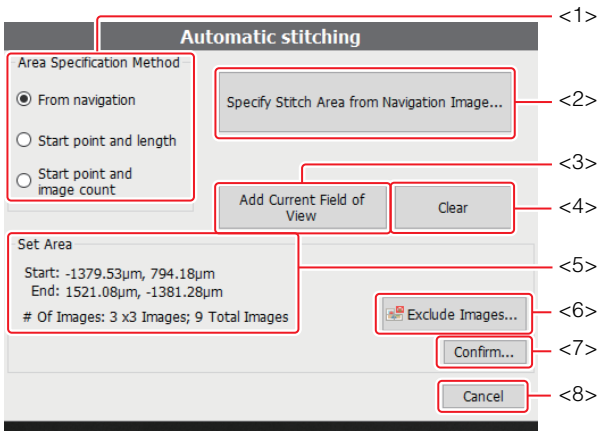
Stitching Measurement View Layout

In the stitching measurement view, you can create a stitching area after selecting how to specify the area.

There are three ways to specify the stitching area: "From navigation," "Start point and length," and "Start point and image count".



From navigation



<1> Area Specification Method
Specify the stitching area by selecting "From navigation," "Start point and length," or "Start point and image count".

<2> [Specify Stitch Area from Navigation Image] button
The [Specify Stitch Area from Navigation Image] screen appears.
In the [Specify Stitch Area from Navigation Image] window, you can specify a stitching area from the navigation area.
"[Specify Stitch Area from Navigation Image] Window" (Page 8-13)

<3> [Add Current Field of View] button
Adds the currently displayed field of view to the stitching area.

<4> [Clear] button
Clears a stitching area you have set.

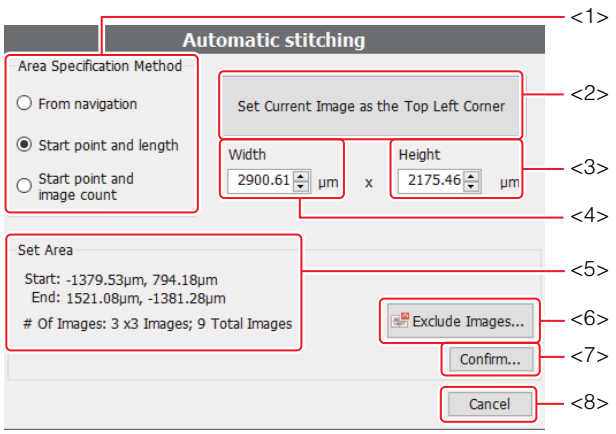
<5> Set Area
Displays the information of the set stitching area.

<6> [Exclude Images] button
Displays the [Exclude Images] window.
In the [Exclude Images] window, you can specify the area to be excluded from the stitching area.
"[Exclude Images] Window" (Page 8-13)

<7> [Confirm] button
The [Move to and Check Stitching Area] dialog box appears.
"[Move to and Check Stitching Area] Dialog Box" (Page 8-14)

<8> [Cancel] button
Ends the stitching measurement and closes the stitching measurement view.

Start point and length



<1> Area Specification Method
Specify the stitching area by selecting "From navigation," "Start point and length," or "Start point and image count".

<2> [Set Current Image as the Top Left Corner] button
Sets the stitching area with the current field of view as the top left corner.

<3> Width
Sets the horizontal width (length) of the stitching area.

<4> Height
Sets the vertical width (length) of the stitching area.

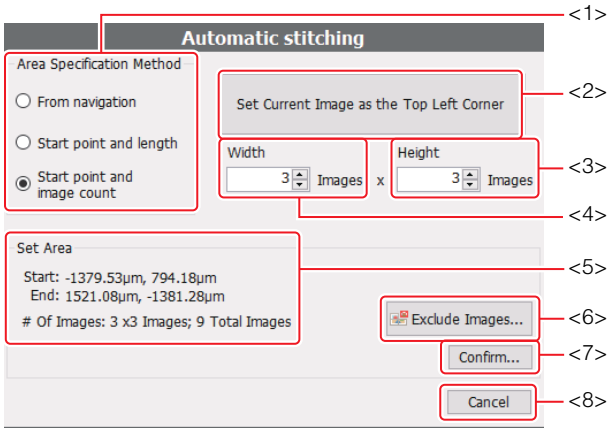
<5> Set Area
Displays the information of the set stitching area.

<6> [Exclude Images] button
Displays the [Exclude Images] window.
In the [Exclude Images] window, you can specify the area to be excluded from the stitching area.
"[Exclude Images] Window" (Page 8-13)

<7> [Confirm] button
The [Move to and Check Stitching Area] dialog box appears.
"[Move to and Check Stitching Area] Dialog Box" (Page 8-14)

<8> [Cancel] button
Ends the stitching measurement and closes the stitching measurement view.

Start point and image count



<1> Area Specification Method
Specify the stitching area by selecting "From navigation," "Start point and length," or "Start point and image count".

<2> [Set Current Image as the Top Left Corner] button
Sets the stitching area with the current field of view as the top left corner.

<3> Width
Sets the horizontal width (No. of images) of the stitching area.

<4> Height
Sets the vertical width (No. of images) of the stitching area.

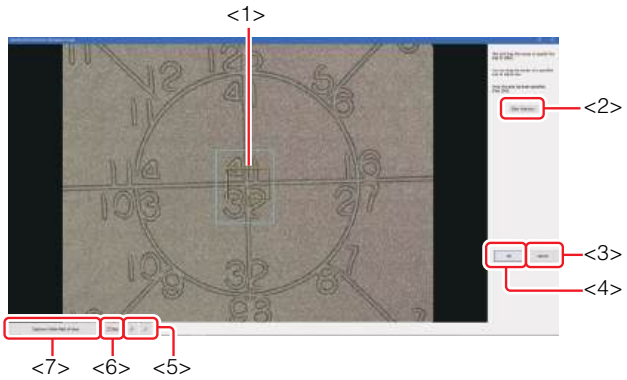
<5> Set Area
Displays the information of the set stitching area.

<6> [Exclude Images] button
Displays the [Exclude Images] window.
In the [Exclude Images] window, you can specify the area to be excluded from the stitching area.
"[Exclude Images] Window" (Page 8-13)

<7> [Confirm] button
The [Move to and Check Stitching Area] dialog box appears.
"[Move to and Check Stitching Area] Dialog Box" (Page 8-14)

<8> [Cancel] button
Ends the stitching measurement and closes the stitching measurement view.

[Specify Stitch Area from Navigation Image] Window



<1> Navigation area
The navigation screen is displayed.
The area enclosed by the mouse will be the stitching area.

<2> [Clear Selection] button
Clears the stitching area you are trying to set.

<3> [Cancel] button
Closes the [Specify Stitch Area from Navigation Image] window without setting the stitching area.

<4> [OK] button
Closes the [Specify Stitch Area from Navigation Image] window after setting the stitching area.

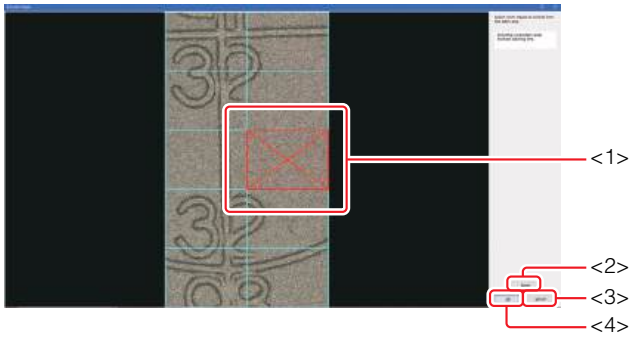
<5> 

Enlarges or reduces the image displayed in the navigation area (<1>).

<6> [Clear] button
Deletes the navigation image displayed in the navigation area.

<7> [Capture a Wider Field of View] button
Obtains an image with a wider area.

[Exclude Images] Window



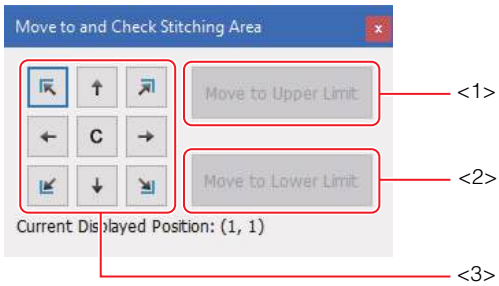
<1> Stitching area
Displays the currently set stitching area.
Clicking the mouse allows you to specify the target area as an exclusion area.

<2> [Reset] button
Resets the stitching exclusion area setting.

<3> [Cancel] button
Closes the [Exclude Images] window without setting the exclusion area.

<4> [OK] button
Closes the [Exclude Images] window after setting the exclusion area.

[Move to and Check Stitching Area] Dialog Box



<1> [Move to Upper Limit] button
Move to the top of the stitching area.

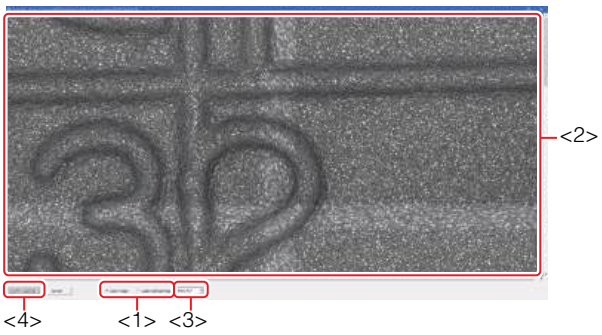
<2> [Move to Lower Limit] button
Move to the bottom of the stitching area.

<3> Arrow buttons in the area

: Moves the stage one level upwards.
: Moves the stage one level downwards.
: Moves the stage one level left.
: Moves the stage one level right.
: Moves the stage to the center.
: Moves the stage to the top left corner of the area.
: Moves the stage to the top right corner of the area.
: Moves the stage to the bottom left corner of the area.
: Moves the stage to the bottom right corner of the area.

Stitching Results

[Assembly result] Screen (Before Saving)



<1> Switching image display
Selects the image to display in the display area.
[Laser image] radio button:
Displays laser image in the image display area.
[Laser + Optical image] radio button:
Displays laser + optical image in the image display area.

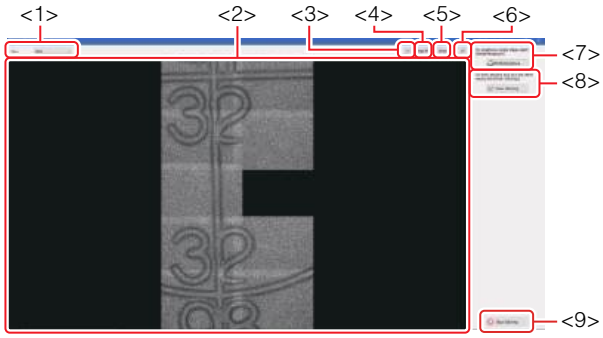
<2> Display area
Displays the stitched image that has been obtained.

<3> [Image Size to Save] box
Selects the size of the image file.

<4> [Comfirm assembly] button
Saves the image file using the current settings.
After saving, the area in the [Assembly result] window is changed.

Reference
The [Display on Analyzer app] button appears when the scan mode is set to white light interferometry and field curvature correction data has been obtained.

[Confirm Stitching Results] Screen (After Saving)



<1> [View] box
Selects the image to display in the display area.

<2> Display area
Displays the stitched image that has been obtained.

<3> 

Displays the image in reduced size in the display area.

<4> [Image Fit] button
Adjusts the image size fit in the display area.

<5> [Absolute] button
Displays the image in 100% size.

<6> 

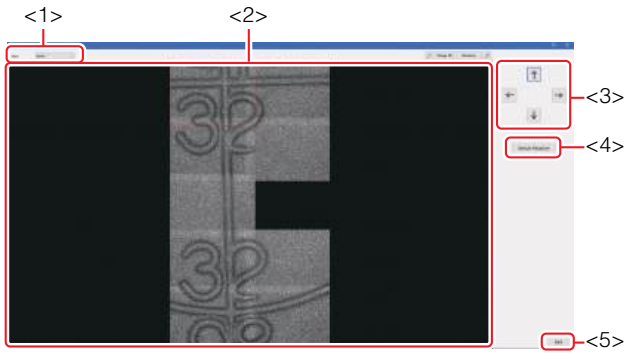
Displays the image in enlarged size in the display area.

<7> [Partial Recapture] button
The [Partial recapture settings] screen appears.

<8> [Finish Stitching] button
The [Save As] dialog box for saving the measurement files appears on the screen.
After saving the file, the measurement result (3D image) appears.
"2D Measurement" (Page 5-1)

<9> [Stop Stitching] button
Aborts the stitching operation and returns to the measurement screen.

[Partial recapture settings] Screen



<1> [View] box
Selects the image to display in the display area.

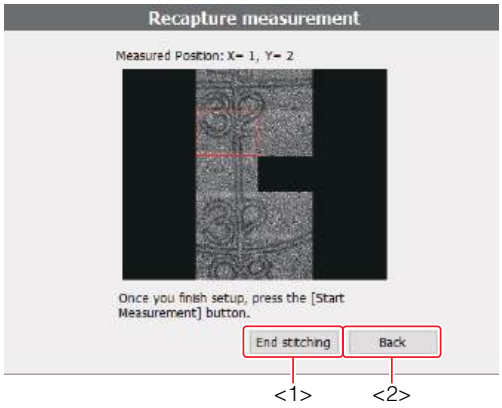
<2> Display area
Displays the stitched image that has been obtained.
The area to be recaptured is shown in a red frame.

<3> [↑] [↓] [←] [→]
Move the area to be recaptured (red frame).

<4> [Execute Recapture] button
Switches to the shape measurement mode (film thickness measurement mode), allowing you to recapture the target area.

<5> [Back] button
Returns to the [Confirm Stitching Results] screen (after saving) screen without recapturing.

Specifying an Exclusion Area



<1> [Complete stitching] button
The stitching measurement will end.

<2> [Back] button
Returns to the [Partial recapture settings] screen without recapturing.

Operation Procedure for Manual Image Stitching

Starting the Manual Image Stitching Function

1 **You can select automatic measurement, manual measurement, or film surface measurement in the [Shape Measurement] tab. Alternatively, select the laser film thickness in the [Film Thickness Measurement] tab.**

Reference "Chapter 6 Shape Measurement" (Page 6-1), "Chapter 7 Film Thickness Measurement" (Page 7-1)

2 **Adjust the measurement unit to adjust measurement conditions such as height range and measurement mode.**

Reference
- "VK-X3000 Series User's Manual"
- "Chapter 6 Shape Measurement" (Page 6-1), "Chapter 7 Film Thickness Measurement" (Page 7-1)

3 **Click the [Stitching] button on the toolbar.**

A dialog box to confirm the creation of navigation image appears.

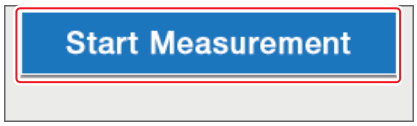
4 **Click the [Yes] button.**

The stitching measurement menu appears.

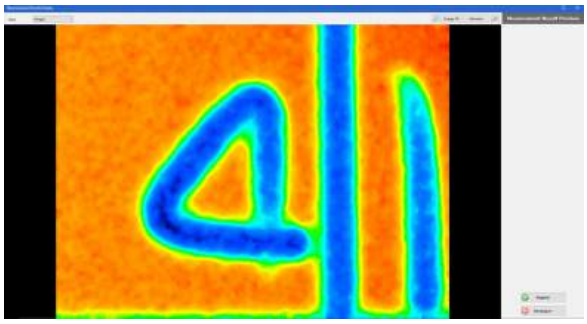
Reference You can perform the same operation by selecting [Stitching] from the [Tools] menu.

Measuring the First Image

1 **Click the [Start Measurement] button.**



After the 3D measurement is completed, the [Measurement Results Display] screen for the first image appears.



2 **When you are satisfied with the measurement result, click the [Register] button.**

The screen returns to the Stitching mode of the Viewer Application.

Reference If the part has not been measured properly, click [Remeasure].

Measuring the Second and Subsequent Images

1 Click the position button specifying a measurement position (<1>) to specify the next measurement position.

The position of the image to be measured changes depending on the clicked radio button.

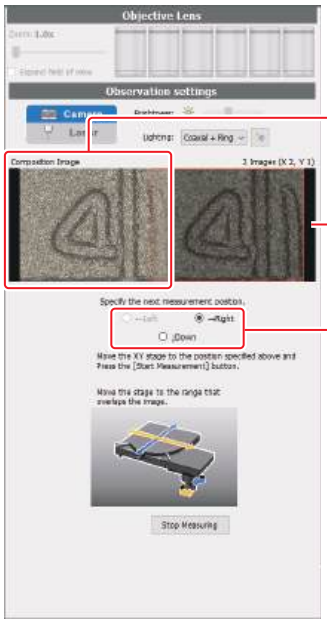


Image to be measured
* The image is displayed on the right side when [→ Right] is clicked.

Image that has been measured

<1>

[← Left]

The area to the left of the current position will be measured next.

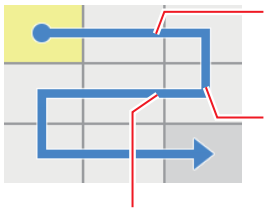
[→ Right]

The area to the right of the current position will be measured next.

[↓ Down]

The area below the current position will be measured next.

Reference The system starts measuring from the upper left in the order of the figure.



To measure the right side next, select [→ Right].

To measure the area below next, select [↓ Down].

To measure the left side next, select [← Left].

2 Display the portion to be measured next in the viewing window.

Turn the X axis stage handle (left/right) and Y axis stage handle (forward/back) to closely align the image to be measured (dark) with the image that has been measured (light).

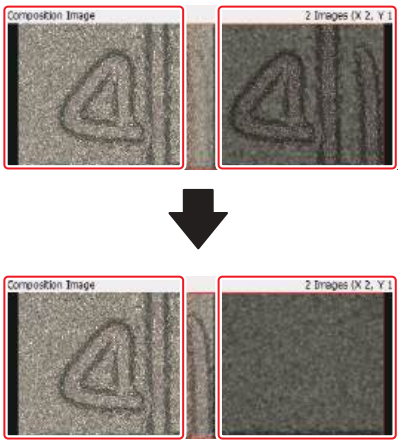


Image that has been measured

Image to be measured
* The image is displayed on the right side when [→ Right] is clicked.

3 Adjust the objective lens height and brightness.

Height

Focus on the highest point in the area and click the [Upper Limit] button.

Focus on the lowest point in the area and click the [Lower Limit] button.

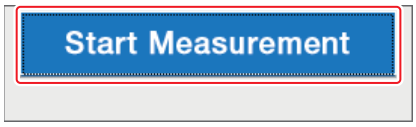
Brightness

Adjust the brightness in the area so that the light is the brightest overall.

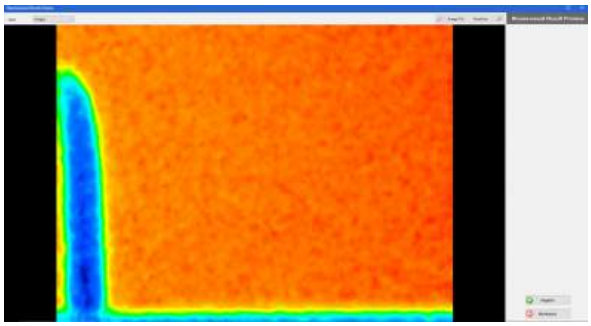
"Optical Image Brightness and Light Settings" (Page 3-6)

"Laser Brightness Adjustment" (Page 3-8)

4 **Click the [Start Measurement] button.**



After the 3D measurement is completed, the [Measurement Results Display] screen appears.



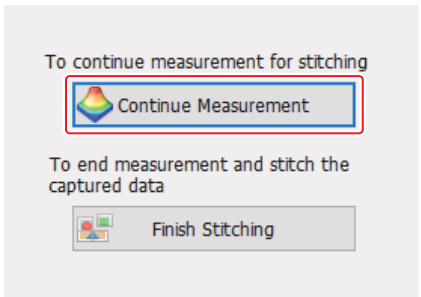
Check that the part is measured properly.

5 **When you are satisfied with the measurement result, click the [Register] button.**

The [Confirm Stitching Results] screen appears.

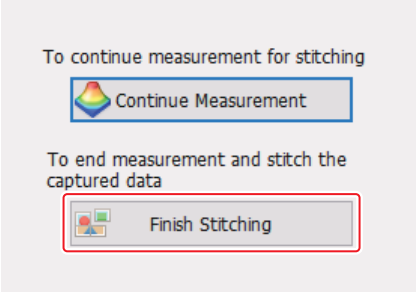
Reference When the part has not been measured properly, click [Remeasure].

6 **To continue to measure, click the [Continue Measurement] button.**



7 **Repeat steps 1 through 5 to measure the entire range you want to stitch.**

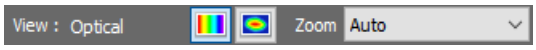
8 **To finish the measurement and stitch the images, click the [Finish Stitching].**



The image is stitched.

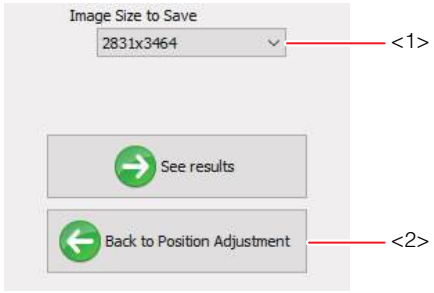
Checking and Saving the Stitched Image

1 Check the stitched result while changing the texture or height and adjusting the display magnification.



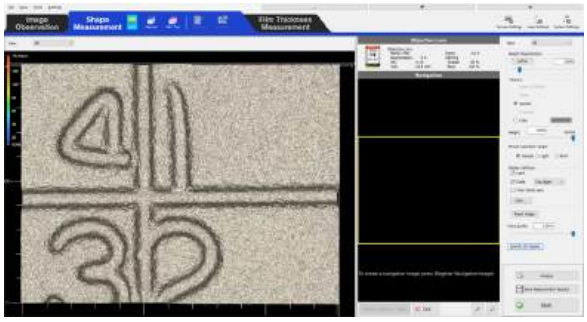
Setting range: Auto, 10 - 200%

2 Select the image size after stitching in the [Image Size to Save] box (<1>).



3 Click the [See results] button (<2>).

The measurement result (3D image) appears.



You can rotate the measurement result (3D image) to confirm the shape and perform 3D measurement.

"2D Measurement" (Page 5-1)

Flow of Stitching Using Image Stitching Module

Measurement

Measuring the source images

The source images are measured using the Viewer Application.

"Shape Measurement" (Page 6-1)

Startup

Starting the Image Stitching Module

Start the Image Stitching Module.

"Starting the Image Stitching Module" (Page 8-23)

Manual image stitching

Selecting source images

Select the source images and the folder containing the source images.

"Selecting Source Images" (Page 8-23)

Manual position alignment

Manually align the images to be stitched.

"Manual Position Alignment" (Page 8-24)

- Automatically fine-tune the image positions.

"Auto Position Adjustment" (Page 8-25)

- Automatically align the images that are arranged side-by-side or top-and-bottom.

"Fixing Adjacent Images" (Page 8-27)

- Change the display format of the images to make them easier to align.

"Changing the Image Display Format" (Page 8-28)

Executing stitching

Execute the image stitching.

"Executing Stitching" (Page 8-29)

Checking and saving the stitched image

Check the image stitching results, and save the images by selecting the display format and image size.

"Confirming and Saving the Stitched Image" (Page 8-30)

Shutdown

Shutting down the image stitching module

Shut down the Image Stitching Module.

"Shutting Down the Image Stitching Module" (Page 8-31)

Image Stitching Using the Image Stitching Module

Multiple images measured by the Viewer Application can be stitched into one image using the Image Stitching Module.

You can also specify the source image files and align the images manually.

Fine adjustment of the position can be completed automatically to support the manual position alignment.

Number and Types of Images that can be Stitched

The number and types of images that can be stitched are as follows.

Viewer Application settings		Max. No. of stitching screens (Vertical)	Max. No. of stitching screens (Horizontal)	Max. total No. of stitching screens
Measurement mode	Resolution			
Surface shape	Standard	100	100	1000 (560)*
	Partial	1	100	100
	Super Fine	50	50	100
Transparent target (Top surface)	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100
Transparent target (Film thickness)	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100

*The maximum number of stitching images increases to 1000 when scanning with focus variation and white light interference. Maximum of 560 can be stitched when the scan mode is the laser confocal.

Important

- **If the measurement size is one line, stitching cannot be performed.**
- **Snapshot images cannot be stitched.**

Point

- If the stitched image size (width x height) exceeds 25,160,256 pixels (the size that allows smooth automatic processing) for the surface shape and transparent target (top surface) data, the size is reduced by compressing the result file down and skipping lines.
- If the stitched image size (width x height) exceeds 6,290,064 pixels for transparent target (film thickness) data, the image is compressed by skipping lines of data.

Unify settings during image measurement

The following settings must be unified when measuring the source images:

- Number of image layers (for transparent target measurement (film thickness - plane))
- RPD selection status
- Measurement mode
- Measurement quality
- Measurement pitch
- Optical zoom magnification
- Lens magnification
- Double scan selection status
- Gain (Second gain is also included if the double scan function is enabled)
- Filter selection
- Average image count
- With or without field curvature correction
- With or without laser intensity eccentricity correction
- XY calibration
- Z calibration
- Edge enhance filter
- Gamma correction/free set setting details
- Fine mode status
- Measurement result adjustment setting details
- HDR and C-DIC should be OFF.

Precautions for source image measurement

Keep the following points in mind when measuring the source images:

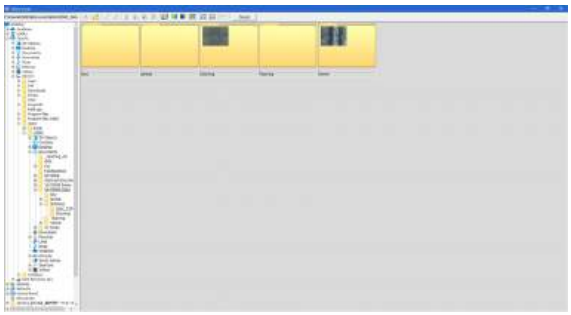
- The overlap between adjacent images should be less than half of the image areas.
- When collecting images by moving the sample on the standard X-Y stage, the measurements should be performed such that about 1/4 of each image overlaps.
- All source images should be saved in the same folder. If they are stored in different folders, group them together in a single folder before stitching them.
- When performing a position alignment, switch [Show image] to [Laser image], [R element], [G element] or [B element]. Automatic position alignment is not available in [Laser + Optical image].

Operation Procedure of Image Stitching Module

Starting the Image Stitching Module

1 **Either double-click the [VK-X 3000 Image Stitching Application] icon or [VK-X 3000 Laser Image Stitching Application] icon on the desktop, or click the [Start] button > [KEYENCE VK-X 3000 Series] > [VK-X 3000 Image Stitching Application] / [VK-X 3000 Laser Image Stitching Application] on the Windows task bar.**

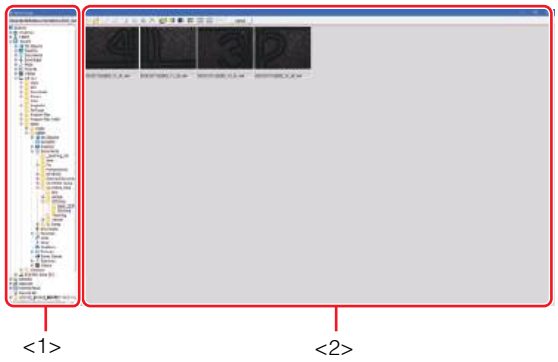
The Image Stitching Module starts, and the [Select image] window is displayed.



Selecting Source Images

1 **In the folder tree <1> in the [Select Image] window, select the folder containing the stitching source images.**

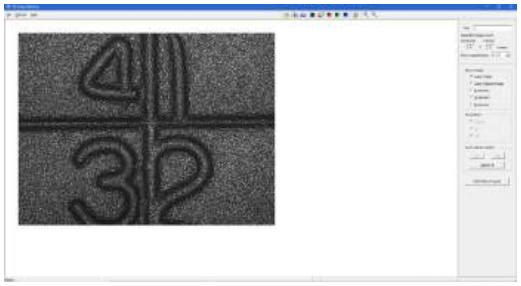
The images in the folder are displayed in the file selection area <2>.



Reference If the [Select Image] window is not displayed, select [Open] from the [File] menu or click the [Open] button on the toolbar.

2 **In the file selection area <2>, double-click one of the images to be stitched.**

Images that can be stitched with the selected images are automatically extracted and placed in the image display area of the main window.



To re-adjust a stitching result image

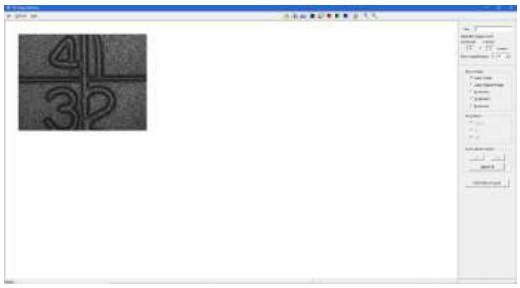
Double-click a stitching result image in the file selection area.

The source images are placed in the main window in their last saved state.

Point

In order to re-adjust a stitching result image, the image file name and the sub-folder containing the source images must have the same name and be in the same folder (e.g. if the file name of the stitching result image is "test1.vk4", then the name of the source image sub-folder must be "test1".
You will be unable to re-adjust the image if you rename or move them to a different folder.

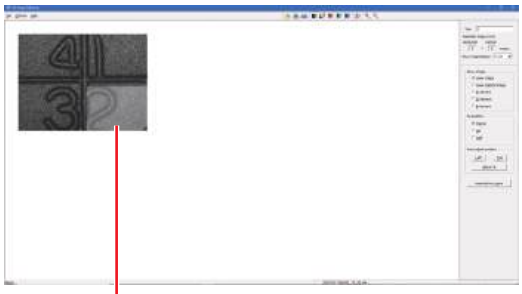
3 Adjust the magnification in the [Show magnification] box so that the extracted images can be placed.



Manual Position Alignment

1 Select the image you wish to move by double-clicking it, and then drag it to adjust its position.

The ⌜ symbol is displayed in the four corners of the currently selected image. Also, the image opacity will be reduced so that the image below can be seen through.



Selected image

2 Repeat the position alignment of each image until you have a single image.

The numbers of vertical and horizontal stitch images are automatically determined according to how the images are arranged and are displayed in [Assembly image count].

● De-selecting images

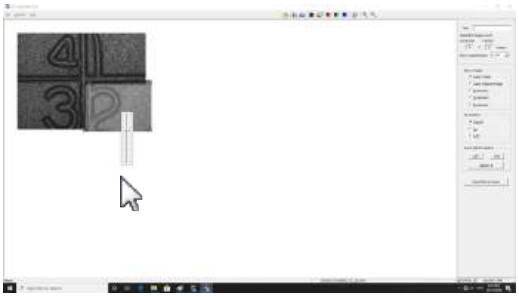
To de-select all images, double-click the currently selected image or a blank part of the image display area.

● Moving an entire image

To move the entire image, drag an area outside of the currently selected image or drag after de-selecting all images.

● Changing the opacity of the selected image

Right-clicking a selected image displays a slider that allows you to change its opacity (transparency). Try adjusting the opacity when it is difficult to see the overlapping part of the image. De-selecting an image restores its original opacity.



Point

- Changing the image display format may make it easier to align the images.
  "Changing the Image Display Format" (Page 8-28)
- You can temporarily stitch two adjacent images and move them as a single image.
  "Fixing Adjacent Images" (Page 8-27)

Auto Position Adjustment

You can automatically fine-tune the position alignment of the images to be stitched.

It is possible to align all images at once or align adjacent images automatically.

Point

- Changing the image display format may improve the precision of the automatic position alignment.
  "Changing the Image Display Format" (Page 8-28)
- When performing a position alignment, switch [Show image] to [Laser image], [R element], [G element] or [B element]. Automatic position alignment is not available in [Laser + Optical image].

Automatic alignment of all images

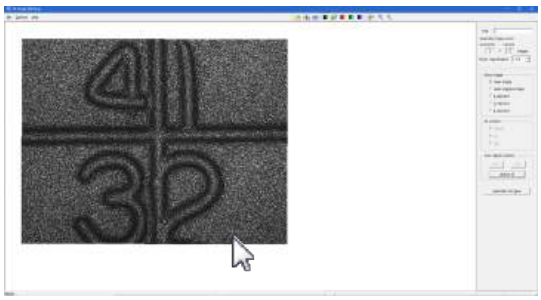
This section describes how to align all images automatically.

1 Roughly adjust the position of all images manually.

"Manual Position Alignment" (Page 8-24)

2 Click the [Adjust all] button under [Auto adjust position].

All images are aligned automatically.



Point

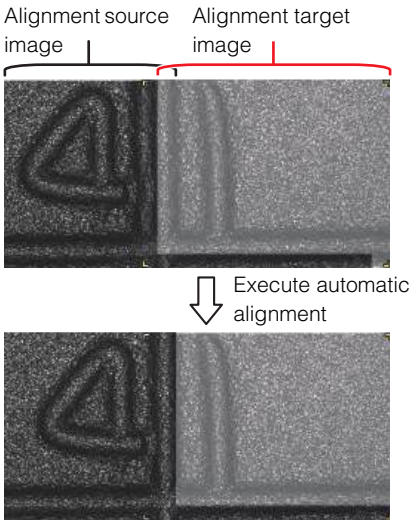
If the message "The images are not aligned properly." is displayed, manually reposition the images and then click the [Adjust all] button again.

Automatic alignment of adjacent images

You can automatically align the images that are arranged side-by-side or top-and-bottom.

The left or top image is the source image (which will not be moved). Select the right or bottom image as the alignment target image (which will be moved).

Example: Side-by-side

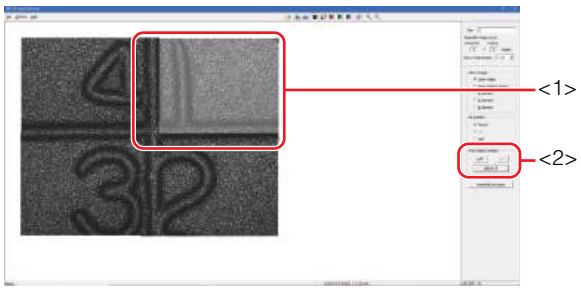


1 Roughly adjust the position of images arranged side-by-side or top-and-bottom manually.

"Manual Position Alignment" (Page 8-24)

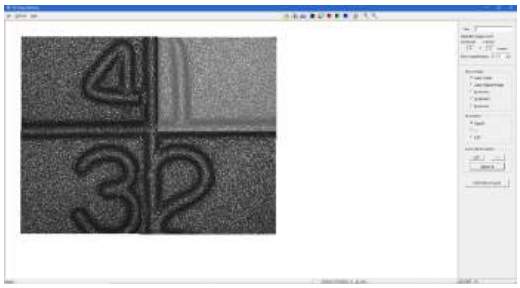
2 Double-click the right or bottom image (alignment target) among the aligned images to select it (<1>).

A symbol is displayed in the four corners of the image to indicate that it is selected.



3 Click the [Left] or [Top] button (<2>) under [Auto adjust position].

The position of the selected image is automatically adjusted relative to the left or top image.



Reference

You can temporarily stitch two images that have been stitched automatically.

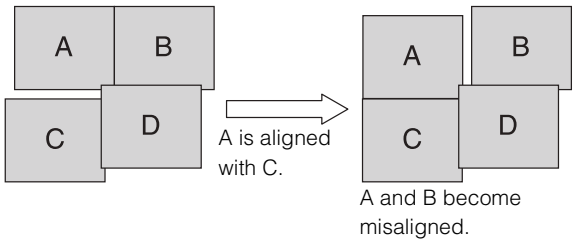
"Fixing Adjacent Images" (Page 8-27)

Fixing Adjacent Images

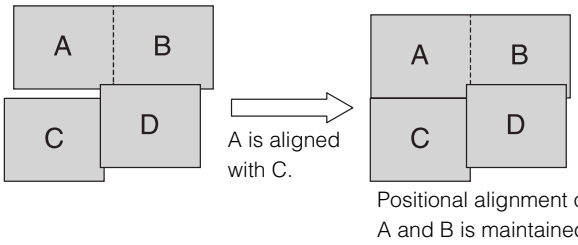
Even if you perform a position alignment between two images, the alignment will be lost if you move either of the images for alignment with another image.

A temporary stitching of images that are arranged side-by-side or top-and-bottom in order to prevent misalignment is referred to as "fixing". Fixed images can be moved together.

- If image B is not fixed with image A



- If image B is fixed with image A



The left or top image is the fixing source image. Select the right or bottom image as the fixing target image.

After fixing, selecting and moving the left or top image will move the right or bottom image with it. However, the right or bottom image will be hidden while moving.

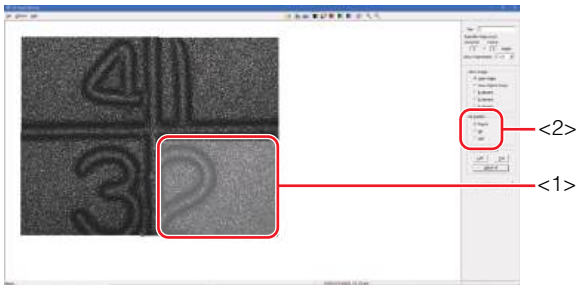
After fixing, the right or bottom image can be selected but not moved.

1 Automatically or manually align the images that are arranged side-by-side or top-and-bottom.

"Manual Position Alignment" (Page 8-24)
"Auto Position Adjustment" (Page 8-25)

2 Double-click the aligned right or bottom image (fixing target) to select it (<1>).

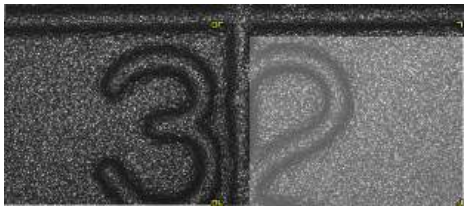
A symbol is displayed in the four corners of the image to indicate that it is selected.



3 Click the [Left] or [Up] radio button (<2>) under [Fix position].

The selected image will be fixed relative to the left or top image.

A symbol is displayed in the corner of the left or top image indicating that it is the fixing source image.



Point

To release the fixing, double-click the right or bottom image (fixing target) to select it and click the [Cancel] radio button.

Changing the Image Display Format

When aligning images, changing the display format may enhance the contrast and make them easier to work with.

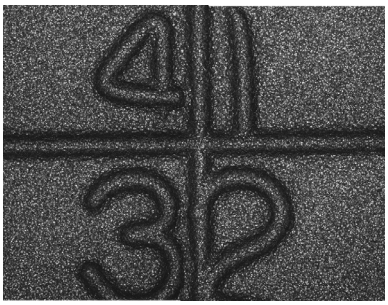
Important

- **Automatic position alignment will be disabled if you set [Show image] to [Laser + Optical image].**
- **Automatic position alignment is performed based on the image data in the display format selected in [Show image]. Selecting a display format that provides better contrast and easier alignment of image shapes and boundaries will improve the precision of automatic alignment.**
- **If [C-DIC] is enabled for the source data to be stitched, C-DIC images will be displayed when you select [Laser + Optical image], [R element], [G element], or [B element], preventing you from stitching the images. De-select the [C-DIC] checkbox in the Viewer Application.**

1 In [Show image], click the radio button of the desired image format.

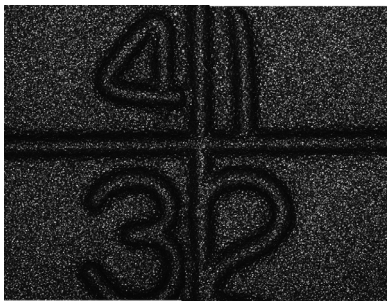
The images will be displayed in the selected format.

- [Laser image] display

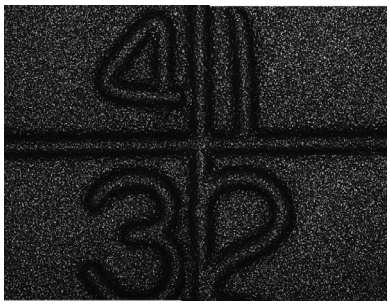


- [Laser + Optical image] display

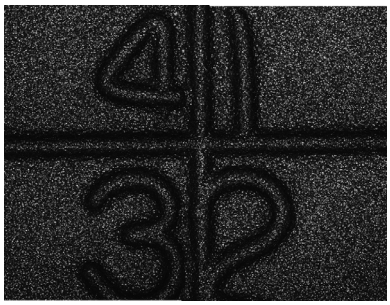
- [R element] display



- [G element] display



- [B element] display



Executing Stitching

Once the images are aligned, they are stitched into one image. The stitching result is then displayed.

1 Click the [Assemble and save] button.

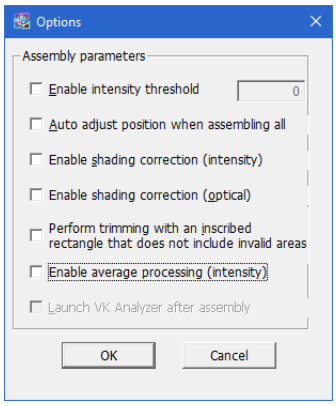
The stitching is executed and the stitched image is displayed in the [Assembly result] window.

Important

"Exclusion areas" during automatic stitching and [Perform trimming with inscribed rectangle that does not include invalid area] cannot be used together. If "exclusion areas" are present, de-select the [Perform trimming with inscribed rectangle that does not include invalid area] checkbox in the dialog box that appears when you select [Options] in the [Options] menu of the Image Stitching Module.

Image correction during stitching

You can set the image correction method for stitching by selecting [Options] in the [Options] menu.



[Enable intensity threshold] checkbox

The height data of areas where the laser intensity is low may contain noise (abnormal values) resulting in unevenness in the stitched image. You can remove this noise by setting the laser intensity threshold (usually set to around 1000).

[Auto adjust postion when assembling all] checkbox

Displays a message confirming whether to perform automatic alignment of the entire image before executing stitching.

[Enable shading correction (intensity)] checkbox

Corrects the laser intensity unevenness at the stitching part of the laser image in the laser image or laser + optical image display.

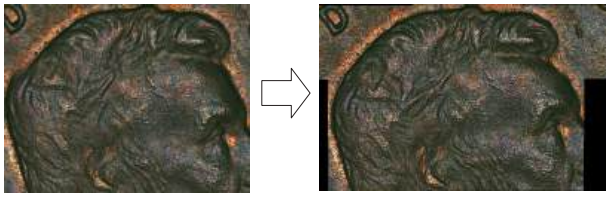
[Enable shading correction (optical)] checkbox

Corrects the color unevenness at the stitching part of the optical image in the laser + optical image display.

[Perform trimming with inscribed rectangle that does not include invalid area] checkbox

Extracts a rectangular area inscribed in the stitched image and automatically drops the invalid area.

[ON] [OFF]



[Enable average processing (intensity)]

Interpolates the brightness with surrounding pixels to make the stitching part caused by uneven intensity of the laser image less noticeable.

Point

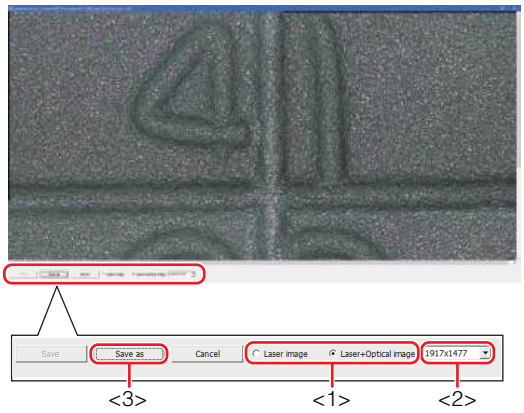
Depending on the texture of the laser image, the stitching part may appear blurred due to the interpolation by the averaging process. Select ON/OFF as needed.

[Launch VK Analyzer after assembly] checkbox

Automatically starts the Analyzer Software after saving the stitched image.

Confirming and Saving the Stitched Image

You can check and save the stitched image in the [Assembly result] window.



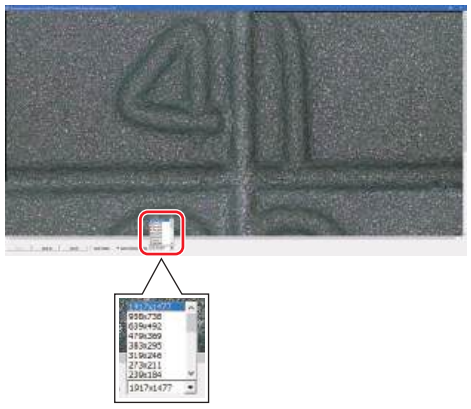
1 Click the [Laser image] or [Laser + Optical image] radio button (<1>).

The image is displayed in the selected format, allowing you to check the stitching results.

2 Select the image size after stitching in the image size selection box (<2>).

Point

If you wish to maintain data integrity of small features and avoid skipping, select a larger image size than is currently selected.



3 **Select how to save the stitched image <3>.**

[Save]
Overwrites an existing stitched image file.

[Save as]
Sets the save destination and file name, and saves the image as a new image file.

[Cancel]
Returns to the main window without saving the image.

If you select [Save] or [Save As], a message will appear to confirm moving of the source data.

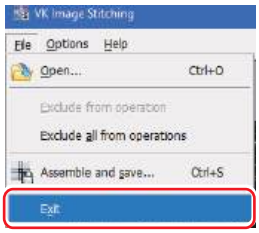
4 **Click the [OK] button.**

The stitching result image is saved.

A sub-folder with the same name as the stitching result image is created; and the source image files are moved to this folder (e.g. if the file name of the stitching result image is "test1.vk4", then the name of the source image sub-folder will be "test1").

Shutting Down the Image Stitching Module

1 **Select [Exit] from the [File] menu.**



Alternatively, click the [x] button on the top right of the main window.

The Image Stitching Module is shut down.

Image Stitching Module Operation Screen

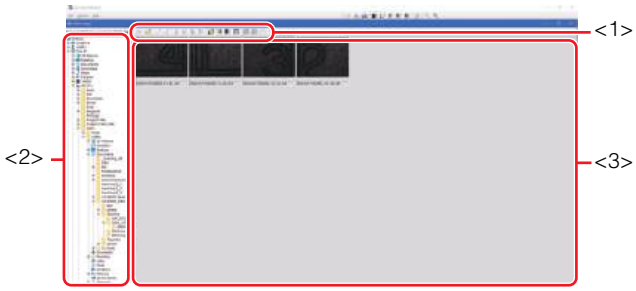
Main Window

The toolbar functions in the main window are the same as for the Image Stitching Module.

Toolbar

The toolbar functions in the main window are the same as for automatic image stitching.

[Select image] Window



<1> Toolbar

Displays the buttons for frequently used functions.

<2> Folder tree

Displays the folders on the control PC in a tree format. Selecting a folder containing saved images files displays the images in a list in the file selection area.

<3> File selection area

Displays the image files in the folder selected in the folder tree as thumbnails.

The title and file name of the image are displayed below the thumbnails.

Toolbar

Open

Use to extract the source images. Selecting an image in the file selection area and clicking this button opens the main window in which images that can be stitched have been automatically extracted.

"Selecting Source Images" (Page 8-23)

New folder

Creates a new folder within the currently selected folder.

Rename

Select an image in the file selection area and click this button to change the image file name.

Rename title

Select an image in the file selection area and click this button to change the image title.

Cut

Used to move image files to a different folder. Select an image in the file selection area and click this button to cut the file.

Copy

Used to copy image files to a different folder. Select an image in the file selection area and click this button to copy the file.

Paste

Pastes an image file that has been cut or copied into the currently selected folder.

Delete

Deletes the selected image file.

Laser + Optical image

Displays a thumbnail of the file with an optical image with added laser intensity information.

Optical image

Displays a thumbnail of the file with an optical image.

Laser image

Displays a thumbnail of the file with a monochrome image based on laser intensity information.

Height image

Displays a thumbnail of the file with an image based on height information.

Sort by name

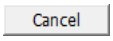
Sorts the images displayed in the file selection area by name. Each time you click the button, the order toggles between ascending and descending.

Sort by date

Sorts the images displayed in the file selection area by date. Each time you click the button, the order toggles between from oldest and newest.

Properties

Select an image in the file selection area and click this button to display the properties of the image file.

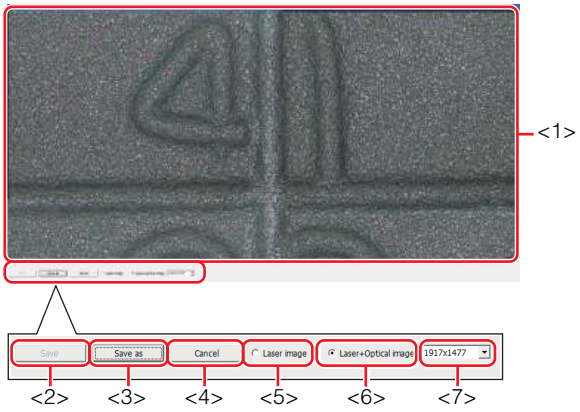


Cancel

Closes the [Select image] window.

You can also perform the functions of each button on the toolbar by opening the right-click menu on the image file.

[Assembly result] Window



<1> Stitched image display area

Displays the stitching result image.

<2> [Save] button

Overwrites the saved stitched image.

<3> [Save as] button

Saves the stitched image as a new image.

<4> [Cancel] button

Returns to the main window without saving the image.

<5> [Laser image] radio button

Switches the image in the stitched image display area to monochrome display using laser intensity information.

<6> [Laser + Optical image] radio button

Switches the image in the stitched image display area to an optical image with added laser intensity information.

<7> Image size selection box

Selects the image size for saving.

Reducing the image size reduces the file size by skipping the data.

MEMO

Chapter 9

Teaching

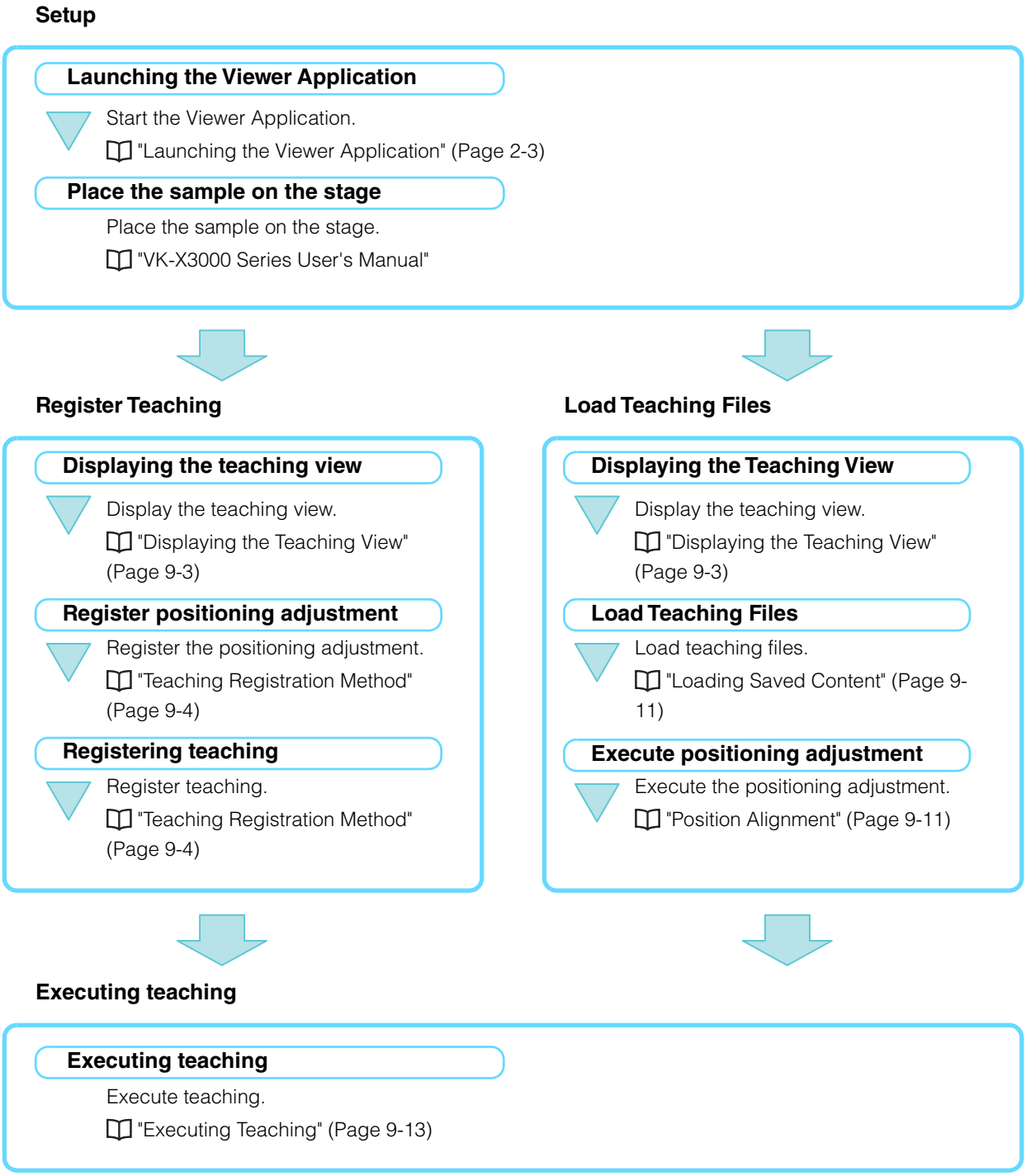
This chapter describes teaching, a function to program the stage to a specified position and make a measurement.

▶ Important

- **Teaching is an advanced function that becomes available by installing the Image Stitching Module (VK-H3J).**
  The Image Stitching Module (VK-H3J) must be installed beforehand.
- **Excel must be installed to use teaching with inspection mode.**

Flow of Operation for Teaching

The teaching procedure is shown below.

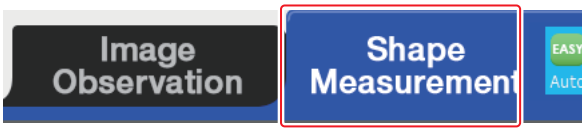


Registering Teaching

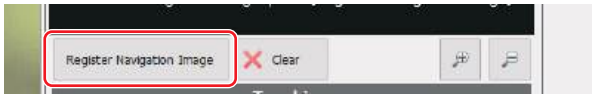
Displaying the Teaching View

Display the view for performing teaching.

1 **On the toolbar, click [Shape Measurement].**



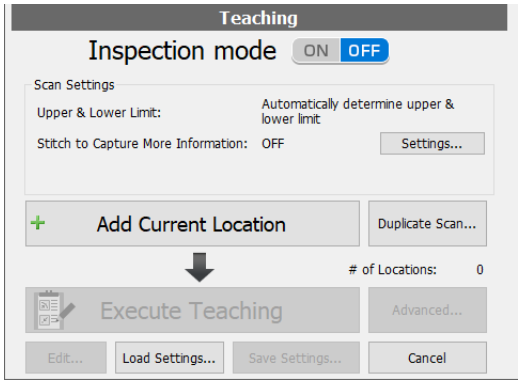
2 **Click the [Register Navigation Image] button.**



The navigation image will be created.

3 **On the toolbar, click the [Teaching] button.**

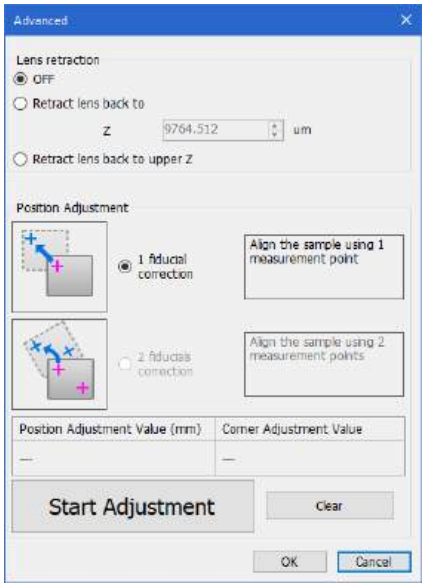
The teaching view appears.



Teaching Registration Method

Point

To increase the accuracy of positioning measurements, positioning objects can be set as the first and second points which are not the original measurement points.



1 Change to the desired objective lens.

"Selecting Magnification" (Page 3-2)

2 Move the XY stage.

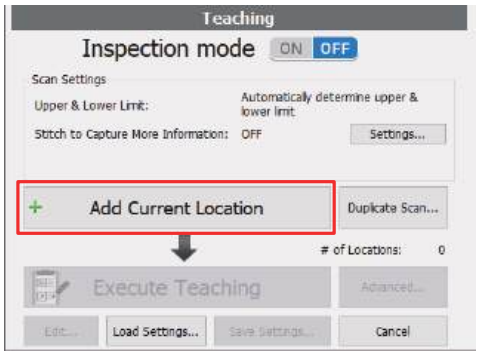
"Adjusting the Motorized XY Stage Position" (Page 3-13)

3 Focus the objective lens.

"Adjusting Focus" (Page 3-3)

4 Set the measurement conditions including the measurement mode, scan mode, and maximum and minimum limit settings.

5 Click the [Add Current Location] button.



The first correction point is registered.

6 Repeat steps 1 to 5 to register all positions.

Reference

Useful measurements applicable to teaching

This setting is used when measuring over a wide range on a stitched image and repeatedly measuring measurement positions placed in equal intervals with measurement conditions in steps 1 to 4.

- Combining the image stitching function
  "Combining with Image Stitching" (Page 9-9)
- Repeat settings
  "Repeat Settings for Teaching" (Page 9-10)

Number of Teaching Positions

You can register up to 3,000 positions.

Point

The teaching function corrects displacement of the entire sample and tilt of the rotating direction, by setting the measurement position, lens magnification, and measurement conditions of the firstly registered sample as the first correction point, and the next registered point as the second correction point.

Teaching Parameters

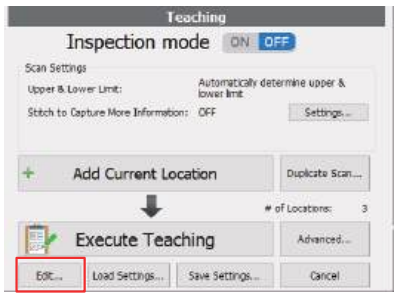
Item	Content	Description
Measurement mode	Manual measurement/Film surface measurement/Laser film thickness/ Spectral film thickness	
Stage X coordinate	X coordinate value	
Stage Y coordinate	Y coordinate value	
Objective lens	Objective lens to be used	Register the name, magnification, NA, and WD. When executing teaching, select the lens that matches the magnification, NA, and WD (the name will be recorded but not checked).
Analysis template file	Template file for Multifile Analyzer Software (.acs)	A macro file that stores analysis data such as image processing and measurement items.
Resolution	Size of the measurement (including line measurements)	1024 x 768 and other sizes
Measurement quality	High precision/High speed/Ultra high speed	
ND Filter	100%/30%/10%/3%/1%	
ND Filter 2	(As above)	A laser light filter used for a second scan when a double scan is manual.
Double scan/HDR/ Smart HDR	Auto judgment/ON/OFF	• Auto judgment is enabled when [Only double scan when necessary] on the [Double Scan Settings] dialog box is selected. • ON is enabled when [Always double scan] on the [Double Scan Settings] dialog box is selected. • OFF is enabled when the [Use double scan (Auto)] check box is cleared on the main control. • When focus variation is enabled, ON/OFF is shown for HDR. • When white light interferometry is enabled, ON/OFF is shown for smart HDR.
Double scan brightness	Auto/Manual	The [Auto setting] check box on the [Double Scan Settings] dialog box.
Laser brightness	Laser brightness	
Laser brightness 2	(As above)	This is the brightness used for a second scan when the double scan brightness is manual.
Camera brightness		Camera brightness. The brightness is automatically set when the camera brightness mode is set to auto. The brightness is manual when the camera brightness is set to manual.
Camera brightness 2	Smart HDR camera brightness	Camera brightness when using Smart HDR with white light interferometry.
Camera digital gain	Camera sensitivity when using white light interferometry.	Camera sensitivity setting when using white light interferometry.
Camera brightness mode	Auto/Manual	A type of camera brightness.

Item	Content	Description
Maximum measurement limit	Position for the maximum limit of the measurement range	
Minimum measurement limit	Position for the minimum limit of the measurement range	
Measurement pitch	Measurement pitch	
Ave. intensity	Average laser intensity in the white light interferometry mode	Setting value of the image integration function used in the white light interferometry mode.
RPD	ON/OFF/---	Confocal laser RPD check box setting. [---] is displayed for focus variation.
Auto Focus	ON/OFF	Selecting [Use autofocus during registration to detemine upper& lower limit] for [Scan Range] turns this setting on.
Auto focus position	Linear scale value for auto focus	This value is used when auto focus is turned on. "---" is displayed when auto focus is turned off.
Auto maximum and minimum limit settings	ON/OFF	Selecting [Automatically determine upper & lower limit] for [Scan Range] turns this setting on.
Line position	Y coordinate for the line	Note: Only enabled when one line is selected.
Zoom	0.7x, 1.0x, 1.2x, 1.5x, 2.0x, 2.5x, 3.0x, 4.0x, 5.0x, 6.0x, and 8.0x	
Z axis mode	Recommended settings/Prioritize accuracy/Prioritize speed	
Average count		
Fine mode	ON/OFF/---	[---] is displayed for focus variation and white light interferometry.
Automatically enable noise region processing	ON/OFF	Indicates whether "Automatically filter noisy data" is ON or OFF in the environment settings menu. Missing data are judged as noise and removed automatically.
Do not capture optical image	ON/OFF	
Film thickness reference value	Omitted	
Interlayer adjustment filter	None/Weak/Normal/Strong	
Detection sensitivity	Setting value of the [Detection sensitivity] track bar	When a part of the reflective layer is obscured by flaws or debris, this function interpolates the height of the obscured part from the surrounding data.
Dark cut	Setting value of the [Dark cut] track bar	
Set film thickness automatically	ON/OFF	
Film thickness coefficient		
Stitch	ON/OFF	[Stitch to Capture More Information]
No. of stitch images	The number of vertical and horizontal stitch images	
Scan mode Laser confocal	Focus Composite/Laser Confocal	
Illumination/Coaxial	OFF/0 - 30	Only available when focus variation is selected.
Ring/Ring illumination	OFF/0 - 100	Only available when focus variation is selected.

Checking/Deleting the Registered Content

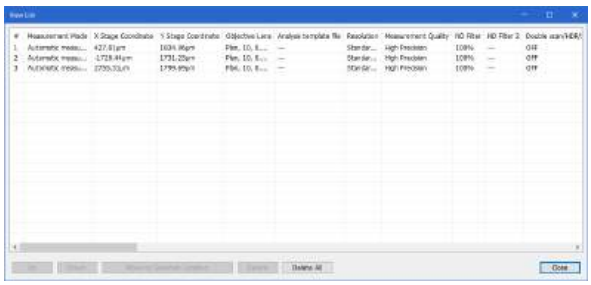
Check/delete the contents of the registered teaching settings.

1 Click the [Edit] button.



The [View List] dialog box appears.

2 Check the registered content.



3 If necessary, delete any registered content.

Delete

Delete the selected content.

Delete All

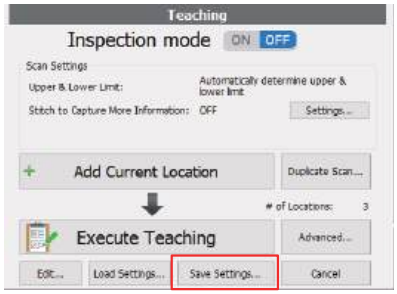
Delete all of the content.

4 Click the [OK] button.

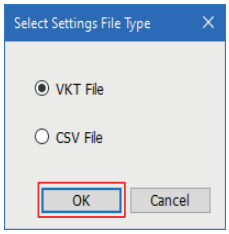
Saving the Registered Content

Save the teaching settings in which the measurement contents have been registered to a file.

1 Click the [Save Settings] button.



2 Select the save format.



VKT file

Save the file in VKT format. You can also save the screens for position alignment.

CSV file

Save the file in CSV format. You can edit the data with commercially-available software like MS Excel.

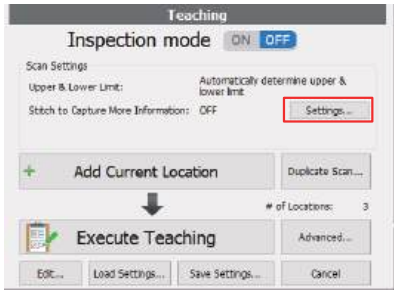
3 Click the [OK] button.

The next steps will differ depending on the selected file format.

Combining with Auto Function

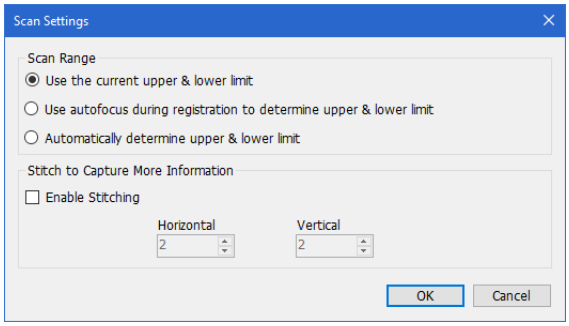
Combining the teaching function with various functions can be used to obtain data under different measurement conditions, such as a dedicated inspection system. This section describes combining it with auto functions, such as the auto maximum and minimum limit settings and image stitching function.

1 Click the [Settings] button.



The [Scan Settings] dialog box appears.

2 Select setting conditions during execution (auto focus, auto maximum and minimum settings, and others) from [Scan Range].



Use the current upper & lower limit

Use this to directly use the maximum and minimum limit settings configured by clicking the [Register current position] button or [Duplicate Scan] button.

Use autofocus during registration to detemine upper& lower limit

Use this to perform the auto focus when the [Register current position] button or [Duplicate Scan] button is pressed, and record the Z position at the time with the item name "Auto focus position".

At the time of execution, use this to move the Z position to the center of the registered upper and lower limit positions, then to perform auto-focus. The upper and lower limit positions are corrected depending on the difference between the Z position at that time and the registered "Auto focus position".

Automatically determine upper & lower limit

Use this to set the upper and lower limits automatically after moving the Z position to the midpoint of the lower and upper limit positions registered at the time of execution, and re-register the upper and lower limits at the measurement.

Point

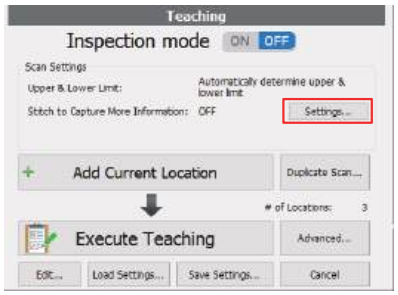
About the [Scan Range] setting during [Easy mode]

The [Scan Range] setting during [Easy mode] is fixed to “Automatically determine upper & lower limit”.

3 Click the [OK] button.

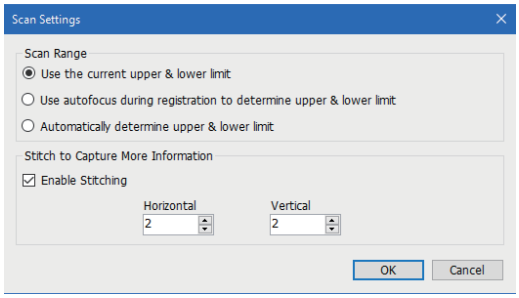
Combining with Image Stitching

1 Click the [Settings] button.



The [Scan Settings] dialog box appears.

2 Select the [Stitch to Capture More Information] checkbox to set the number of images to be stitched.



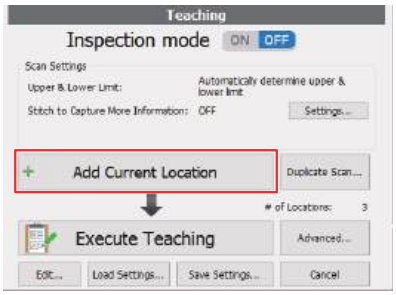
Reference The number and types of images that can be stitched by [Stitch to Capture More Information] are as follows.

Viewer Application settings		Max. No. of stitching screens (Vertical)	Max. No. of stitching screens (Horizontal)	Max. Total No. of stitching screens
Measurement mode	Resolution			
Automatic measurement	-	100	100	1000 (560)*
Manual measurement	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100
Film surface measurement	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100
Film thickness measurement	Standard	100	100	560
	Partial	1	100	100
	Super Fine	50	50	100

*The maximum number of stitching images increases to 1000 when scanning with focus variation and white light interference. Maximum of 560 can be stitched when the scan mode is the laser confocal.

3 Click the [OK] button.

4 Click the [Add Current Location] button.

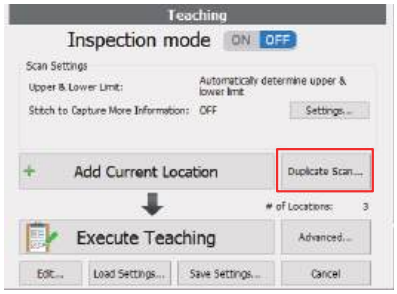


The current stage position is registered as the top left reference (start point for stitching).

Repeat Settings for Teaching

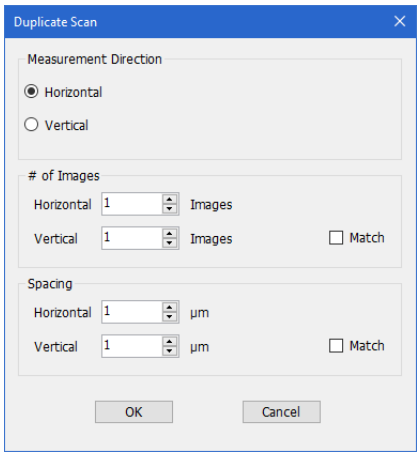
The repeat settings are suited for measurement of a sample like devices which are aligned evenly.

1 Click the [Duplicate Scan] button.



The [Duplicate Scan] dialog box appears.

2 Enter the measurement conditions for the repeat measurement.



Measurement Direction

For the repeat direction, select [Horizontal] or [Vertical].

# of images

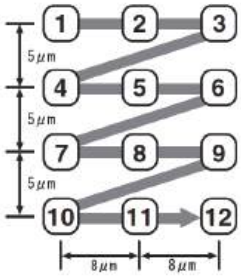
Specify the number of repeat images in the [Horizontal] and [Vertical] boxes. Selecting the [Match] check box sets [Vertical] to the same value as [Horizontal].

Spacing

Specify the repeat interval in the [Horizontal] and [Vertical] boxes. Selecting the [Match] check box sets [Vertical] to the same value as [Horizontal].

Point

If you specify [Horizontal] for the measurement direction, 3 and 4 for the No. of images of horizontal and vertical directions respectively, and 8 µm and 5 µm for the horizontal and vertical interval, the information file will be configured as shown below.



Reference

The number and interval of images that can be stitched by [Duplicate Scan] are as follows.

- Max. number of images:100
- Interval settings value:0 - 9999999
- Max. measurement point:3000

3 Click the [OK] button.

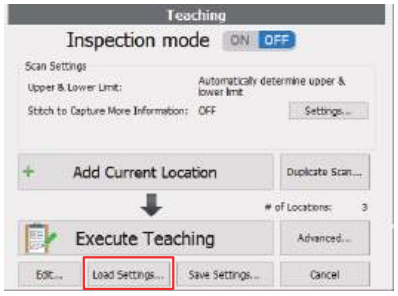
The measurement points are registered in a grid pattern with the registered number of images and intervals by setting the current stage position as the top left reference.

Executing Teaching

Loading Saved Content

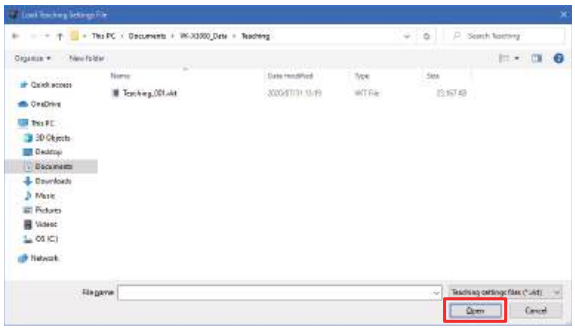
Load the teaching setting files where the measurement contents have been registered.

1 Click the [Load Settings] button.



The [Load Teaching Settings File] dialog box appears.

2 Specify the folder and file name, and click the [Open] button.



The teaching settings are loaded.

Teaching settings save file (*.vkt)

This is a proprietary format especially for the Viewer Application. This includes data to display semi-transparent images for position alignment.

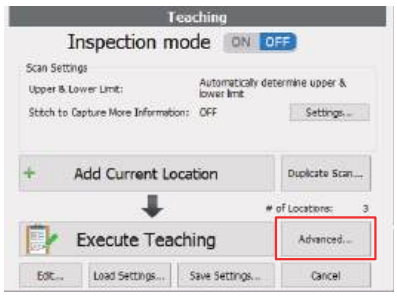
Teaching settings save file (*.csv)

This is a text file that can be edited with commercially-available software such as MS Excel.

Position Alignment

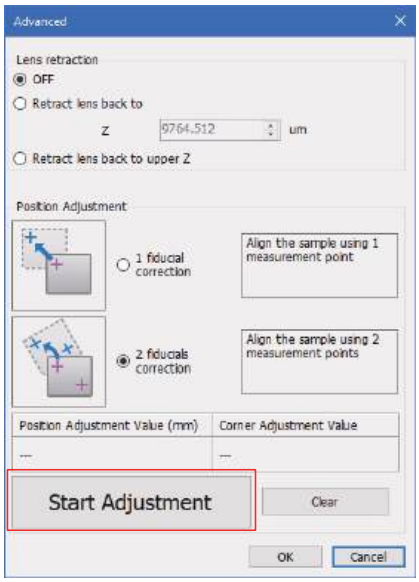
1 Place the measurement sample on the stage.

2 Click the [Advanced] button.



The [Advanced] dialog box appears.

3 Select the method to adjust the position.



1 fiducial correction

Align the position of the sample with the first measurement point.

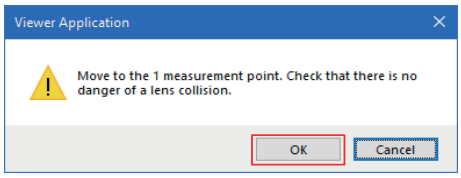
2 fiducial correction

Align the position of the sample with the first and second measurement points.

4 Click the [Start Adjustment] button.

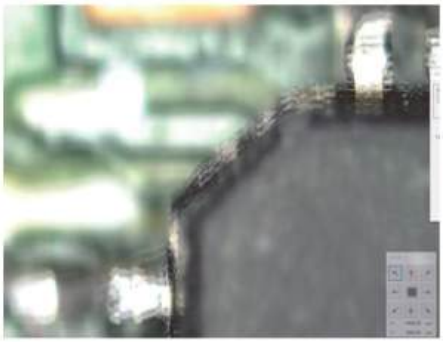
A confirmation message appears.

5 **Click the [OK] button.**

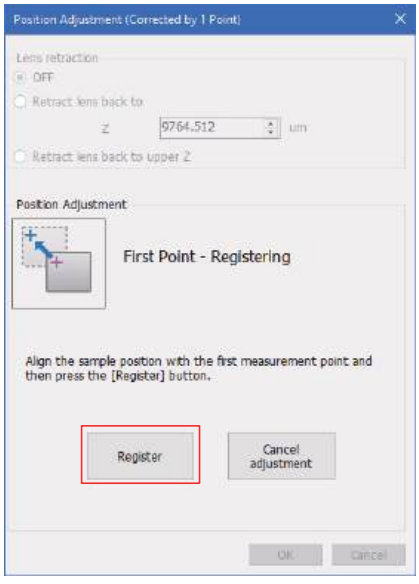


The XY stage moves and auto focus is executed.
The [Position Adjustment] dialog box appears.

6 **Align the positions of the teaching measurement points and sample by moving the stage.**

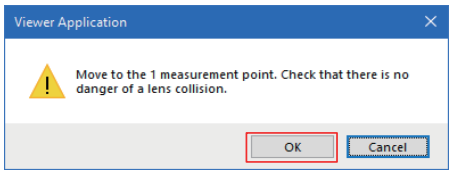


7 **1st point - Click the [Register] button.**



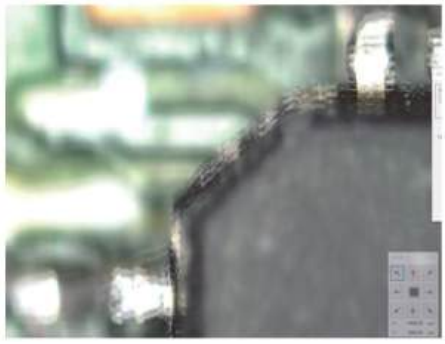
For [1 fiducial correction], the [Position Adjustment Result] dialog box appears. Proceed to step 10.
For [2 fiducial correction], a confirmation message appears.

8 **Click the [OK] button.**

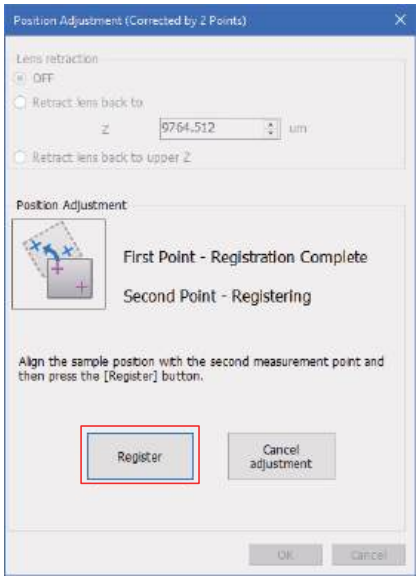


The XY stage moves and auto focus is executed.
The [Position Adjustment] dialog box appears.

9 **Align the positions of the teaching measurement points and sample.**

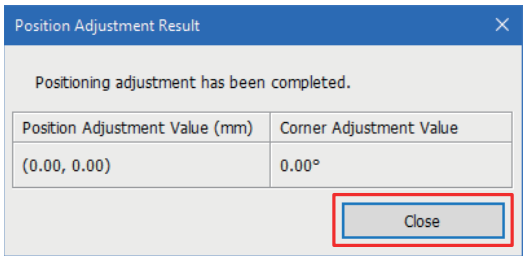


10 **2nd point - Click the [Register] button.**

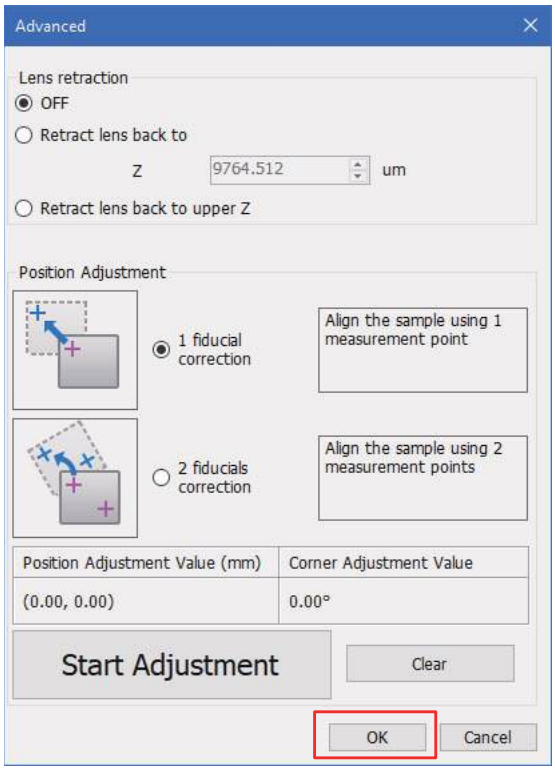


The [Position Adjustment Result] dialog box appears.

11 **Click the [Close] button.**



12 **Click the [OK] button.**

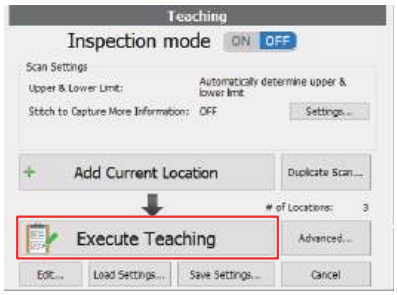


The [Advanced] dialog box closes.

Reference Clicking the [Clear] button clears the position adjustment results.

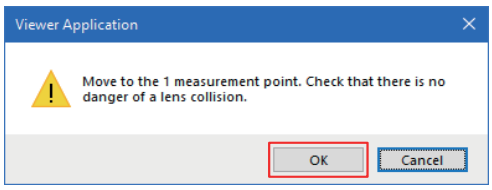
Executing Teaching

1 **Click the [Execute Teaching] button.**



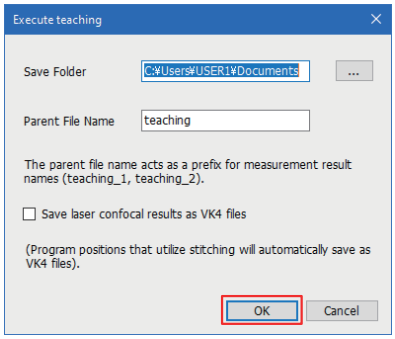
A confirmation message appears.

2 **Click the [OK] button.**



The [Execute teaching] dialog box appears.

3 **Determine the save folder and parent name for the measurement results. Click [OK] button.**



Teaching is executed.

Teaching settings save file (*.vkt)

This is a proprietary format especially for the Viewer Application. This includes data to display semi-transparent images for position alignment.

Teaching settings save file (*.csv)

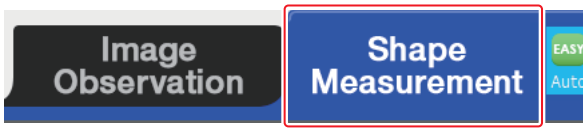
This is a text file that can be edited with commercially-available software such as MS Excel.

Teaching View Description

Displaying the Teaching View

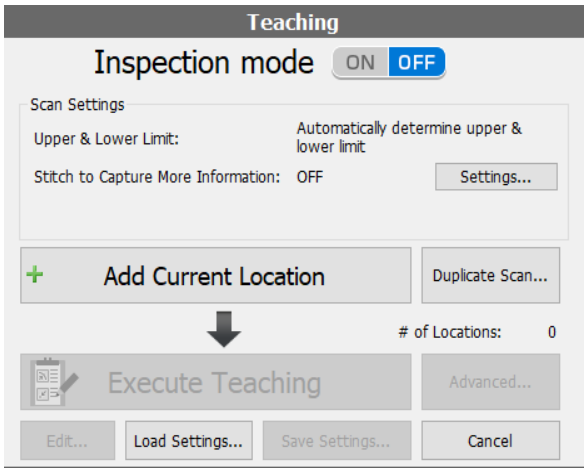
Display the view for performing teaching.

1 On the toolbar, click [Shape Measurement] or [Film Thickness Measurement].

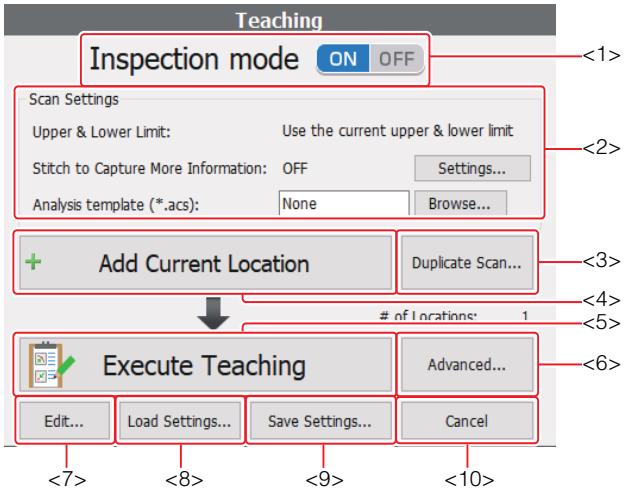


2 Click the [Teaching] button.

The teaching view appears.



Teaching View Layout



<1> Inspection mode

Selects the teaching range.

- OFF: Executes a process that can be executed in the Viewer Application.
- ON: Executes a process that can be executed in the Viewer Application and Multifile Analyzer Software.

<2> Scan Settings

The teaching ("Maximum and minimum limit settings", "Stitch to Capture More Information", or "Analysis template") registration method is displayed.

Reference "Analysis template" can be set only when "Inspection mode" is ON.

To change the settings ("Maximum and minimum limit settings" or "Stitch to Capture More Information"), click the [Settings] button.

"[Scan Settings] Dialog Box" (Page 9-15)

To select "Analysis template", click the [Browse] button.

<3> [Duplicate Scan] button

The [Duplicate Scan] dialog box appears.

"[Duplicate Scan] Dialog Box" (Page 9-16)

<4> [Add Current Location] button

Registers the current position and measurement conditions as teaching conditions.

<5> [Execute Teaching] button

Execute teaching under the specified conditions.

"[Execute teaching] Dialog Box" (Page 9-18)

<6> [Advanced] button

The [Advanced] dialog box appears.

"[Advanced] Dialog Box" (Page 9-19)

<7> [Edit] button

The [View List] dialog box appears.

"[View List] Dialog Box" (Page 9-16)

<8> [Load settings] button

Displays a dialog box and loads the teaching setting file.

<9> [Save Settings] button

The [Select Settings File Type] dialog box appears.

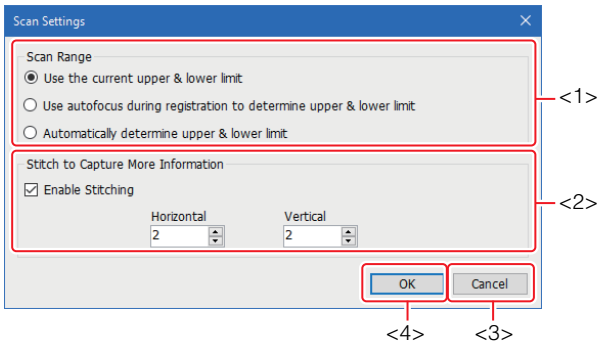
"[Select Settings File Type] Dialog Box" (Page 9-17)

<10> [Cancel] button

Ends the teaching and closes the teaching view.

[Scan Settings] Dialog Box

Set the automatic measurement conditions and number of stitching images.



<1> Scan Range

Select auto focus during execution, auto maximum and minimum settings, and other setting conditions from the option buttons.

- Use the current upper & lower limit
- Use autofocus during registration to detemine upper& lower limit
- Automatically determine upper & lower limit

Point

- If the scan mode is set to focus variation, the [Scan Range] setting is disabled.
- You cannot set the [Scan Range] setting for automatic measurement.

<2> Stitch to Capture More Information

Select the [Enable Stitching] check box to enable stitching.

Specify the number of stitching images in the [Horizontal] and [Vertical] boxes.

Important

When **using stitching images, the start point is on the top left of the registered image.**

<3> [Cancel] button

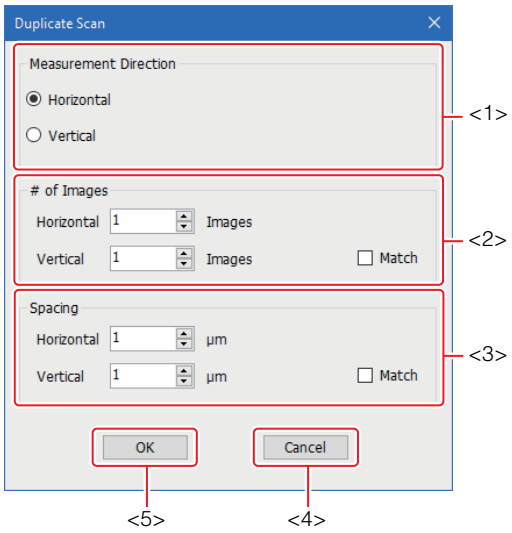
Closes the [Scan Settings] dialog box without applying the settings.

<4> [OK] button

Changes the settings and closes the [Scan Settings] dialog box.

[Duplicate Scan] Dialog Box

Enter the measurement conditions for the repeat measurement.



<1> Measurement Direction

For the repeat direction, select [Horizontal] or [Vertical].

<2> # of images

Specify the number of repeat images in the [Horizontal] and [Vertical] boxes.

Selecting the [Match] check box sets [Vertical] to the same value as [Horizontal].

<3> Spacing

Specify the repeat interval in the [Horizontal] and [Vertical] boxes.

Selecting the [Match] check box sets [Vertical] to the same value as [Horizontal].

<4> [Cancel] button

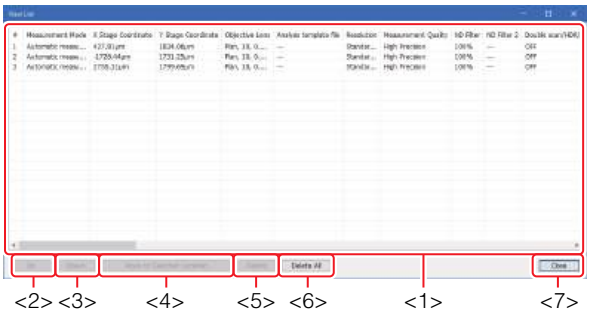
Closes the [Duplicate Scan] dialog box without applying the settings.

<5> [OK] button

Changes the settings and closes the [Duplicate Scan] dialog box.

[View List] Dialog Box

Check the registered content.



<1> Setting display area

Displays a list of settings registered for teaching.

<2> [Up] button

Moves up one setting.

<3> [Down] button

Moves down one setting.

<4> [Move to Selected Location] button

Moves to the selected setting location.

<5> [Delete] button

Deletes the selected setting.

<6> [Delete All] button

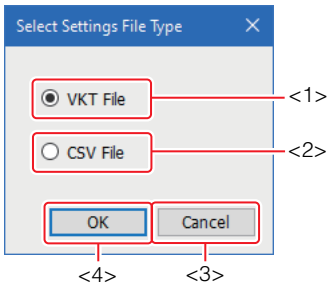
Deletes all settings.

<7> [Close] button

Closes the [View List] dialog box.

[Select Settings File Type] Dialog Box

Select the save format.



<1> [VKT File] radio button

Save the file in VKT format. You can also save the screens for position alignment.

<2> [CSV File] radio button

Save the file in CSV format.

<3> [Cancel] button

Closes the [Select Settings File Type] dialog box without changing the settings.

<4> [OK] button

The next steps will differ depending on the selected file format.

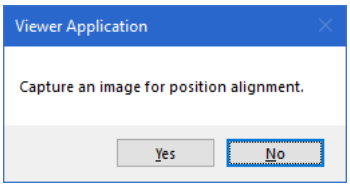
"When a VKT file is selected" (Page 9-17)

"When a CSV file is selected" (Page 9-18)

When a VKT file is selected

A confirmation message appears.

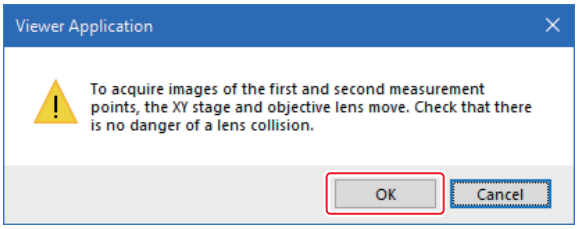
1 Select whether or not to obtain screens for position alignment images.



If you clicked [Yes], a confirmation message appears.

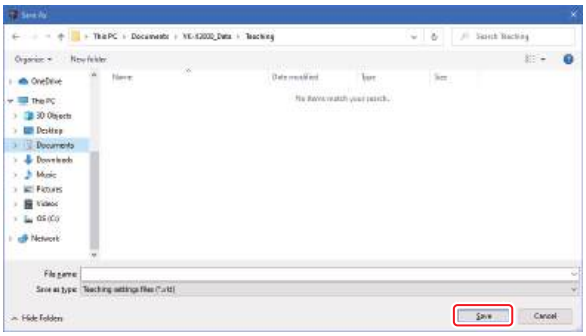
If you clicked [No], the [Save As] dialog box appears. Proceed to step 3.

2 Click the [OK] button.



Once the image is obtained, the [Save As] dialog box appears.

3 Specify the folder and file name to save the file to, and click the [Save] button.

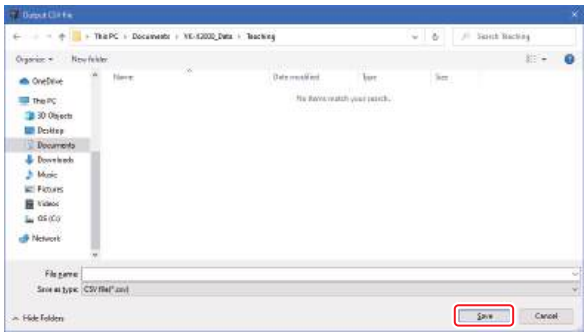


The registered content is saved.

When a CSV file is selected

The [Output CSV file] dialog box appears.

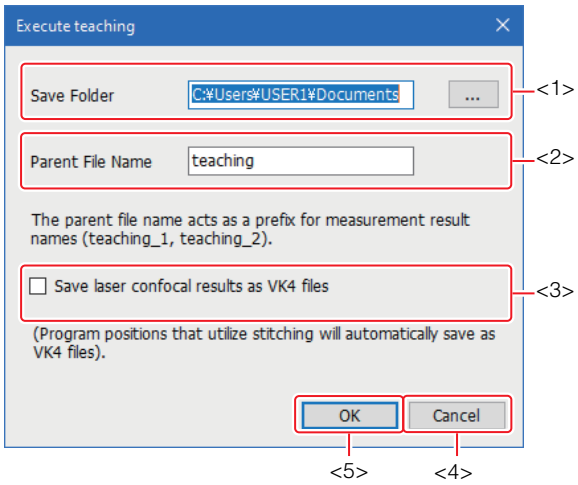
1 Specify the folder and file name to save the file to, and click the [Save] button.



The registered content is saved.

[Execute teaching] Dialog Box

Set the save conditions and execute teaching.



<1> [Save Folder] box

This is the save folder for the teaching files.

Click the [...] button and select a save folder from the dialog box.

<2> [Parent File Name] box

The first character to be appended to the teaching files.

<3> [Save laser confocal results in VK4 files] checkbox

Select the check box to save measurement results in laser confocal mode in VK4 format.

<4> [Cancel] button

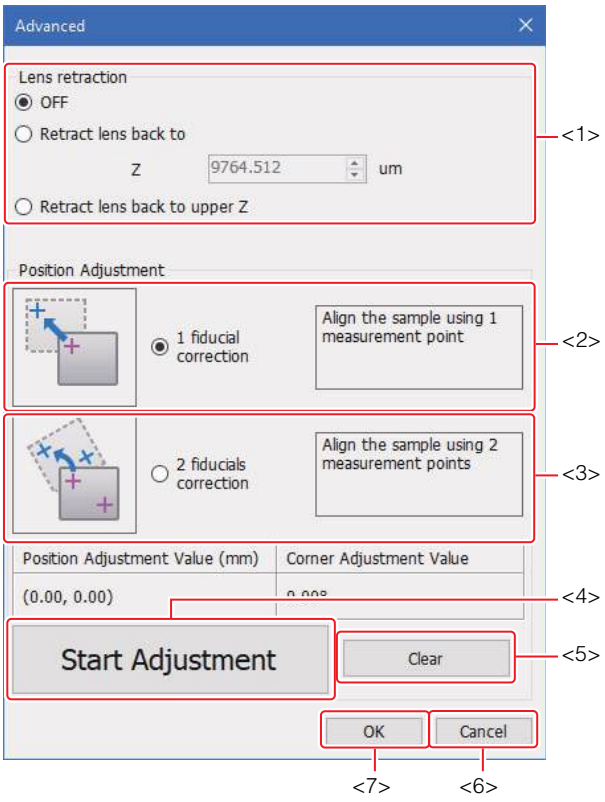
Closes the dialog box without executing teaching.

<5> [OK] button

Execute teaching.

[Advanced] Dialog Box

You can set the lens retraction and position alignment methods.



<1> Lens retraction

Set the lens retraction conditions when the XY stage moves during teaching from the following:

- OFF: Does not move the objective lens.
- Retract lens back to Z: Moves the objective lens to the specified Z position for each measurement.
- Retract lens back to upper Z: Moves the XY stage after moving the objective lens to the upper limit position.

<2> [1 fiducial correction] radio button

Align the position of the sample with the first measurement point.

<3> [2 fiducial correction] radio button

Align the position of the sample with the first and second measurement points.

<4> [Start Adjustment] button

Performs a position alignment using the specified conditions.

<5> [Clear] button

Clears the position adjustment result.

<6> [Cancel] button

Closes the [Advanced] dialog box without changing the settings.

<7> [OK] button

Changes the settings and closes the [Advanced] dialog box.

MEMO

Chapter 10

Result View Type

This chapter describes how to switch the display of the measurement result and how to make the measurement result easier to view.

Combining Measurement Mode and Displayable Measurement Results

The combination of measurement mode, scan mode, and measurement size dictates how the results can be viewed, as shown below.

This section describes the types of collected data that can be saved and image information that can be obtained.

Measurement mode	Scan mode	Resolution	Result View Type
Automatic measurement	Focus variation	Standard (1024 x 768)	3D Height Optical
	Laser confocal	Standard (1024 x 768)	3D Height Laser Laser + Optical C-DIC Optical
	White light interferometry	Standard (1024 x 768)	3D Height Monochrome C-DIC Optical
Manual measurement	Focus variation	Standard (1024 x 768)* Super Fine (2048 x 1536)*	3D Height Optical
	Laser confocal	Standard (1024 x 768) Super Fine (2048 x 1536)	3D Height Laser Laser + Optical C-DIC Optical
		Partial (1024 x 64)	3D Height Laser C-DIC
		1 Line (1024 x 1)	Optical
	White light interferometry	Standard (1024 x 768) Super Fine (2048 x 1536)	3D Height Monochrome C-DIC Optical
Film top measurement	Laser confocal	Standard (1024 x 768) Super Fine (2048 x 1536) Partial (1024 x 64)	3D Height Laser Laser + Optical C-DIC Optical
		Partial (1024 x 64)	3D Height Laser C-DIC
		1 Line (1024 x 1)	Optical

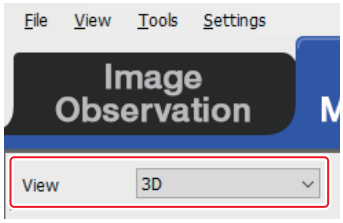
Measurement mode	Scan mode	Resolution	Result View Type
Laser film thickness	Laser confocal	Standard (1024 x 768) Super Fine (2048 x 1536) Partial (1024 x 64)	3D Height Laser Laser + Optical C-DIC Optical
		Partial (1024 x 64)	3D Height Laser C-DIC
		1 Line (1024 x 1)	Optical Laser cross section
Spec. film			Optical

* When [Expand field of view] is enabled, standard is 1366 x 1024 and high definition is 2732 x 2048.

Viewing Measurement Results

The measurement result can be viewed in different ways depending on the user's preference.

1 In the [View] selection box, select the display format.



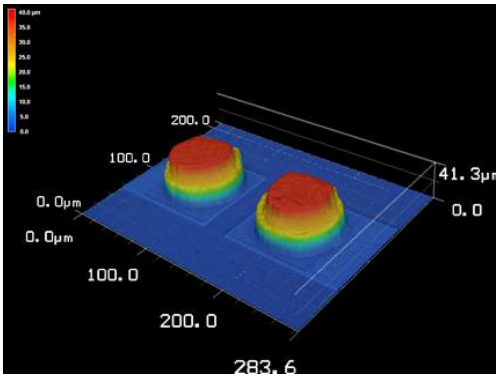
The result view type is switched.

The formats that can be displayed depend on the measurement mode.

"Combining Measurement Mode and Displayable Measurement Results" (Page 10-2)

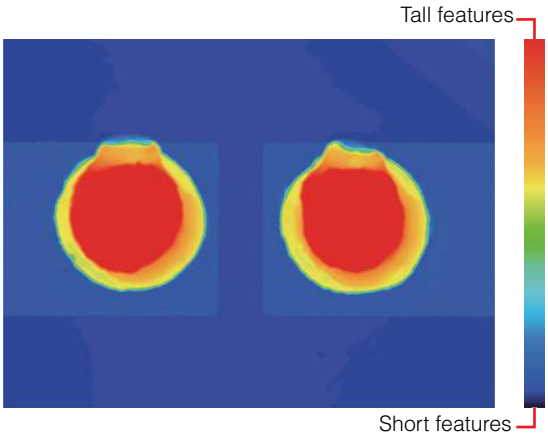
● 3D

The image of the measurement result expressed in 3D based on the height information.



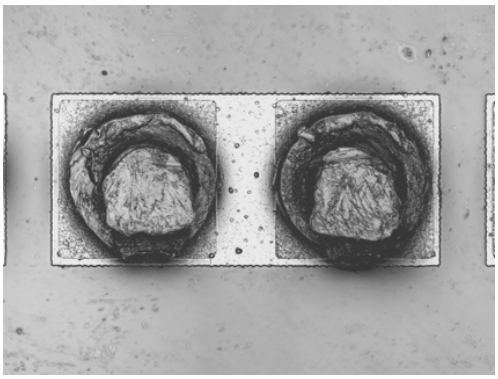
● Height

The image of the height expressed in color



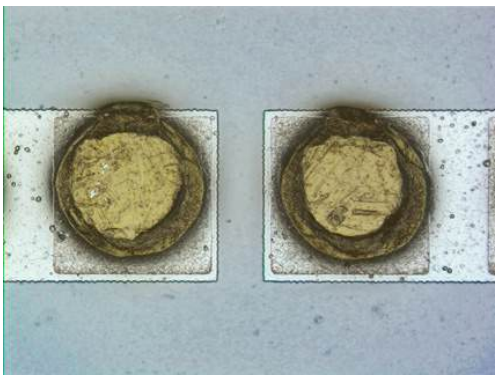
● Laser

A monochrome omnifocal image from recorded light intensity data when the laser reflection intensity from the sample becomes the maximum value (when the objective lens is in focus).



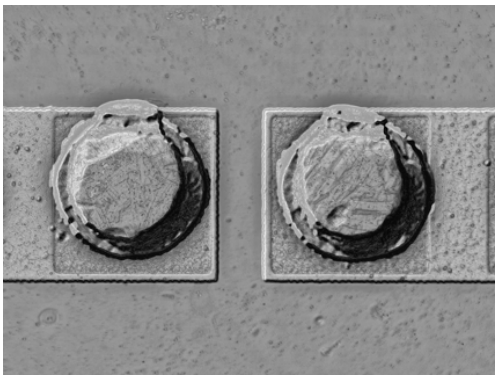
● Laser + Optical

An image comprised of a high contrast laser image and the RGB of the color image.



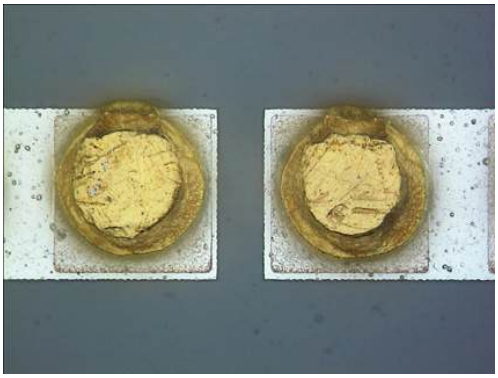
● C-DIC

An image comprised of a high contrast laser image and the differentiated height image.

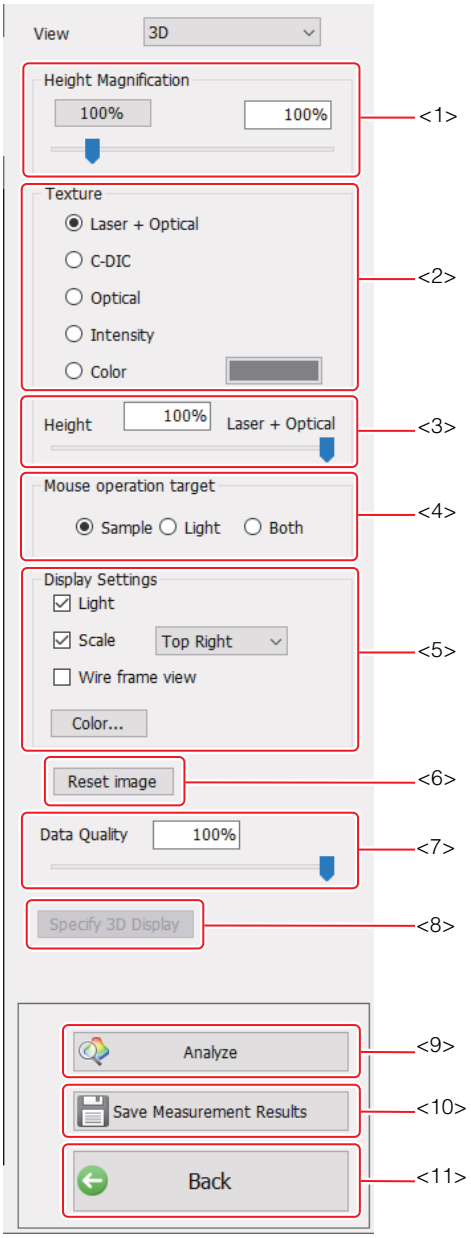


● Optical

A color image created using the camera focus composite.



3D Side Panel

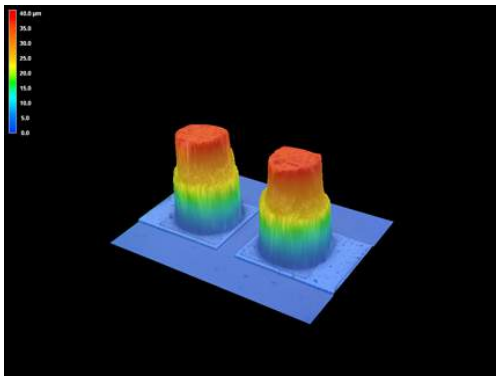


<1> Height Magnification

Move the slider to set the image height magnification of a 3D image.

Settings Range: 0 to 50000%

Clicking the [100%] button sets the height magnification to 100%.



<2> Texture

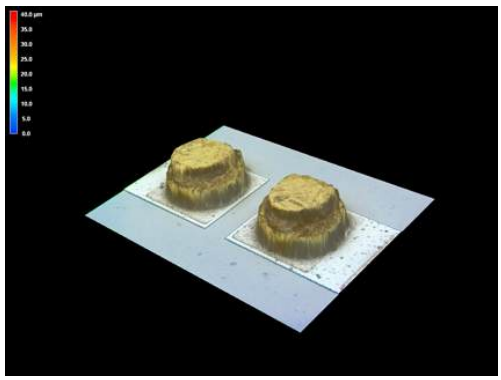
Select the type of texture image (the content that makes up the 3D image surface).

The images that can be selected are the content that can be displayed in the [View] selection box and [Color].

"Combining Measurement Mode and Displayable Measurement Results" (Page 10-2)

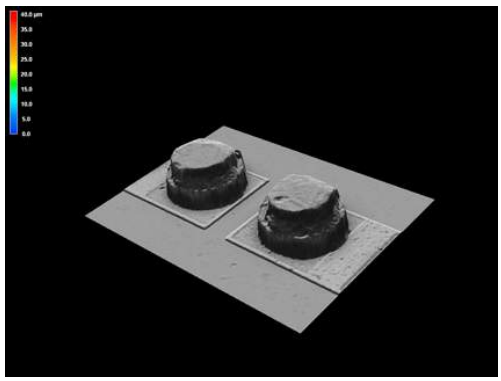
- [Laser + Optical] option button

  Composes a laser and color image.



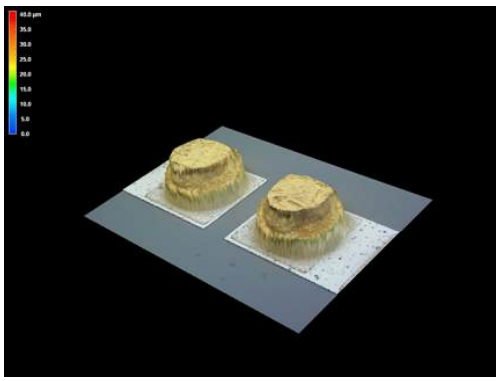
- [C-DIC] radio button

  Composes a C-DIC image.



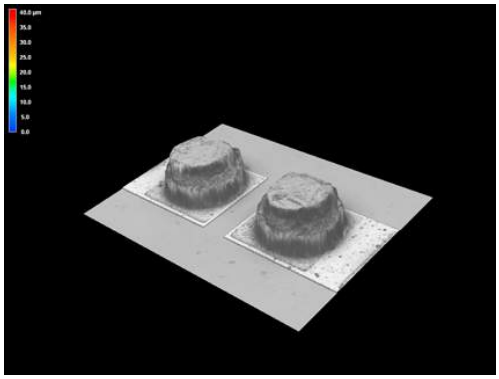
- [Optical] option button

Composes a color image.



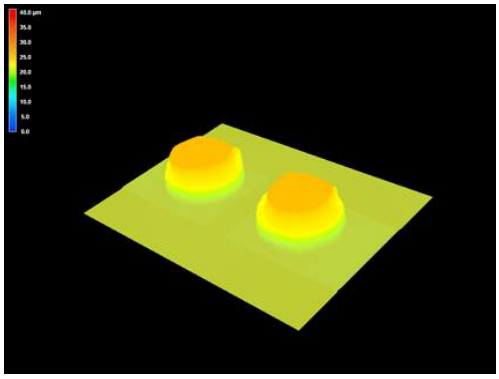
• [Intensity] radio button

Composes a laser image.



• [Color] option button

Creates an image with a single arbitrary color.



To change the set color, click the color palette.

"Color Settings" (Page 5-5)

<3> Height/Texture slide bar

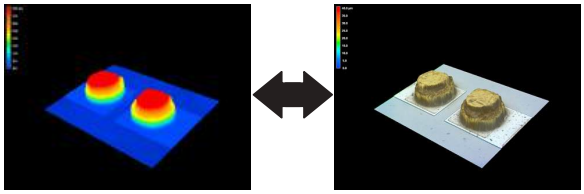
Sets the ratio to compose texture images on the 3D image surface.

The smaller the value is, the more the height images are displayed.

The larger the value is, the more the texture images are displayed.

Settings Range: 0 to 100%

[0%] [100%]



<4> Mouse operation target

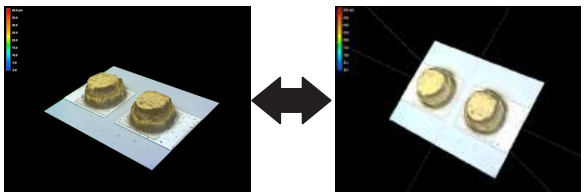
Select the target to operate with the mouse. For details about operating 3D images, see "Operating the 3D Display Image" (Page 10-10).

• [Sample] option button

Operates the 3D image of the sample with the light (light source) fixed.

The appearance of unevenness in surface changes as the way the light strikes the sample changes.

[OFF] [ON]

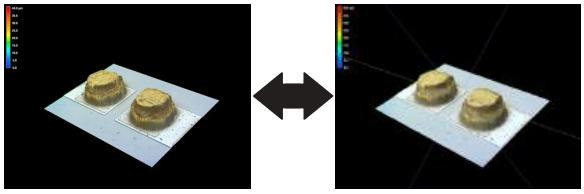


• [Light] option button

Operates the light (light source) with the 3D image of the sample fixed.

The appearance of unevenness in surface changes as the way the light strikes the sample changes.

[OFF] [ON]

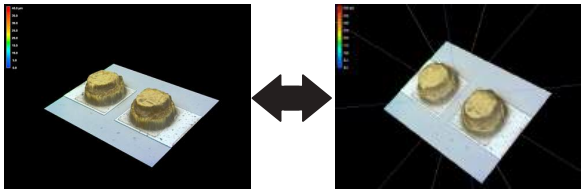


• [Both] option button

Operates both the sample and the light (light source).

You can move or rotate the stage without changing the way the light is shined onto the target.

[OFF] [ON]

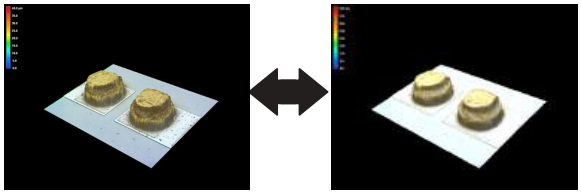


<5> Display Settings

• Light

Selecting the check box turns on the light.

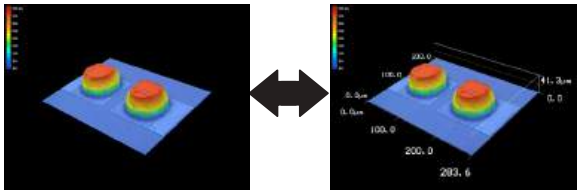
[OFF] [ON]



• Scale

Selecting this check box to display the scale.

[OFF] [ON]



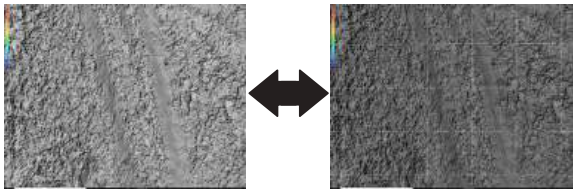
You can also set the position to display the scale on the selection box.

Setting range: Top Right, Top Left, Bottom Right, and Bottom Left.

• Wire frame view

Selecting the check box displays the height information as tesselations.

[OFF] [ON]



• [Color] button

Displays the [Color Settings] dialog box and sets the background color, main line color of the scale, and sub line color of the scale.

"[Color Settings] dialog box" (Page 10-9)

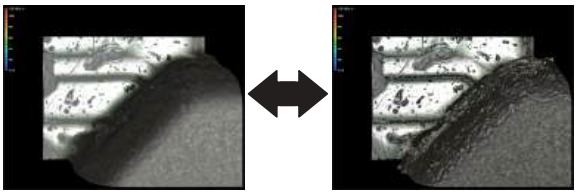
<6> [Reset Image] button

Restore the 3D image that was rotated, magnified/reduced or moved, to the default settings.

<7> [Data Quality] slider

Set the accuracy of the 3D image.
The larger the value, the higher the accuracy that is displayed.
Settings Range: 0 to 100%

[0%] [100%]



<8> [Specify 3D Display] button

Specifies the area for displaying the 3D image.
When this button is clicked, the [Area Settings] dialog box appears.

<9> [Analyze] button

Multifile Analyzer Software becomes active, and the measurement data is displayed in the report editing window.

<10> [Save Measurement Results] button

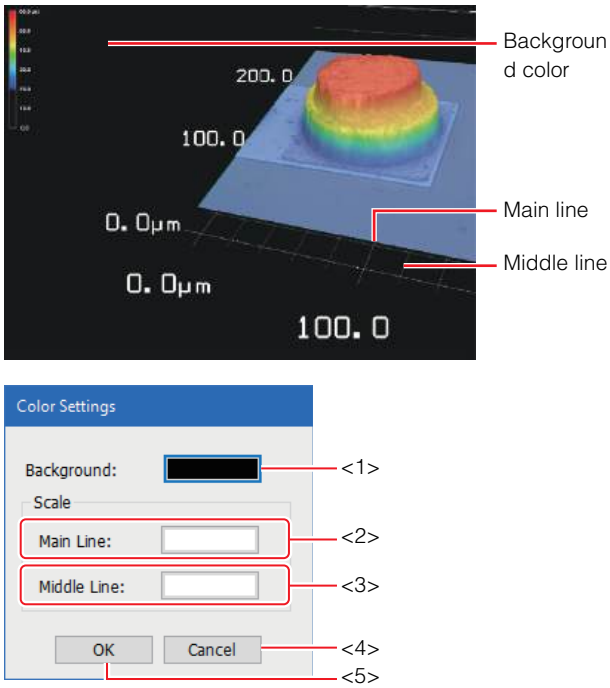
Save the measurement result.

<11> [Back] button

The screen returns to the measurement mode screen.

[Color Settings] dialog box

You can set the background color, main line color of the scale, and sub line color of the scale.



<1> [Background] color palette

Sets the background color of the 3D image.
When this button is clicked, the [Color] dialog box appears.
"[Color] dialog box" (Page 5-6)

<2> [Main Line] color palette

Sets the main line color for the scale.
When this button is clicked, the [Color] dialog box appears.
"[Color] dialog box" (Page 5-6)

<3> [Middle line] color palette

Sets the sub line color for the scale.
When this button is clicked, the [Color] dialog box appears.
"[Color] dialog box" (Page 5-6)

<4> [Cancel] button

Closes the [Color Settings] dialog box without changing the settings.

<5> [OK] button

Changes the settings and closes the [Color Settings] dialog box.

Operating the 3D Display Image

When the 3D image is displayed, it can be rotated, magnified, reduced or moved using the mouse.

Point

If the 3D image moves out of the viewing window, restore it to the default display by either of the two operations below:

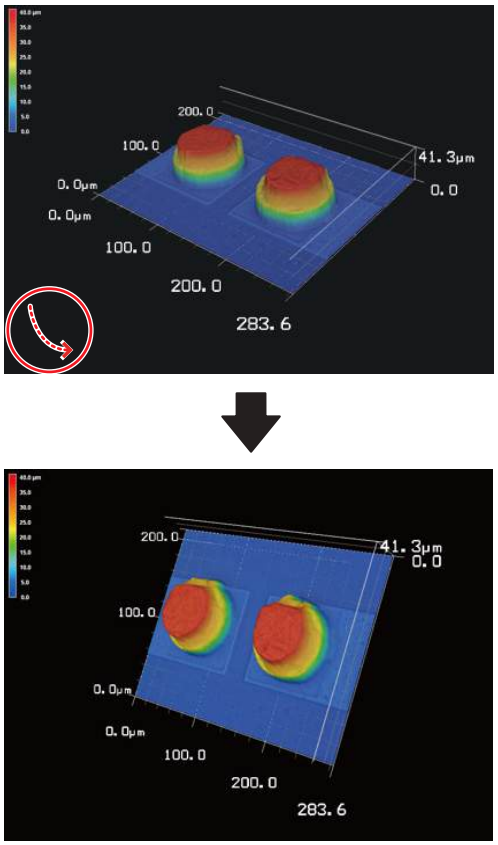
- Double-click the scroll wheel of the mouse in the viewing window.
- Click the [Reset Image] button.

Rotation

Rotate the image by dragging it in any direction while holding down the left side of the mouse. By releasing the mouse while dragging, the image will rotate continuously.

Reference

- Click the viewing window to stop rotating continuously.
- To specify the center of the rotation, double-click the left of the mouse.



Magnification/reduction

Drag the image up/down while holding down the scroll wheel of the mouse. By releasing the wheel while dragging, the image is magnified/reduced continuously.

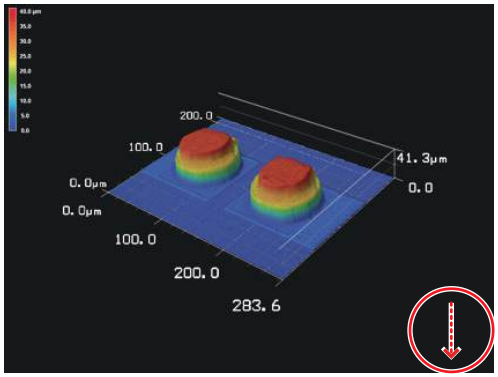
You can zoom in or out on the image by rotating the mouse wheel.

Point

The light (light source) cannot be increased or decreased.

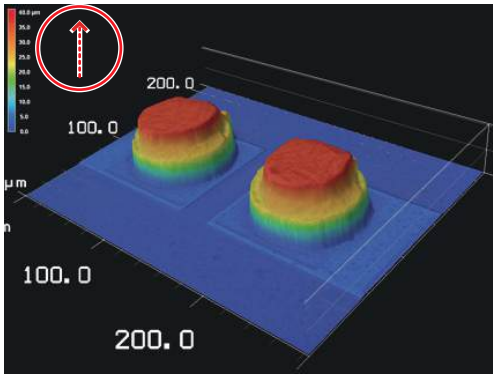
Reference

Click the viewing window to stop magnifying/reducing continuously.



Dragging upward (rotate forward)

Dragging downward (rotate backward)

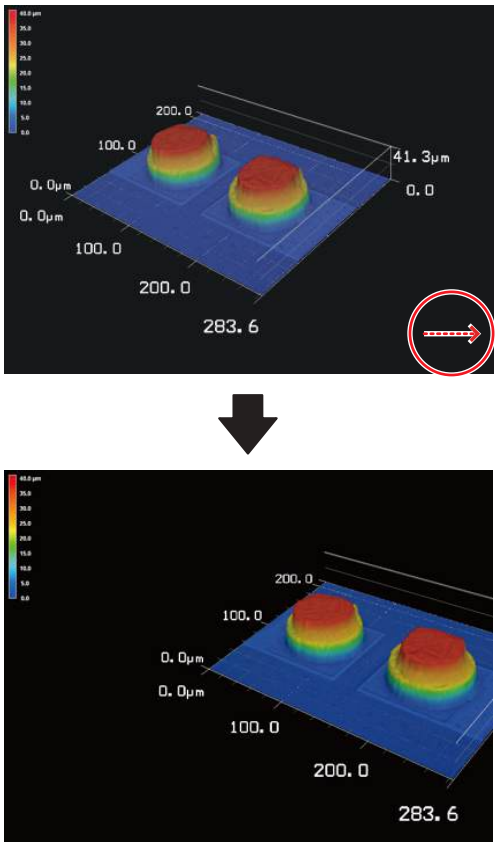


Move

To move the image in the XY axis, drag it in the moving direction such as up/down, left/right or diagonal on the XY plane while holding down the right of the mouse.

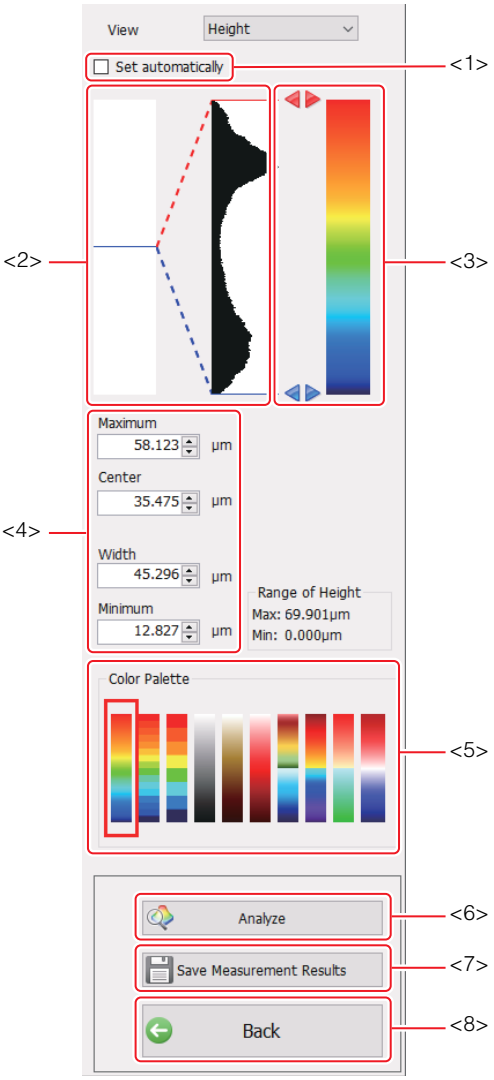
Point

The light (light source) cannot be moved.



Height

Height Side Panel



<1> [Set automatically] checkbox

Automatically optimizes the upper and lower limits of the height data to be displayed with 256 step gradation.

<2> Full-scale display range

Specify the upper and lower limits of the height data to be displayed with 256 step gradation within the actual range of height data. In other words, specify what range of the height data is to be displayed with 256 step gradation.

To do so, drag the red (for the upper limit) and blue (for the lower limit) cursors on the frame to set the range.

<3> 256 step display range

Specify the upper and lower limits of the height data within the 256 step display range.

To do so, drag the red (for the upper limit) and blue (for the lower limit) cursors on the frame to set the range.

<4> Maximum, center, width and minimum

- [Maximum] box
  Shows the upper limit value specified in the 256 step display range.
- [Center] box
  Shows the center value between the upper and lower limits of the specified range.
- [Width] box
  Shows the width of the range specified with the upper and lower limits.
- [Minimum] box
  Shows the lower limit value specified in the 256 step display range.

<5> Color Palette

Use it to select the color palette for the height image.

<6> [Analyze] button

Multifile Analyzer Software becomes active, and the measurement data is displayed in the report editing window.

<7> [Save Measurement Results] button

Save the measurement result.

<8> [Back] button

The screen returns to the measurement mode screen.

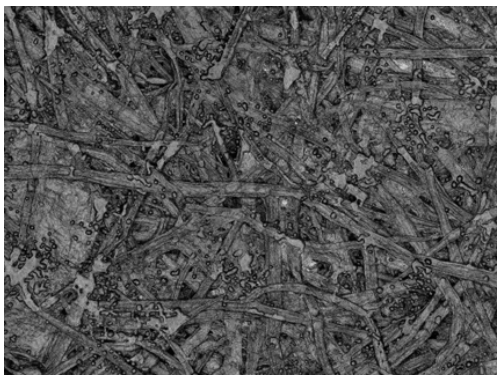
Laser Side Panel

<1> [Enable image adjustment] check box

Enables image adjustment.

<2> [Auto] button

Automatically adjusts the image.



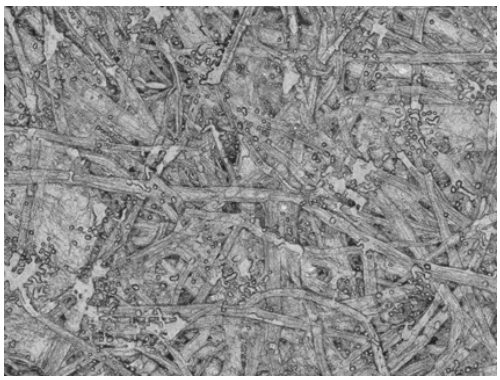
<3> [More] button

Displays or hides [Contrast] and [Color].

<4> [Brightness] slide bar

Adjusts the brightness of the image. The larger the value, the brighter.

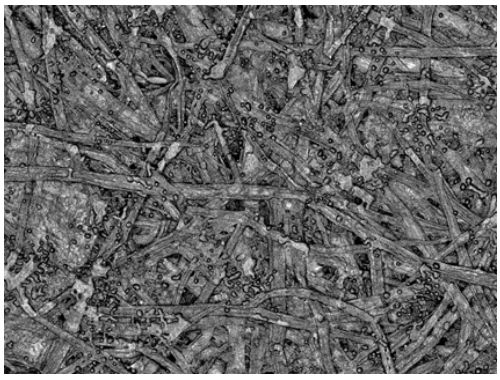
Settings Range: 0 - 100



<5> [Texture] slide bar

Emphasizes fine surface patterns. The larger the value, the more enhanced the image.

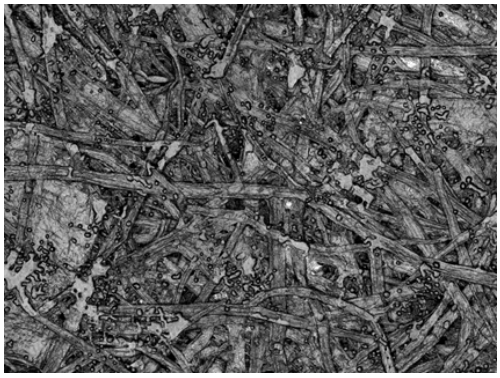
Settings Range: 0 - 100



<6> [Contrast] slide bar

Adjusts the image contrast shading. The larger the value, the larger the difference between the bright and dark parts.

Settings Range: 0 - 100



<7> [Analyze] button

Multifile Analyzer Software becomes active, and the measurement data is displayed in the report editing window.

<8> [Save Measurement Results] button

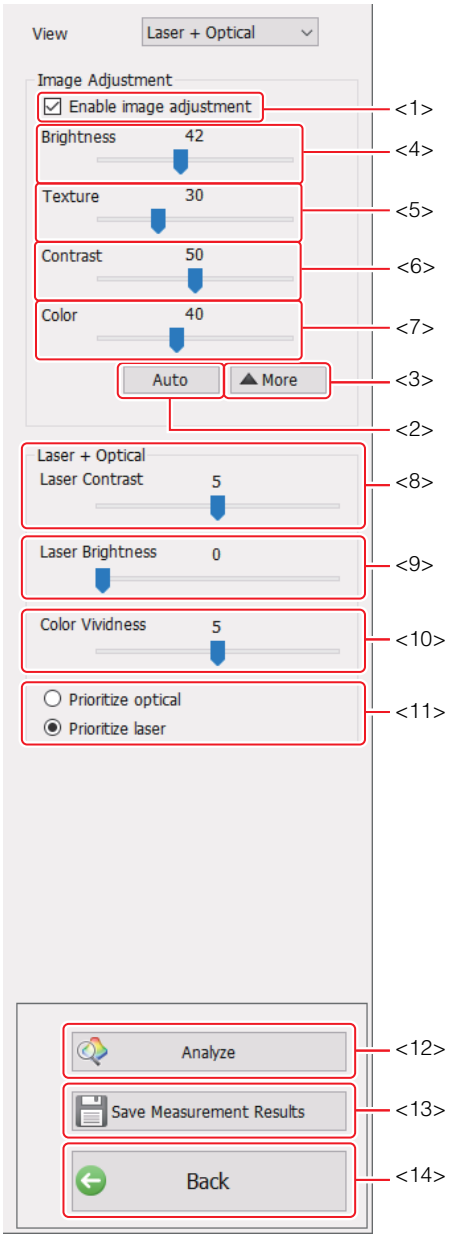
Save the measurement result.

<9> [Back] button

The screen returns to the measurement mode screen.

Laser + Optical

Laser + Optical Side Panel

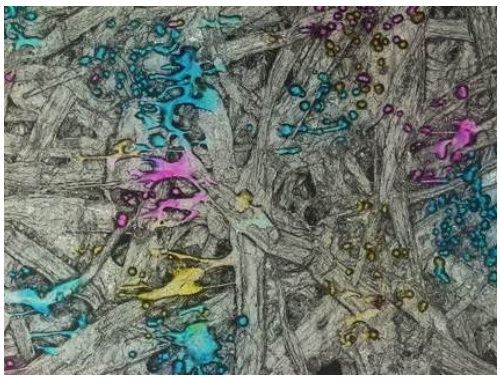


<1> [Enable image adjustment] check box

Enables image adjustment.

<2> [Auto] button

Automatically adjusts the image.



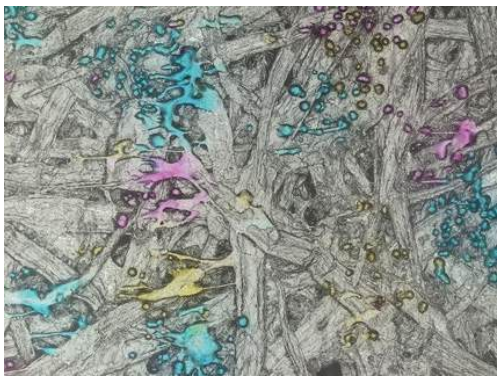
<3> [More] button

Displays or hides [Contrast] and [Color].

<4> [Brightness] slide bar

Adjusts the brightness of the image. The larger the value, the brighter.

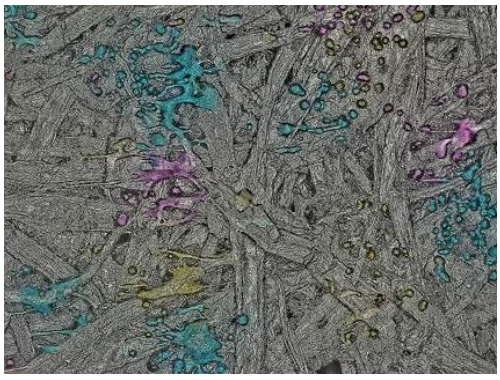
Settings Range: 0 - 100



<5> [Texture] slide bar

Emphasizes fine surface patterns. The larger the value, the more enhanced the image.

Settings Range: 0 - 100



<6> [Contrast] slide bar

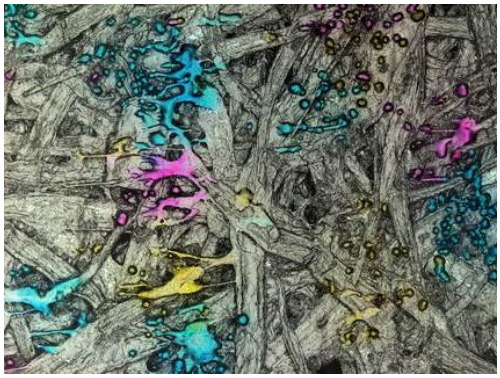
Adjusts the image contrast shading. The larger the value, the larger the difference between the bright and dark parts.

Settings Range: 0 - 100

<7> [Color] slide bar

Adjusts the color saturation (color intensity) of the image. The larger the value, the more vivid the color.

Settings Range: 0 - 100



<8> [Laser Contrast] slide bar

Adjusts the image contrast shading.

The larger the value, the larger the difference between the bright and dark parts.

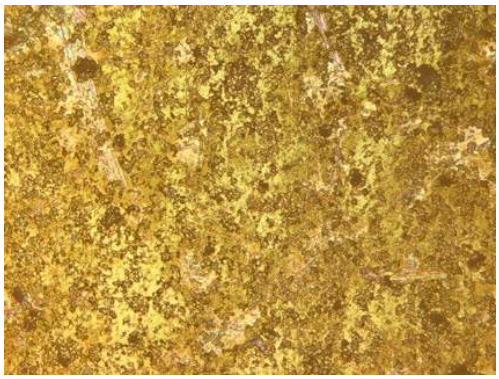
Settings Range: 0 - 10

<9> [Laser Brightness] slide bar

Adjusts the brightness of the image.

The larger the value, the brighter.

Settings Range: 0 - 100

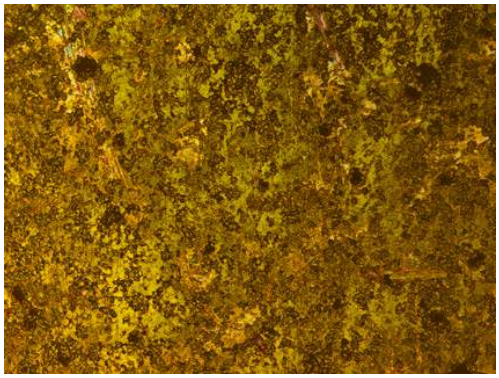


<10> [Color Vividness] slide bar

Adjusts the degree (saturation) of the vividness of the image.

The larger the value, the more vivid the color.

Settings Range: 0 - 10



<11> Prioritize optical/Prioritize laser

Select whether to prioritize color or laser using the option buttons.

<12> [Analyze] button

Multifile Analyzer Software becomes active, and the measurement data is displayed in the report editing window.

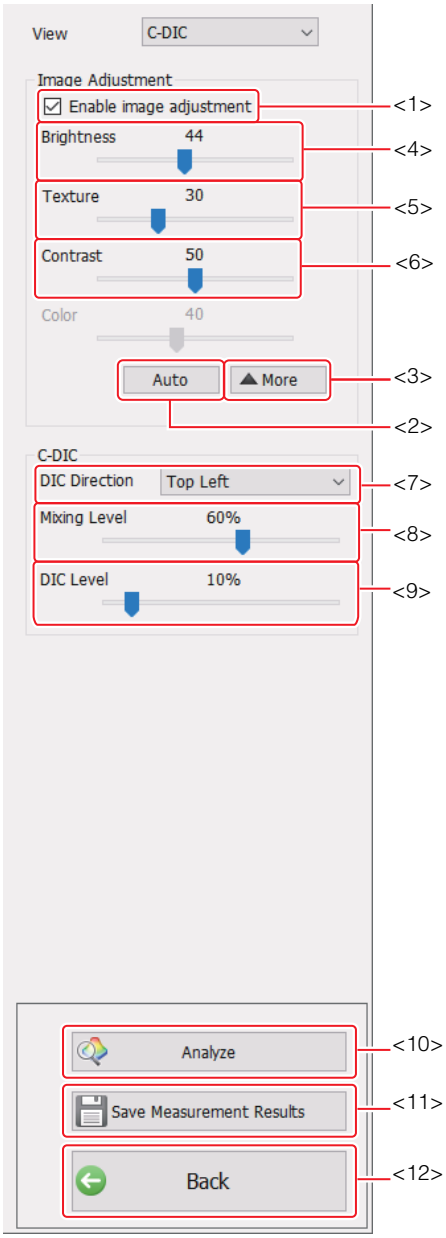
<13> [Save Measurement Results] button

Save the measurement result.

<14> [Back] button

The screen returns to the measurement mode screen.

C-DIC Side Panel

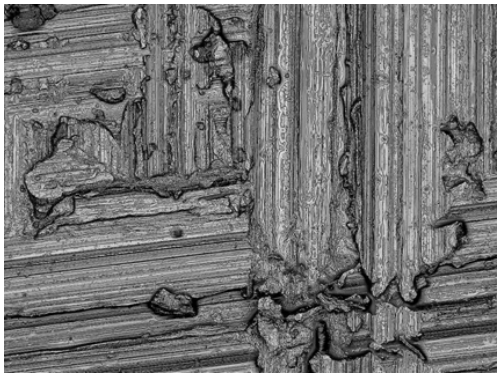


<1> [Enable image adjustment] check box

Enables image adjustment.

<2> [Auto] button

Automatically adjusts the image.



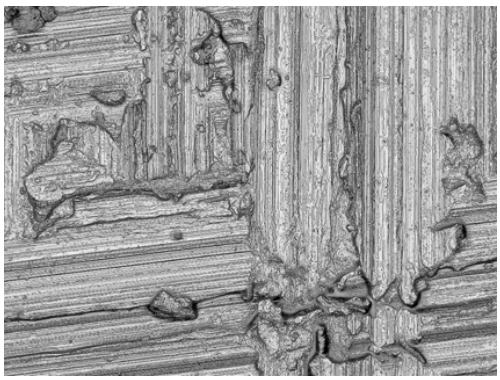
<3> [More] button

Displays or hides [Contrast] and [Color].

<4> [Brightness] slide bar

Adjusts the brightness of the image. The larger the value, the brighter.

Settings Range: 0 - 100



<5> [Texture] slide bar

Emphasizes fine surface patterns. The larger the value, the more enhanced the image.

Settings Range: 0 - 100

<6> [Contrast] slide bar

Adjusts the image contrast shading. The larger the value, the larger the difference between the bright and dark parts.

Settings Range: 0 - 100

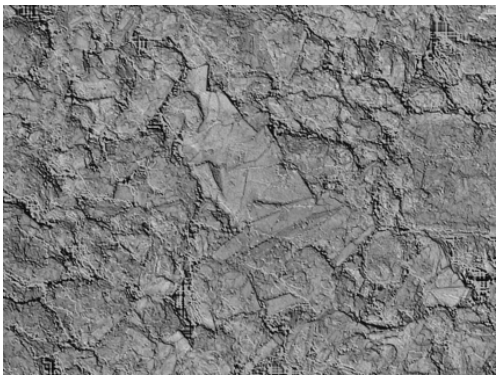
<7> [DIC Direction] box

• Top Right

• Top Left

• Bottom Right

• Bottom Left

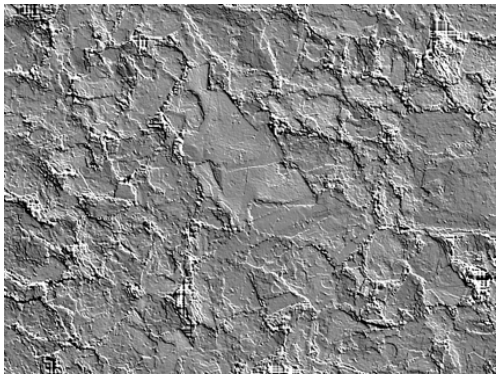


<8> [Mixing Level] slide bar

Adjusts the ratio to compose the laser and C-DIC images.

The higher the value, the greater the C-DIC image ratio.

Settings Range: 0 to 100%

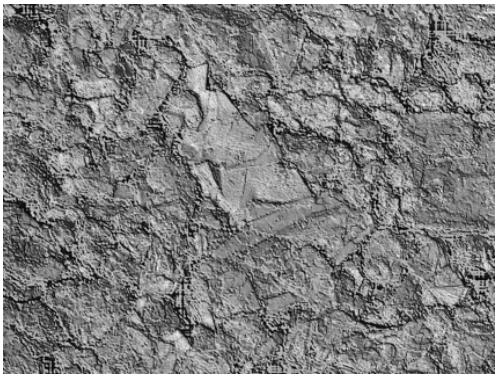


<9> [DIC Intensity] slide bar

Sets the strength corresponding to the differential interference.

The larger the value, the more enhanced the sample thickness.

Settings Range: 0 to 100%



<10> [Analyze] button

Multifile Analyzer Software becomes active, and the measurement data is displayed in the report editing window.

<11> [Save Measurement Results] button

Save the measurement result.

<12> [Back] button

The screen returns to the measurement mode screen.

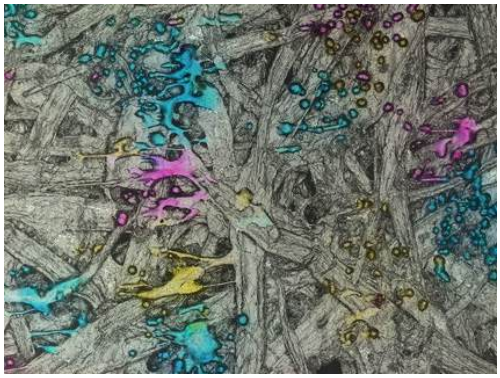
Optical Side Panel

<1> [Enable image adjustment] check box

Enables image adjustment.

<2> [Auto] button

Automatically adjusts the image.



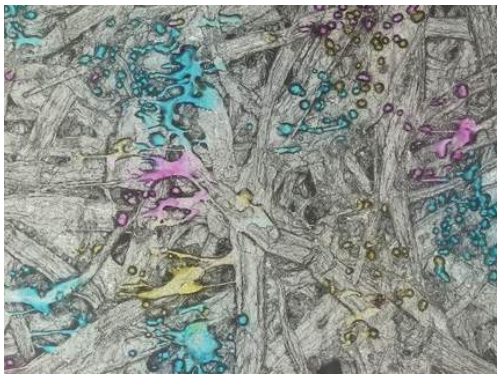
<3> [More] button

Displays or hides [Contrast] and [Color].

<4> [Brightness] slide bar

Adjusts the brightness of the image. The larger the value, the brighter.

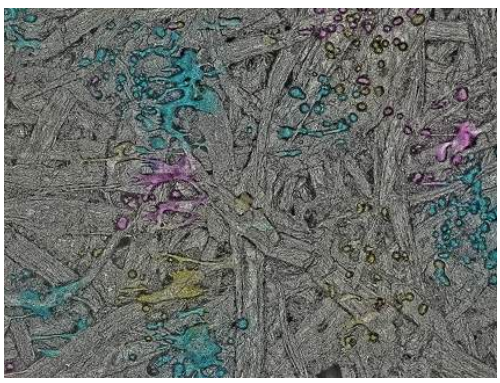
Settings Range: 0 - 100



<5> [Texture] slide bar

Emphasizes fine surface patterns. The larger the value, the more enhanced the image.

Settings Range: 0 - 100



<6> [Contrast] slide bar

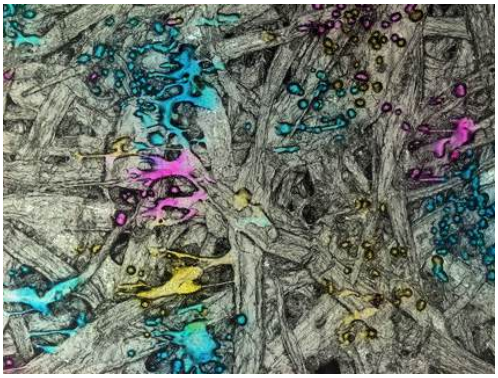
Adjusts the image contrast shading. The larger the value, the larger the difference between the bright and dark parts.

Settings Range: 0 - 100

<7> [Color] slide bar

Adjusts the color saturation (color intensity) of the image. The larger the value, the more vivid the color.

Settings Range: 0 - 100



<8> [Analyze] button

Multifile Analyzer Software becomes active, and the measurement data is displayed in the report editing window.

<9> [Save Measurement Results] button

Save the measurement result.

<10> [Back] button

The screen returns to the measurement mode screen.

MEMO

Chapter 11

Adjustment and calibration

This section allows users to correct errors that may occur due to measurement environment such as ambient temperature when the VK-X3000 Series is installed or to confirm operation after a long break in usage.

Registering and Adjusting the Objective Lens

It's necessary to perform lens adjustments when a new objective lens is mounted on the revolver or when an objective lens is replaced.

Procedure to Use an Objective Lens

When mounting an objective lens for the first time

Registering Lens Information

Register lens information.

Registering new lens information (Page 11-4)
Loading Lens Information (Page 11-7)

When replacing an objective lens

Removing an objective lens

Remove the objective lens.

Removing an objective lens (Page 11-10)

Optional

Registering Lens Information

Register lens information.

Registering new lens information (Page 11-4)
Loading Lens Information (Page 11-7)

Mounting an Objective Lens

Mount an objective lens.

Mounting an objective lens (Page 11-8)

Adjusting the Objective Lens

Adjust the mounted objective lens.

Adjusting the Objective Lens (Page 11-12)

NOTICE	**When you install a new objective lens, always register the lens. If the details registered for the new lens are incorrect or if the lens is mounted in the wrong position, there is a risk of a lens crash.**

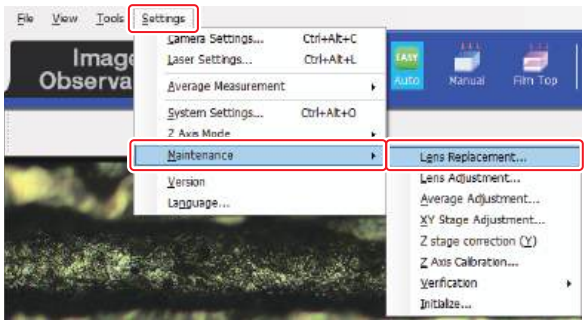
Registering and Editing Lens Information

Displaying the lens registration screen

Edit and register lens information on the [Lens Registration] dialog box.

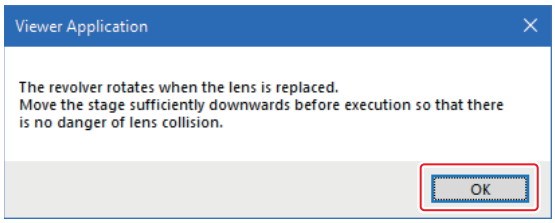
Display the [Lens Registration] dialog box with the procedure below.

1 Select [Lens Replacement] from [Maintenance] in the [Settings] menu.



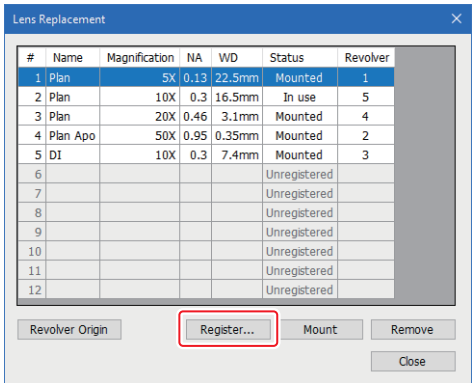
The confirm dialog box appears.

2 Click the [OK] button.

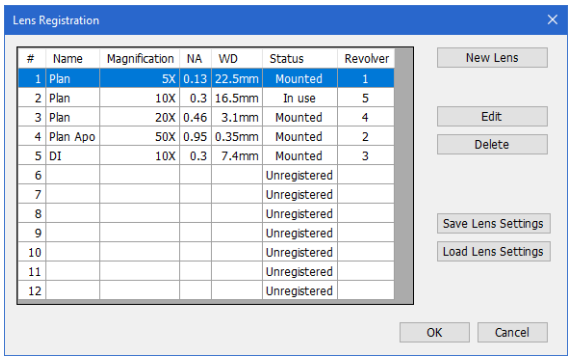


The [Lens Replacement] dialog box appears.

3 Click the [Register] button.



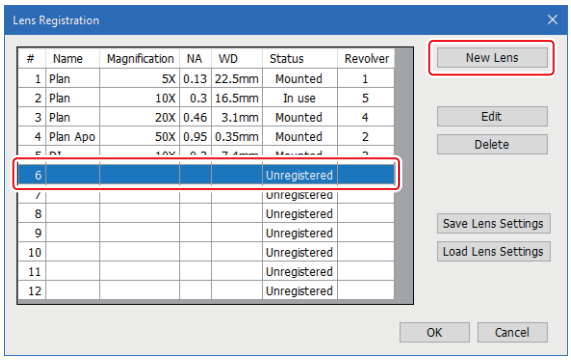
The [Lens Registration] dialog box appears.



Registering new lens information

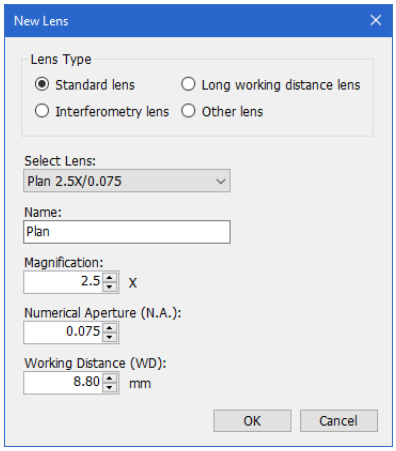
Register lens information in the Viewer Application to mount an objective lens for the first time.

1 Select the row for which the status column shows "Unregistered" and click the [New Lens] button.



The [New Lens] dialog box appears.

2 Input the objective lens information.



Point

If you select the objective lens to be mounted with the [Lens Type] radio button, other information automatically changes.

[Lens Type] radio button

Select the type of objective lens.

[Select Lens] box

Select the objective lens.

[Name] box

Input a name to identify the objective lens.

Setting range: Max. 64 characters (excluding characters that cannot be used in file names)

[Magnification] box

Input the magnification of the objective lens.

Setting range: 1.0 to 999.9 X

[Numerical Aperture (N.A.)] box

Input the numerical aperture (N.A.) of the objective lens.

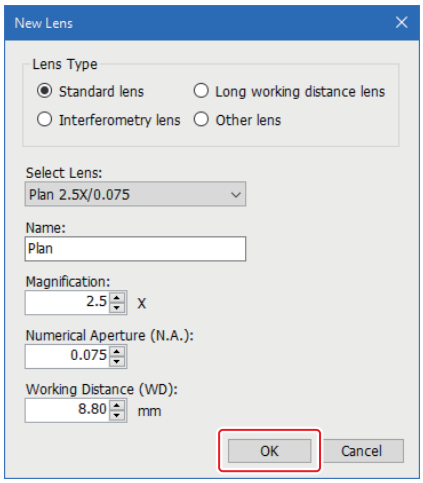
Setting range: 0.001 to 1.999

[Working Distance (WD)] box

Input the working distance (WD) of the objective lens.

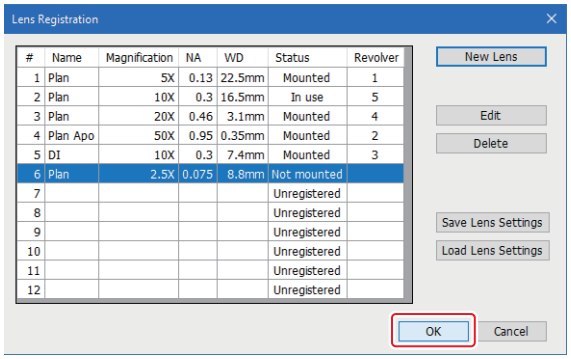
Setting range: 0.01 to 99.99 mm

3 Click the [OK] button.

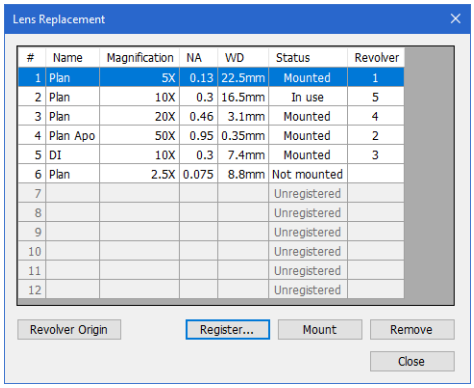


The [New Lens] dialog box closes and the lens information is displayed on the [Lens Registration] dialog box.

4 **Click the [OK] button.**



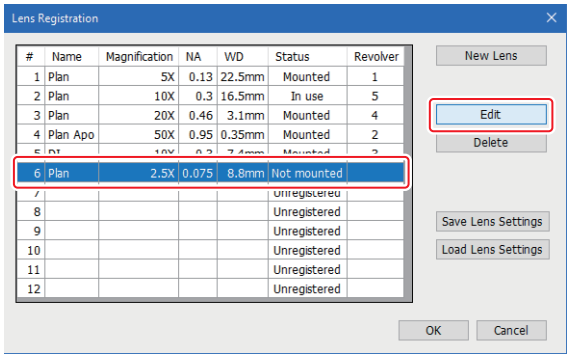
The lens information is registered.



Editing lens information

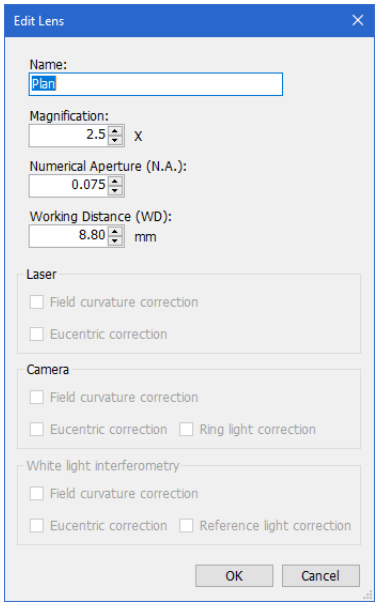
Edit registered lens information.

1 **Select the lens that you want to edit and click the [Edit] button.**



The [Edit Lens] dialog box appears.

2 **Edit the contents.**



[Name] box

Input a name to identify the objective lens.

Setting range: Max. 64 characters (excluding characters that cannot be used in file names)

[Magnification] box

Input the magnification of the objective lens.

Setting range: 1.0 to 999.9 X

[Numerical Aperture (N.A.)] box

Input the numerical aperture (N.A.) of the objective lens.

Setting range: 0.001 to 1.999

[Working Distance (WD)] box

Input the working distance (WD) of the objective lens.

Setting range: 0.01 to 99.99 mm

Laser

[Field curvature correction] check box

Select this check box to enable field curvature correction.

[Eucentric correction] check box

Select this check box to enable intensity eccentricity correction.

Camera

[Field curvature correction] check box

Select this check box to enable field curvature correction.

[Eucentric correction] check box

Select this check box to enable intensity eccentricity correction.

[Ring light correction] check box

Select this check box to enable ring illumination correction.

White light interferometry

[Field curvature correction] check box

Select this check box to enable field curvature correction.

[Eucentric correction] check box

Select this check box to enable intensity eccentricity correction.

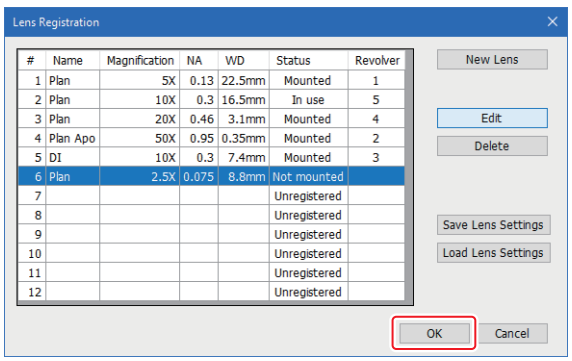
[Reference light correction] check box

Select this check box to enable ring illumination correction.

3 Click the [OK] button.

The [Edit Lens] dialog box closes and the details on the [Lens Registration] dialog box updates.

4 Click the [OK] button.



The lens information is updated.

Deleting lens information

Delete registered lens information.

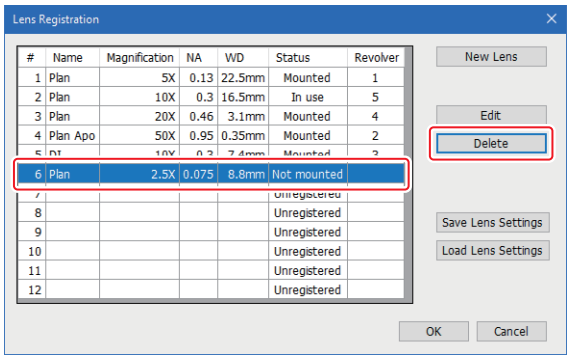
Reference

You cannot delete information for mounted lenses.

To delete information for mounted lenses, you need to remove the lens.

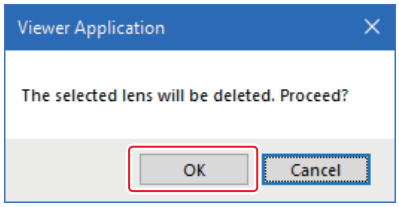
Removing an objective lens (Page 11-10)

1 Select the lens that you want to delete and click the [Delete] button.



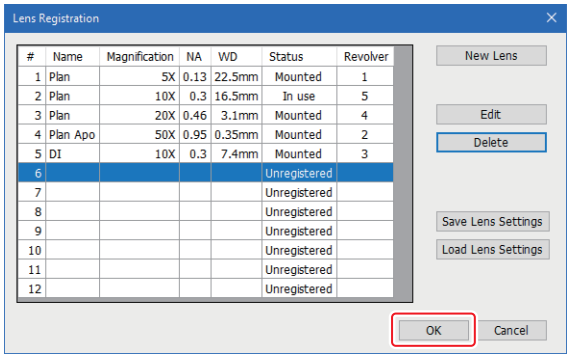
A confirmation message appears.

2 Click the [OK] button.



The confirmation message closes.

3 Click the [OK] button.

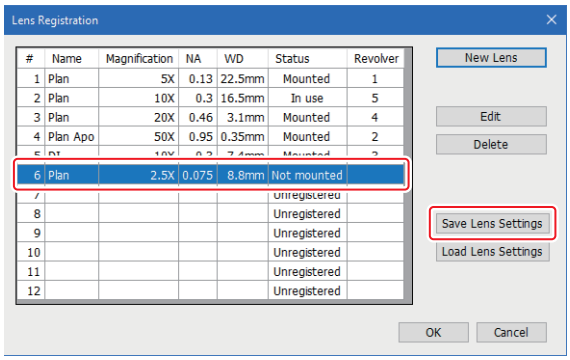


The lens information is deleted.

Saving lens information

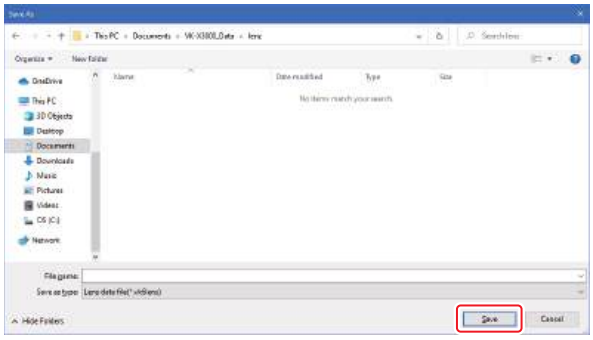
Save registered lens information to a file.

1 Select the lens for which you want to save information and click the [Save Lens Settings] button.



The [Save As] dialog box appears on the screen.

2 Specify the folder and file name to save the file to, and click the [Save] button.

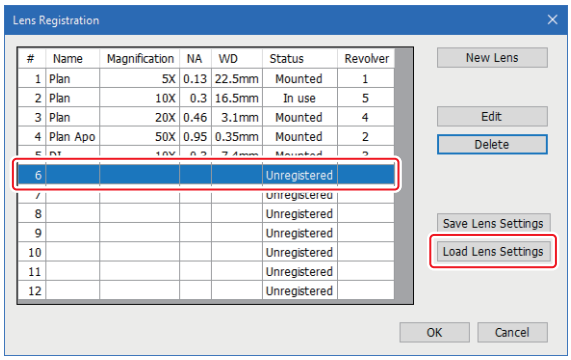


The lens information is saved.

Loading Lens Information

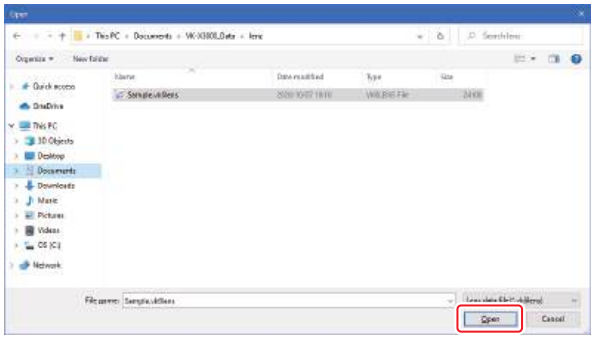
Load lens information from data.

1 Select the lens for which you want to load information and click the [Load Lens Settings] button.

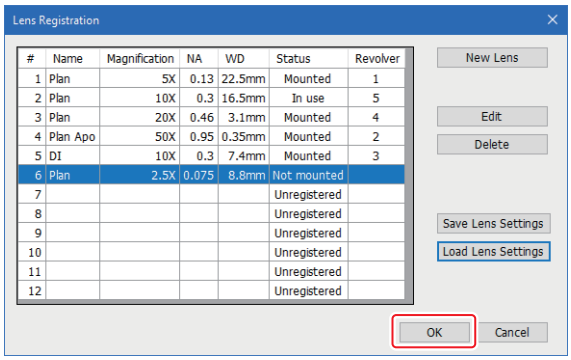


The [Open] dialog box appears.

2 Specify the folder and file name, and click the [Open] button.



3 Click the [OK] button.



The lens information is registered.

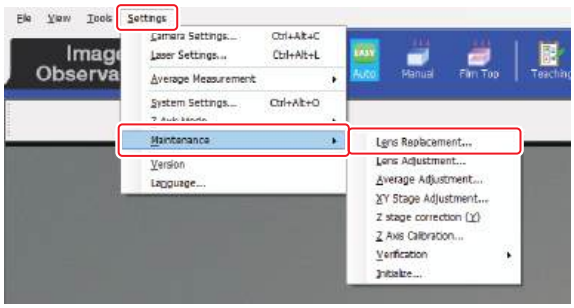
Mounting and Removing an Objective Lens

Displaying the lens replacement screen

Use the [Lens Replacement] dialog box to mount and remove an objective lens.

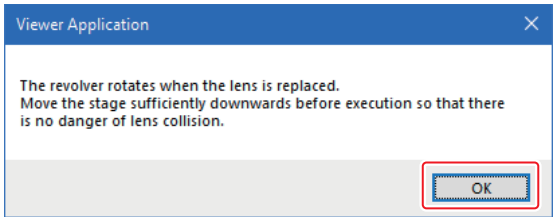
Display the [Lens Replacement] dialog box with the procedure below.

1 Select [Lens Replacement] from [Maintenance] in the [Settings] menu.

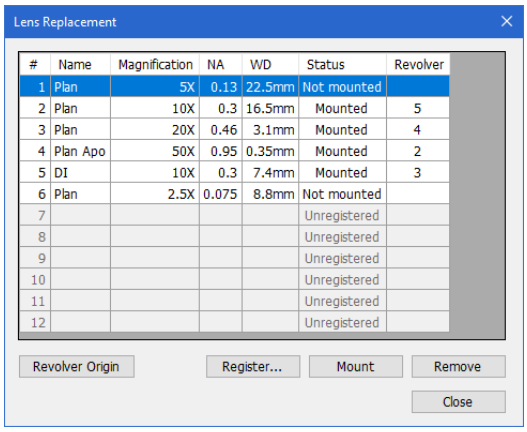


The confirm dialog box appears.

2 Click the [OK] button.



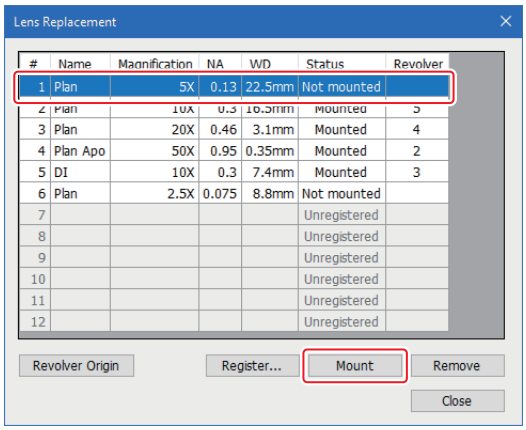
The [Lens Replacement] dialog box appears.



Mounting an objective lens

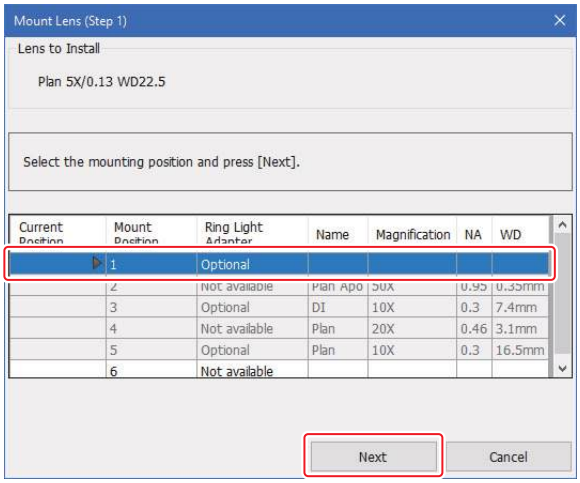
Mount an objective lens.

1 Select the target lens information and click the [Mount] button.



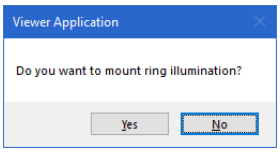
The [Mount Lens (Step 1)] dialog box appears.

2 Select the mount position for the target lens and click the [Next] button.



Reference

- To attach a ring illumination to an objective lens, select the location that a ring illumination can be attached to.
- If you selected a location that a ring illumination can be attached to, a confirmation message appears.



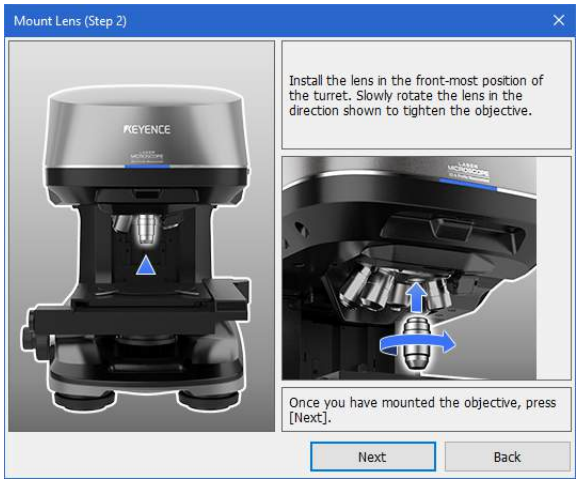
Clicking the [Yes] button enables a ring illumination to be attached.

The revolver rotates and moves to a position where the objective lens can be mounted.
The [Mount Lens (Step 2)] dialog box appears.

The subsequent procedures differ depending on whether a ring illumination is attached or not.

● When attaching a ring illumination adapter

3 Follow the on-screen instructions to mount an objective lens.



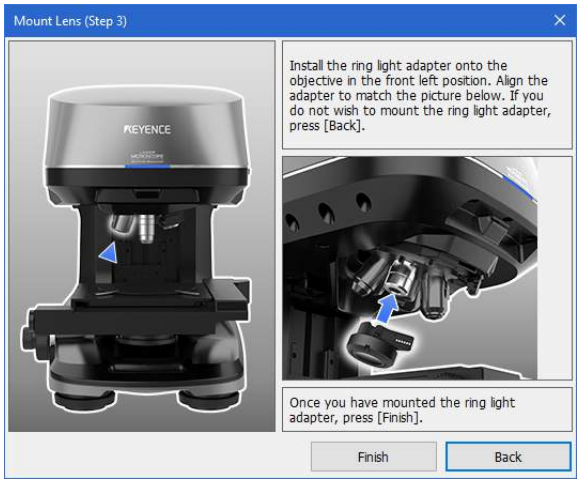
Important

Only an objective lens is mounted at this point.
Attach a ring illumination in a subsequent step.

4 Click the [Next] button.

The revolver rotates and moves to a position where the ring illumination can be attached.
The [Mount Lens (Step 3)] dialog box appears.

5 Follow the on-screen instructions to attach a ring illumination adapter.

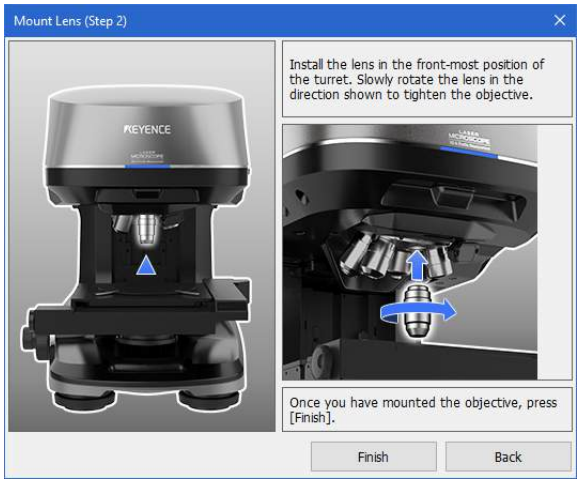


6 Click the [Finish] button.

The attached objective lens is displayed in the objective lens view.

● When not attaching a ring illumination adapter

3 **Follow the on-screen instructions to mount an objective lens.**



4 **Click the [Finish] button.**

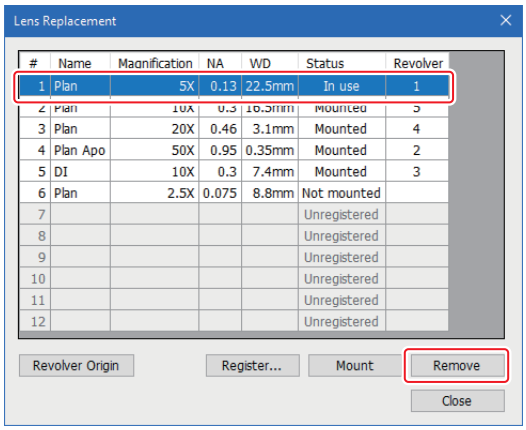
The attached objective lens is displayed in the objective lens view.

Removing an objective lens

Remove the objective lens.

■ When removing an objective lens that has a ring illumination attached to It

1 **Select the target lens information and click the [Remove] button.**



The [Remove Lens (Step 1)] dialog box appears.

The revolver rotates and moves to a position where the objective lens can be removed.

2 **Follow the on-screen instructions to remove the ring illumination.**

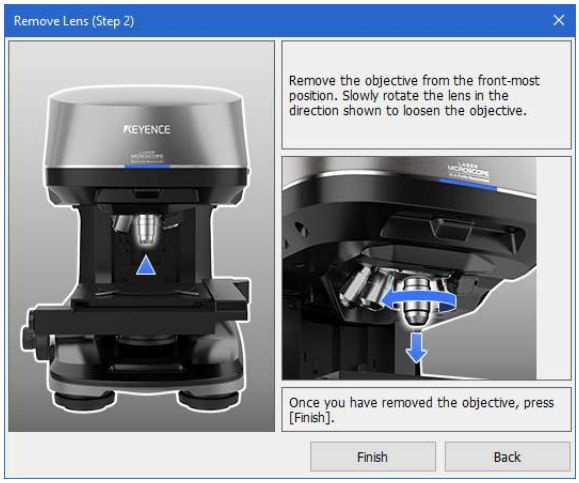
Important

Only the ring illumination is removed at this point.
The objective lens is removed in the next step.

3 **Click the [Next] button.**

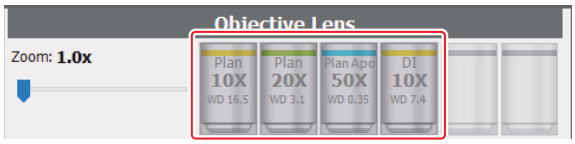
The [Remove Lens (Step 2)] dialog box appears.

4 **Follow the on-screen instructions to remove the objective lens.**



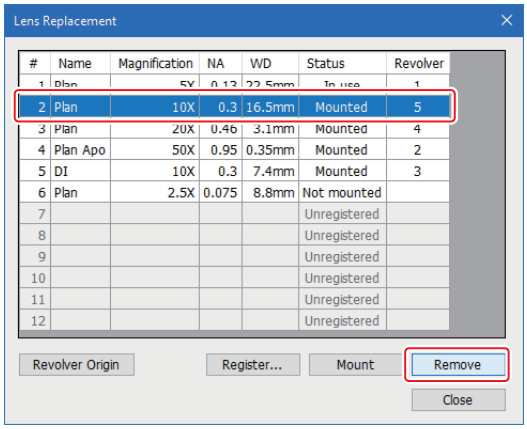
5 **Click the [Finish] button.**

The details in the objective lens view updates.



■ When removing an objective lens that does not have a ring illumination adapter attached to It

1 **Select the target lens information and click the [Remove] button.**



The [Remove lens] dialog box appears.

The revolver rotates and moves to a position where the objective lens can be removed.

2 **Follow the on-screen instructions to remove the objective lens.**

3 **Click the [Finish] button.**

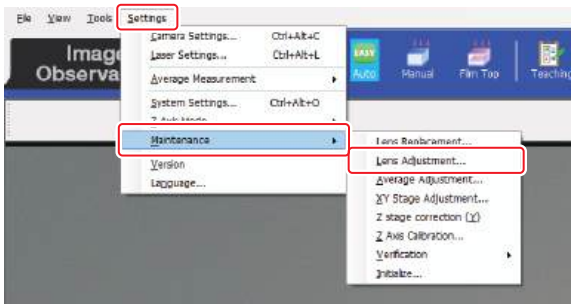
The details in the objective lens view updates.

Adjusting the Objective Lens

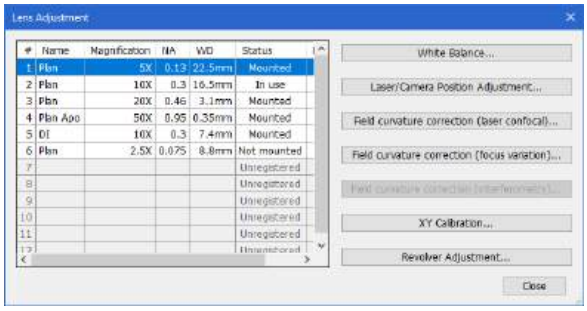
Displaying the lens adjustment screen

Adjust the lens on the [Lens Adjustment] dialog box.
Display the [Lens Adjustment] dialog box with the procedure below.

1 Select [Lens Adjustment] from [Maintenance] in the [Settings] menu.



The [Lens Adjustment] dialog box appears.

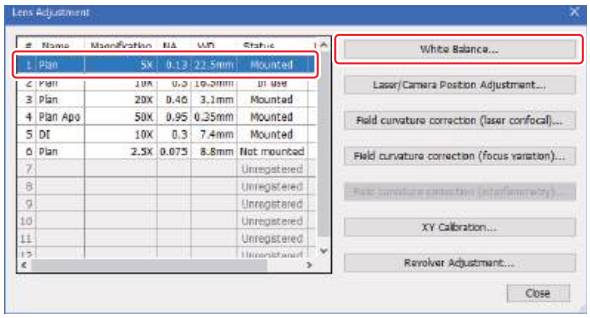


Adjusting white balance

Adjust the white balance of the camera.

■ To automatically adjust the white balance

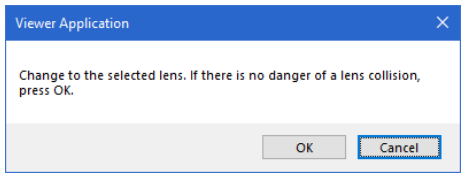
1 Select the target objective lens and click the [White Balance] button.



The [White Balance Adjustment] dialog box appears.

Reference

If you selected an objective lens other than the one currently in use, the following confirmation message appears.



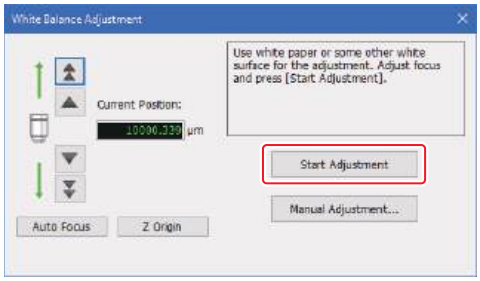
When you click the [OK] button, the revolver rotates and the objective lens changes.

2 Place a sample to be used as a reference for the white color on the stage.

3 Adjust the focus.

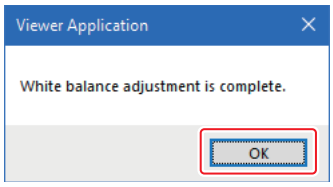
Adjusting Focus (Page 3-3)

4 **Click the [Start Adjustment] button.**



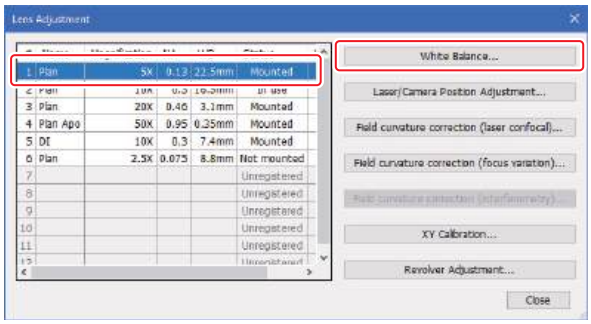
After it is completed, a confirmation message appears.

5 **Click the [OK] button.**



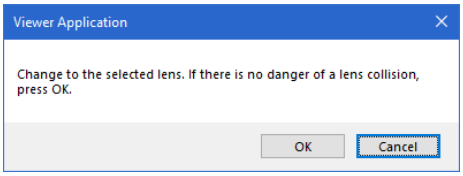
■ To manually adjust the white balance

1 **Select the target objective lens and click the [White Balance] button.**



The [White Balance Adjustment] dialog box appears.

Reference If you selected an objective lens other than the one currently in use, the following confirmation message appears.



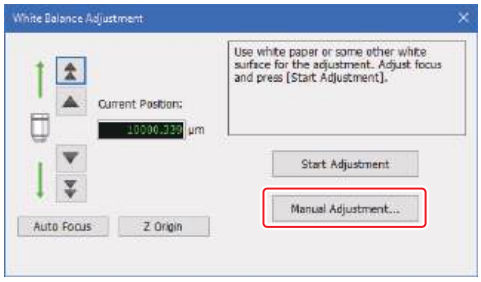
When you click the [OK] button, the revolver rotates and the objective lens changes.

2 **Place a sample to be used as a reference for the white color on the stage.**

3 **Adjust the focus.**

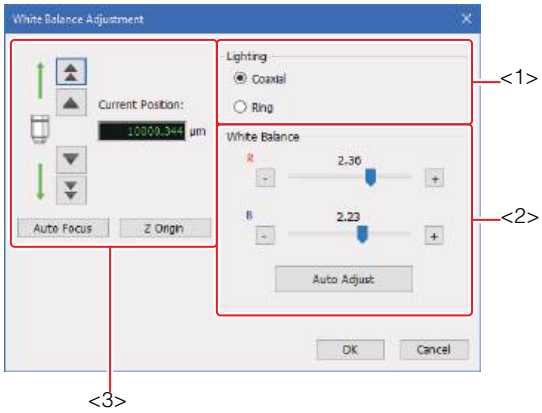
Adjusting Focus (Page 3-3)

4 **Click the [Manual Adjustment] button.**



The details on the [White Balance Adjustment] dialog box changes.

5 Adjust the white balance.



<1> Lighting

Select either [Coaxial] or [Ring] for the light that you want to adjust the white balance for.

<2> White Balance

Adjust the white balance with the slide bar.

Click the [Auto Adjust] button to automatically adjust the white balance.

- **[R] slide bar**

  Adjust the red balance. The greater the value, the darker the red is.

  Setting range: 1.00 to 3.00

- **[B] slide bar**

  Adjust the blue balance. The greater the value, the darker the blue is.

  Setting range: 1.00 to 3.00

<3> Objective lens operation panel

Operates the objective lens.

6 Click the [OK] button.

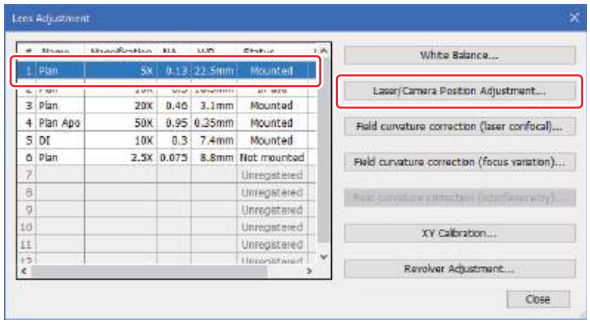
Adjusting the laser camera position

You can correct the misalignment between camera and laser images (laser/camera position adjustment). The interference objective lens also adjusts the focal position of the camera image and the interference fringes.

Important **Before adjusting the interference objective lens, make sure that the correction of misalignment between the camera and laser images is optimal. If the camera and laser images are misaligned, re-adjust the images before adjusting the interference objective lens.**

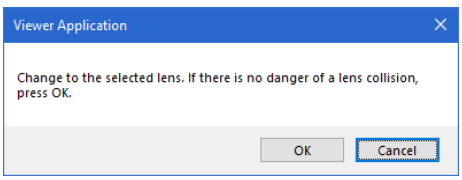
Reference A distortion can also occur due to vibration or temperature changes during transportation, resulting in misalignment between optical and laser images. A laser/camera position alignment should also be performed in such cases.

1 Select the target objective lens and click the [Laser/Camera Position Adjustment] button.



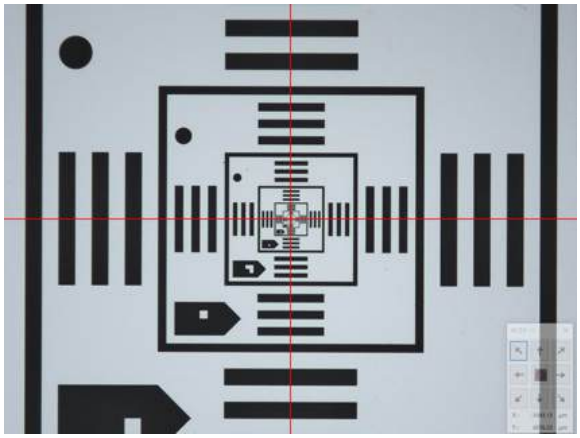
The [Laser/Camera Position Adjustment] dialog box appears.

Reference If you selected an objective lens other than the one currently in use, the following confirmation message appears.

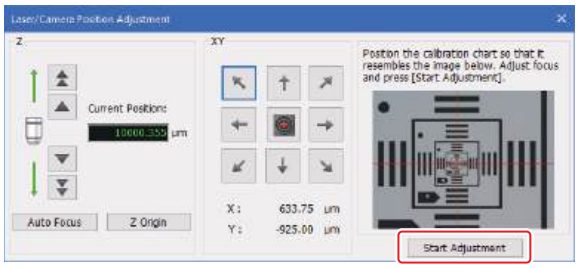


When you click the [OK] button, the revolver rotates and the objective lens changes.

2 **Set the chart for adjustment in the center of the screen and adjust the focus.**

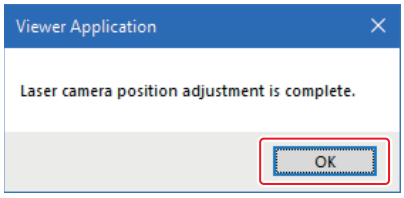


3 **Click the [Start Adjustment] button.**



When adjustment starts, the display switches between the optical image and the intensity image. After adjustment finishes, a confirmation message appears.

4 **Click the [OK] button.**

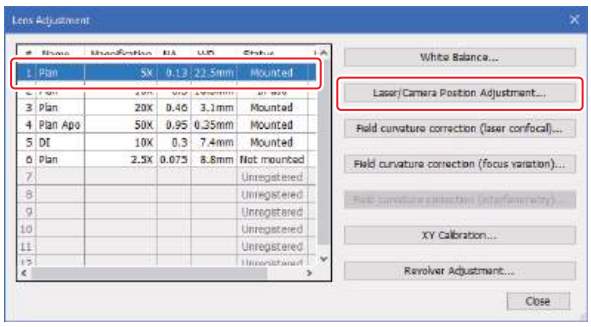


■ Adjusting manually

You can manually adjust the position of the laser camera if automatic adjustment was not successful or to make minute adjustments.

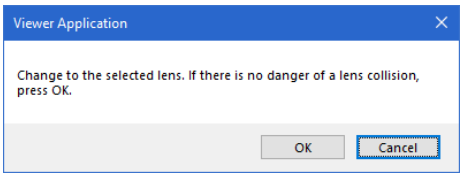
Important **Although optical zoom adjustments are performed automatically in automatic adjustment, you need to adjust the objective lenses and optical zooms in manual adjustment.**

1 **Select the target objective lens and click the [Laser/Camera Position Adjustment] button.**



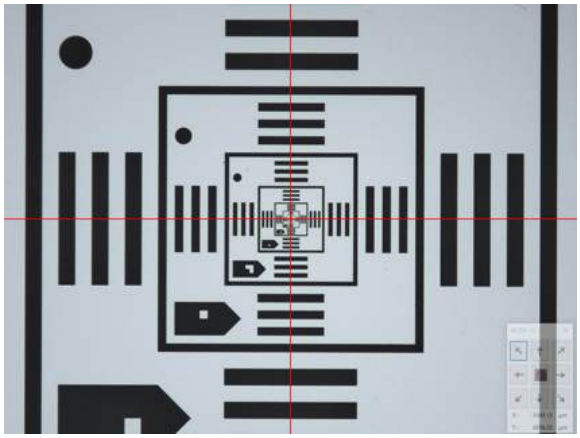
The [Laser/Camera Position Adjustment] dialog box appears.

Reference If you selected an objective lens other than the one currently in use, the following confirmation message appears.



When you click the [OK] button, the revolver rotates and the objective lens changes.

2 **Set the chart for adjustment in the center of the screen and adjust the focus.**

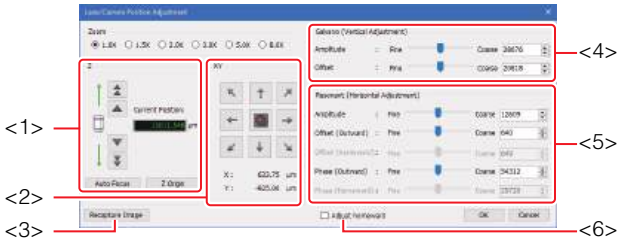


3 **Press the Ctrl+Shift+Alt+M keys.**

The [Capture Current Image] dialog box appears. After a short period of time, the contents of the [Laser/Camera Position Adjustment] dialog box refreshes.

4 **Select the optical zoom magnification that you want to adjust from [Zoom].**

5 **Use the controls in the [Laser/Camera Position Adjustment] dialog box and align the intensity image to the optical image.**



<1> Objective lens operation panel

Operates the objective lens.

<2> Motorized XY stage operation panel

Operates the motorized XY stage.

<3> [Recapture Image] button

Captures the latest optical image.

You can check whether the latest optical image and post-adjustment intensity image are aligned or not.

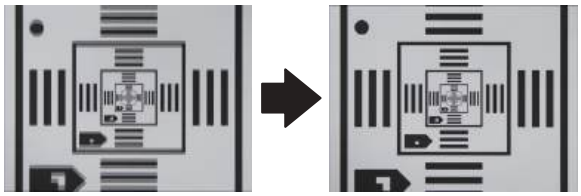
<4> Galvano (Vertical Adjustment)

Amplitude

Adjust the size (amplitude) of the vertical direction with the [Fine] slider or [Coarse] text box.

Adjust so that the vertical size of the optical image and intensity image match while looking at the image.

The higher the value, the smaller the vertical size.

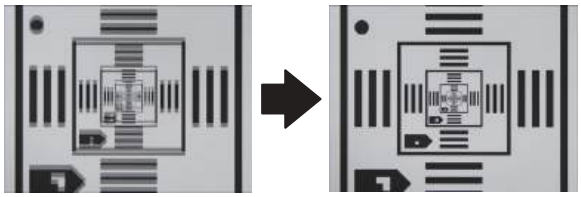


Offset

Adjust the position (offset) of the vertical direction with the [Fine] slider or [Coarse] text box.

Adjust so that the vertical position of the optical image and intensity image match while looking at the image.

The higher the value, the more the position moves downwards.



Reference

- The [Fine] slider is for fine adjustments.
- The [Coarse] text box is for coarse adjustments.
- You can also adjust the control with the mouse scroll wheel. Align the cursor with the items that you want to adjust and turn the mouse scroll wheel.

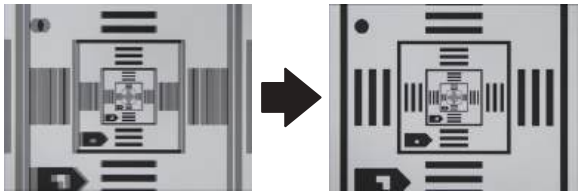
<5> Resonant (Horizontal Adjustment)

Amplitude

Adjust the size (amplitude) of the horizontal direction with the [Fine] slider or [Coarse] text box.

Adjust so that the horizontal size of the optical image and intensity image match while looking at the image.

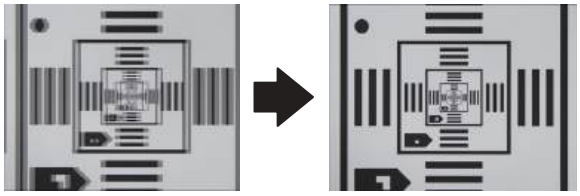
The higher the value, the smaller the horizontal size.



Offset (Outward)/offset (Homeward)

Adjust the position (offset) of the horizontal direction with the [Fine] slider or [Coarse] text box.

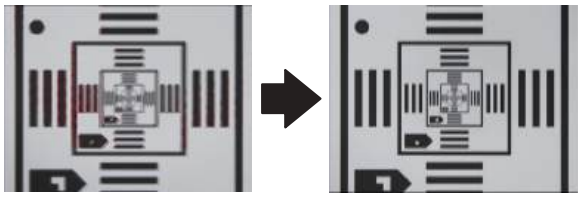
Adjust so that the horizontal position of the optical image and intensity image match while looking at the image.



Phase (Outward)/phase (Homeward)

Adjust the outwards and inwards alignment with the [Fine] slider or [Coarse] text box.

Adjust so that the edges of the lengthwise lines of the intensity image are no longer blurred while looking at the image.



Reference

- The [Fine] slider is for fine adjustments.
- The [Coarse] text box is for coarse adjustments.
- You can also adjust the control with the mouse scroll wheel. Align the cursor with the items that you want to adjust and turn the mouse scroll wheel.

<6> [Adjust homeward] check box

Select this check box to enable [Offset (homeward)] and [Phase (homeward)].

6 Click the [OK] button.

The [Laser/Camera Position Adjustment] dialog box closes.

Correcting field curvature/laser intensity eccentricity (laser confocal)

A field curvature adjustment (a correction for recognizing a plane as a plane) is performed for each objective lens.

■ What is field curvature adjustment?

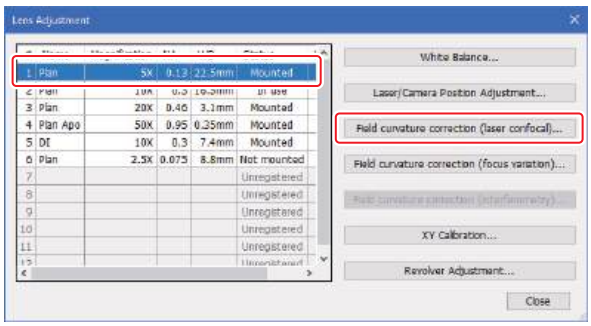
This function adjusts errors in the height data that are caused by distortions in individual objective lenses.

It measures a flat and smooth sample with high reflectance, such as a plane mirror-surface object, and creates correction data (i.e. field curvature and laser intensity eccentricity correction data) based on the height data. The field curvature will be very small for x50 and higher lenses.

Reference

It cannot be selected if you select an objective lens for white light interferometry.

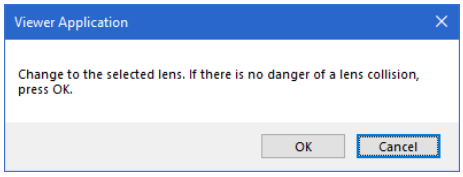
1 Select the target objective lens and click the [Field curvature correction (laser confocal)] button.



The [Field curvature correction (laser confocal)] dialog box appears.

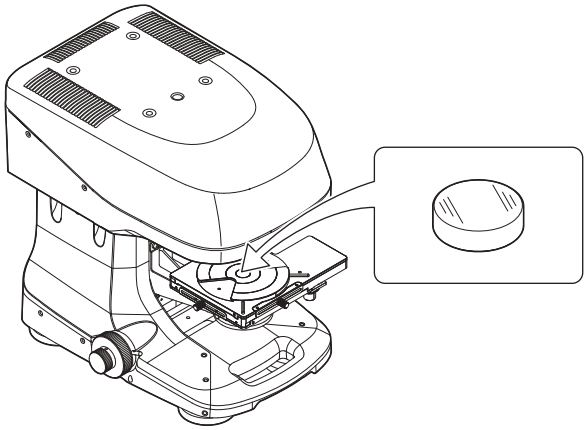
Reference

If you selected an objective lens other than the one currently in use, the following confirmation message appears.



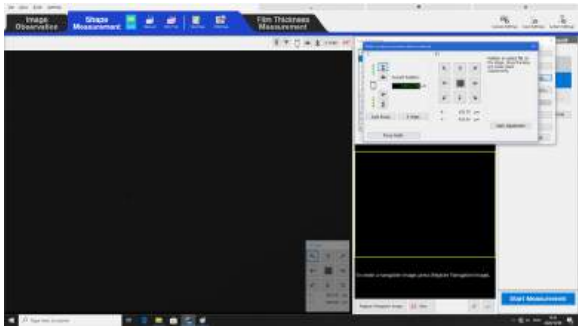
When you click the [OK] button, the revolver rotates and the objective lens changes.

2 **Place the plane mirror for laser confocal adjustment on the stage.**

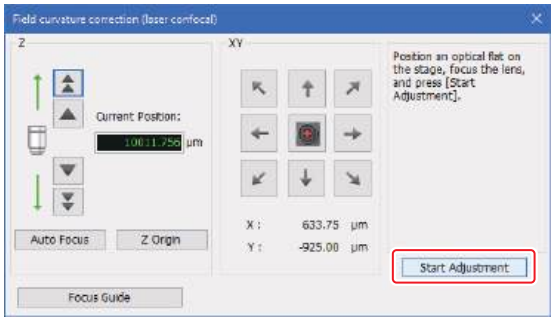


3 **Adjust the focus.**

Adjusting Focus (Page 3-3)

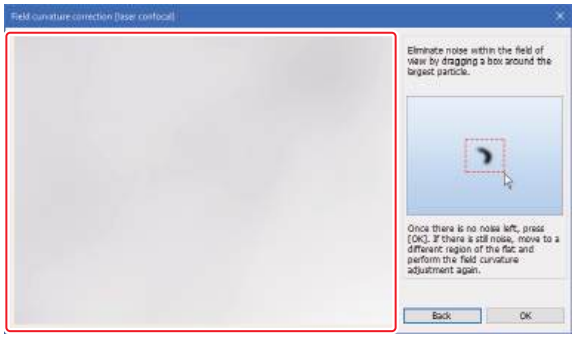


4 **Click the [Start Adjustment] button.**



When the adjustment is finished, the [Field curvature correction (laser confocal)] dialog box appears.

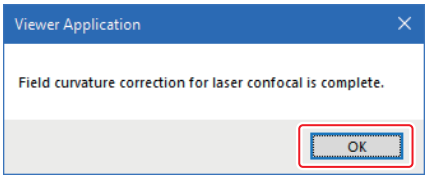
5 **If there is any noise on the display, drag the mouse to enclose the largest foreign body.**



6 **Click the [OK] button.**

A confirmation message appears.

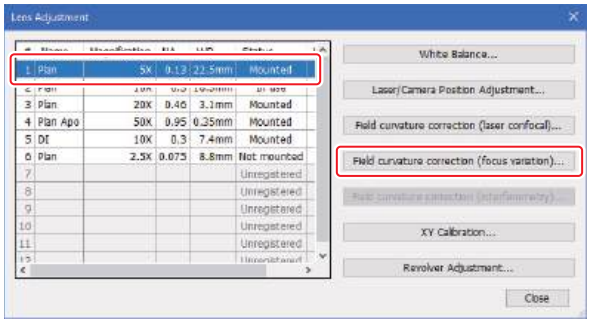
7 **Click the [OK] button.**



Correcting field curvature/laser intensity eccentricity (focus variation)

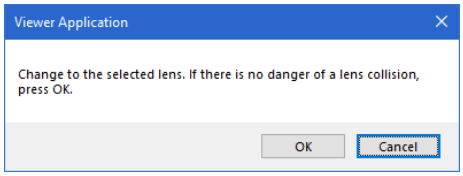
Reference It cannot be selected if you select an objective lens for white light interferometry.

1 Select the target objective lens and click the [Field curvature correction (focus variation)] button.



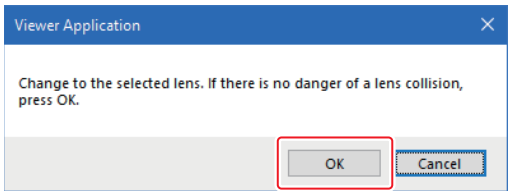
A confirmation message appears.

Reference If you selected an objective lens other than the one currently in use, the following confirmation message appears.



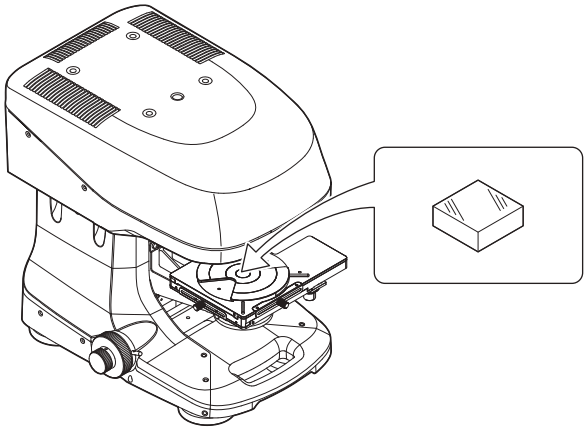
When you click the [OK] button, the revolver rotates and the objective lens changes.

2 Click the [OK] button.



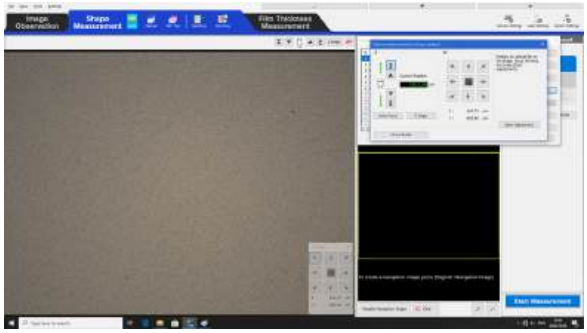
3 Place the plane plate for focus variation adjustment on the stage.

The [Field curvature correction (focus variation)] dialog box appears.

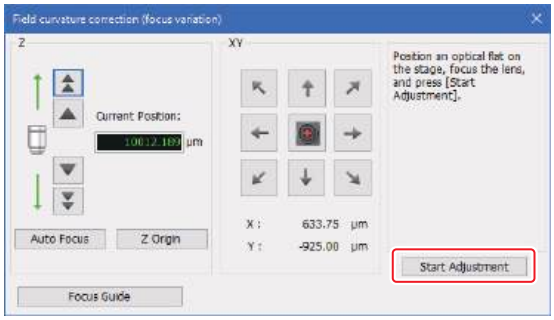


4 Adjust the focus.

Adjusting Focus (Page 3-3)

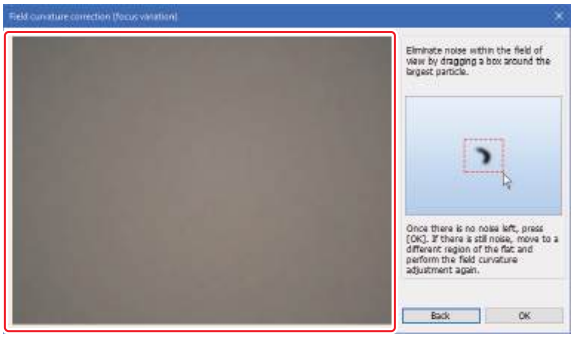


5 Click the [Start Adjustment] button.



When the adjustment is finished, the [Field curvature correction (focus variation)] dialog box appears.

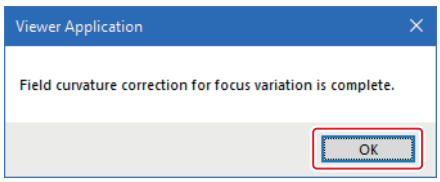
6 **If there is any noise on the display, drag the mouse to enclose the largest foreign body.**



7 **Click the [OK] button.**

A confirmation message appears.

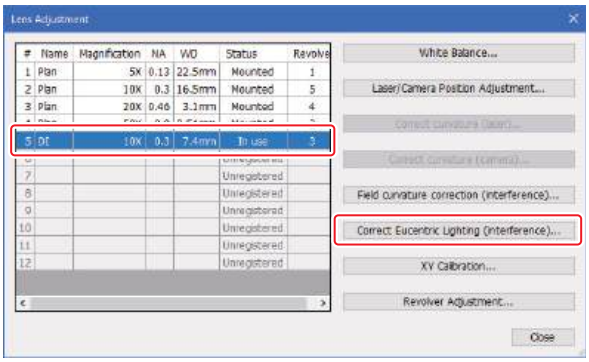
8 **Click the [OK] button.**



Correct Eucentric Lighting (white light interferometry)

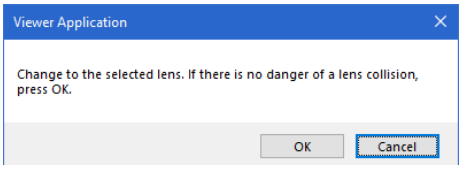
Reference It can only be selected if you select an objective lens for white light interferometry.

1 **Select the target objective lens and click the [Correct Eucentric Lighting (interference)] button.**



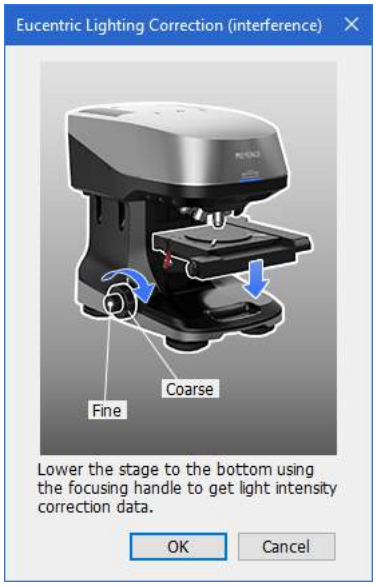
A confirmation message appears.

Reference If you selected an objective lens other than the one currently in use, the following confirmation message appears.



When you click the [OK] button, the revolver rotates and the objective lens changes.

2 **Lower the stage to the bottom, and click the [OK] button.**

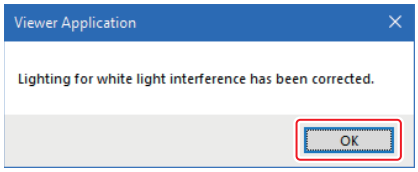


Important

- **Be sure to lower the stage as the reference light of the lens is being corrected.**
- **Do not place anything on the stage.**

After adjustment finishes, a confirmation message appears.

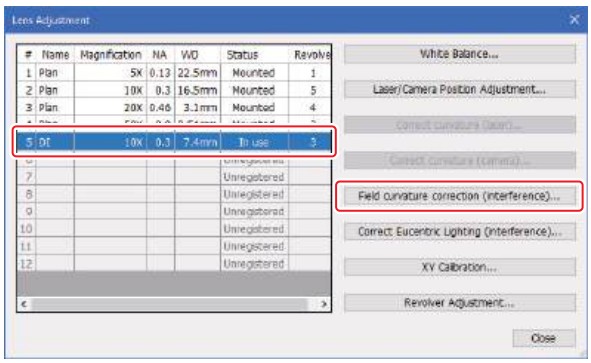
3 **Click the [OK] button.**



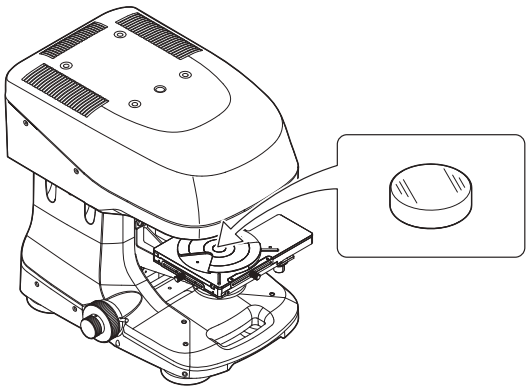
Field curvature correction (white light interferometry)

Reference It can only be selected if you select an objective lens for white light interferometry.

1 **Select the target objective lens and click the [Field curvature correction (interference)] button.**



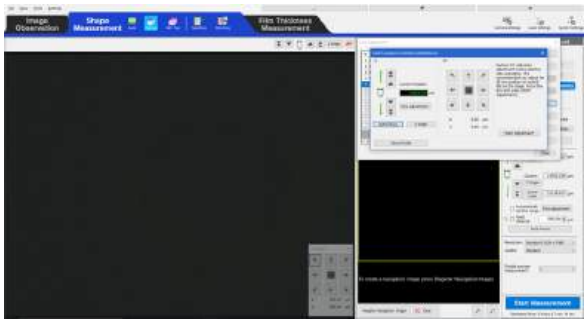
2 **Place the plane mirror for white light interferometry adjustment on the stage.**



Important **For the plane mirror used for a field curvature adjustment, use the plane mirror for white light interference adjustment supplied with the VKH3I, or the mirror for optical adjustment with a surface accuracy of λ/20.**

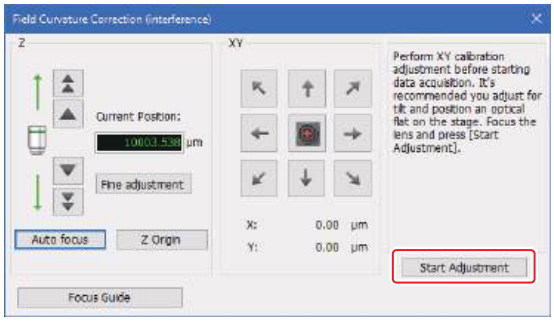
3 **Adjust the focus on the surface of the plane mirror for white light interference adjustment.**

Adjusting Focus (Page 3-3)



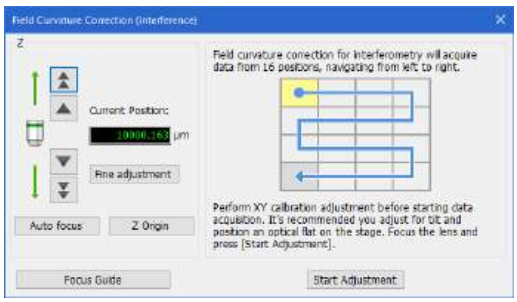
4 **Adjust the stage tilt so that interference fringes displayed in the optical image are minimized.**

5 **Click the [Start Adjustment] button.**

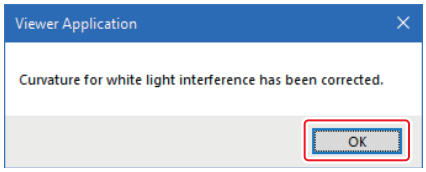


After adjustment finishes, a confirmation message appears.

Important **If you are using a manual XY stage, follow the instructions in the dialog box to perform the correction while moving the stage.**

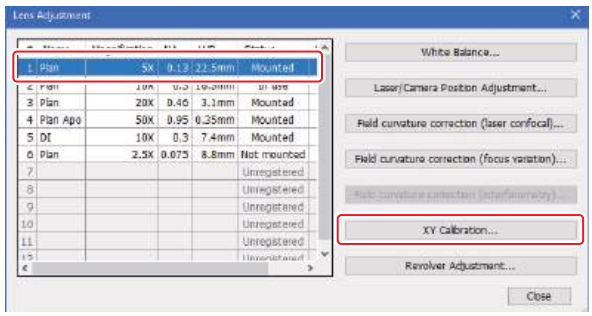


6 **Click the [OK] button.**



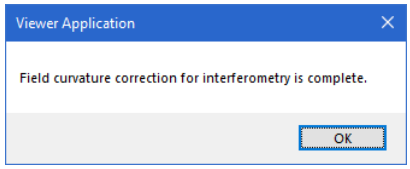
XY calibration

1 **Select the target objective lens and click the [XY Calibration] button.**



The [XY Calibration] dialog box appears.

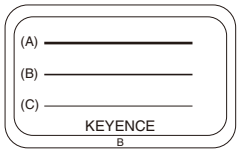
Reference If you selected an objective lens other than the one currently in use, the following confirmation message appears.



When you click the [OK] button, the revolver rotates and the objective lens changes.

2 **Place the OP-87657 chart for adjustment on the stage.**

Point Use side B of the OP-87657.



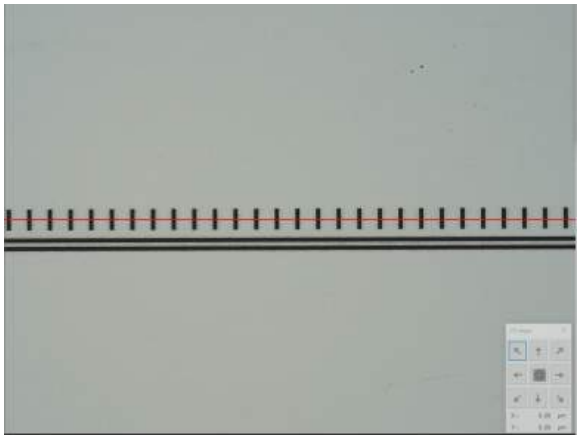
(A): Scale with a pitch of 1000 µm
(B): Scale with a pitch of 100 µm
(C): Scale with a pitch of 10 µm

The memory used per lens is listed below.

Lens (magnification)	Memory type	Memory used by calibration (µm)
2.5	A	4000
5	B	2000
10	B	1200
20	B	500
50	B	200
100	C	110
150	C	80

3 **Adjust the focus.**

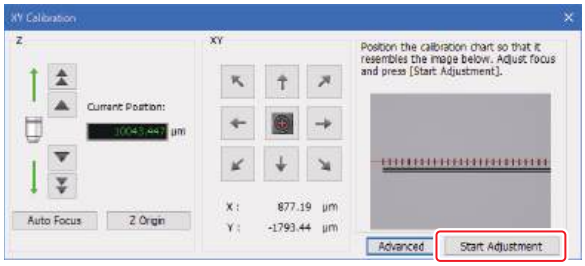
4 **Align the chart so that the position of the red lines on the viewing window match.**



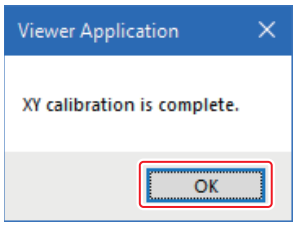
Point

Configure the settings so the chart for adjustment is viewed the same as the image displayed in the settings menu.

5 **Click the [Start Adjustment] button.**

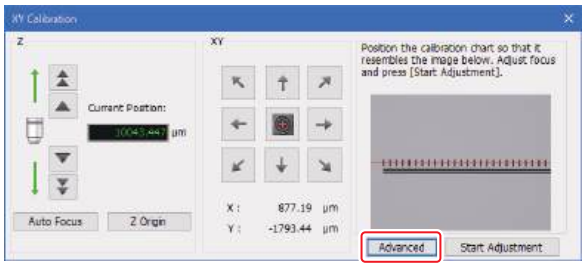


6 **Click the [OK] button.**

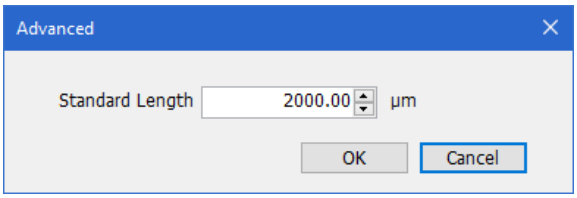


XY Calibration, Advanced

1 **Use the calibration values of the chart for adjustment, the OP-87657 VHX correction scale, to perform advanced calibration.**
Click the [Advanced] button.



2 **Enter the calibration value written on the OP-87657 inspection report for the Standard Length.**



Viewing the OP-87657 inspection report

Check the calibration value for the lens in use. Use the information in the table to check the corresponding part of the inspection report.

Point

Subtract the instrumental error at a nominal size of 0 from the calibration result. This instrumental error is the measurement error applied to the origin coordinates.

For example, when using a 50× lens, check the calibration value for memory B and 200 µm in the bottom row of the inspection report. Subtract the instrumental error at a nominal size of 0 from this calibration value.

No. SH0012345

検査成績書

Inspection Result

品　　名(Description)　：　校正スケール　Calibration Scale
型　　式(Model)　：　ＯＰ－８７６５７
製造番号(Serial number)　：　22954-1234-56
検査日(Date of Inspection)　：　December 14, 2020

上記の製品は、当社の管理された品質システムのもと、下記の検査項目について厳重な検査を致しております。
The product above has been given a rigorous inspection regarding the following items under KEYENCE's controlled quality system.

(A)

公称値(µm) Nominal Size	器差(µm) Instrumental Error
0.00	−0.04
2000.00	−0.07
4000.00	−0.03
6000.00	−0.07
8000.00	−0.06
10000.00	−0.09
12000.00	−0.10
14000.00	0.02
16000.00	−0.14
18000.00	−0.16
20000.00	−0.18

(B)

公称値(µm) Nominal Size	器差(µm) Instrumental Error
0.00	−0.07
1000.00	0.04
2000.00	0.00
3000.00	−0.05
4000.00	−0.06
5000.00	−0.11
6000.00	−0.09
7000.00	−0.12
8000.00	−0.10
9000.00	−0.11
10000.00	−0.12

(C)

公称値(µm) Nominal Size	器差(µm) Instrumental Error
0.00	−0.14
100.00	0.07
200.00	0.05
300.00	−0.01
400.00	0.04
500.00	−0.16
600.00	0.01
700.00	0.05
800.00	−0.08
900.00	0.08
1000.00	−0.11

(B)

公称値(µm) Nominal Size	器差(µm) Instrumental Error
0.00	0.00
100.00	0.10
200.00	0.06
300.00	0.00
400.00	0.12
500.00	−0.08
600.00	0.09
700.00	0.08
800.00	−0.01
900.00	0.14
1000.00	0.02
1100.00	0.15
1200.00	0.17
1300.00	−0.03
1400.00	0.10
1500.00	−0.06
1600.00	0.06
1700.00	0.06
1800.00	0.01
1900.00	0.09
2000.00	−0.08

(C)

公称値(µm) Nominal Size	器差(µm) Instrumental Error
0.00	0.05
10.00	0.08
20.00	0.06
30.00	0.02
40.00	0.04
50.00	0.02
60.00	0.06
70.00	0.06
80.00	0.08
90.00	0.07
100.00	0.08
110.00	0.09
120.00	0.11
130.00	0.13
140.00	0.16
150.00	0.18
160.00	0.18
170.00	0.19
180.00	0.21
190.00	0.22
200.00	0.23

真の値(True value)
＝公称値(Nominal Size)
＋器差(Instrumental Error)

材質(Material)：
石英ガラス(Quartz Glass)

規格値（Specification value）
±1µm

総合判定（Test result）
合格（Acceptable）

測定器(Measuring instrument)：超精密座標測定装置 Ultra-Precision Coordinate Measurement Machine Mercury 5000SHR（ZUK-I-044）
測定条件(Measuring condition)：温度(Temperature) ２３．０℃ ／ 湿度(Humidity) ５０．５%

Prepared by　　Approved by

株式会社キーエンス
KEYENCE CORPORATION

A (top row) : Calibration values at intervals of 2000 µm for a scale with a pitch of 1000 µm

B (top row) : Calibration values at intervals of 1000 µm for a scale with a pitch of 100 µm

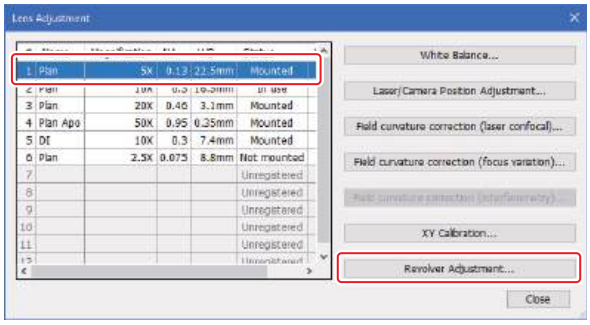
B (bottom row) : Calibration values at intervals of 100 µm for a scale with a pitch of 100 µm

C (top row) : Calibration values at intervals of 100 µm for a scale with a pitch of 10 µm

C (bottom row) : Calibration values at intervals of 10 µm for a scale with a pitch of 10 µm

Adjusting the revolver

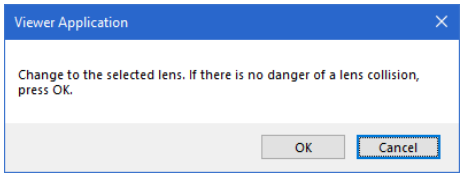
1 Select the target objective lens and click the [Revolver Adjustment] button.



The [Revolver Adjustment] dialog box appears.

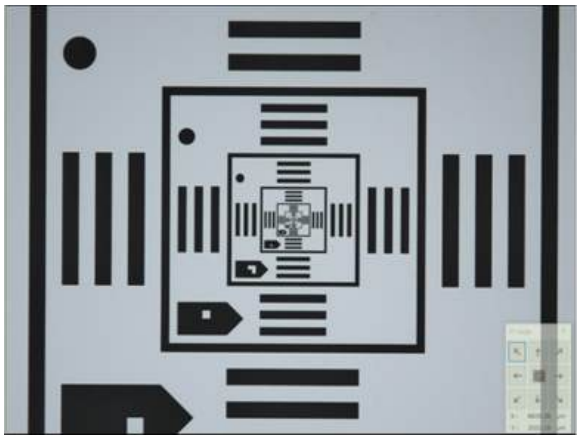
Reference

If you selected an objective lens other than the one currently in use, the following confirmation message appears.

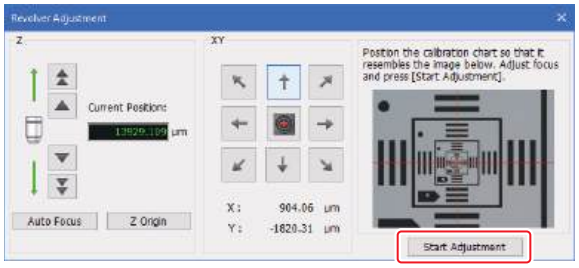


When you click the [OK] button, the revolver rotates and the objective lens changes.

2 Set the chart for adjustment in the center of the screen and adjust the focus.

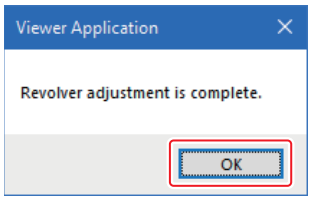


3 **Click the [Start Adjustment] button.**



Once adjustment begins, the objective lens changes. After adjustment finishes, a confirmation message appears.

4 **Click the [OK] button.**



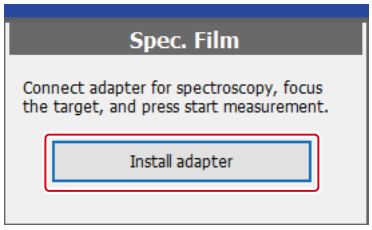
Mounting and Removing the Spectral Film Thickness Unit

Displaying the adapter setting window

Use the [Install adapter] dialog box to mount and remove the spectral film thickness unit.

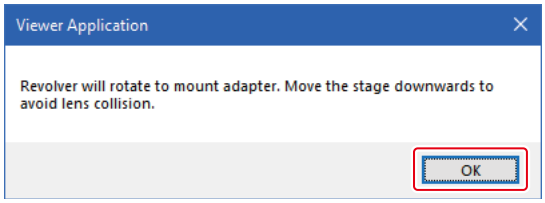
Display the [Install adapter] dialog box with the procedure below.

1 Click the [Install adapter] button from the spectroscopy film thickness of the film thickness measurement mode.



The confirm dialog box appears.

2 Click the [OK] button.



The [Install adapter] dialog box appears.

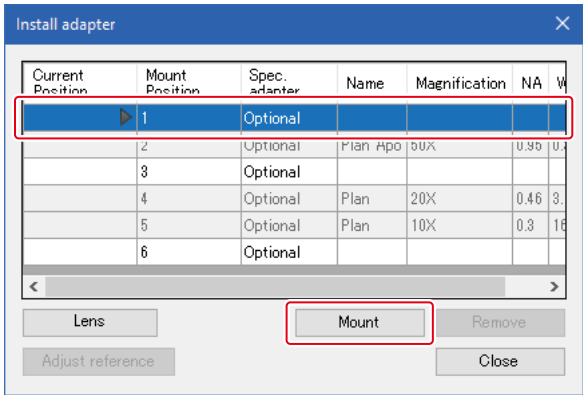
Mounting the spectral film thickness unit

Mount the spectral film thickness unit.

Point

If you select the objective lens to be mounted with the [Lens Type] radio button, other information automatically changes.

1 Select the mount position for the spectral film thickness unit and click the [Mount] button.

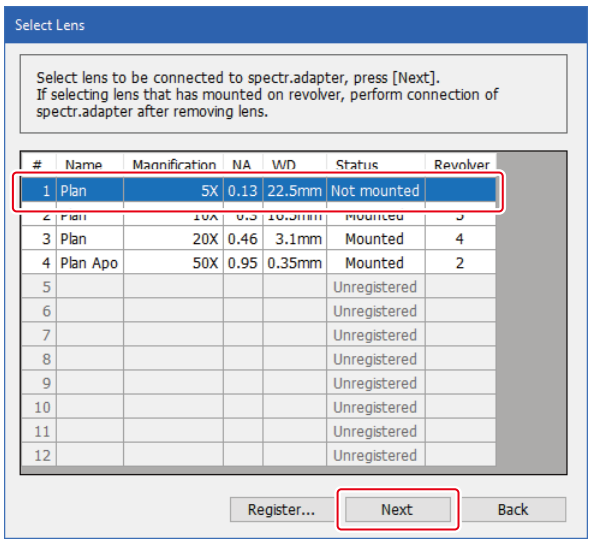


Reference

Select a location that a spectral adapter can be attached to.

The [Select Lens] dialog box appears.

2 Select the objective lens to be used, and click the [Next] button.



The [Remove Lens (Step 1)] dialog box appears.

The revolver rotates and moves to a position where the objective lens can be removed.

3 **Remove the objective lens.**

Removing an objective lens (Page 11-10)

The [Mount bracket] dialog box appears.

4 **Follow the on-screen instructions to mount the bracket, and click the [Next] button.**

The [Mount adapter] dialog box appears.

5 **Follow the on-screen instructions to mount the adapter, and click the [Next] button.**

The [Mount Lens] dialog box appears.

6 **Follow the on-screen instructions to mount the lens, and click the [Finish] button.**

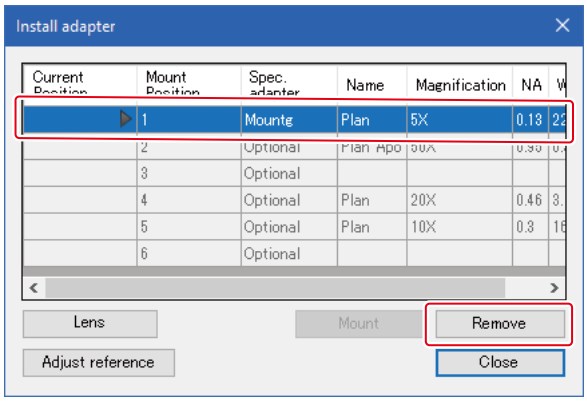
The confirm dialog box appears.

Reference After this, connect the spectrometer to the control PC via the fiber optic cable, then perform reference adjustments.

Removing the spectral film thickness unit

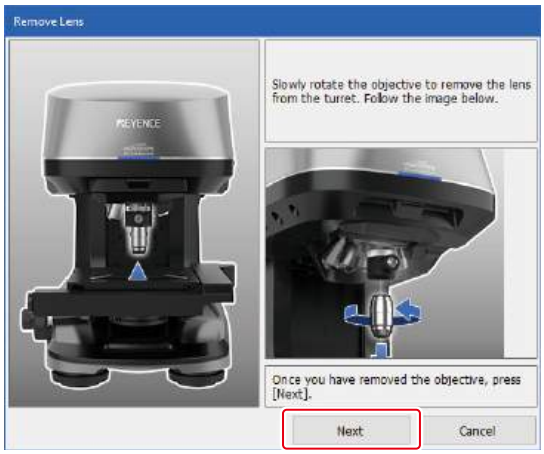
Remove the spectral film thickness unit.

1 **Select the target information and click the [Remove] button.**



The [Remove Lens] dialog box appears.

2 **Follow the on-screen instructions to remove the lens, and click the [Next] button.**

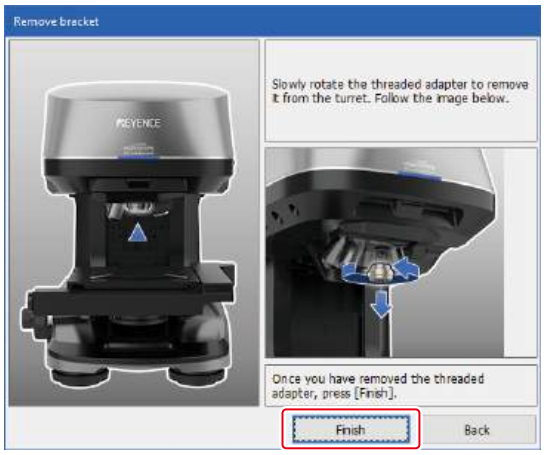


The [Remove adapter] dialog box appears.

3 **Follow the on-screen instructions to remove the adapter, and click the [Next] button.**

The [Remove bracket] dialog box appears.

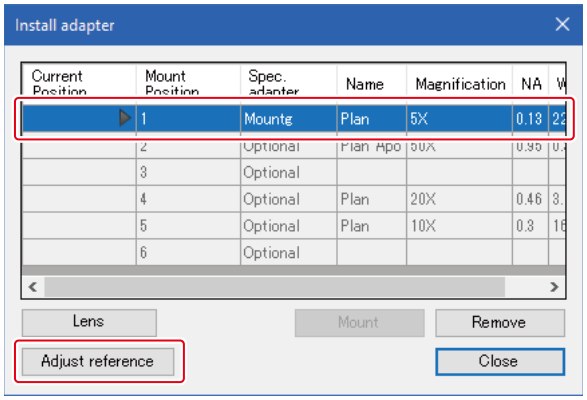
4 **Follow the on-screen instructions to remove the bracket, and click the [Finish] button.**



Adjusting the spectroscopy adapter unit

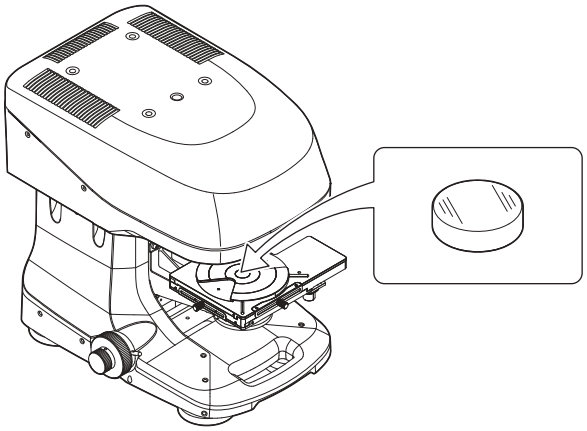
Execute the reference adjustment.

1 **Click the [Adjust reference] button.**

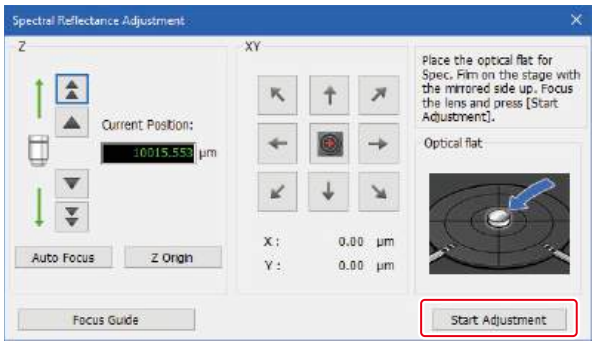


The [Spectral Reflectance Adjustment] dialog box appears.

2 **Set the mirror (optical flat) for adjusting the reference for the spectral film thickness, and then adjust the focus.**

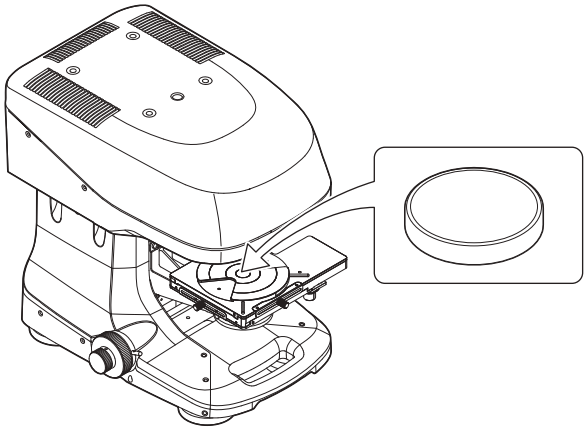


3 **Click the [Start Adjustment] button.**

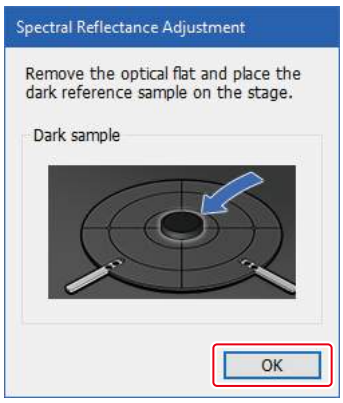


The [Spectral Reflectance Adjustment] dialog box appears.

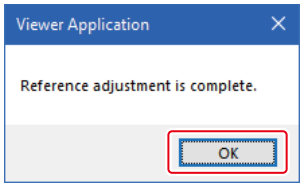
4 **Set the dark sample for adjusting the reference for the spectral film thickness, and then adjust the focus.**



5 **Click the [OK] button.**



6 **Click the [OK] button.**



Height Adjustment

This adjustment allows for correction of height discrepancies that could occur due to ambient temperature or other issues in measurement environment.

Height Adjustment (Z Calibration)

Important

- **Before performing a Z-axis calibration, reset the calibration value to the default value (1.000).**
- **The Z-axis calibration is applied to all lens measurement results. Please note that adjusting to a specific lens or gauge may increase errors with other lenses.**

Reference

This function normally does not need to be used.

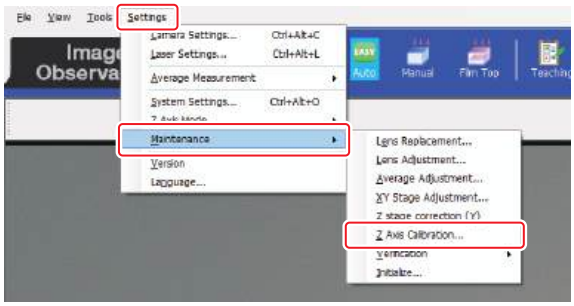
1 Measure the height of the standard of a level gauge for which you know the true value.

2 Calculate the calibration value from the measurement and true values.

Formula

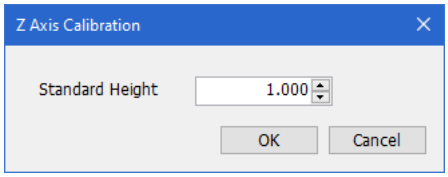
Calibration value = true value / measurement value

3 Select [Z Axis Calibration] from [Maintenance] on the [Settings] menu.



The [Z Axis Calibration] dialog box appears.

4 Set [Standard Height].



5 Click the [OK] button.

Verification (Calibration)

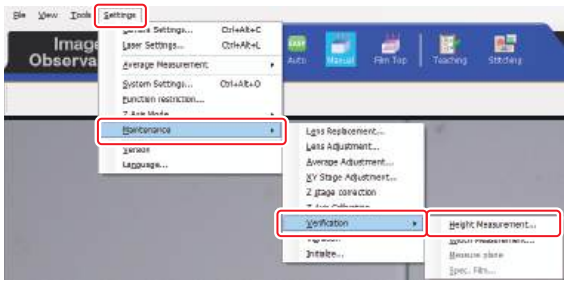
When the VK-X3000 Series laser microscope is used after a long break in usage, the measurement values are not stable or there are large measurement errors, the "Height measurement" function and the "Width measurement" function can be used for confirming the accuracy.

Height Measurement

This section describes how to calibrate height measurements using focus variation and laser confocal.

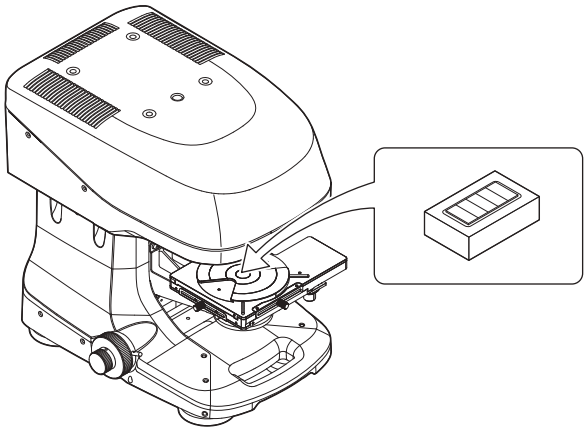
1 **Select the standard objective lens for the operation check on the objective lens view.**

2 **Select [Verification] > [Height Measurement] from [Maintenance] in the [Settings] menu.**



The [Height Verification] dialog box appears.

3 **Place a commercially-available gauge for height accuracy on the stage plate.**



■ **Recommended level gauge**

Focus variation

- OP-88248 Calibration Gauge

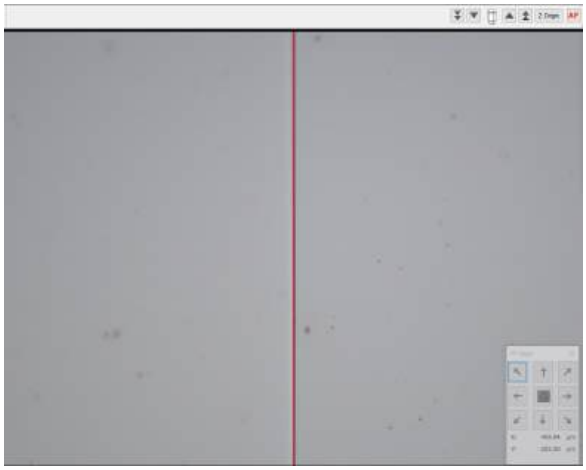
Laser confocal

- Level block (4-step) No.178-610 manufactured by Mitutoyo Corporation
- Film thickness step height standard SHS-1.8QC, 8.0QC, 19.5QC manufactured by KLA-Tencor Corporation

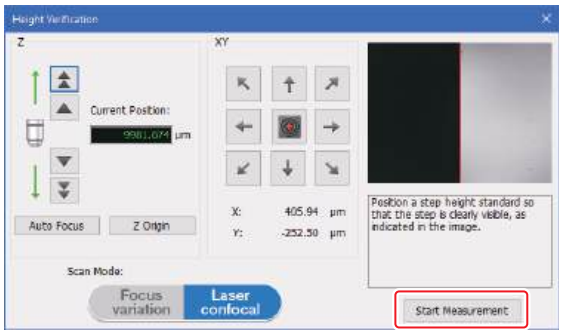
4 **Focus on the gauge for height accuracy check.**

Adjusting Focus (Page 3-3)

5 **Align the chart so that the position of the red lines on the viewing window match.**

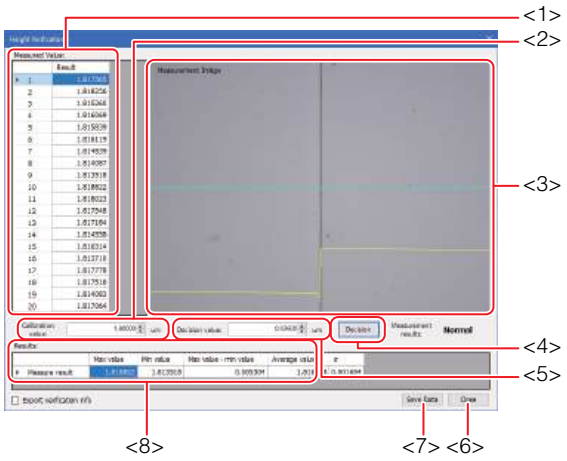


6 Select the scan mode to check the accuracy and click the [Start Measurement] button.



The measurement adjustment is started. When the measurement is finished, the [Height Verification] dialog box appears.

7 Check the measurement result.



<1> Measured Value

Displays the measurement value of the height that was measured 20 times.

<2> [Calibration value] box

Enter the calibration value of the gauge for checking the accuracy of the height used.

<3> Measurement Image

Displays the measured images.

<4> [Decision] button

The average value of the result of a height measured 20 times is judged on whether it is within the calibration value ± the judgment value and whether it is abnormal or normal is displayed.

<5> [Decision value] box

Enter an acceptable error value.

<6> [Close] button

Closes the [Height Verification] dialog box.

<7> [Save Data] button

The displayed results are saved to a CSV file.

Clicking this button displays the [Output CSV file] dialog box.

Saving the Measurement Result (Page 2-6)

<8> Results

The results of measuring 20 times such as Maximum value, Minimum value, Maximum value - Minimum value, Average value and 3 sigma are displayed.

8 Click the [Close] button (<5>).

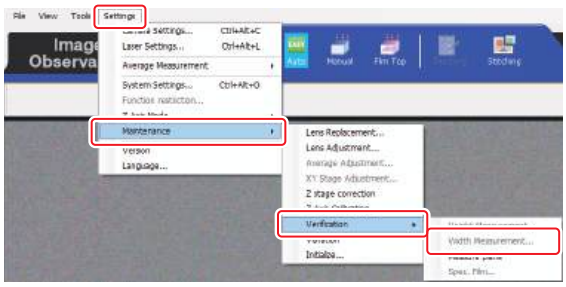
The [Height Verification] dialog box closes.

Width Measurement

This section describes how to calibrate width measurements using focus variation and laser confocal.

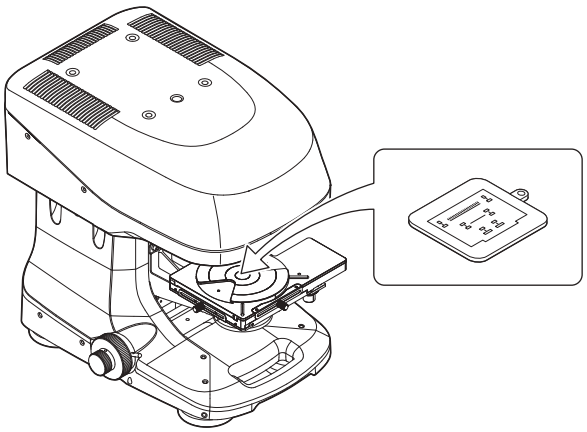
1 Select the standard objective lens for the operation check on the objective lens view.

2 Select [Verification] > [Width Measurement] from [Maintenance] in the [Settings] menu.



The [Width Verification] dialog box appears.

3 Place a chart for width accuracy check on the stage plate.



■Recommended level gauge

Focus variation

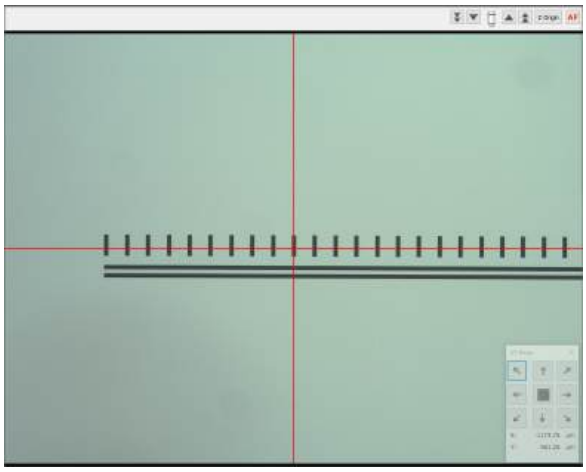
Laser confocal

- OP-87657 VHX correction scale manufactured by Keyence Corporation

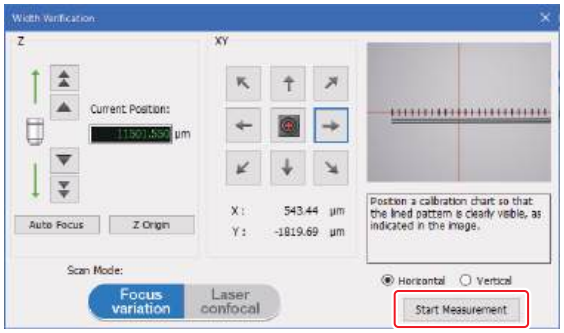
4 Focus on the chart for width accuracy check.

Adjusting Focus (Page 3-3)

5 Align the chart so that the position of the red lines on the viewing window match.



6 Select the scan mode to check the accuracy and click the [Start Measurement] button.

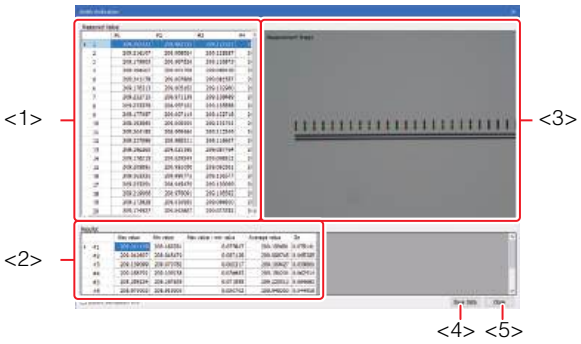


The measurement is started. The [Width Verification] dialog box appears when the measurement is complete.

Important

When checking the measurement accuracy in the vertical direction (Y) on the screen, place the chart vertically and select [Vertical].

7 Check the measurement result.



<1> Measured Value

Displays the measurement value of the width that was measured 20 times.

<2> Results

The results of measuring 20 times such as Maximum value, Minimum value, Maximum value - Minimum value, Average value and 3 sigma are displayed.

<3> Measurement Image

Displays the measured images.

<4> [Save Data] button

The displayed results are saved to a CSV file.

Clicking this button displays the [Output CSV file] dialog box.

Saving the Measurement Result (Page 2-6)

<5> [Close] button

Closes the [Width Verification] dialog box.

8 Click the [Close] button (<5>).

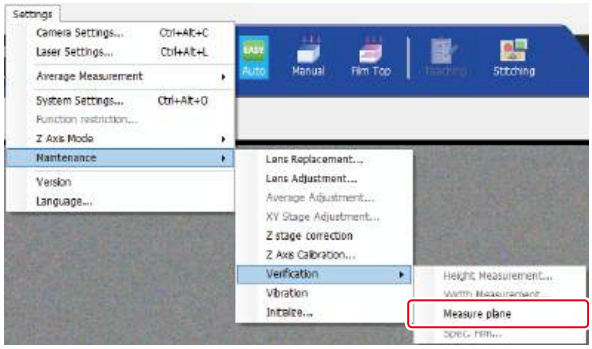
The [Width Verification] dialog box closes.

Plane Measurement

This section describes how to check the repeatability of height measurements using the white light interference.

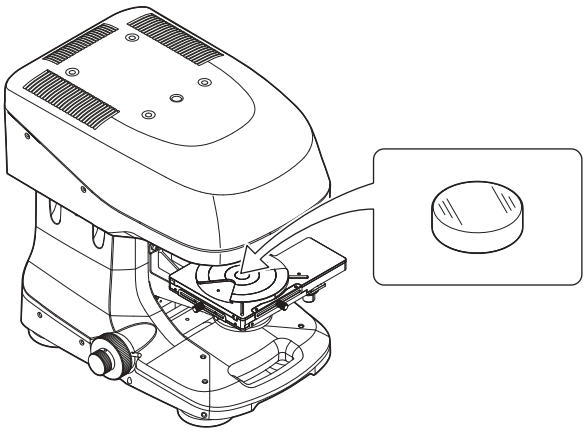
1 Select the objective lens for the white light interference to check the operation on the objective lens view.

2 Select [Verification] > [Plane] from [Maintenance] in the [Settings] menu.



The [Plane] dialog box appears.

3 Place the plane mirror for White light interferometry adjustment on the stage plate.



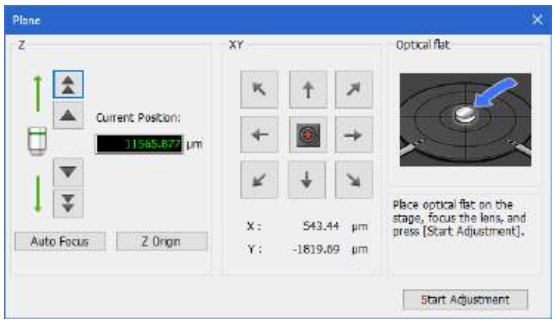
■Recommended level gauge

- VK-H3I Mirror for white light interferometry adjustment By KEYENCE Corporation

4 Focus on the plane mirror for White light interferometry adjustment.

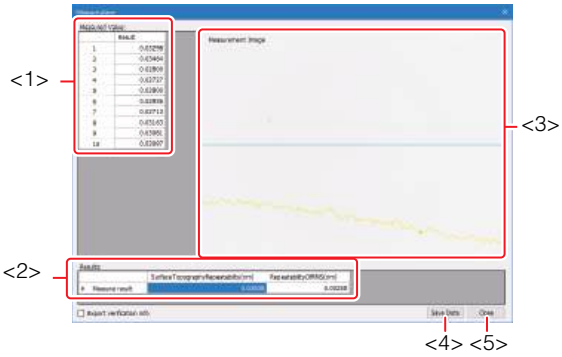
Adjusting Focus (Page 3-3)

5 Click the [Start Adjustment] button.



The measurement is started. When the measurement is finished, the [Measure plane] dialog box appears.

6 Check the measurement result.



<1> Measured Value

Displays the measurement value of the plane that was measured 10 times.

<2> Results

Displays SurfaceTopographyRepeatability (nm) and RepeatabilityOfRMS (nm) of the results of 10 measurements.

<3> Measurement Image

Displays the measured images.

<4> [Save Data] button

The displayed results are saved to a CSV file.

Clicking this button displays the [Output CSV file] dialog box.

Saving the Measurement Result (Page 2-6)

<5> [Close] button

Closes the [Plane] dialog box.

7 Click the [Close] button (<5>).

The [Plane] dialog box closes.

Spectroscopy film thickness measurement

This section describes how to check the repeatability of film thickness measurements performed by using the spectroscopy film thickness function.

1 **On the toolbar, click [Film Thickness Measurement].**

2 **Click the [Laser film thickness] button.**

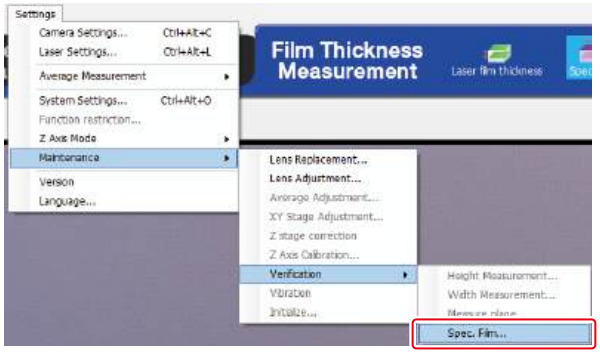
It will switch to the spectroscopy film thickness of the film thickness measurement mode.

3 **Mount the spectral film thickness unit.**

Click the [Install adapter] button from the spectroscopy film thickness of the film thickness measurement mode.

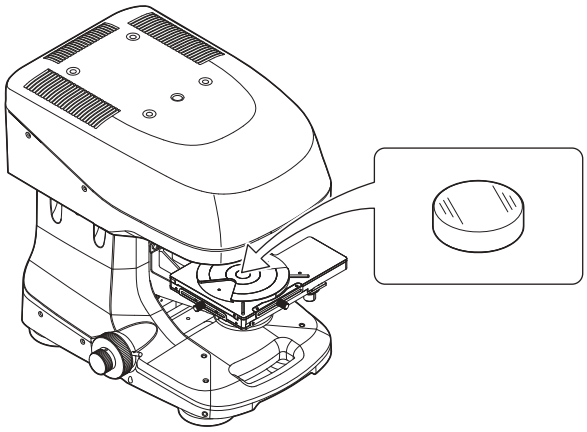
Mounting and Removing the Spectral Film Thickness Unit (Page 11-26)

4 **Select [Verification] > [Spec. Film] from [Maintenance] in the [Settings] menu.**

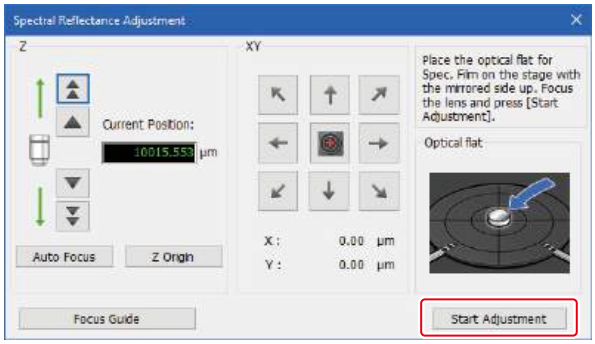


The [Spectral Reflectance Adjustment] dialog box appears.

5 **Set the mirror (optical flat) for adjusting the reference for the spectral film thickness, and then adjust the focus.**

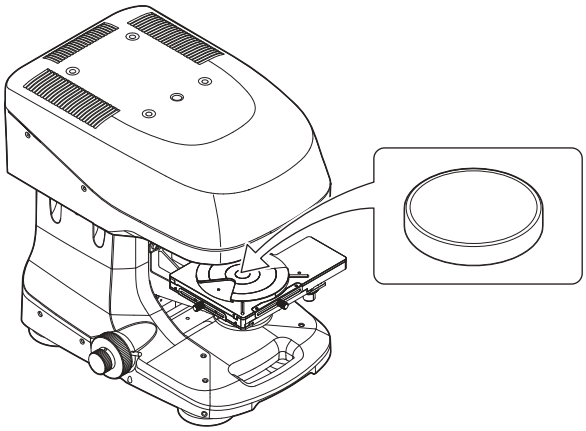


6 **Click the [Start Adjustment] button.**

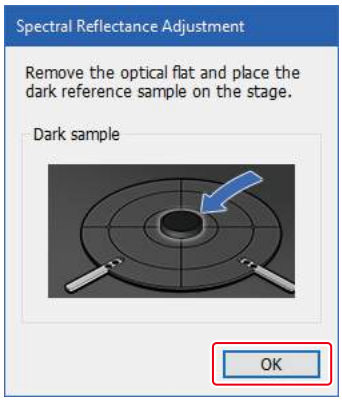


The [Spectral Reflectance Adjustment] dialog box appears.

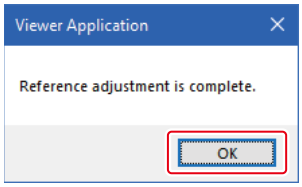
7 **Set the dark sample for adjusting the reference for the spectral film thickness, and then adjust the focus.**



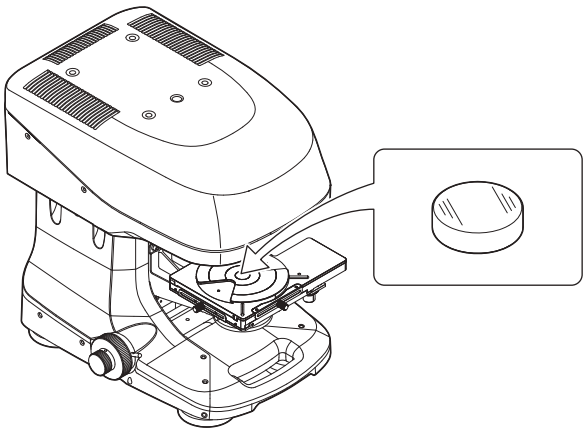
8 **Click the [OK] button.**



9 Click the [OK] button.



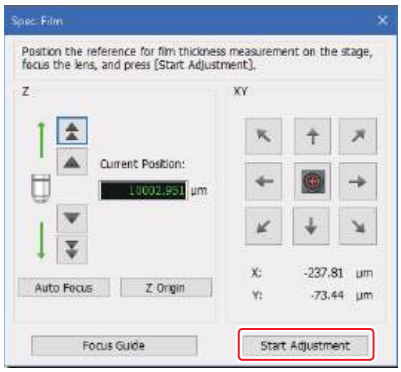
10 Place the master sample on the stage plate.



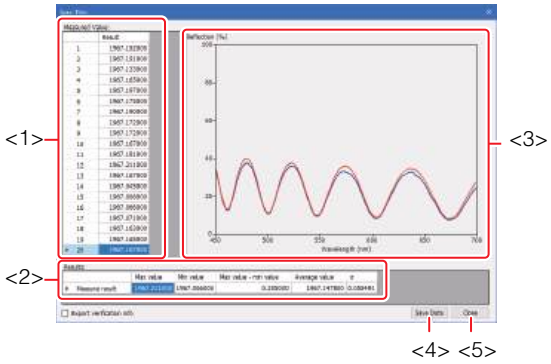
11 Adjust the focus on the master sample.

Adjusting Focus (Page 3-3)

12 Click the [Start Adjustment] button.



13 Check the measurement result.



<1> Measured Value

Displays the measurement value of the width that was measured 20 times.

<2> Results

The results of measuring 20 times such as Maximum value, Minimum value, Maximum value - Minimum value, Average value, and sigma are displayed.

<3> Graph

A reflection graph for each wavelength appears.

<4> [Save Data] button

The displayed results are saved to a CSV file.

Clicking this button displays the [Output CSV file] dialog box.

Saving the Measurement Result (Page 2-6)

<5> [Close] button

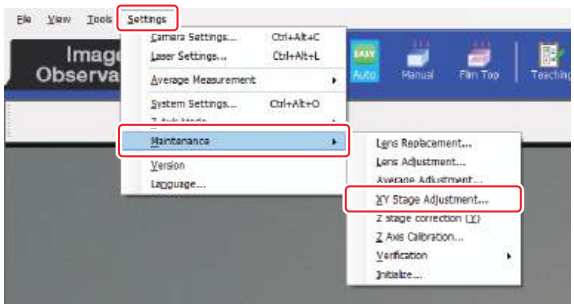
Closes the [Spec. Film] dialog box.

Motorized XY Stage Adjustment

The motorized XY stage should be adjusted when you attach the motorized XY stage to a new location.

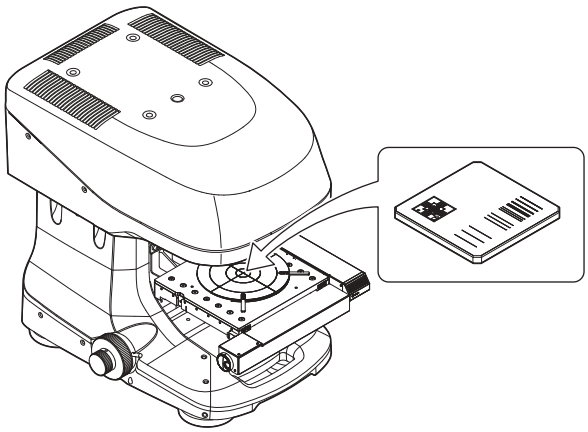
1 **Select the standard objective lens for the operation check on the objective lens view.**

2 **Select [XY Stage Adjustment] from [Maintenance] in the [Settings] menu.**



The [XY Stage Adjustment] dialog box appears.

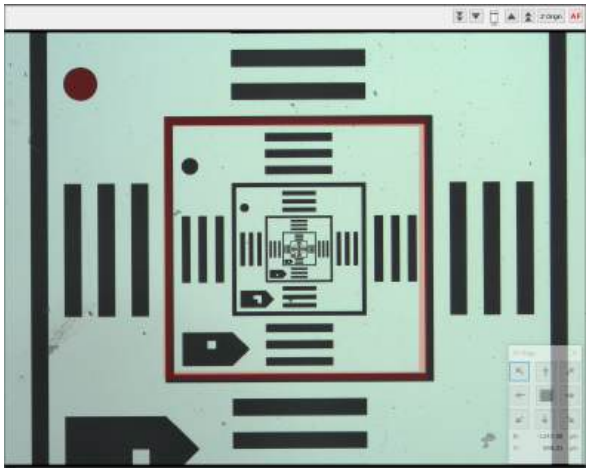
3 **Place a chart for accessory adjustment on the stage plate.**



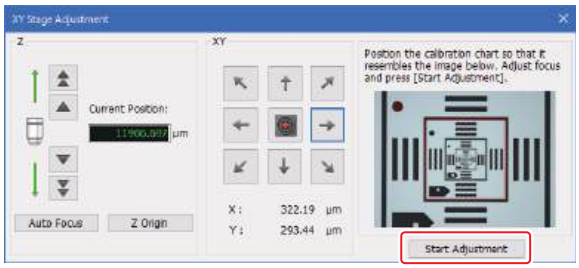
4 **Focus on the chart for adjustment.**

Adjusting Focus (Page 3-3)

5 **Align the chart so that the ○/□ marks on the viewing window and ●/■ marks on the chart match.**



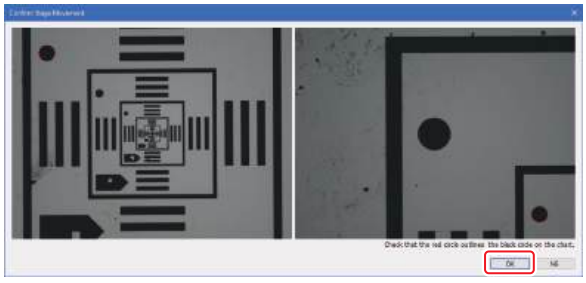
6 **Click the [Start Adjustment] button.**



The motorized XY stage moves and is automatically adjusted.

When the adjustment is finished, the [Confirm Stage Movement] dialog box appears.

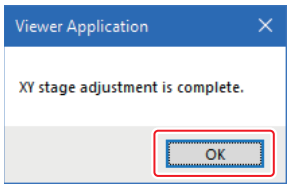
7 **Check whether the motorized XY stage has been adjusted correctly and click the [OK] button.**



Reference If it has not been adjusted correctly, click the [NG] button and repeat steps 4 to 6 to adjust the motorized XY stage.

A confirmation message appears.

8 **Click the [OK] button.**



Adjusting Deviation in Displaying Averaging Setting (Averaging Adjustment)

When [Average Measurement] is set to [2] or more, the averaging adjustment is performed:

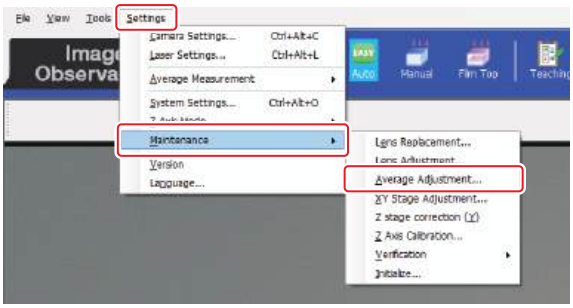
- The positions of the optical image and intensity image are misaligned when displayed.
- When [Resolution] is set to [Super Fine] or [1 Line (1024x1)], or when [Quality] is set to [High Speed] or [Ultra High Speed], the measuring position is misaligned with the optical image when displayed.

Use the glass chart to complete the average adjustment.

Important **It is necessary to perform the average adjustment in a vibration-free environment. Adjustment may fail when performed in a location with vibrations.**

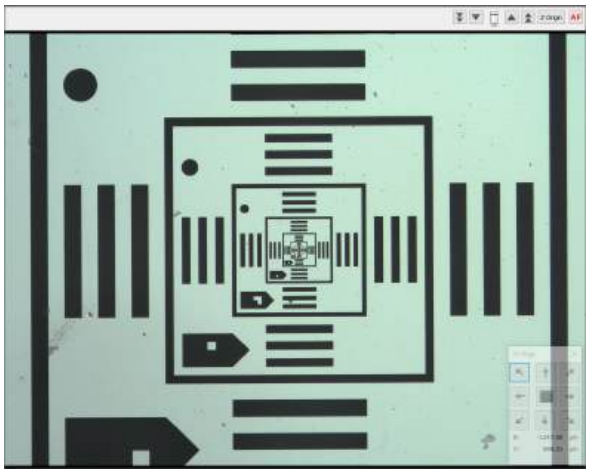
1 **Select the standard objective lens for the operation check on the objective lens view.**

2 **Select [Average Adjustment] from [Maintenance] in the [Settings] menu.**

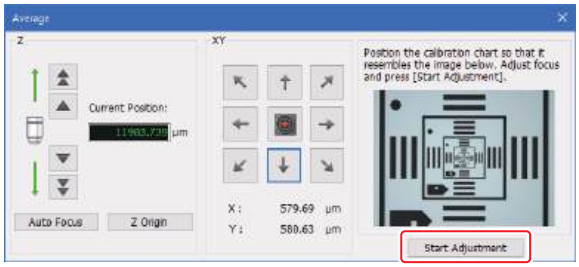


The [Average] dialog box appears.

3 **Set the chart for adjustment in the center of the screen and adjust the focus.**

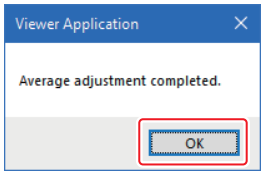


4 **Click the [Start Adjustment] button.**



When adjustment starts, the display switches between the optical image and the intensity image. After adjustment finishes, a confirmation message appears.

5 **Click the [OK] button.**



Appendix

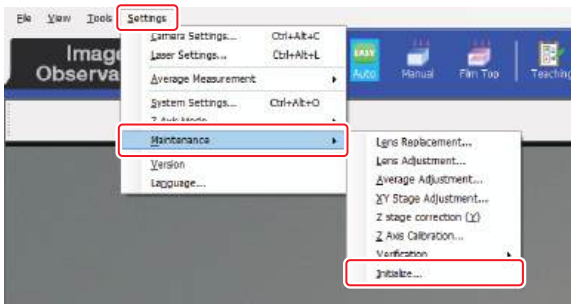
Initializing the Settings

This section describes how to return the settings to the default settings.

Important

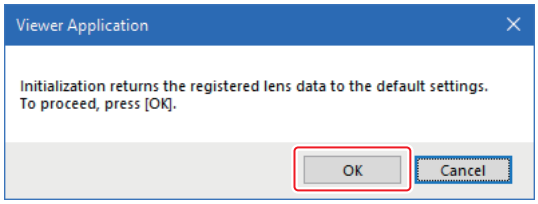
If new lenses have been registered, the new lens information is erased when the settings are initialized.
It is recommended that you save the new lens information to a file before performing initialization.
The saved lens information can be loaded and re-registered after initialization.
"Saving lens information" (Page 11-7)
"Loading Lens Information" (Page 11-7)

1 Select [Initialize] from [Maintenance] in the [Settings] menu.



A message confirming that you want to perform initialization appears.

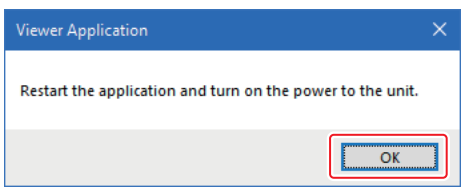
2 Click the [OK] button.



After the settings are initialized, the controller power turns off.

A confirmation message appears.

3 Click the [OK] button.



Exit the Viewer Application.

4 Turn the controller power on and start the Viewer Application.

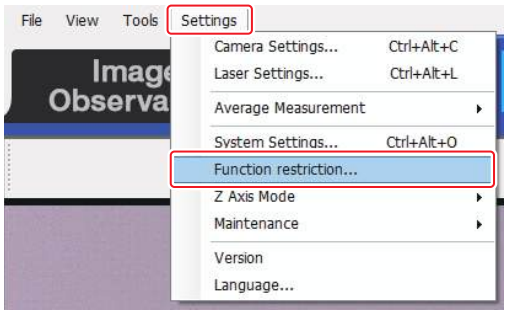
Important

Check that the controller power is completely turned off and then turn the power on.

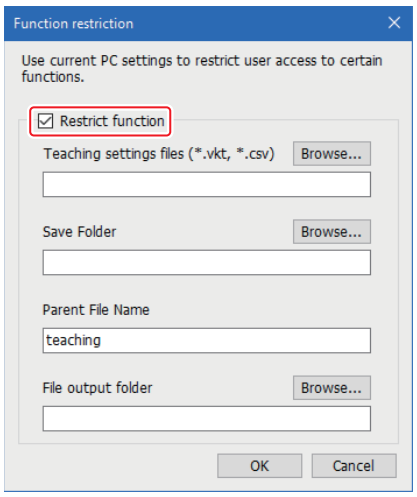
Function restriction

If the access level for the user account on the computer in which the observation application is installed is anything other than administrator privileges, operations other than the specified teaching measurement cannot be performed.

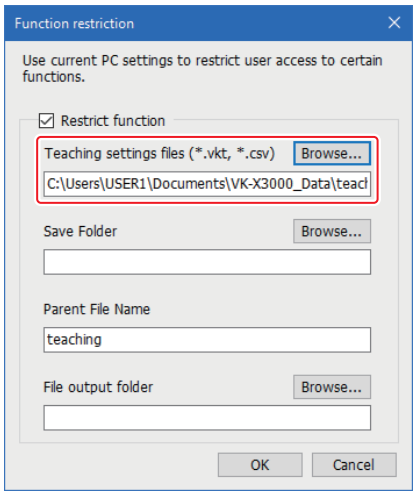
1 **With a user account that has administrator privileges, from the [Settings] menu select [Function restriction].**



2 **Select the [Restrict function] check box.**



3 **Specify the teaching settings file for the specified teaching measurement.**



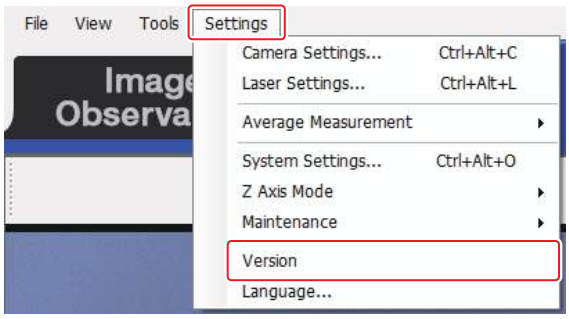
Point

If you logged in with a user account that does not have administrator privileges, the settings menu for which measurement conditions change will be unavailable.

Confirming the Version Information

You can check information about the system version. You should check the version when making inquiries or updating the firmware.

1 Select [Version] from the [Settings] menu.



The [About VK Viewer] dialog box appears.

2 Check the version information.

Viewer Application version

Displays the version of the Viewer Application.

Various versions

Displays the versions of each of the firmware and hardware.

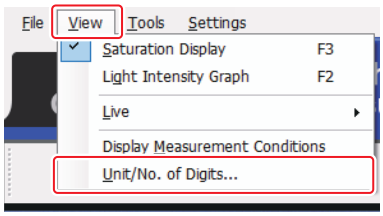
3 Click the [OK] button.

The [About VK Viewer] dialog box closes.

Setting the Display Units and Number of Decimal Places in Numerical Values

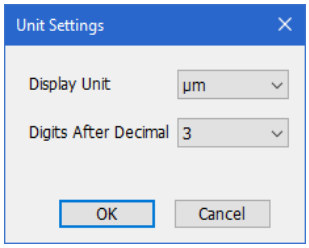
The display units and the number of decimal places for values and data displayed in the Viewer Application can be set.

1 Select [Unit/No. of Digits] from the [View] menu.



The [Unit Settings] dialog box appears.

2 Set the display units and the number of decimal places.



[Display Unit] box

Selects the display units for measured values.

Setting range: mm, µm, nm

[Digits After Decimal] box

Selects the number of decimal places in displayed values.

Setting range: 0, 1, 2, 3, 4

Reference You can only select [4] if you set [Display Unit] to [µm].

3 Click the [OK] button.

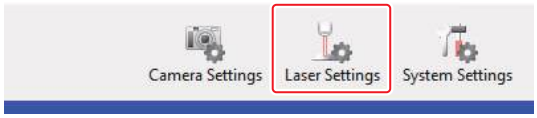
The settings are changed and the [Unit Settings] dialog box closes.

Reference If you click the [Cancel] button, the [Unit Settings] dialog box closes without changing the settings.

Checking the Laser Settings and Life

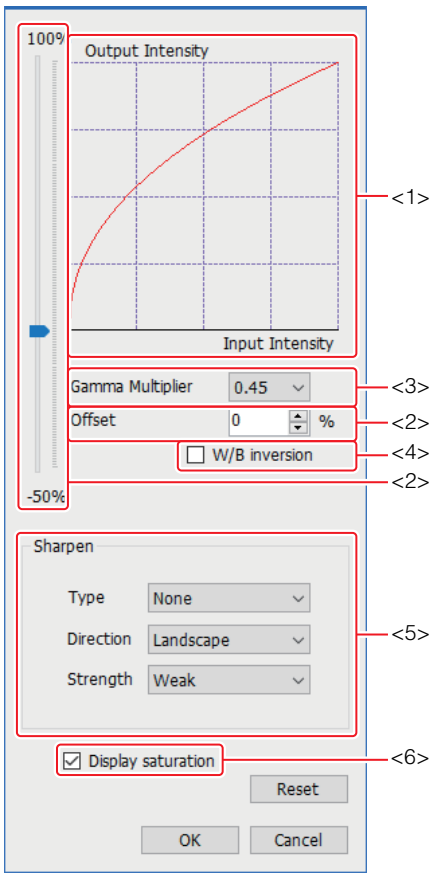
Laser Settings

1 On the toolbar, click the [Laser Settings] button.



The [Laser Settings] dialog box appears.

2 Configure the required settings.



<1> γ correction graph

Shows how to correct the output intensity for the input intensity.

<2> Offset slide bar/[Offset] selection box

Adjusts the contrast over the entire image.

Settings range: -50% to 100%

<3> [Gamma Multiplier] drop-down box

Input the value for the γ correction graph.

Settings range: 0.3 to 1.75

<4> W/B inversion

Selecting this check box can display the black and white of the laser image to be reversed.

<5> Real-time edge enhancement

Execute edge enhancement using the [Type], [Direction], and [Strength] drop-down boxes.

[Type] drop-down box

Selects the type of edge enhancement.

Setting range: Sharpen, Relief

[Direction] drop-down box

Selects the direction to enhance the shade.

Setting range: Horizontal, Vertical

[Strength] drop-down box

Setting range: Weak, Medium, Strong

<6> [Display saturation] check box

Selecting this check box allows you to display areas that are saturated by the laser reflection intensity (areas that receive too much light) in red.

3 Click the [OK] button.

The [Laser Settings] dialog box closes.

Reference

- Click the [Reset] button to restore the settings to their previous values.
- Click the [Cancel] button to close the [Laser Settings] dialog box without applying the settings.

Average Laser Life

The average lifespan of the semiconductor laser units fitted in the VK-X3000 Series are as follows.

Model	Laser	Average life*
VK-X3050	Red laser	Approx. 40,000 hours
VK-X3100	Violet laser	Approx. 6,000 hours

* In a room temperature (25°C) environment

Improving the Laser Life

In the VK-X3000 Series, the following measures have been taken to prevent unnecessary laser deterioration.

- The laser emission time is suppressed to the bare minimum.

  The laser emits light only while scanning.
- The device is equipped with an auto laser off function.

  If a predetermined time elapses with the laser emitting light (when not in use for measurement), the laser turns off.

Reference You can set the time until the laser light turns off. For more information about the settings, see "Lighting" (Page A-13).

Laser Life Warning Function

When the accumulated laser power-on time reaches the estimated life time, a laser life warning message window appears.

Contact your nearest KEYENCE service office.

Important

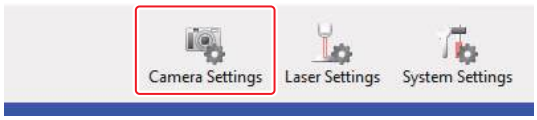
- **If the VK-X3000 Series continues to use a laser that has deteriorated over time, the repeatability and reliability of the measurement data decreases. Measurement may also become impossible without setting the gain to a high value.**
- **The laser can be used for approximately 50 to 100 hours after the laser life warning message window appears, but the accuracy is not guaranteed.**

Reference Once the laser life warning message window has appeared, the laser life warning message window appears whenever the Viewer Application is started.

Adjusting the Camera Settings Brightness

You can adjust the camera brightness.

1 On the toolbar, click the [Camera Settings] button.



The [Camera Settings] screen appears.

2 Adjust the brightness.

<1> Brightness

Select a mode for setting the brightness.

- Auto

  This is a mode for setting the brightness.

  Drag the slider or click [-]/[+] button to adjust the image brightness. The higher the value, the brighter the image.

  Setting range: 1 to 255

  Reference The shutter speed is automatically adjusted to match the brightness setting, and the shutter speed will be changed when the condition of the sample or the illumination is changed.

- Manual

  This is a mode for setting the shutter speed.

  Drag the slider or click the [-]/[+] button to adjust the shutter speed.

  The higher the value, the slower the shutter speed and the brighter the image will be.

  Setting range: 0.1 to 300

  Reference The shutter speed will not change if the conditions of the sample and lighting change.

- Digital gain

  Sets the camera sensitivity when the scan mode is the white light interferometry.

  In the white light interferometry, the brightness of the obtained 3D image may be darker depending on the brightness of the interference stripes.

  When it turns to dark, adjust the brightness of the entire image by adjusting the camera sensitivity.

<2> Sharpen

Sets the strength of the edge enhancement.

You can turn this setting on or off by selecting or clearing the [ON] check box.

Drag the slide bar or click the [-] or [+] buttons to adjust the image outline.

Settings range: 0.0 to 10.0

3 Click the [OK] button.

Changing the Display Language

Select your desired language to be displayed on windows and dialog boxes in the Viewer Application. You can select Japanese, English, German, Chinese (simplified and traditional), or Korean.

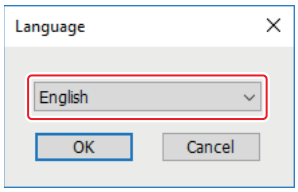
Important

Use the same display language as you are using for Windows for the Viewer Application display language.
If this condition is not met, problems may occur such as jumbled characters, invalid file input and output, and not being able to edit CSV files in Excel. Furthermore, the teaching setting file may not load correctly after changing the language.
For example, if you create the teaching file with the application display language and computer display language set to Japanese and then change the application display language to German, the teaching file that was created in Japanese will not be loadable. The environment that the teaching file is created and used in should be the same.

Setting the Display Language

1 **Select [Language] from the [Settings] menu.**
The [Language] dialog box appears.

2 **Select your desired language from the list.**



3 **Click the [OK] button.**

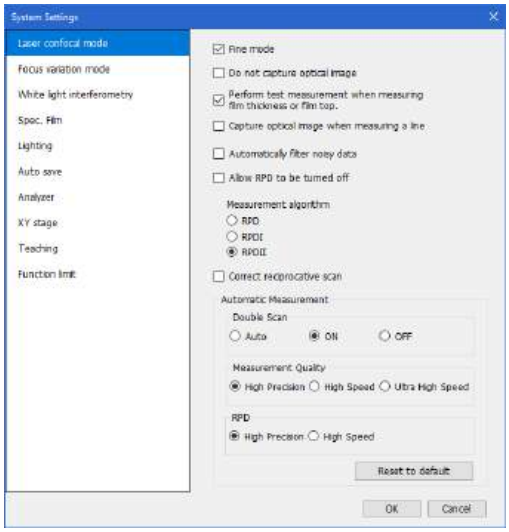
Next time the system is started, the specified language will appear on the screen.

Viewer Application Environment Settings

How to Configure the Environment

1 On the toolbar, click the [System Settings] button.

The [System Settings] dialog box appears.



2 Configure the required settings.

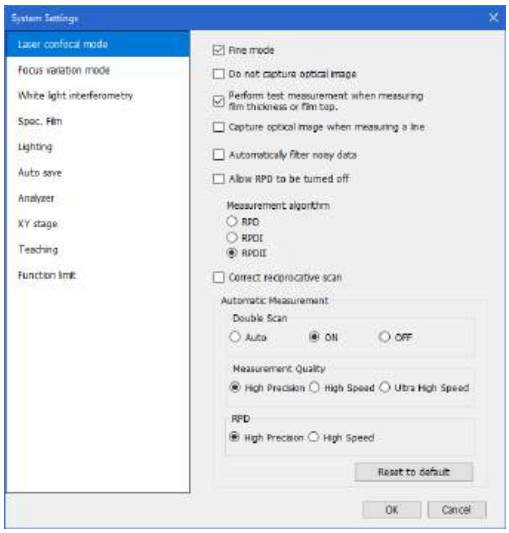
"Description of the Settings" (Page A-10)

Click the [OK] button.

Description of the Settings

Laser confocal mode

This setting is only available when you select laser confocal for the scan mode.



Fine mode

Select the check box to enable fine mode.

Do not capture optical image

Select the check box to not capture color images.

Perform test measurement when measuring film thickness or film top.

Select the check box to preview measurements.

Capture optical image when measuring a line

Select the check box to capture color images at the measurement start position when measuring lines.

Automatically filter noisy data

Select the check box to enable noise region processing.

Allow RPD to be turned off

Select the check box to display RPD check boxes.

Point

- The RPD method cannot be used when "Measurement mode" is [Transparent target (Film thickness)], and [Resolution] is [1 Line (1024 x 1)].
- When the measurement mode is [Transparent target (Top surface)] or [Transparent target (Film thickness)], the selectable measurement pitch is only the precision priority.

Reference

An algorithm to detect the focal point position can be selected.

Normally, the RPD (Real Peak Detection) method is used.

RPD method

This is a method to determine the focal point position from changes in measurement data by calculation. Even if measuring at a rougher pitch (interval) than the peak holding method, the focal point position can be detected more accurately than the peak holding method.

Peak holding method

The peak holding method is the system to detect the position of the objective lens at which the laser reflection returns most intensely as the focal point position, by moving up and down the objective lens at a specified pitch (interval). If measurement is done with fine pitch to increase accuracy, the measurement time becomes longer, and if a rough pitch is used to reduce the measurement time, the focal point position cannot be detected accurately.

- Measurement algorithms

  Select a measurement algorithm for RPD from the [RPD], [RPD I] or [RPD II] radio button.

  - RPD

    A calculation method that suits measurement of targets that have steep shape changes (fast responsiveness of waveform shapes).

  - RPD I

    A calculation method that outputs steep shape changes and intensity changes.

  - RPD II

    A calculation method that reduces noise caused by steep shape changes and intensity changes.

Correct reciprocative scan

Select the check box to correct the reciprocative scan.

Automatic Measurement

Set the automatic measurement related.

- Double Scan

  Select whether to execute the double scan at measurement from the [Auto], [ON], or [OFF] radio button.

- Measurement Quality

  Select the measurement quality at measurement from the [High Precision], [High Speed], or [Ultra High Speed] radio button.

- RPD

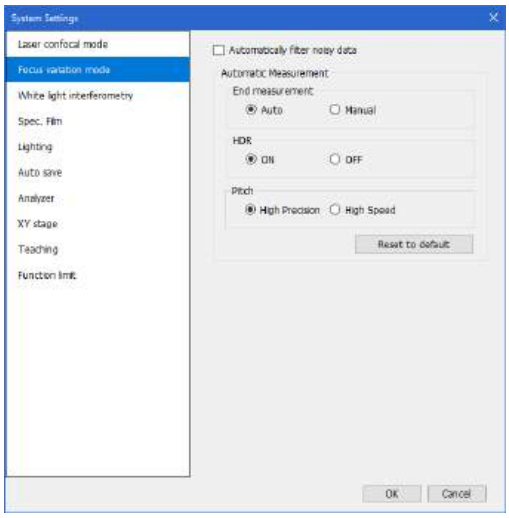
  Select RPD from the [High Precision] or [High Speed] radio button.

- Reset to default

  Click to reset the [Automatic measurement] settings to the default.

Focus variation mode

This setting is only available when you select focus variation for the scan mode.



Automatically filter noisy data

Select the check box to enable noise region processing.

Automatic Measurement

Set the automatic measurement.

- End measurement

  Select the assessment for the end of measurement from the [Auto] or [Manual] radio button.

- HDR

  Select whether to use HDR at measurement.

- Pitch

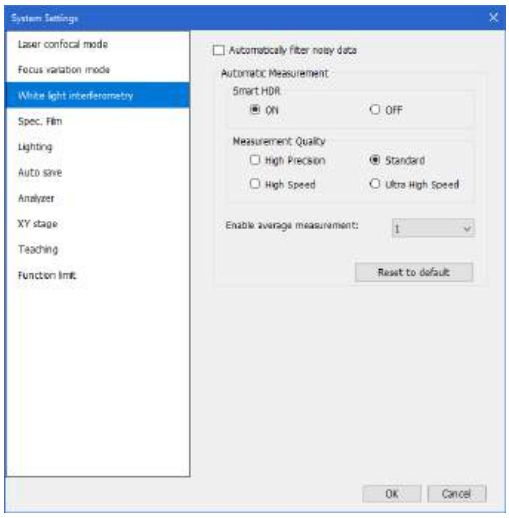
  Select the pitch at measurement from the [High Precision] or [High Speed] radio button.

- Reset to default

  Click to reset the [Automatic Measurement] settings to the default.

White light Interferometry

This setting is when you set the white light interferometry for the scan mode.



Automatically filter noisy data

Select the check box to enable noise region processing.

Automatic Measurement

Set the automatic measurement related.

- Smart HDR

  Select whether to use the smart HDR at measurement.

- Measurement Quality

  Select the measurement quality at measurement from the [High Precision], [Standard], [High Speed], or [Ultra High Speed] radio button.

- Enable average measurement

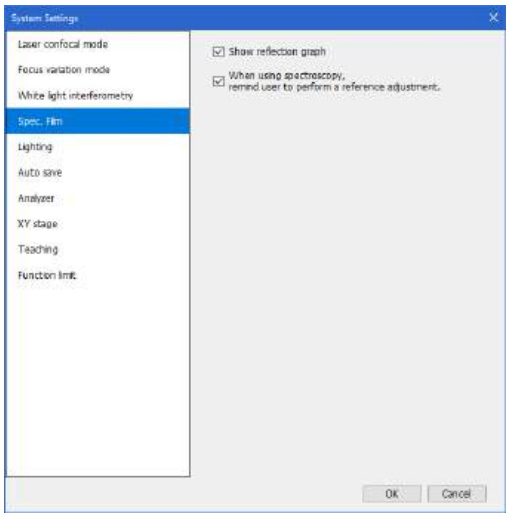
  Select the average intensity for measurement.

- Reset to default

  Click to reset the [Automatic Measurement] settings to the default.

Spec. Film

This is the setting at the spectral film thickness measurement.



Show reflection graph

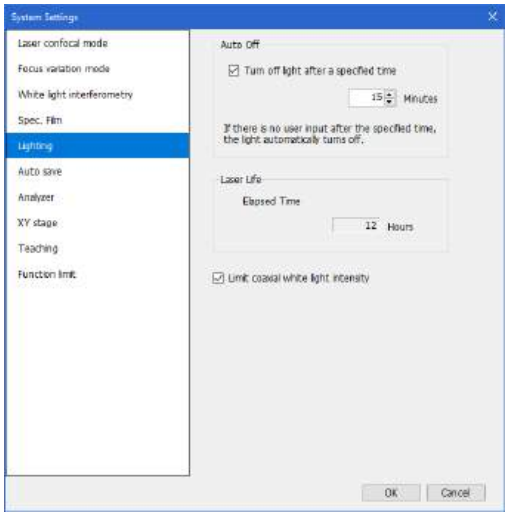
Select the check box to display the reflection graph.

When using spectroscopy, remind user to perform a reference adjustment.

Select the check box to display a message that makes you to perform reference adjustment when connecting the spectroscopy adapter.

Lighting

These are settings for lighting.



Auto Off

Select the [Turn off light after a specified time] check box to automatically turn off the light at the specified time.

Specify the time in the selection box.

Laser Life

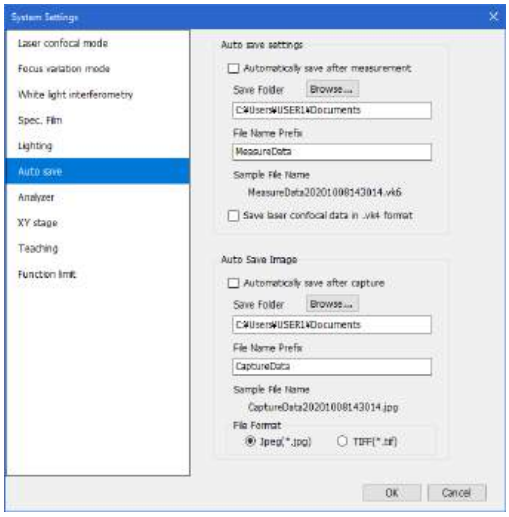
The laser power-on time can be confirmed.

Limit coaxial white light intensity

Select the check box to limit the laser intensity of the coaxial lighting.

Auto save

These are settings for saving data automatically.



Auto save settings

Configure settings for automatically saving shape measurement data.

- Automatically save after measurement
  Select the check box to automatically save measurement results.
- Save Folder
  Specify the save folder by clicking the [Browse] button.
  You can check the save destination in the box below the button.
- File Name Prefix
  Enter the character prefixed to the head of the file name in the auto save.
  The file name in the auto save is [File name prefix] [Date and time of the save (YYYYMMDDhhmmss)].
- Save laser confocal data in .vk4 format
  Select the check box to save data measured in laser confocal mode in vk4 format.

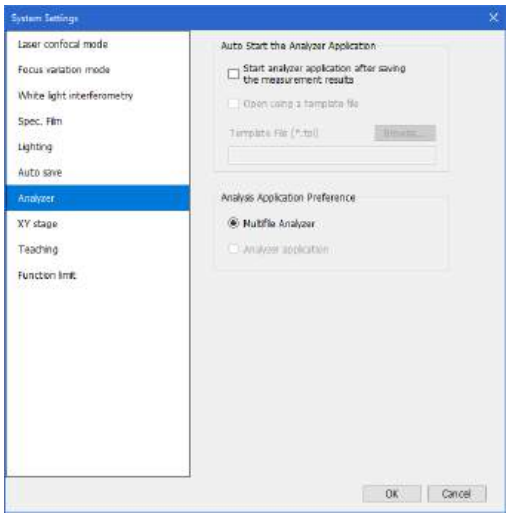
Auto Save Image

Configure settings for automatically saving image observation data.

- Automatically save after capture
  Select the check box to automatically save images when they are captured.
- Save Folder
  Specify the save folder by clicking the [Browse] button.
  You can check the save destination in the box below the button.
- File Name Prefix
  Enter the character prefixed to the head of the file name in the auto save.
  The file name in the auto save is [File name prefix] [Date and time of the save (YYYYMMDDhhmmss)].
- File Format
  Select either JPEG or TIFF as the save format.
  - Jpeg
    Saves data in a compressed form.
  - TIFF
    Save image without compressing data. The image is saved at high quality, but the file size increases and the number of files that can be saved decreases.

Analyzer

These are settings for the analyzer application that is started from the Viewer Application.



Auto Start Analyzer Application

Configure settings for when starting the analyzer application.

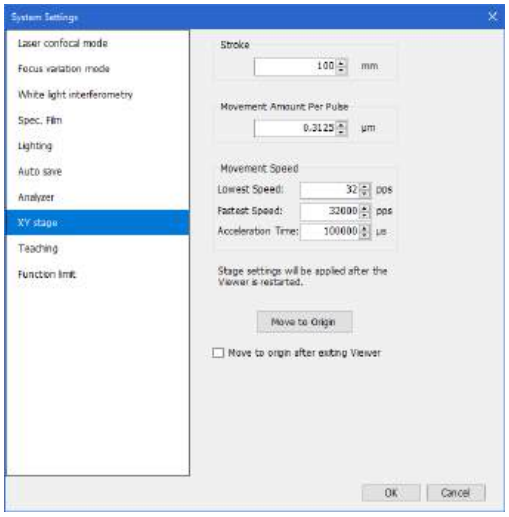
- Start analyzer application after saving the measurement results
  Select the check box to start the analyzer application after saving the shape measurement data.
- Open using a template file
  Select the check box to use a template and start the analyzer application.
- Template File
  Specify the template file that you want to use with the [Browse] button.
  You can check the template file in the box below the button.

Analysis Application Preference

Select the analyzer application that you want to run by selecting [Multifile Analyzer] or [Analyzer application].

XY stage

These are settings for the XY stage.



Stroke

Set the stroke amount for the XY stage.
The default value is 100 mm.

Movement Amount Per Pulse

Set the amount of movement per pulse.
The default value is 0.3125 µm.

Movement Speed

Set the movement speed for the XY stage.

- Lowest Speed
  Set the open speed for the XY stage.
  The default value is 32 pps.
- Fastest Speed
  Set the fastest moving speed.
  The default value is 32,000 pps.
- Acceleration Time
  Set the acceleration time when moving.
  The default value is 100,000 µs.

Move to Origin

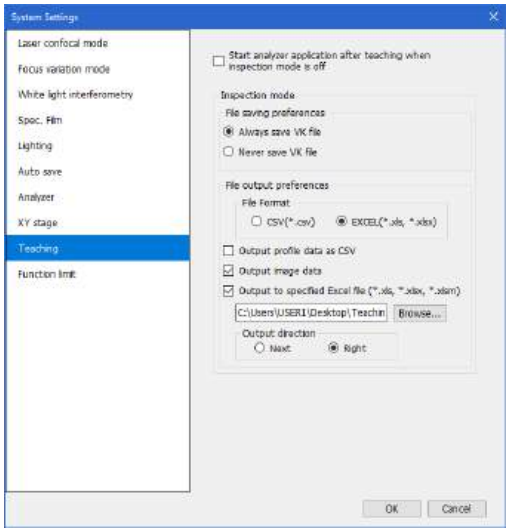
Click this button to set the XY stage origin.

Move to origin after exiting Viewer

Select the check box to return the XY stage to the origin point when exiting the Viewer Application.

Teaching

These are settings for teaching.



Start analyzer application after teaching when inspection mode is off

Select the check box to start Multifile Analyzer automatically after measuring teaching when inspection mode is off, and display the results.

Inspection mode

Perform the setting when executing teaching in the inspection mode.

- File save preferences

  Select whether to save measurement results of teaching from the [Always save VK file] or [Never save VK file] radio button.

- File output preferences
  - Output to specified EXCEL file (*.xls, *.xlsx, *.xlsm)

    Select the check box to output a result to a specified Excel file.

    Select the output method of the result from the [Next] or [Right] radio button.

    Use quick parts to determine the report layout in Excel.

    Create a template so that quick parts that you want to output are put into cells and the required information is automatically output into the desired cells.

    The list of quick parts are shown below.

Output content	Quick parts	Supplementary
Teaching point number	[TeachingNumber]	This refers to the number of a registered point.
File name	[MeasureDataName]	This refers to the file name which was set at the time of saving.
Anal.temp.name	[AnalysisTemplate Name]	This refers to the file name of a saved analysis template.
Measurement name	[AnalysisName]	This refers to the name of a measurement mode.
Main image	[MainImage]	This refers to a color image of depth composition.
Profile graph image	[GraphImage]	This refers to an image of profile lines.
Name of element 1	[Element1Name]	This refers to the name of a measurement line.
Number of element 2	[Element2Number]	This refers to the number of a measurement tool.
Name of element 2	[Element2Name]	This refers to the name of a measurement tool.
Measured value	[MeasureResultValue]	This refers to a measured value.
Unit	[MeasureResultUnit]	This refers to the unit of a measured value.

  - Output image data

    Select the check box to include image data to the output data.

  - Output profile data as CSV

    Select the check box to save the profile graph of the profile measurement automatically to a CSV file.

Troubleshooting

Problem	Possible cause	Remedy
The optical image is not displayed.	Camera is not selected for live display.	Select [Camera] from [Live] in the [View] menu.
	The objective lens is not set correctly on the revolver.	Set the objective lens correctly. "VK-X3000 Series User's Manual"
	The image is not focused.	Adjust the focus. "Adjusting Focus" (Page 3-3) "VK-X3000 Series User's Manual"
	The cable is not connected.	Connect the cable. "VK-X3000 Series User's Manual"
	The cable is broken.	Contact the local sales representatives or the nearest KEYENCE office.
	The lighting is too dark.	Adjust the shutter speed. "Optical Image Brightness and Light Settings" (Page 3-6)
	The USB cable is not connected.	Connect the USB cable. "VK-X3000 Series User's Manual"
	The USB cable is broken.	Replace the USB cable. "VK-X3000 Series User's Manual"
The optical image is not updated.	The optical image is paused.	Click [Back to Live Image] button to cancel pause. "Step 1: Pause" (Page 4-4)
The laser image is not displayed.	The objective lens is not set correctly on the revolver.	Set the objective lens correctly. "VK-X3000 Series User's Manual"
	The cable is not connected.	Connect the cable. "VK-X3000 Series User's Manual"
	The cable is broken.	Replace the cable. "VK-X3000 Series User's Manual"
	The filter selection and brightness adjustment are not correct.	Reselect the filter selection and readjust the brightness. "Laser Brightness Adjustment" (Page 3-8)
	The image is not focused.	Adjust the focus. "Adjusting Focus" (Page 3-3) "VK-X3000 Series User's Manual"

Installation

This section describes the operating environment required to install the Viewer Application and Image Stitching Module (VK-H3J), and white light interferometry module (VK-H3I), and also describes the procedure for installing the software.

Operating Environment

The control PC on which the Viewer Application and Image Stitching Module, and white light interferometry module are installed must satisfy the following requirements.

Operating environment

OS	Windows 10/11 Pro 64-bit version must be pre-installed.
CPU	Intel® Core™ i5-11600 or later
Memory	At least 16 GB
USB port	USB 2.0 x 2, USB 3.0 x 1
Video card	NVIDIA® T400 2GB
Display resolution	1920 x 1080 pixels

▶ Important

- **Log on to the control PC with your user account using administrator privileges.**
- **Set all of the power settings to "None" on the Power Options Properties dialog box for the control PC.**
- **During measurement, the sleep feature of the energy saving function is disabled.**
- **When you perform the sleep operation from the Start Menu, the PC goes into sleep mode even if measurement is in progress. In this case, measurement is interrupted and the measurement result will not be saved.**
- **While the Viewer Application is in use (during telecommunication with the controller), using the Windows sleep feature may result in the controller being disconnected when recovering from sleep mode.**
- **While communicating with the controller, do not put it to sleep or pause.**
  To put the PC into sleep mode or hibernation mode, turn off the controller power.
- **If communications with the controller are disconnected, turn off the power to the controller and turn it on again.**
- **While communicating with the controller, do not disconnect the USB cable.**
- **When using external media like USB device or HDD (Hard Disk Drive) at the same time, connect them to ports attached to a different root hub. If the other USB devices are inserted and removed to and from the same root hub as that of this unit, they all may malfunction.**

Reinstalling the Viewer Application

Place the Viewer Application DVD-ROM into the CD/DVD drive of the control PC and install the application following the on-screen instructions.

Point

- The software must be installed on the Administrator user account on the Windows 10 Pro control PC.
- Uninstall the currently installed application before updating or reinstalling the application.
- If the [User Account Control] dialog box appears when updating or reinstalling the application software, click [Yes].

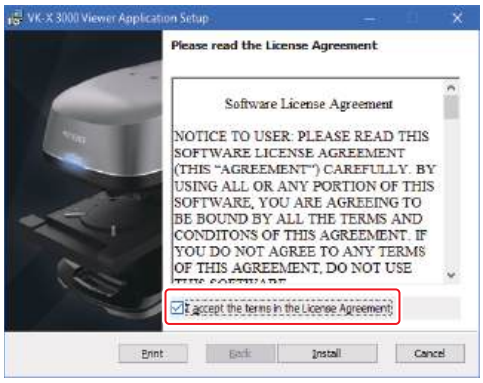
Reference

When the Viewer Application is installed, the USB driver is also installed.

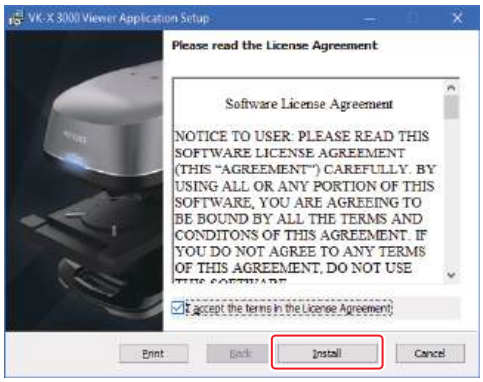
1 **Set the Viewer Application DVD-ROM into the CD/DVD drive mounted on the control PC.**

The installation software starts automatically and the installation wizard window appears.

2 **Read the license agreement and select the [I accept the terms in the License Agreement] check box.**

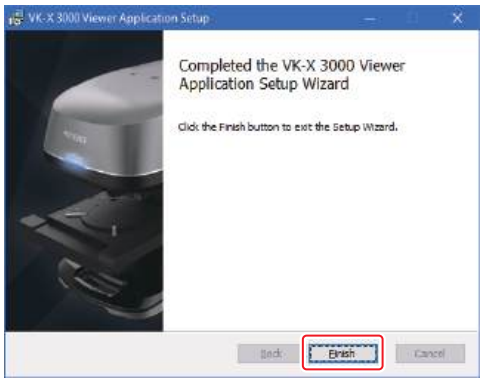


3 **Click the [Install] button.**



The installation starts. After it is completed, a confirmation message appears.

4 **Click the [Finish] button.**



The installation is completed.

Installing the Image Stitching Module

Place the Image Stitching Module CD-ROM into the CD/DVD drive of the control PC and install it following the on-screen instructions.

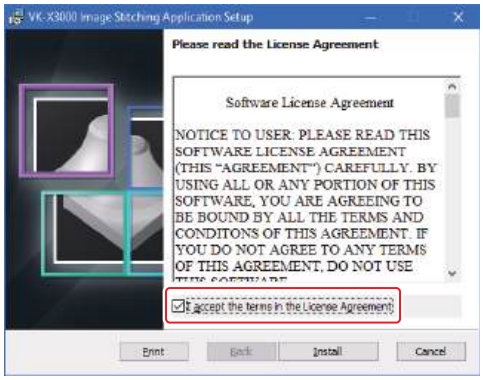
Point

- The software must be installed on the Administrator user account on the Windows 10 Pro control PC.
- Uninstall the currently installed application before updating or reinstalling the application.
- If the [User Account Control] dialog box appears when updating or reinstalling the application software, click [Yes].

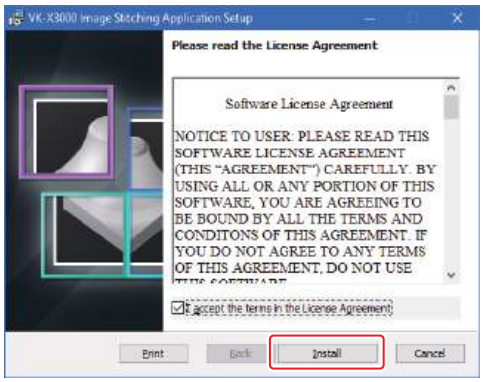
1 Set the Image Stitching Module CD-ROM into the CD/DVD drive mounted on the control PC.

The installation software starts automatically and the installation wizard window appears.

2 Read the license agreement and select the [I accept the terms in the License Agreement] check box.

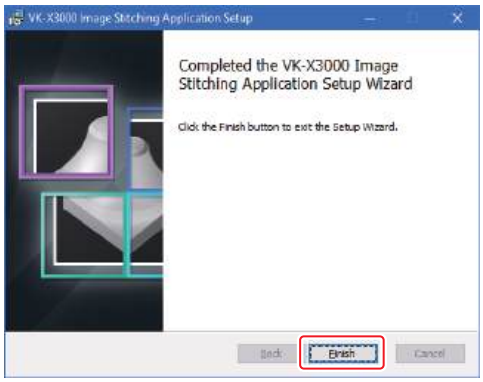


3 Click the [Install] button.



The installation starts. After it is completed, a confirmation message appears.

4 Click the [Finish] button.



Once the first installation (the image stitching function for laser confocal) is completed, the second installation wizard (the image stitching function for focus variation) window appears.

5 Repeat steps 2 to 4.

The installation is completed.

Uninstallation

This section describes the procedure for uninstalling the Viewer Application and Image Stitching Module.

Uninstalling the Viewer Application

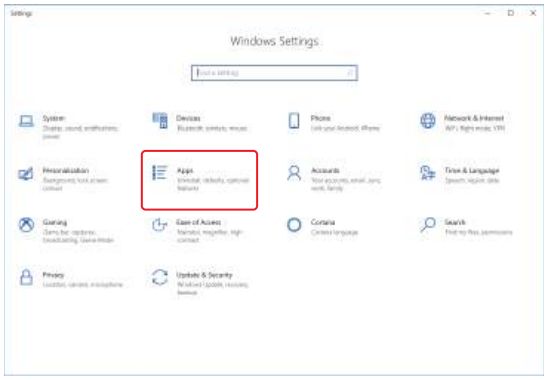
Point

- The software must be installed on the Administrator user account on the Windows 10 Pro control PC.
- If the [User Account Control] dialog box appears when uninstalling the application, click [Yes].

1 On the Windows task bar, select [Settings] from the [Windows] button.

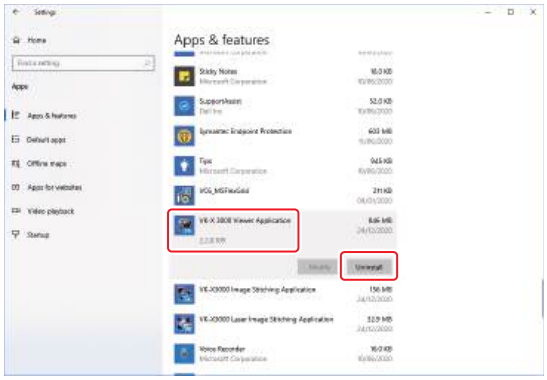
The [Settings] window appears.

2 Click [Apps].

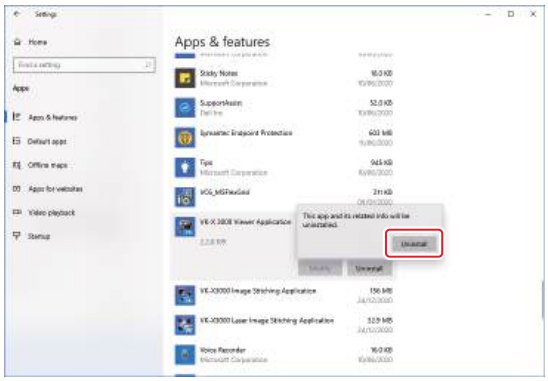


The [Apps & features] window appears.

3 Select [VK-X 3000 Viewer Application] and click [Uninstall].



4 Click the [Uninstall] button.



The Viewer Application is removed.

Point

If a confirmation message to delete shared files appears, click the [Yes] button for all to delete.

Uninstalling the Image Stitching Module

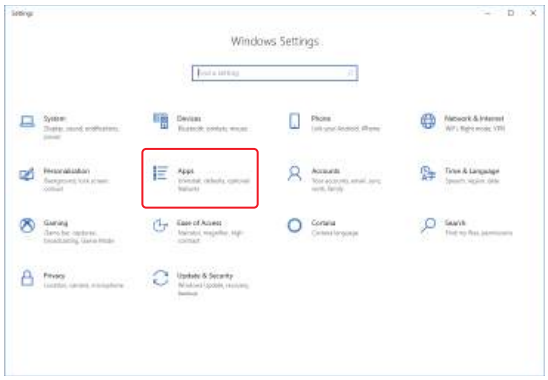
Point

- The software must be uninstalled on the Administrator user account on the Windows 10 Pro control PC.
- If the [User Account Control] dialog box appears when uninstalling the application, click [Yes].

1 On the Windows task bar, select [Settings] from the [Windows] button.

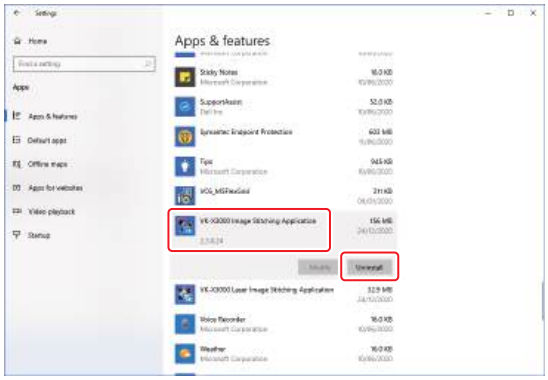
The [Settings] window appears.

2 Click [Apps].

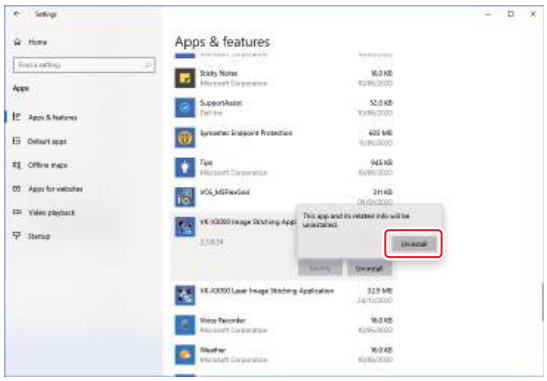


The [Apps & features] window appears.

3 Select [VK-X3000 Image Stitching Application] and click [Uninstall].



4 Click the [Uninstall] button.



The application is removed.

Point

If a confirmation message to delete shared files appears, click the [Yes] button for all to delete.

5 Repeat steps 4 to 5.

The Uninstallation is completed.

Point

The Image Stitching Module for focus variation and laser confocal are installed. If you remove one application, they will both be removed.

A Appendix

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Revision History

Print date	Revision no.	Description
February 2021	Official release	
March 2021	2nd edition	
June 2021	Revised 1st edition	
August 2021	Revised 2nd edition	
May 2024	Revised 3rd edition	

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