KEYENCE

96M16921

Using the VK-X3000 Series for the First Time

3D Surface Profiler

Quick Start Guide

- Teaching Module -

KEYENCE CORPORATION

Introduction

Thank you for your purchase of the VK-X3000 Series 3D Surface Profiler. First, we will introduce basic operation. You can understand basic operation using a common object such as a coin. This manual describes methods using the laser confocal measurement principle.

This manual describes the teaching function of the VK-X3000 Series.
The teaching function is useful for evaluating multiple measurement positions by changing the lens to be used or measurement method or with various measurement conditions.
Teaching can also be used as an inspection mode with the addition of a template file that contains nominal values and tolerances.

● Requirements for the Teaching Operating Environment

To perform teaching, the following operating environment is necessary:

- Image stitching module VK-H3J
- Motorized XY stage

In addition, to perform teaching in the inspection mode, the following operating environment is necessary:

- MultiFile Analyzer Application
- Excel

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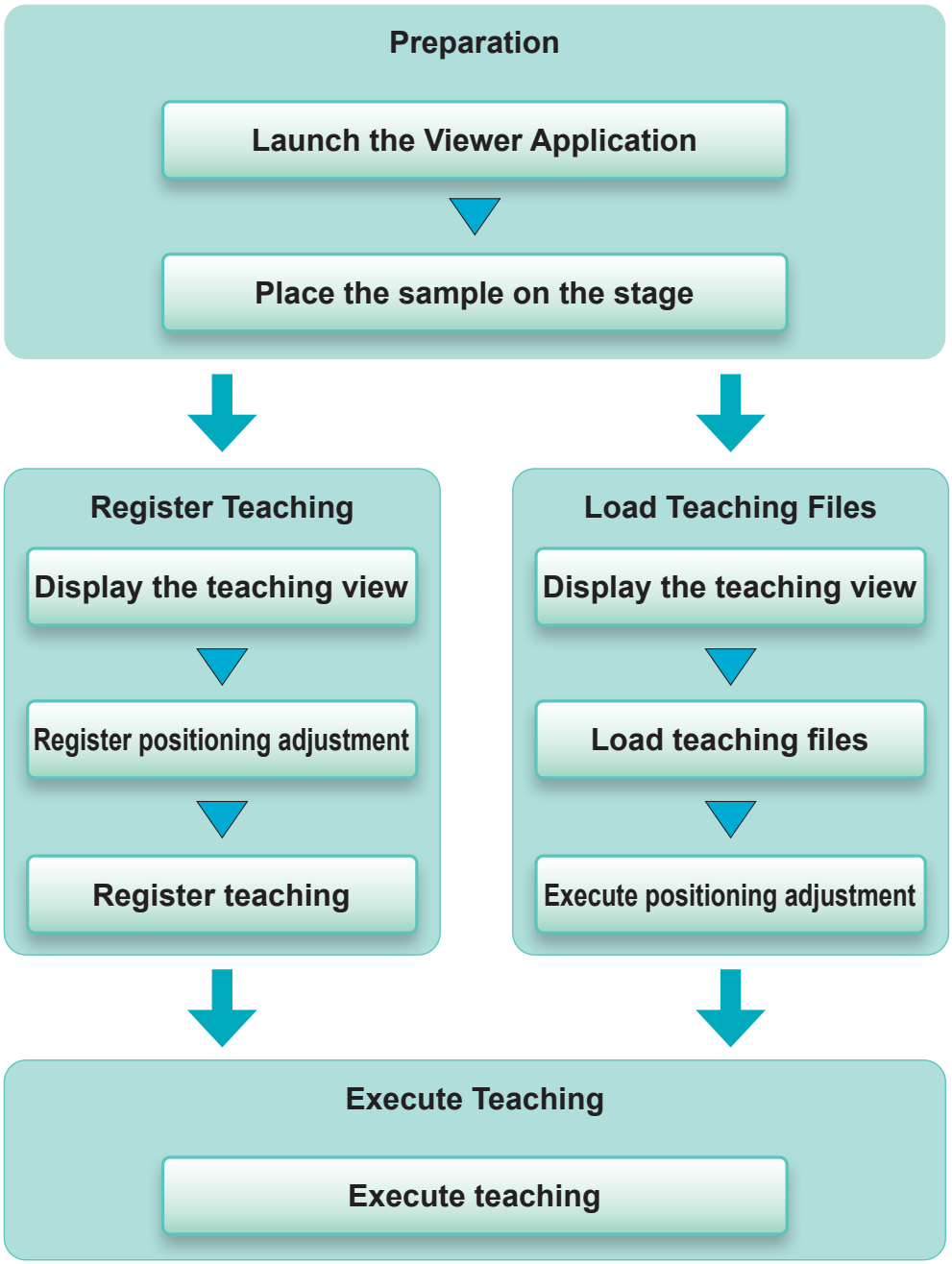
Chapter 1

Before Starting Operation

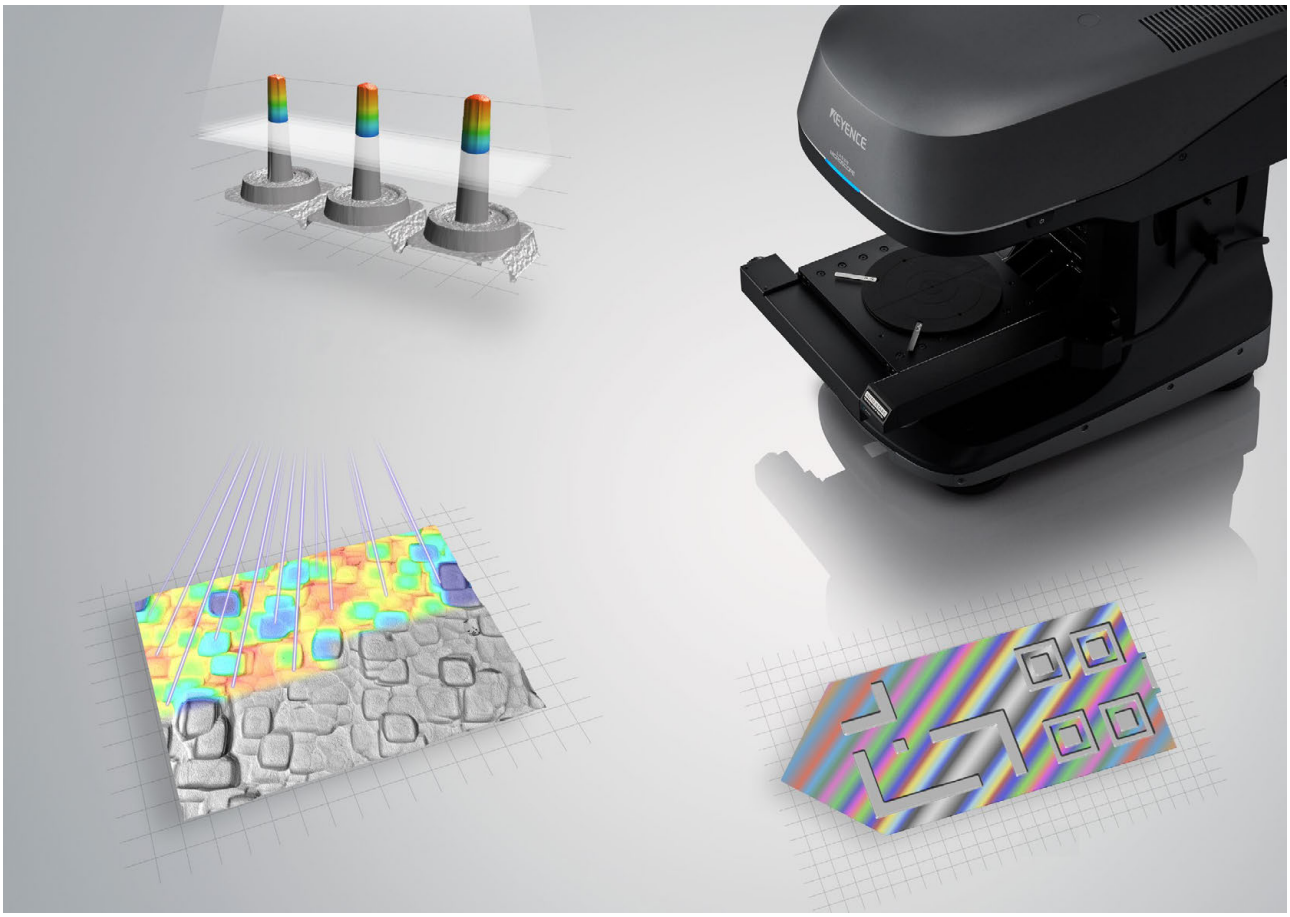
1-1 Understanding the Operation Flow

The operation flow of the teaching function is as follows.



Chapter 2

Registering and Executing Teaching

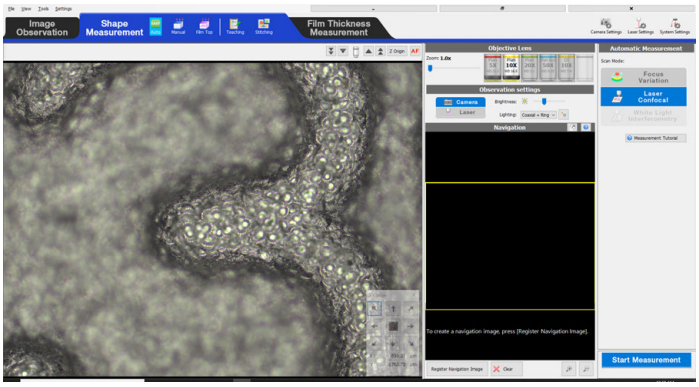


2-1 Displaying the Teaching View

This description begins with the situation in which the Viewer Application has been launched and a sample has been placed on the stage.

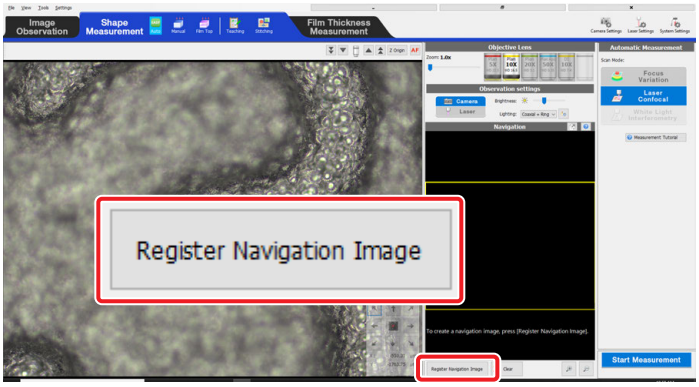
1. Start the Viewer Application, and place the sample on the stage.

Move the sample to the place you want to measure, and adjust the focus.

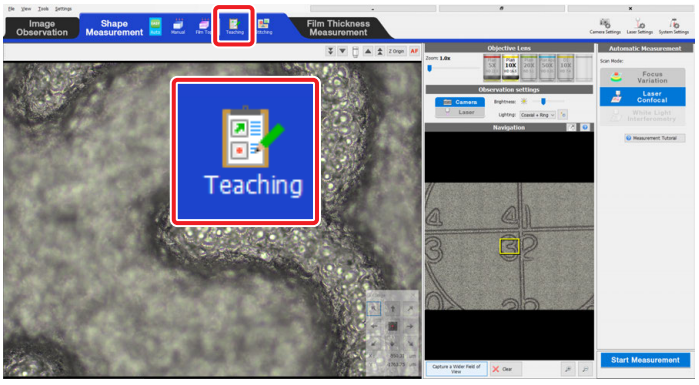


2. Create a navigation image.

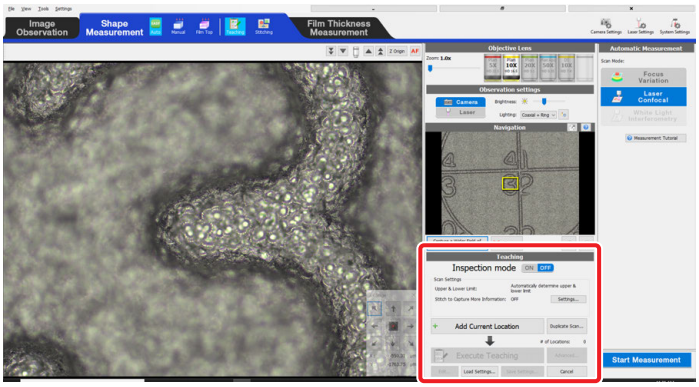
Click the [Register Navigation Image] button.



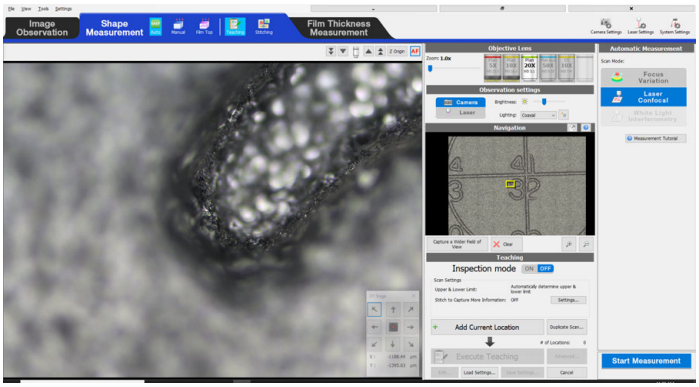
3. Click the [Shape Measurement] or [Film Thickness Measurement] button from [Teaching].



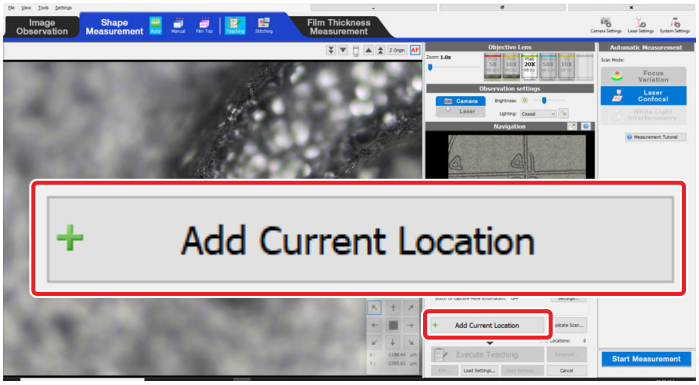
The teaching view appears.



1. **Move the view to the place you want to measure using the XY stage, and adjust the focus by switching to the appropriate lens.**

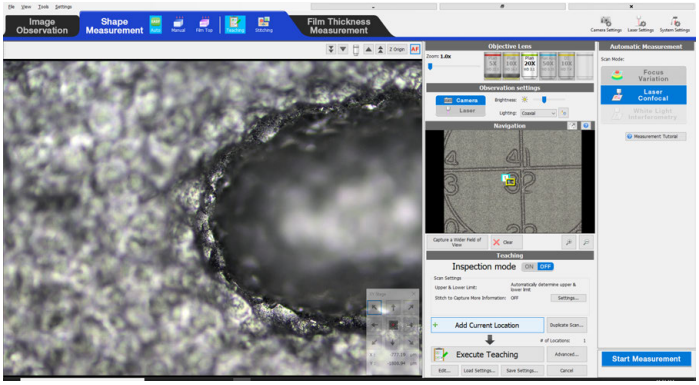


2. **Set the measurement conditions such as the measurement mode, scan mode, and upper and lower limit settings, then click the [Add Current Location] button.**



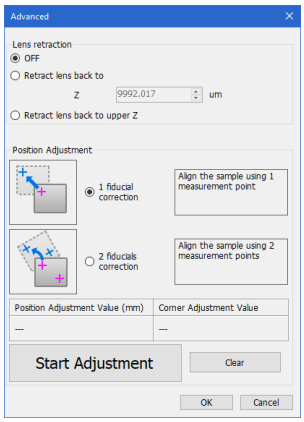
The first measurement position is registered.

3. **Move the view to the place you want to measure next using the XY stage, and adjust the focus by switching to the appropriate lens.**



● To improve the positioning measurement accuracy

The teaching function corrects displacement and tilt of the entire sample. The measurement position, lens magnification, and measurement conditions of the first point registered is the first correction point. The next registered point is the second correction 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.

● About registering teaching

The registration of teaching using the automatic measurement mode (auto setting for measurement conditions) is described as an example this time.

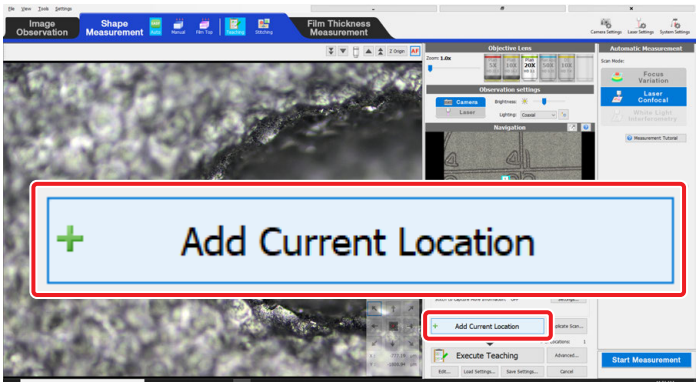
● **Number of Teaching Positions**

You can register up to 3,000 positions for the teaching.

● **About the correction for the measurement position**

When you reposition a sample or measure another sample, the position where the sample is located may be displaced. The position adjustment can be done using the first and second registration locations.

4. Set the measurement conditions such as the measurement mode, scan mode, and upper and lower limit settings, then click the [Add Current Location] button.



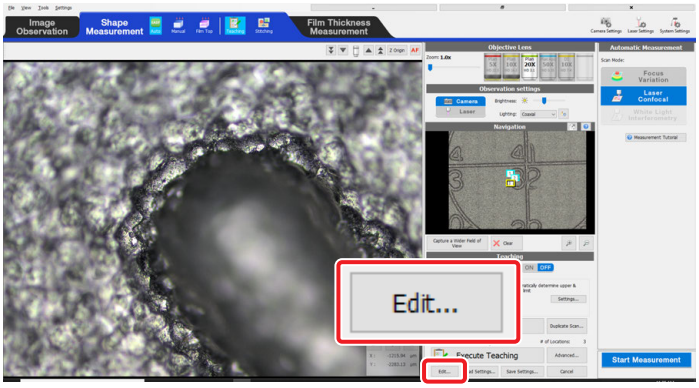
The second measurement position is registered.

For the third position and later, repeat steps 1 to 2 to register all positions.

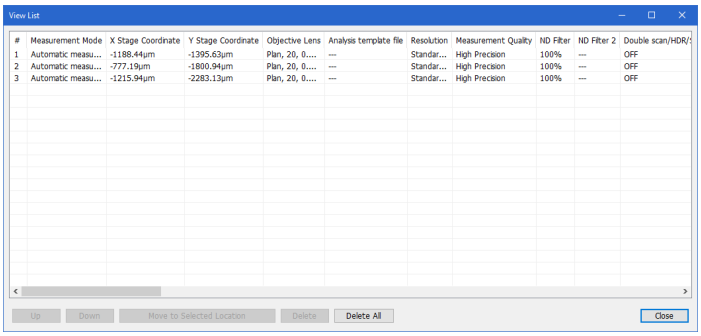
2-3 Editing the Registered Teaching Settings

Check/delete the contents of the registered teaching settings.

1. Click the [Edit] button.



2. Check the registered content.



3. If necessary, delete any registered content.

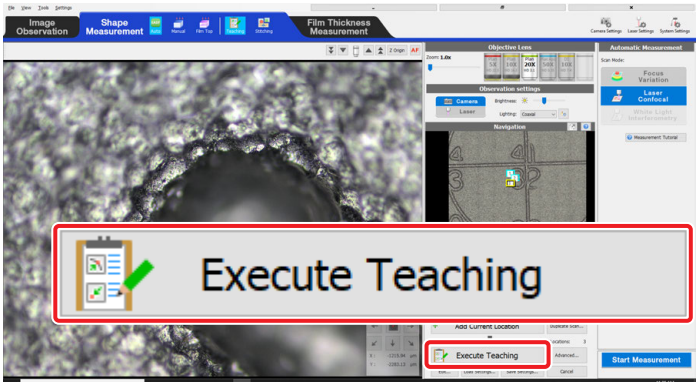
- [Delete] button

  Delete the selected content.
- [Delete All] button

  Delete all of the content.

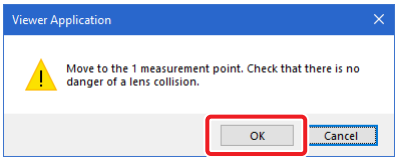
4. Click the [Close] button.

1. Click the [Execute Teaching] button.



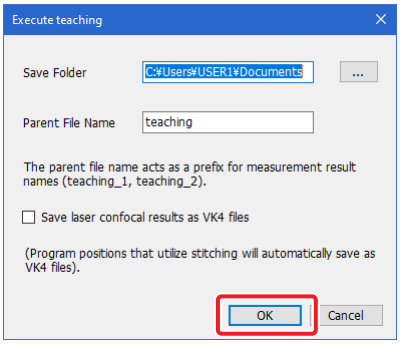
A confirmation message appears.

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.

● In the case of the inspection mode

An analysis result is exported in the Excel format file to the folder specified in “Save folder”.

● Teaching Settings File

With the teaching function, you can save measurement settings in a file so that you can reproduce registered sample measurement positions, lens magnification, measurement conditions, and so on.

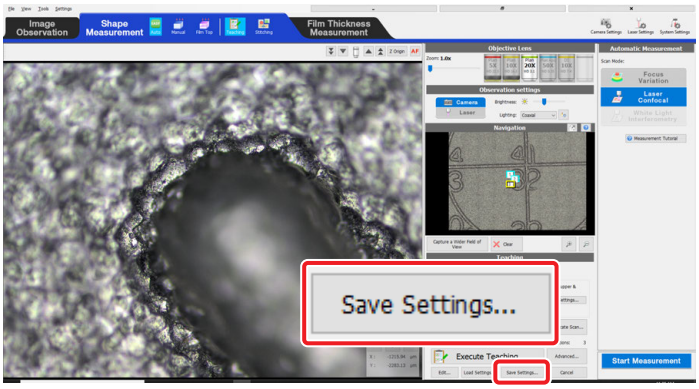
There are two file formats used to save teaching settings.

- 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.

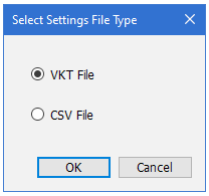
2-5 Saving the Teaching Settings

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] radio button
  Save the file in VKT format. You can also save the screens for position alignment.
- [CSV File] radio button
  Save the file in CSV format. You can edit the data with commercially-available software like MS Excel.

3. Click the [OK] button.

● Teaching Settings File

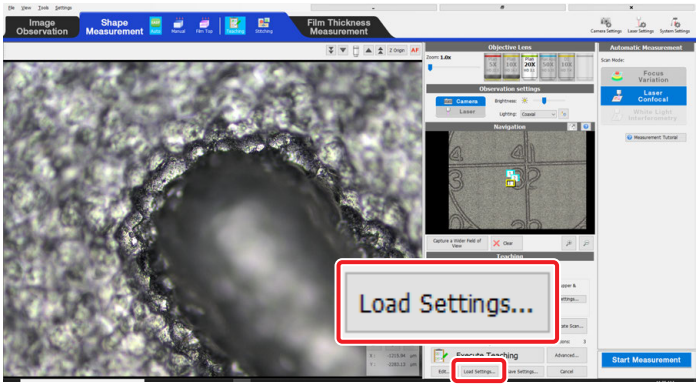
With the teaching function, you can save measurement settings in a file so that you can reproduce registered sample measurement positions, lens magnification, measurement conditions, and so on.
There are two file formats used to save teaching settings.

- 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.

Loading the Teaching Settings

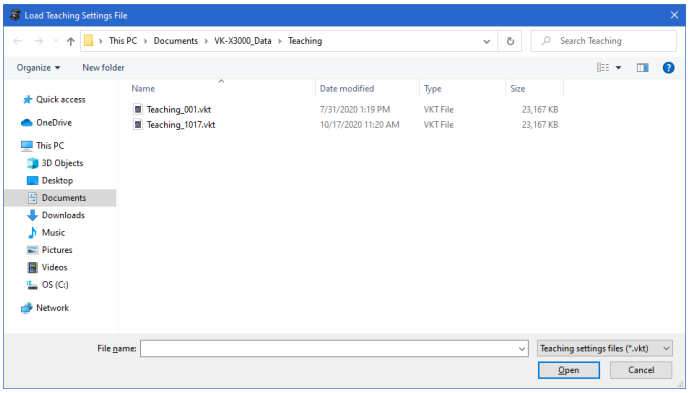
Load the teaching setting files where the measurement contents have been registered.

1. Click the [Import 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 File

With the teaching function, you can save measurement settings in a file so that you can reproduce registered sample measurement positions, lens magnification, measurement conditions, and so on.

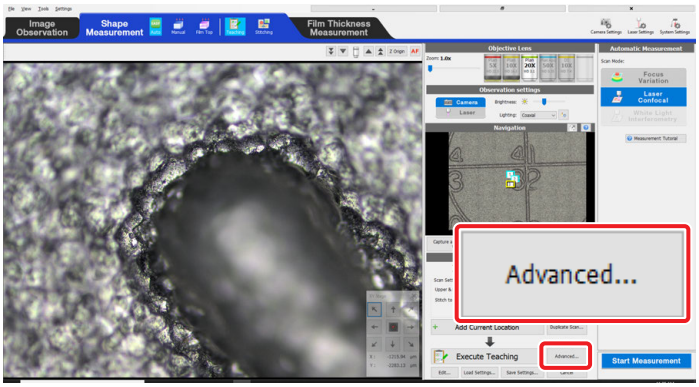
There are two file formats used to save teaching settings.

- 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.

2-7 Correcting the Teaching Settings Position

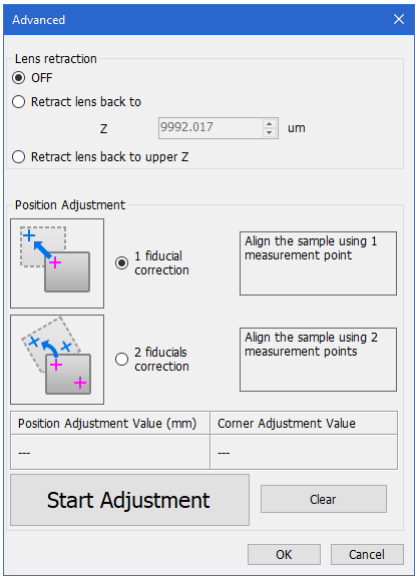
1. Place the measurement sample on the stage.

2. Click the [Advanced] button.



The [Advanced] dialog box appears.

3. Select the method to adjust the position.

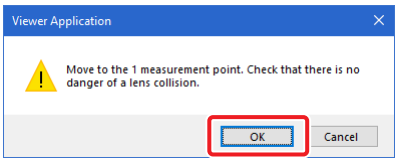


- [1 fiducial correction] radio button
  Align the position of the sample with the first measurement point.
- [2 fiducial correction] radio button
  Align the position of the sample with the first and second measurement points.

4. Click the [Start Adjustment] button.

A confirmation message appears.

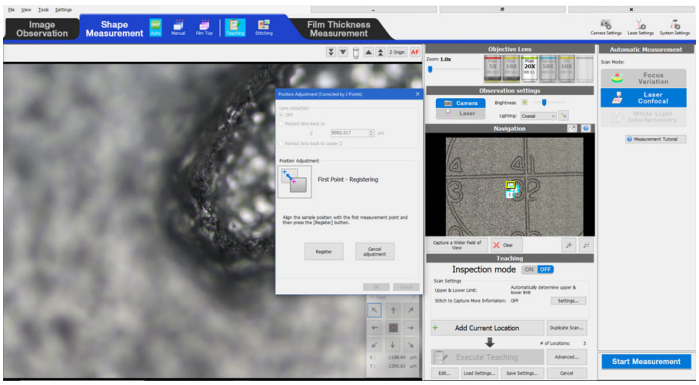
5. Click the [OK] button.



The XY stage moves and auto focus is executed.

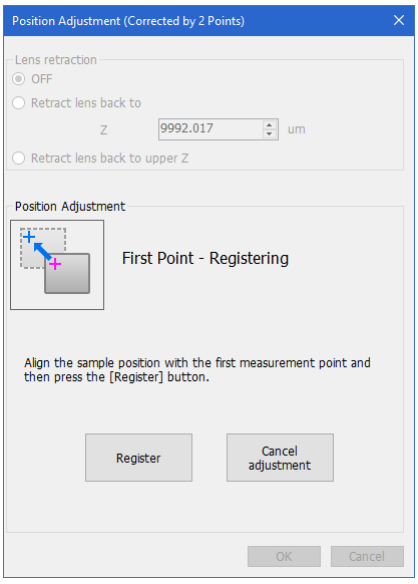
The [Position Adjustment] dialog box appears.

6. Align the positions of the teaching measurement points and sample by moving the stage.



7. Register the correction position of the 1st point.

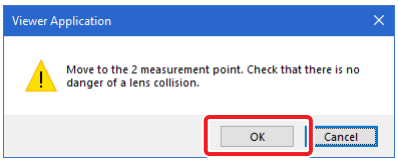
Click the [Register] button.



For 1 fiducial correction, the [Position Adjustment Result] dialog box appears. Proceed to step 11.

For 2 fiducial correction, a confirmation message appears.

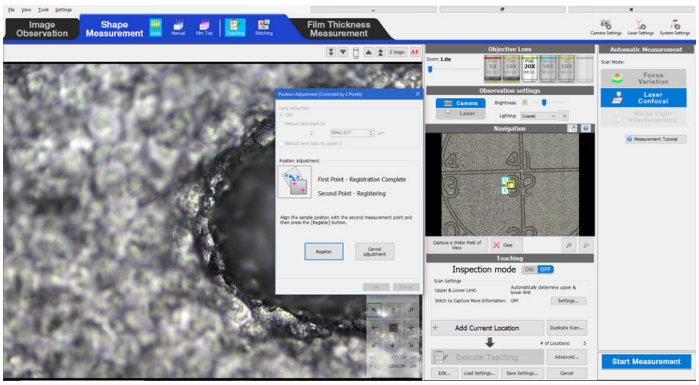
8. Click the [OK] button.



The XY stage moves and auto focus is executed.

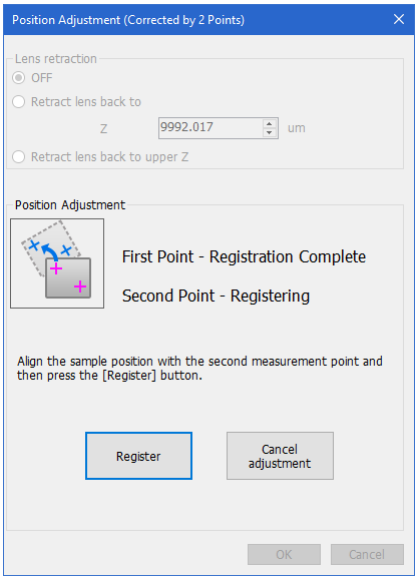
The [Position Adjustment] dialog box appears.

9. Align the positions of the teaching measurement points and sample by moving the stage.



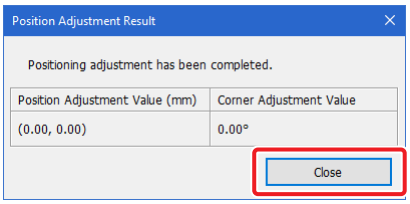
10. Register the correction position of the 2nd point.

Click the [Register] button.

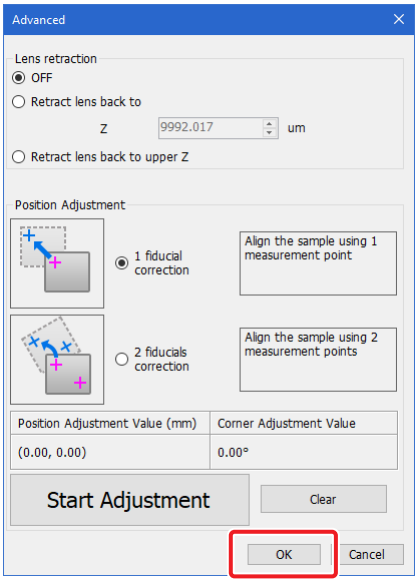


The [Position Adjustment Result] dialog box appears.

11. **Click the [Close] button.**



12. **Click the [OK] button.**



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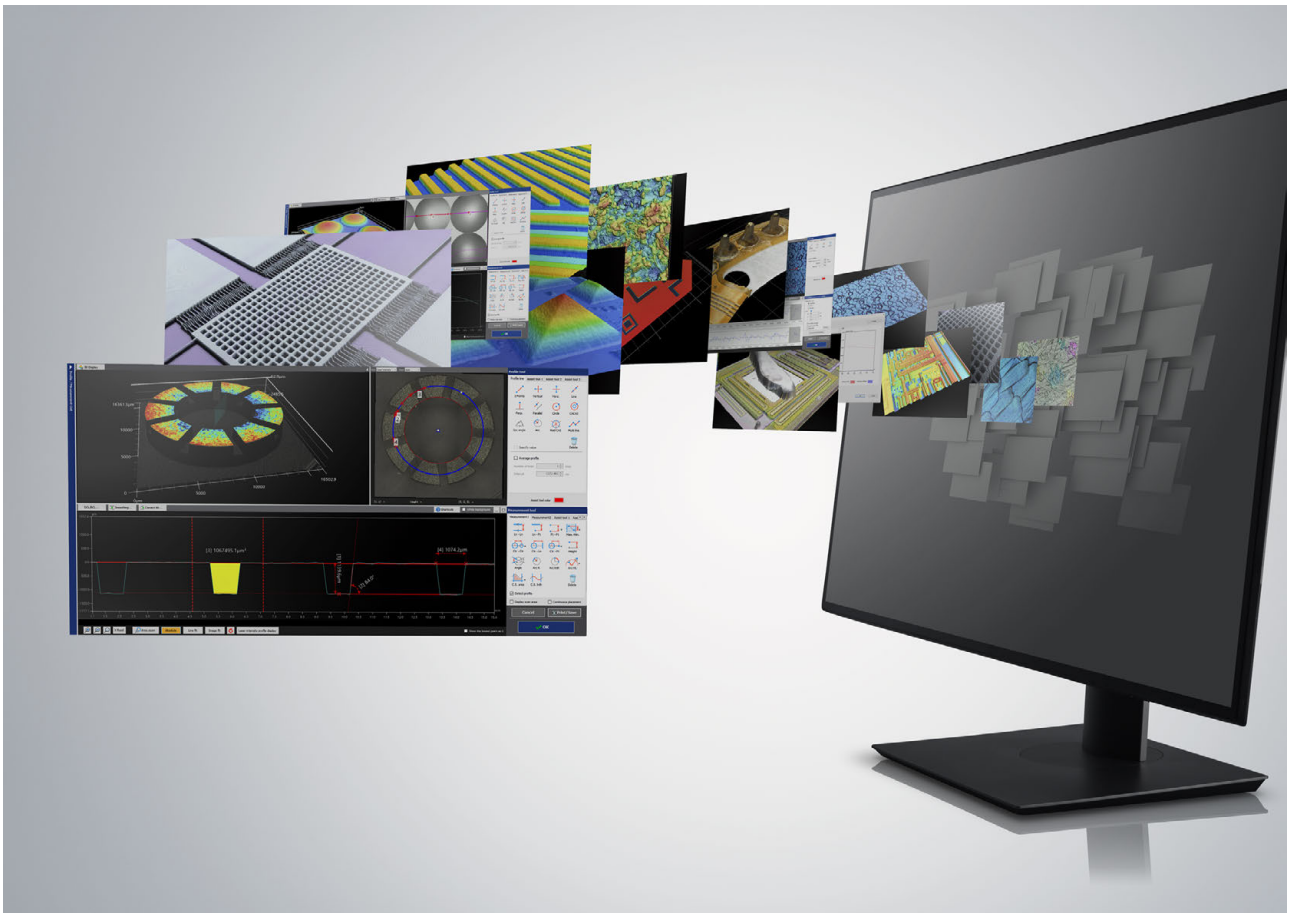
Chapter 3

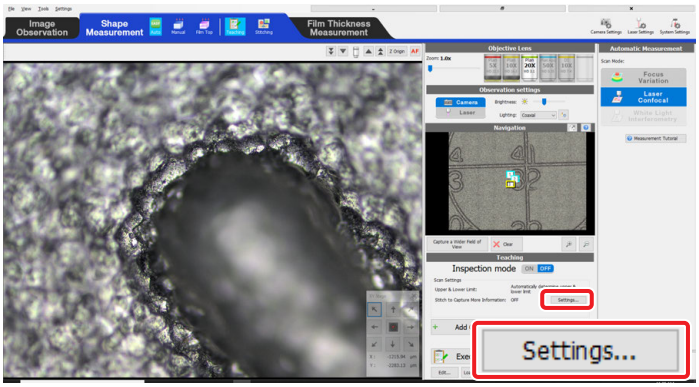
Advanced Settings



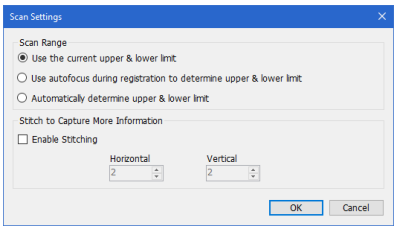
3-1 Combining the Auto Function

The teaching function can be combined with various functions for advanced data acquisition. This section of the guide describes combining teaching with auto max and min settings as well as stitching.

1. Click the [Settings] button.



2. Select setting conditions during execution (auto focus, auto maximum and minimum settings, and others) from [Scan Range].



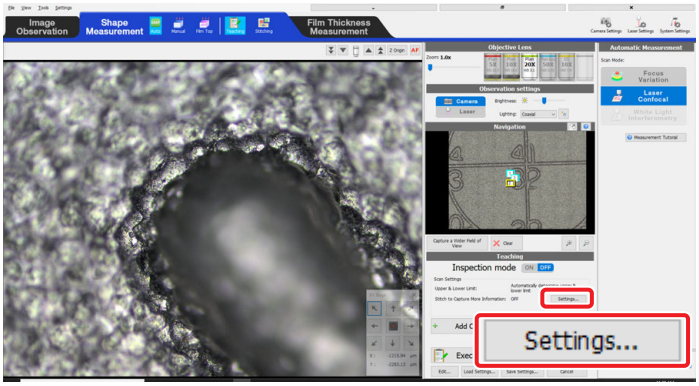
- Use the current upper & lower limit
  Use this to execute maximum and minimum limit settings setting configured by clicking the [Add Current Location] button or [Duplicate Scan] button.
- Use autofocus during registration to detemine upper& lower limit
  Use this to perform the auto focus when clicking the [Add Current Location] or [Duplicate Scan] button, 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.

3. Click the [OK] button.

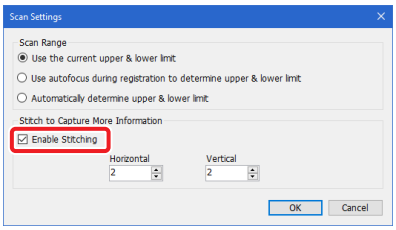
● About the [Scan Range] setting during [Easy mode]

The [Scan Range] setting during [Easy mode] is fixed to “Automatically determine upper & lower limit”.

1. **Click the [Settings] button.**

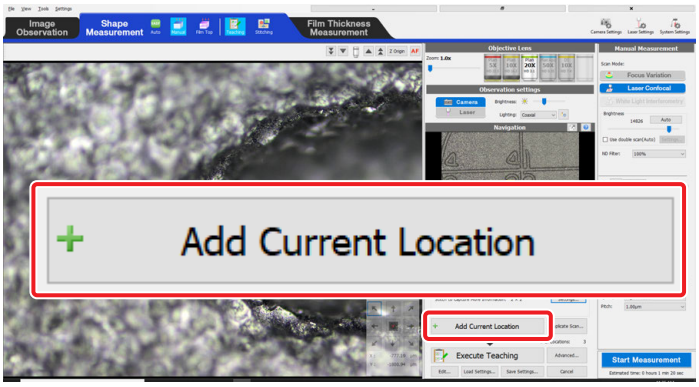


2. **Select the [Stitch to Capture More Information] checkbox to set the number of images to be stitched.**



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).

- **About the number and types of images that can be stitched by [Stitch to Capture More Information]**

The number and types of images that can be stitched are as follows.

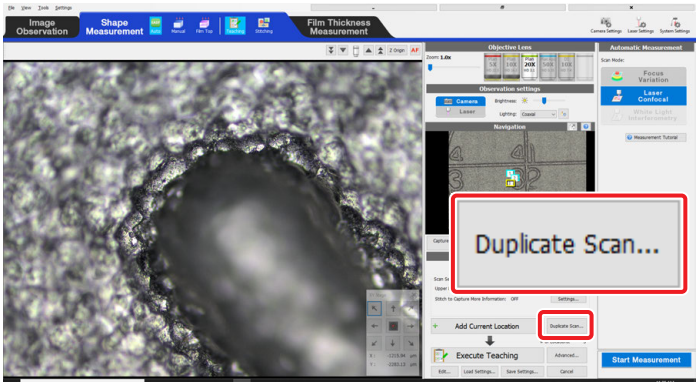
Viewer Application settings		Max. No. of stitching screens (vertical)	Max. No. of stitching screens (horizontal)	Max. layer No. of stitching screens
Measurement mode	Resolution			
Automatic measure-ment	-	100	100	1000(560)*
Manual measure-ment	Standard	100	100	560
	Part 1/12	1	100	100
	Superfine	50	50	100
Film surface measurement	Standard	100	100	560
	Part 1/12	1	100	100
	Superfine	50	50	100
Film thickness measurement	Standard	100	100	560
	Part 1/12	1	100	100
	Superfine	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.

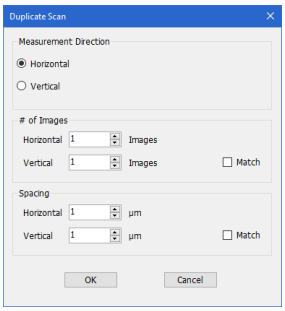
3-3 Combining the Repeat Settings for Teaching

The repeat settings are useful for samples with equally spaced features, such as a BGA.

1. Click the [Duplicate Scan] button.



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].

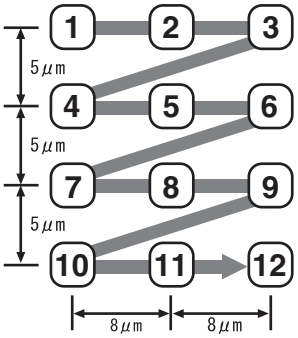
● About the number of images and intervals to be set in [Duplicate Scan]

The number of images and intervals that can be stitched are as follows.

Max. No. of images: 100
Interval settings value: 0 - 9999999
Max. measurement point: 3000

Example)

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 teaching settings will be configured as shown below.



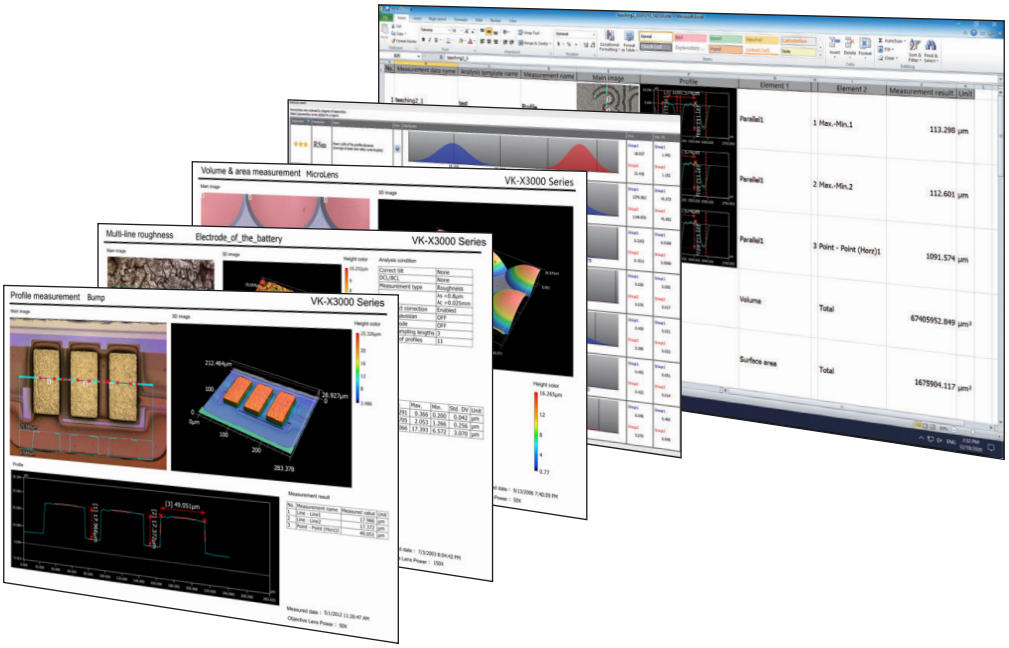
3. Click the [OK] button.

The measurement points are registered in a grid pattern with the number of images and intervals by setting the current stage position as the top left reference.

MEMO

Chapter 4

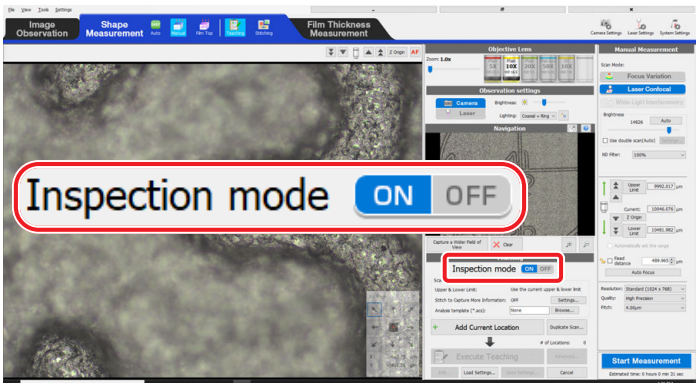
Registering and Executing the Inspection Mode



The inspection mode is a function that performs inspections by using the teaching function and Excel or .csv templates.
The judgment of OK/Fail is not made by the Multifile Analyzer Software, but by the calculation functions of Excel or .csv.
This section describes how to turn ON/OFF the inspection mode, how to create a template, and how to judge OK/Fail.

1. Select the inspection mode.

Click the [ON] button.

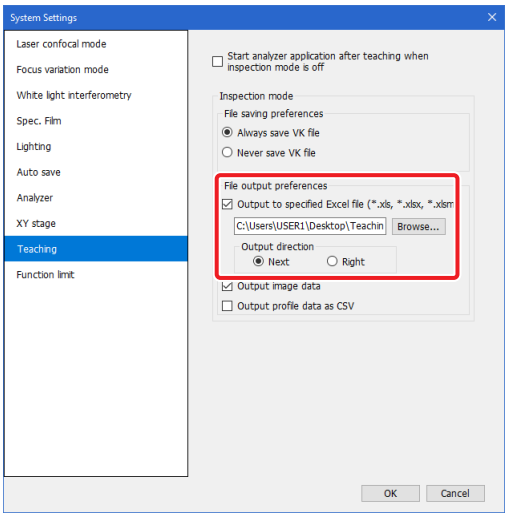


2. Create a template for the inspection.

Use the quick parts to format the layout of the inspection report. Place the quick parts listed below into cells to be output, and create a template so that the necessary information is automatically output from the desired cells.

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	[AnalysisTemplateName]	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.

In [Teaching] of the [System settings] dialog box of the Viewer Application, the output direction (Next or Right) of the report for data can be selected. If output Next, place the quick parts in the topmost cell. The data will be output automatically into the remaining cells.



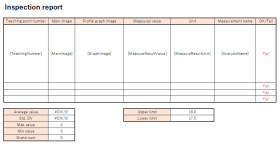
● When the ON/OFF inspection mode option is switched

The teaching settings being used will be discarded.

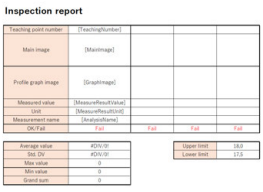
● To use the inspection mode

To use the inspection mode, it is required to create and save an analysis template in which the image processing and analysis contents have been set in advance.
For details, see "VK-X3000 Multifile Analyzer Reference Manual".

● If output Next:



● If output Right:



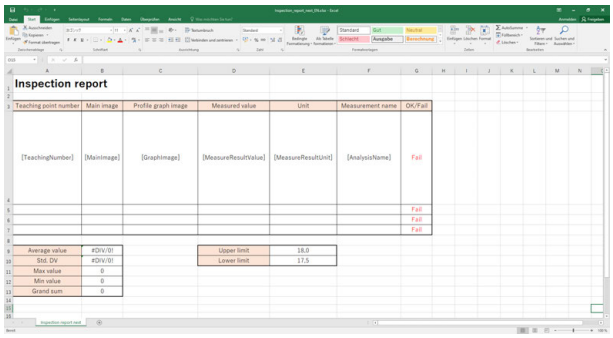
4-1 Before starting the inspection mode

● **Formula to calculate statistical results**

Average value	=AVERAGE(D4:D7)
Standard deviation	=STDEV.P(D4:D7)
Max. value	=MAX(D4:D7)
Min. value	=MIN(D4:D7)
Total	=SUM(D4:D7)

3. Calculate pass/fail judgment and statistical results by using the calculation functions of Excel.

■Formula for pass/fail judgment

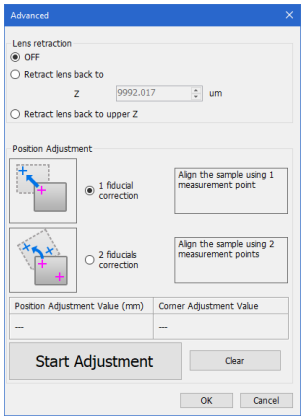


This is the formula for the case where the upper limit is defined in cell E9, whereas the lower limit is defined in cell E10, and the output of measurement values starts from cell D4.
=IF(AND(D4<E9, D4>E10),"OK","Fail")

4-2 Registering the Inspection Settings

● **To improve the positioning measurement accuracy**

The teaching function corrects displacement and tilt of the entire sample. The measurement position, lens magnification, and measurement conditions of the first point registered is the first correction point. The next registered point is the second correction point.

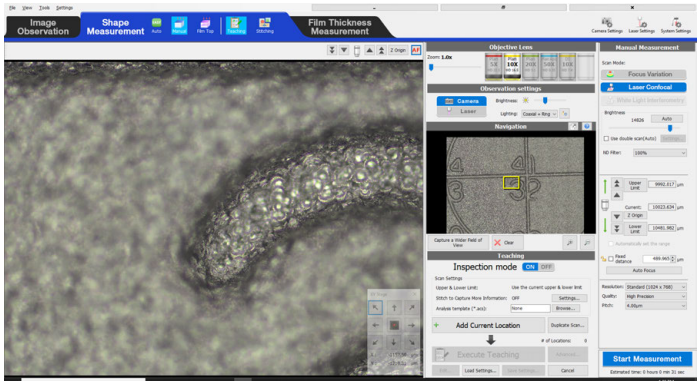


To increase the accuracy of positioning measurements, positioning objects can be set as the first and second points which are not the original measurement points.

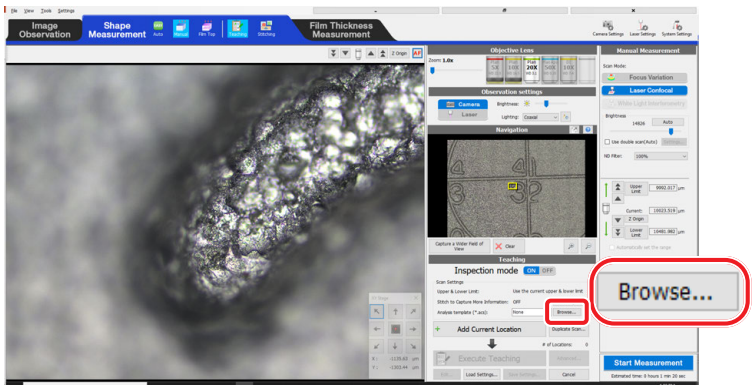
● **About registering the inspection mode**

The registration of the teaching using the automatic measurement mode (auto setting for measurement conditions) is described as an example this time.

1. Move the view to the place you want to measure using the XY stage, and adjust the focus by switching to the appropriate lens.

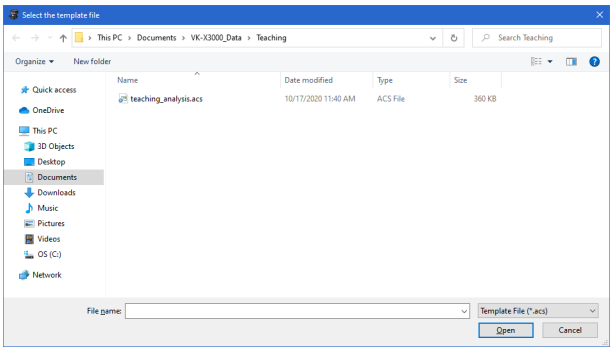


2. Specify the analysis template. Click the [Browse] button, and select the saved analysis template file (.acs).



The [Select the template file] dialog box appears.

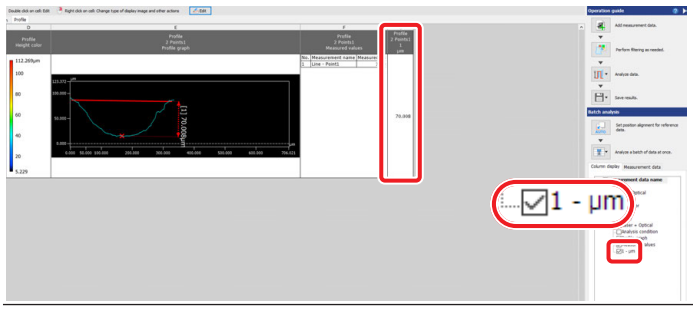
3. Specify the file name, and click the [Open] button.



The analysis template will be loaded.

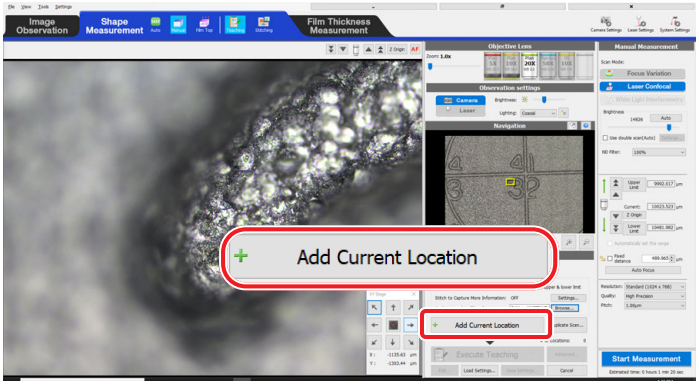
Point

The checkbox of the [Column display] tab must be selected so that the measurement results are exported to the cells in the worksheet to create the analysis template.



Selecting the [Column display] tab adds the each result of the measurement items to each cell of the measurement results.

4. Set the measurement conditions such as the measurement mode, scan mode, and upper and lower limit settings, then click the [Add Current Location] button.

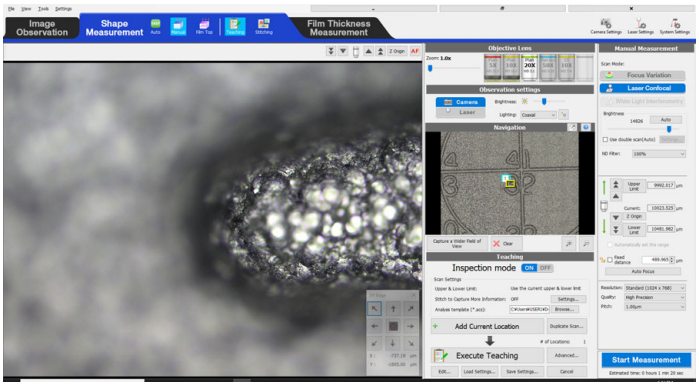


The first correction point is registered.

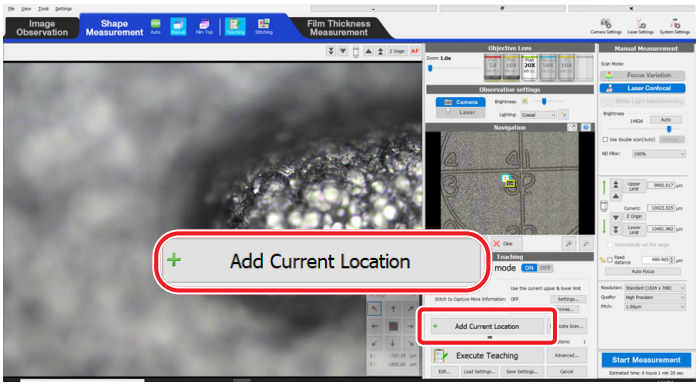
- **Number of Teaching Positions**

You can register up to 3,000 positions for the teaching.

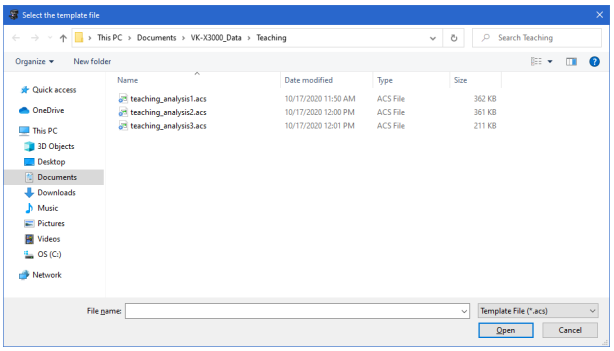
5. **Move the view to the place you want to measure next using the XY stage, and adjust the focus by switching to the appropriate lens.**



6. **Set the measurement conditions such as the measurement mode, scan mode, and upper and lower limit settings, then click the [Add Current Location] button.**



7. **Specify the second analysis template.**



The second measurement position is registered.

For the third position and later, repeat steps 1 to 4 to register all measurement positions and analysis contents.

● **Saving the Inspection mode settings**

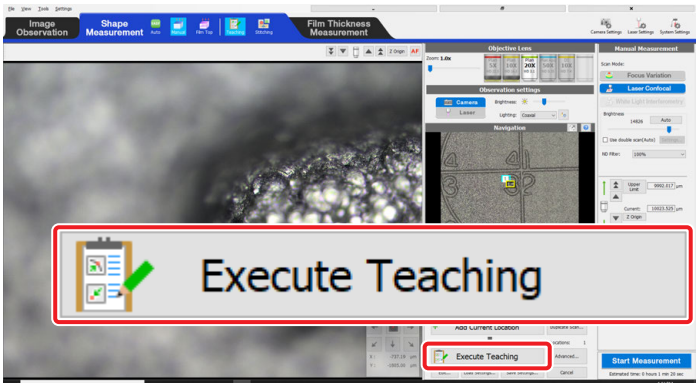
The setting file of the inspection mode can be saved to the file as in the teaching function. In addition, you can reproduce the setting for the inspection mode by loading the setting file.

The method to save and load the setting file is the same operating procedures as that of the teaching function.

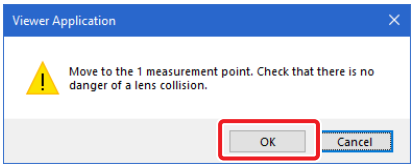
4-3 Executing the Inspection Mode

When executing the inspection mode, the 3D images obtained by the teaching function, and the Excel file of the analysis results from the registered analysis template will be saved in the specified save destination folder.

1. Click the [Execute Teaching] button.

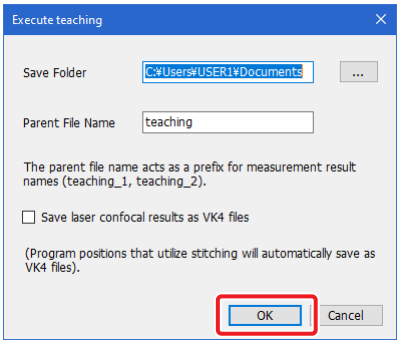


2. Click the [OK] button.



The [Execute teaching] dialog box appears.

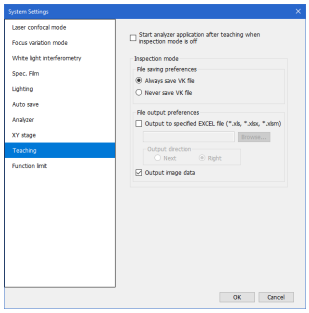
3. Determine the save folder and parent name for the measurement results. Click [OK] button.



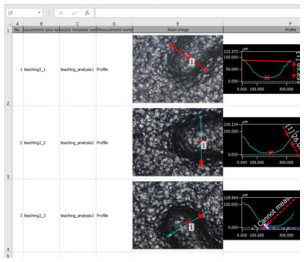
Teaching is executed.

● **Specifying the file export**

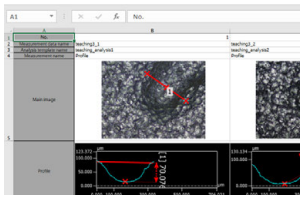
Specifying the export file of the inspection mode can be changed from [System Settings] → [Teaching] → [File output preferences] of the Viewer Application.



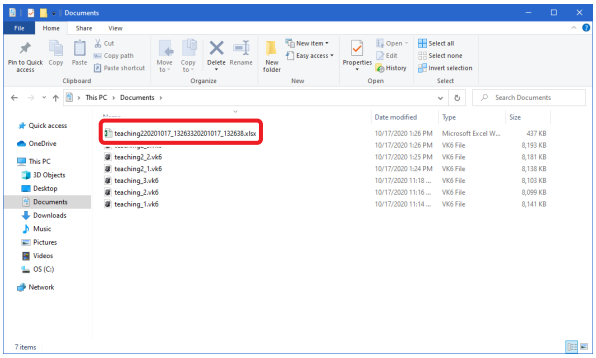
■ Data output direction: in the bottom direction



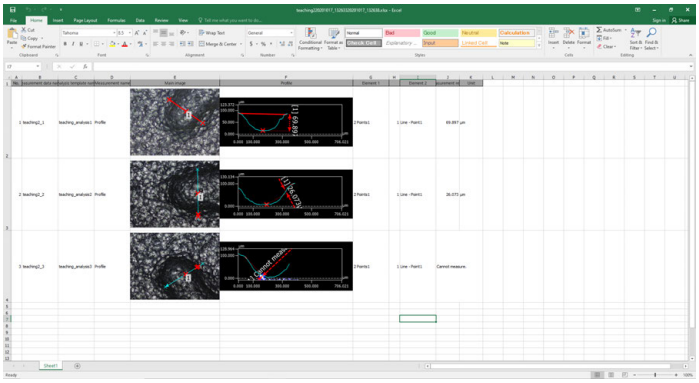
■ Data output direction: in the right direction



4. Checking the folder in which the measurement results was saved finds that the Excel file has been generated.



Inspection mode, an example of measurement results



Specifications are subject to change without notice.

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