

## Digital Microscope VHX-7000

# User's Manual

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







1	Before Using the VHX-7000
2	Installation and Connections
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# Introduction

Read this manual before using the product in order to achieve maximum performance.  
Keep this manual in a safe place after reading it so that it can be used at any time.

## Symbols

In this manual, the following symbols alert you to important messages.  
Be sure to read the messages.

	<b>It indicates a hazardous situation which, if not avoided, will result in death or serious injury.</b>
	<b>It indicates a hazardous situation which, if not avoided, could result in death or serious injury.</b>
	<b>It indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.</b>
	<b>It indicates a situation which, if not avoided, could result in product damage as well as property damage.</b>



Important

**It indicates cautions and limitations that must be followed during operation.**



Point

**It indicates additional information on proper operation.**



Reference

It indicates tips for better understanding or useful information.







It indicates the reference pages and items in this manual.

## Cautions


- (1) Unauthorized reproduction of this manual in whole or part is prohibited.
- (2) The contents of this manual may be changed for improvements without prior notice.
- (3) An utmost effort has been made to ensure the contents of this manual are as complete as possible. If there are any mistakes or questions, please contact a KEYENCE office listed in the back of the manual.
- (4) Regardless of item (3), KEYENCE will not be liable for any effect resulting from the use of this unit.
- (5) Any manuals with missing pages or other paging faults will be replaced.

# Safety information for VHX-7000 Series

## General Precautions


	<ul style="list-style-type: none"> <li>• Do not use this product for the purpose to protect a human body or a part of human body.</li> <li>• This product is not intended for use as explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere.</li> </ul>
	<p>If this product is not used in accordance with the rules set by KEYENCE, the product protection may not function properly.</p>
	<ul style="list-style-type: none"> <li>• You must verify that this product is operating correctly in terms of functionality and performance before the start and the operation of this product.</li> <li>• We recommend that you take substantial safety measures to avoid any damage in the event of an assumed problem occurring.</li> </ul>
	<ul style="list-style-type: none"> <li>• Do not use this product and its accessories in locations where sudden changes in temperature or condensation are likely to occur. Doing so may cause malfunction.</li> <li>• Do not modify this product, or use it in any way other than described in the specification.</li> <li>• When this product is used in combination with other instruments, functions and performance may be degraded, depending on the operating conditions and surrounding environment.</li> <li>• Unplug the AC power cord set if the VHX-7000 will not be used for prolonged periods.</li> </ul>


## Precaution for Abnormalities

	<p>Shut the power off immediately in these instances. Continued use under these conditions may result in fires, electric shock, or product failure. Contact your nearest KEYENCE sales office for repair work.</p> <ul style="list-style-type: none"> <li>• When water or foreign objects enter the instrument.</li> <li>• When you drop the instrument or damage the case.</li> <li>• If you notice smoke or abnormal odor coming from the instrument.</li> </ul>
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# Important Instructions

## Precautions on use


	<ul style="list-style-type: none"> <li>• Be sure to turn the main power switch off when connecting cables or servicing this instrument. Failure to do so may lead to electric shock.</li> <li>• Do not bend the power cable with excessive force, or place it under heavy objects. Doing so may damage the cable and cause fires and electric shock. Do not use if cable is damaged.</li> <li>• Do not insert foreign objects. Doing so may result in fires, electric shock, product failure, and other hazards.</li> <li>• Never remove the case cover. Touching internal parts with your hands may result in electric shock.</li> <li>• The power supply cord set is not provided with the VHX-7000 Series. Use the cord set, which complies with the regulations and standards in the country or the region in which the VHX-7000 Series are used. (In North America, use the cord set, which type of cable is SVT or equivalent, 18AWG or better, rated temperature 90°C or better.)</li> <li>• Do not disassemble or modify the VHX-7000. Doing so may result in fires, electric shock, product failure, and other hazards.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Do not block the air vents on any of the units.</li> <li>• Supply the correct power voltage. Otherwise the VHX-7000 may fail.</li> <li>• Do not stand on the VHX-7000. Doing so may damage it.</li> <li>• Do not place any objects on the VHX-7000. Otherwise the VHX-7000 may fail.</li> <li>• Do not wipe the LCD monitor or the VHX-7000 with thinners or other organic solvents. Doing so may damage the VHX-7000.</li> <li>• If the VHX-7000 becomes dirty wipe with a dry cloth.</li> <li>• Always turn the main power switch off before disconnecting or removing the AC power cord set, camera unit, etc. Otherwise the VHX-7000 may fail.</li> </ul>
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 Important

In the high magnification region, the focal position may shift because of the thermal expansion effects of the object and the monochrome plate.  
If the expansion of the monochrome plate is a problem, use a glass plate instead.

## Precaution at Installing

	<p>When installing the VHX-7000, be sure to connect the protective earthing terminal on the AC power cable to the protective earthing conductor in the building installation. Otherwise, electric shock or product damage may result.</p>
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	<p>To ensure correct and safe operation, the VHX-7000 must be installed in an appropriate location. Doing so may result in fires, electric shock, or product failure. Use the specified voltage. Failure to do so may cause malfunction.</p> <ul style="list-style-type: none"> <li>• ultraviolet rays cause wear on the LCD monitor. Do not use this under direct sunlight or strong ultraviolet rays for prolonged periods of time.</li> <li>• direct vibration or shock.</li> <li>• ambient temperatures outside the range of 5 to 40°C.</li> <li>• ambient humidity outside the range of 35 to 80% RH (no condensation).</li> <li>• sharp temperature changes.</li> <li>• air flow from an air-conditioner vent.</li> <li>• volatile flammable materials and corrosive gases.</li> <li>• large amounts of dust, salts, irons, greasy fumes.</li> <li>• water, oil, and chemicals.</li> <li>• intense magnetic or electric fields.</li> <li>• large voltage fluctuations.</li> </ul>
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## Precaution at Transportation

**NOTICE**

- Be sure to turn the main power switch off before disconnecting or removing cables for transporting.
- Be sure to use packing material specified by KEYENCE for transporting. Otherwise the VHX-7000 may become damaged.

## Precaution at Storage

**NOTICE**

Avoid storing in areas subject to:

- ambient temperatures outside the range of +5 to 40°C.
- ambient humidity outside the range of 35 to 80% RH (no condensation).
- direct sunlight or wind and rain.
- volatile flammable materials and strong corrosive chemicals.
- unstable surfaces where the microscope could fall from.

## Other Precautions

**Point**

- The VHX-7000 uses a hard disk drive (HDD) to store image data and measurement data.
- Data stored on the HDD may become lost if the VHX-7000 fails. Make a backup of the data stored on the HDD regularly. We recommend making backups immediately after acquiring important data.
- KEYENCE provides no warranty for data stored on the HDD when performing repairs. Make a backup of the data before repairing the VHX-7000.

# Safety Precautions on LED Product

The degree of risk of this product is shown below.

Name / Light source	Degree of risk *
High-Performance Camera (Ring light)	Risk Group 1

\* The degrees of risk of LED illuminations are classified as shown below according to IEC 62471.

- Exempt group : Does not pose any photobiological hazard
- Risk group 1 (low risk) : Does not pose a hazard due to normal behavioral limitations on exposure.
- Risk group 2 (moderate risk) : Does not pose a hazard due to the aversion response to very bright light sources or due to thermal discomfort.
- Risk group 3 (high risk) : May pose a hazard even for momentary or brief exposure.

# Precautions on Regulations and Standards

## CE Marking

Keyence Corporation has confirmed that this product complies with the essential requirements of the applicable EU Directive(s), based on the following specifications. Be sure to consider the following specifications when using this product in the Member States of European Union.

### ● EMC Directive

- Applicable Standard : EN61326-1, Class A
- The length of all I/O cables must be less than 30m.

#### Remarks:

These specifications do not give any guarantee that the end-product with this product incorporated complies with the essential requirements of EMC Directive. The manufacturer of the end-product is solely responsible for the compliance on the end-product itself according to EMC Directive.

### ● Machinery Directive

- Applicable Standard : EN ISO 12100  
EN61010-1  
EN IEC 61010-2-120  
EN62471
- Overvoltage category II
- Use this product under pollution degree 2.
- Use this product at the altitude of 2000m or less.
- Indoor use only
- This product is designed as a Class I equipment. Be sure to connect the protective earthing terminal on the AC power cable to the protective earthing conductor in the building installation.
- The Appliance inlet is designed as a disconnecting device. Install this product so that the AC power cable can be removed immediately from the appliance inlet when an abnormality occurs.

## CSA Certificate

This product complies with the following CSA and UL standards and has been certified by CSA.

- Applicable Standard : CAN/CSA C22.2 No.61010-1  
UL61010-1

Be sure to consider the following specifications when using this product as a product certified by CSA.

- Overvoltage category II
- Use this product under pollution degree 2.
- Use this product at the altitude of 2000m or less.
- Indoor use only
- This product is designed as a Class I equipment. Be sure to connect the protective earthing terminal on the AC power cable to the protective earthing conductor in the building installation.
- The Appliance inlet is designed as a disconnecting device. Install this product so that the AC power cable can be removed immediately from the appliance inlet when an abnormality occurs.

## FCC Regulations

This product complies with the following regulations specified by the FCC.

- Applicable Standard : FCC Part 15 Subpart B ClassA

#### Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### ● FCC CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Best Management Practice for Perchlorate Materials - California only

This product uses components containing perchlorate material. When you ship this product or your end-product installing this product to California, you must label or mark the following statement on the exterior of all outer shipping packages and on consumer packages or you must include the following statement in an instruction manual or MSDS accompanied with the product.

"Perchlorate Material – special handling may apply, See [www.dtsc.ca.gov/hazardouswaste/perchlorate](http://www.dtsc.ca.gov/hazardouswaste/perchlorate)."

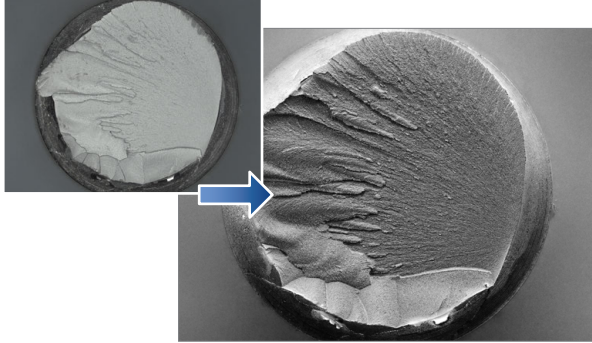
# Feature of VHX-7000

## Additional Features for Improved Observation

### Clear observation of subtle flaws

Use the "Optical Shadow Effect Mode" function. This function allows the user to draw surface details that otherwise could not be seen.

[screw fracture surface (30x)]

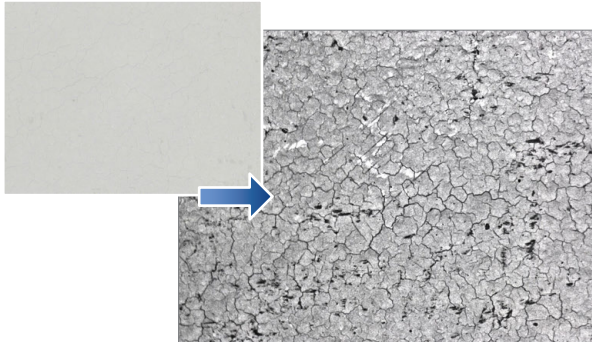


For details, refer to □ "Optical Shadow Effect Mode" (Page 8-2).

### Low contrast parts can be seen accurately

Use the "HDR" function. This function allows the user to see details on parts with low levels of contrast.

[Inkjet paper (300x)]

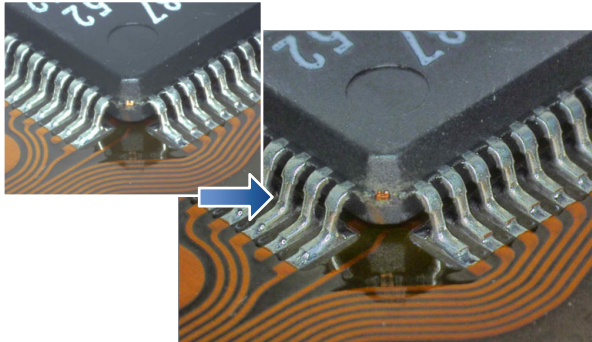


For details, refer to □ "Increase Resolution (HDR)" (Page 8-8).

### Glare of the highly reflective surfaces can be removed

Use the "Glare removal" function. This function allows the user to minimize the glare on reflective components.

[Solder (50x)]

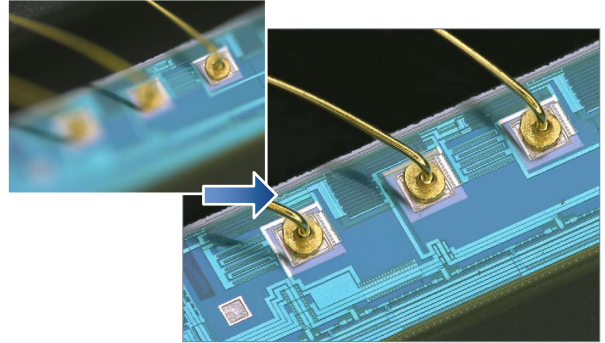


For details, refer to □ "Removing Glare (Reflected light Removal)" (Page 8-6).

### Observe parts completely in focus even if the parts have significant height variation

Use the "Depth Composition" function. Fully focused images can be displayed.

[Wire bonding (300x)]

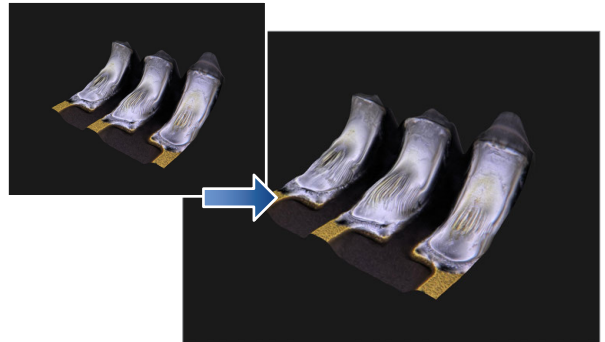


For details, refer to □ "Types and Features of Depth Composition" (Page 9-2).

### The true shape of an object can be understood fully

Use the "3D Display" function. This function allows the user to confirm 3D images.

[HDD head connection (1000x)]

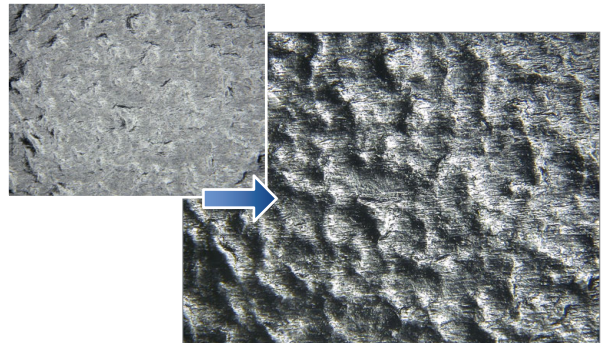


For details, refer to □ "3D MENU" (Page 9-14).

### Surface features can be accentuated for inspection

Use the "Multi-lighting]"function. The function can change the lighting angle to enhance flaws. The function also allows you to check the image and change the lighting angle after capture.

[Grain of resin (250x)]



For details, refer to □ "Changing Illumination Direction (Multi-lighting)" (Page 8-10).

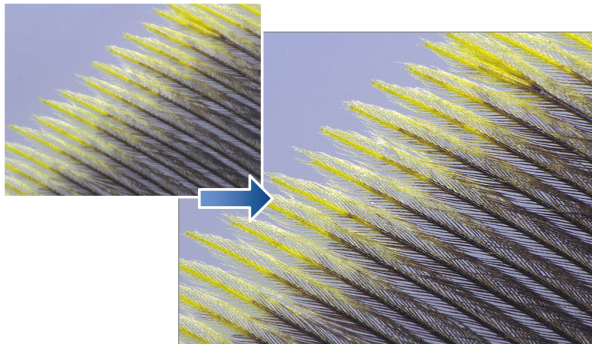


## Advanced Analysis Functions

### Capture high resolution images of features

Use the "High Definition" image capture function. This function allows the user to capture high resolution images with the maximum of 108 MegaPixels of resolution.

[Feathers of a Paradise bird (150x)]

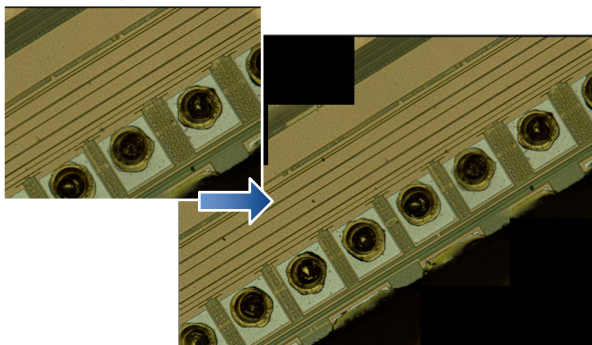


For details, refer to □ "REC Mode Settings" (Page 4-4).

### Expanded viewing area image capture

Use the "Serial Recording" function. This function allows the user to capture wide area images without sacrificing resolution.

[Wire bonding (1000x)]

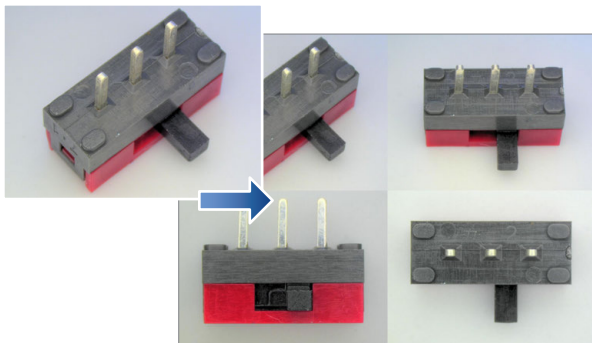


For details, refer to □ "Chapter 10 Serial Recording" (Page 10-1).

### Comparative analysis directly on the system

Use the "Split Screen" function. This function allows the user to visually compare two objects side by side directly on the system.

[Switch (20x)]

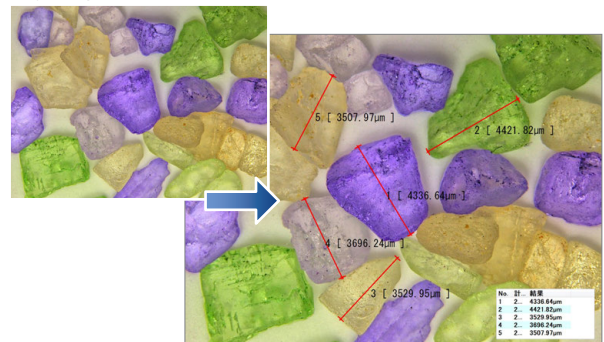


For details, refer to □ "Split Screen /Zoom" (Page 6-2).

### Measure critical features quickly

Use the "Measure" function. This function allows the user to measure observed features instantly.

[Crystal grains (20x)]

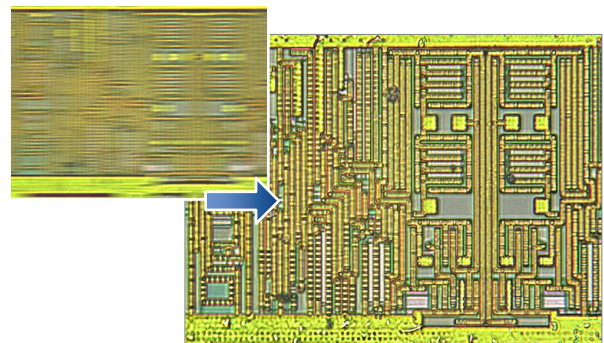


For details, refer to □ "Chapter 7 Measuring" (Page 7-1).

### Eliminate vibration

Use the "Anti-vibration" function. This function allows for clear real time (video) observation by eliminating vibration.

[IC pattern (3000x)]

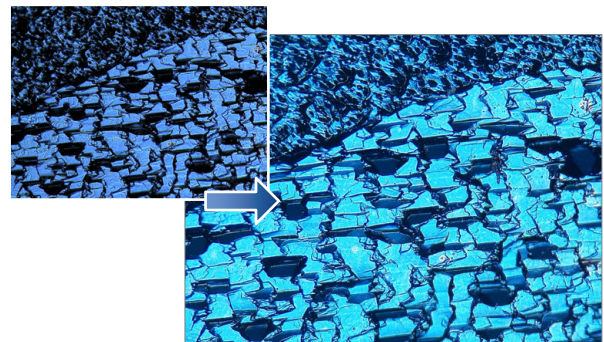


For details, refer to □ "Anti-vibration" (Page 6-8).

### Capture sharp images

Use the "Sharpening Image" function. This function brightens and sharpens for the image for improved observation.

[Solar battery cell (500x)]



For details, refer to □ "Sharpening Image Mode" (Page 4-8).

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# 1

## Before Using the VHX-7000

## Package Contents and Product Overview

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# Checking the Package Contents

## Contents

### VHX-7000 package contents

- Controller unit (VHX-7000)



### VHX-A70E package contents

- Console



- Mouse with wheel
- Capture/still photo remote terminal connector
- User's manual (this document)
- Quick start guide
- Keyboard
- Leaflet advertising communication software

## Camera unit

- Fully-Integrated (FI) Head VHX-7100



- High-Performance Camera VHX-7020



## Option

### Lens for Fully-Integrated Head

- Low magnification lens for Fully-Integrated (FI) Head VHX-E20 20 to 100x



- Medium magnification lens for Fully-Integrated (FI) Head VHX-E100 100 to 500x



- High magnification lens for Fully-Integrated (FI) Head VHX-E500 500 to 2500x



- Highest magnification lens for Fully-Integrated (FI) Head VHX-E2500 2500 to 6000x



## RZ Lens

- High-performance, low magnification zoom lens  
VH-Z20R/VH-Z20T 0 to 50x



- Ultra small, high performance zoom lens  
VH-Z22R/VH-Z22T 20 to 200x



- Universal zoom Lens  
VH-Z22UR/VH-Z22UT 20 to 200x



- Wide-range zoom Lens  
VH-Z100R/VH-Z100T 100 to 1000x



- Universal zoom Lens  
VH-Z100UR/VH-Z100UT 100 to 1000x



- Dual light high magnification zoom lens  
VH-Z250R/VH-Z250T 250 to 2500x



- High resolution zoom lens  
VH-Z500R/VH-Z500T 500 to 5000x



- Long distance, high performance zoom lens  
VH-Z50L/VH-Z50T 50 to 500x



- High resolution zoom lens  
VH-ZST 20 to 2000x



## Stands

- Free-angle observation system VHX-S770E (100 mm stage)



- Free-angle observation system VHX-S750E (40 mm stage)



- Free-angle observation system VHX-S600E (70 mm stage)



- VH-S5 Vibration-resistant, high-magnification zoom observation system



- VH-M100E XY measurement system



**Point** Requires separately sold XY measurement software, VHX-H3M3.

## Software

- 3D profile measurement software VHX-H5M
- XY measurement software VHX-H3M3

## Others

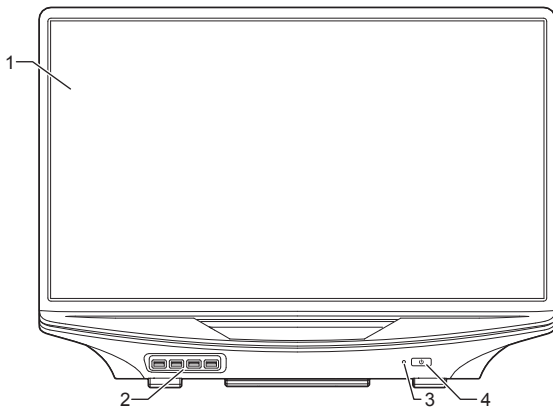
- Joint holder OP-88338



## Names and Functions

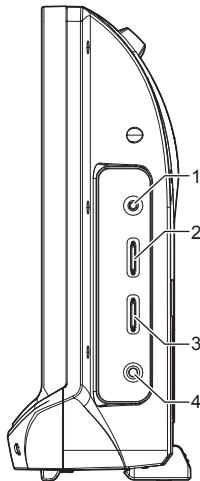
### Main Unit (VHX-7000)

#### Front view



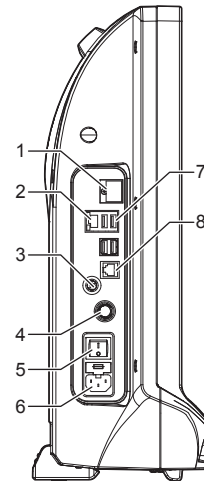
- 1 **LCD monitor**  
27" UHD (3840 x 2160 pixels) LCD monitor.
- 2 **USB ports**  
Connect a keyboard, mouse, and USB memory including other USB devices.  
(USB 3.0 x 2 ports, USB 2.0 x 2 ports)
- 3 **Power indicator**  
Light in orange when the main power switch is on, flash in orange at sleep.
- 4 **Power switch**  
Turn the power on or off. (The main power switch on the left side must be turned on.)

#### Right view



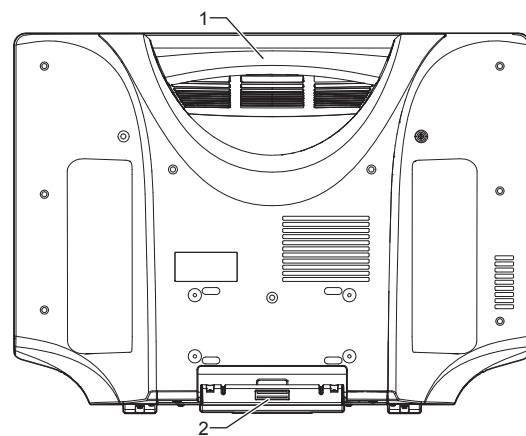
- 1 **TRIPLE'R connection port**  
Connect the Z-axis motorized stage/automatic lens/zoom recognition cable for the camera unit.
- 2 **CAMERA connection port 1**  
Connect the Fully-Integrated (FI) Head/High-Performance Camera camera cable.
- 3 **CAMERA connection port 2**  
Connect the Fully-Integrated (FI) Head/High-Performance Camera camera cable.
- 4 **STAGE connection port**  
Connect the controller connection cable for the free angle observation system (VHX-S770E/S750E and others).

#### Left view



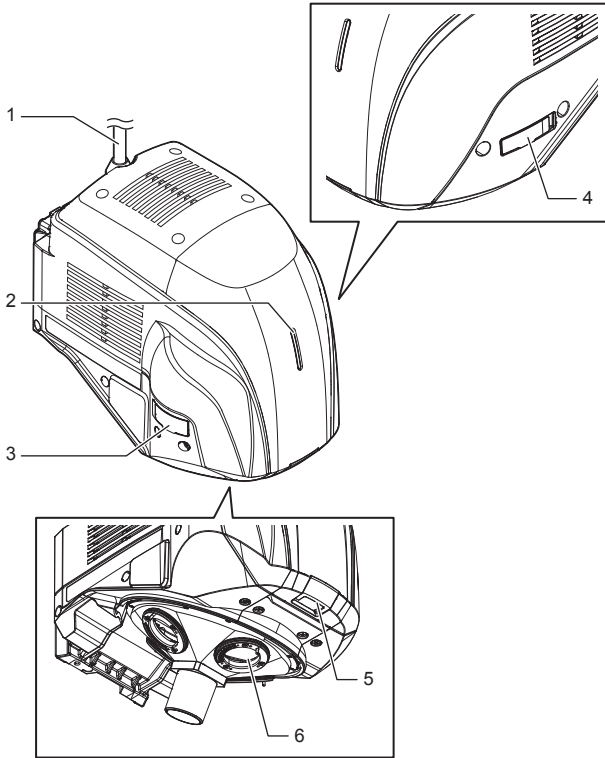
- 1 **MONITOR connection port**  
Output an external monitor or projector equipped with a Display Port output.
- 2 **LAN port**  
Connect a LAN cable when connecting this microscope to a LAN. (RJ-45 100BASE-TX/1000BASE-T)
- 3 **REMOTE connection port**  
A switch (such as a foot-activated switch) can be connected to the capture/pause REMOTE connector to capture and pause images.
- 4 **Multi light unit connection connector**  
Connect the multi light unit controller connection cable.
- 5 **Main power switch**  
Turn the power on or off. When the main power switch is turned off, the power switch on the front panel will not work. This switch is normally left on. Turn this switch off when moving the microscope to another location or removing the camera unit.
- 6 **AC power supply connection port**  
Connect the AC power cord set. (AC100 to 240V/50/60Hz)
- 7 **USB ports**  
Connect a keyboard, mouse, and USB memory including other USB devices.  
(USB 2.0 x 4 ports)
- 8 **Console port**  
Connect the console.

#### Rear view



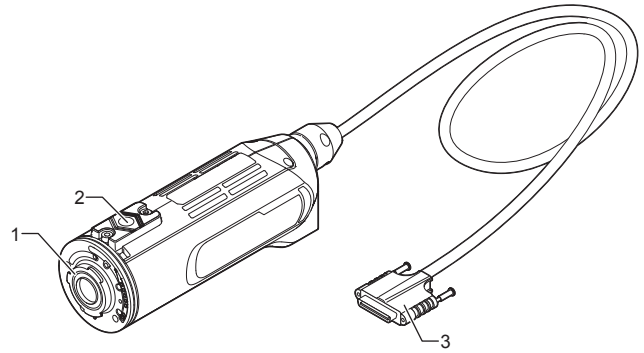
- 1 **Handle**  
Used when carrying the microscope.
- 2 **Tilt stand**  
Used to support the VHX if it is tilted backward.

## Fully-Integrated (FI) Head (VHX-7100)



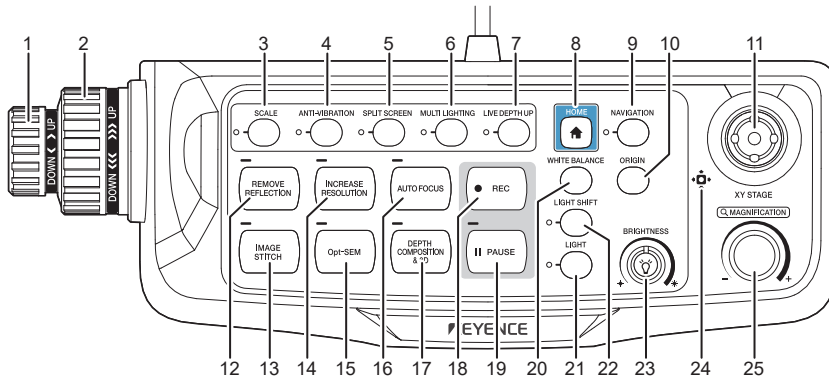
- 1 Head cable**  
Connect it to the controller.
- 2 Head LED**  
Light with the power turned on.
- 3 Polarizer installation slot**  
Install the optional polarizer and lambda plate.  
The cover is attached at delivery.
- 4 Analyzer installation slot**  
Install the optional analyzer.  
The cover is attached at delivery.
- 5 DIC prism installation slot**  
Install the optional DIC prism.  
The cover is attached at delivery.
- 6 Revolver**  
Mount the objective lens.

## High-Performance Camera (VHX-7020)



- 1 Mount**  
Used to mount the lens.
- 2 Tapped hole for a tripod**  
Threaded hole (1/4-20 UNC) used to secure the camera to a tripod.
- 3 Camera cable**  
Connect to the CAMERA connector on the controller.

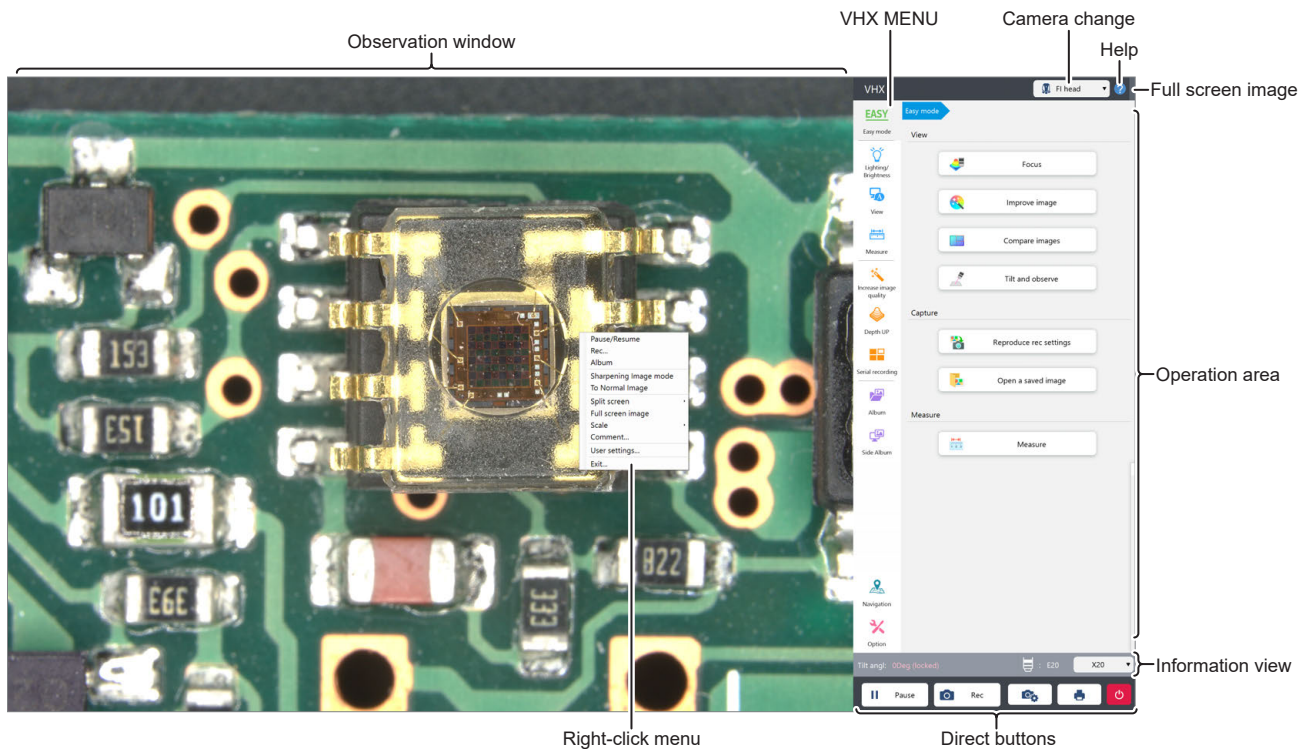
## Console



- 1 Fine focus dial**  
Raises or lowers the Z-axis stage to adjust focus.
- 2 Coarse focus dial**  
Raises or lowers the Z-axis stage to adjust focus.
- 3 SCALE button**  
Toggles the scale display between on or off.
- 4 ANTI-VIBRATION button**  
Allows for observation without vibration.
- 5 SPLIT SCREEN button**  
Displays the observation window as split screens.
- 6 MULTI LIGHTING button**  
This button allows you to observe the object illuminated from several directions.
- 7 LIVE DEPTH UP button**  
The system will automatically scan through the height of the sample, building a fully focused image even with the depth-of-field limited.
- 8 HOME button**  
Press this button to return to default settings. Settings such as glare removal are reset.
- 9 NAVIGATION button**  
Display the navigation window.
- 10 ORIGIN button**  
Move the XYθ stage to the origin (center).
- 11 Joystick**  
Move the position of XYθ stage. Depending on the tilt angle, the movement speed changes in stages.
- 12 REMOVE REFLECTION button**  
Suppresses glare on highly reflective objects.
- 13 IMAGE STITCH button**  
Joins multiple adjacent images as they are captured. The image stitching menu appears.
- 14 INCREASE RESOLUTION button**  
Improves visibility of the images with methods of HDR.
- 15 Opt-SEM (Optical Shadow Effect Mode) button**  
An observation method to highlight subtle flaws of objects.
- 16 AUTO FOCUS button**  
An area specified with the focus area automatically comes into focus.
- 17 DEPTH COMPOSITION & 3D button**  
Performs depth composition and displays 3D images.
- 18 REC button**  
Stores images on the screen to the hard drive in the microscope.
- 19 PAUSE button**  
Pauses the screen temporarily. Press again to release the paused state and return to live image mode.
- 20 WHITE BALANCE button**  
Adjust the white balance.
- 21 LIGHT button**  
Turns the lamp on or off.
- 22 LIGHT SHIFT button**  
Changes the orientation of the light to emphasize height differences on the object.
- 23 BRIGHTNESS dial**  
Adjusts the brightness of the image by adjusting the shutter speed. When observing dark images, the controller will automatically increase the gain or use the supercharge shutter.
- 24 XY STAGE**  
The LED blinks when the initialization of XYθ stage is not complete. The LED goes on and stays on when the initialization is complete.
- 25 MAGNIFICATION dial**  
Change the magnification level when using the fully-integrated (FI) head.

# Viewing the Screen

Refer to the following pages for details on the menus provided in the microscope interface.



1

Before Using the VHX-7000

## Observation window

Displays the image acquired by the camera in 3840 x 2160 pixels.

## Right-click menu

This menu appears when the right mouse button is clicked over the observation window.

### ● Pause/Resume

Toggles the screen between a paused or frozen image and a live image.

### ● Rec

Captures the displayed image and stores it on the hard drive.  
 ☞ "Capturing and Saving Still Images" (Page 4-2)

### ● Album

Allows playback and editing of captured image files.  
 ☞ "Album" (Page 11-2)

### ● Sharpening Image mode

Applies vivid color enhancements and profile emphasis to the image.  
 ☞ "Sharpening Image Mode Settings" (Page 4-8)

### ● To Normal Image

Returns the image to standard condition before applying emphasis on height difference and Vivid & Sharp mode enhancements.

### ● Split screen

Splits the observation window to compare images.  
 ☞ "Split Screen /Zoom" (Page 6-2)

### ● Full screen image

The VHX MENU on the right side of the screen can be closed to allow the observation window to occupy the entire screen.  
 ☞ "Full Screen Image" (Page 6-10)

### ● Scale

Displays a scale on the observation screen.  
 ☞ "Displaying a Scale" (Page 7-25)

### ● Comments

A tool to enter comments such as text and markings on the observed image.  
 Displays the bar.  
 ☞ "Displaying Text and Markers (Comment)" (Page 6-4)

### ● User settings

Stores various settings on the [Camera/Image Enhancement], [Options] menu.  
 ☞ "User Settings" (Page 12-2)

### ● Exit

Turns the microscope power off.



## VHX MENU

The following commands are displayed as icons. Clicking the icon executes the command.



Easy mode

### Easy mode

This allows you to easily call useful functions.

#### ● View

- ☐ "Focus" (Page 3-8)
- ☐ "Improving image" (Page 3-9)
- ☐ "Comparing images" (Page 3-9)
- ☐ "Tilting and observing" (Page 3-9)

#### ● Capture

- ☐ "Reproducing rec settings" (Page 3-10)
- ☐ "Opening a saved image" (Page 3-10)

#### ● Measure

- ☐ "Measure" (Page 3-10)

Lighting/  
Brightness

### Lighting/Brightness

Use this to make advanced adjustments for images that are too bright, or too dark, to correct the color tone, or for fast moving objects.

#### ● Lighting

- ☐ "Switching Lighting ON/OFF" (Page 5-2)
- ☐ "Changing the Lighting Method" (Page 5-3)

#### ● Brightness

- ☐ "Adjusting Image Brightness" (Page 5-5)



View

### View

Sets the image display method.

These settings allow you to zoom in on an image or zoom out or split the screen and tile images for comparison.

- ☐ "Split Screen /Zoom" (Page 6-2)
- ☐ "Displaying Text and Markers (Comment)" (Page 6-4)
- ☐ "Anti-vibration" (Page 6-8)
- ☐ "Tilting and Observing" (Page 6-9)
- ☐ "Show Software Keyboard" (Page 6-9)
- ☐ "Wide-View" (Page 6-10)
- ☐ "Full Screen Image" (Page 6-10)



Measure

### Measure

Measures distances, areas, angles, etc., of the object.

Measurements can also be made while moving the object horizontally (XY direction) by using the VH-M100E stage.

- ☐ "Plane Measurement" (Page 7-2)
- ☐ "Displaying a Scale" (Page 7-25)
- ☐ "Auto Area Measurement (Grain Count)" (Page 7-26)
- ☐ "Contamination Analysis" (Page 7-42)
- ☐ "Maximum Area Measurement" (Page 7-50)
- ☐ "One-Click Automatic Measurement" (Page 7-52)
- ☐ "Teaching Auto Measurement" (Page 7-56)
- ☐ "XY Stage Measurement (Optional)" (Page 7-62)
- ☐ "Calibration" (Page 7-5)

Increase image  
quality

### Increase image quality

Applies advanced imaging features to see images that are difficult to observe normally.

- ☐ "Optical Shadow Effect Mode" (Page 8-2)
- ☐ "Increase Resolution (HDR)" (Page 8-8)
- ☐ "Removing Glare (Reflected light Removal)" (Page 8-6)
- ☐ "Changing Illumination Direction (Multi-lighting)" (Page 8-10)
- ☐ "Selecting an Image from 9 Different Settings (Optimize)" (Page 8-13)



Depth UP

### Depth UP

This command is used to adjust the focus on the entire object when it has large height differences.

It combines and displays the focused parts of multiple images with different focal points. The combined image can be used to form a 3D image.

- ☐ "Live Depth Composition" (Page 9-2)
- ☐ "Quick Composition and 3D" (Page 9-4)
- ☐ "Fine Depth Composition" (Page 9-9)
- ☐ "Manual 3D Composition" (Page 9-13)
- ☐ "Z Stage Control" (Page 9-51)



Serial recording

### Serial recording

This allows you to observe an area larger than the normal field-of-view in its original clarity by connecting several images.

Place the object on the XY stage and capture an image while moving the stage.

Images can be connected to form 2D images or 3D images.

- ☐ "Automatic Image Stitching" (Page 10-2)
- ☐ "Manual Image Stitching" (Page 10-7)
- ☐ "Split Recording" (Page 10-9)
- ☐ "Registering the Stage Position" (Page 10-11)



Album

### Album

Displays thumbnails of captured (saved) images for review and management.

Double-clicking a thumbnail displays or plays the recorded image.

Images can be printed, written to a CD/DVD, or edited using copy and cut functions.

- ☐ "Album" (Page 11-2)



Side Album

### Side Album

Displays the album in the operation area.

This allows you to display a screen in the observation window while viewing the thumbnail of another image.

Double click or drag & drop a thumbnail onto the observation window to display or play it back.

- ☐ "Side Album" (Page 11-15)



Navigation

### Navigation

Registers a wide field-of-view image as the navigation image.

- ☐ "Navigation" (Page 3-11)



Option

### Option

Sets option settings.

- ☐ "Video Recording" (Page 4-6)
- ☐ "Timer Record" (Page 4-9)
- ☐ "Settings" (Page 12-2)
- ☐ "System" (Page 12-13)

## Viewing the Screen

### Camera switch

Changes the camera to be used at controller.  
This appears when 2 cameras are connected to the controller.

### Help

Displays a summary of operating procedures.

### Full screen image

The VHX MENU on the right side of the screen can be closed to allow the observation window to occupy the entire screen.  
☞ "Full Screen Image" (Page 6-10)

### Operation area

Displays the settings of functions selected from the VHX MENU or the console buttons.

### Information view

Lens name, effects such as HDR, tilt angle, rotated angle and playback file name are displayed.  
Also, the lens magnification in use can be changed.

### Direct buttons



The display in the observation window is paused.



Records and saves an image displayed in the observation window.



Performs recording settings.  
☞ "REC Settings" (Page 4-4)



An image displayed in the observation window can be printed directly.  
☞ "Printer" (Page 4-10)



Turns the microscope power off.  
([Sleep], [Shutdown], or [Restart] can be selected.)  
☞ "Clicking the Exit Button" (Page 3-7)

# 2

## Installation and Connections

### Connecting Devices to the VHX-7000

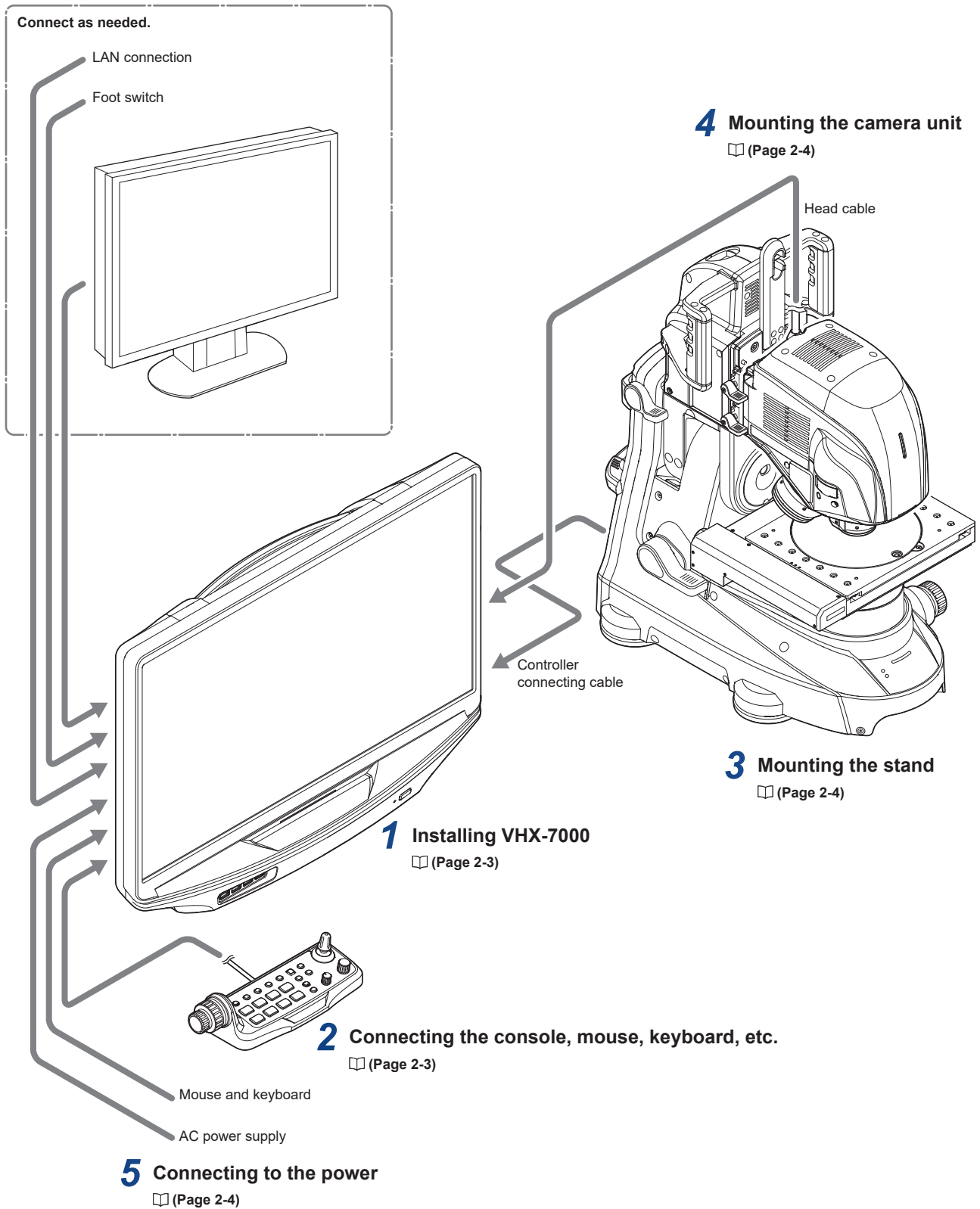
#### System Configuration and Connection Flow . . . . 2-2

Installing VHX-7000 . . . . .	2-3
Connecting the Console, Mouse, etc. . . . .	2-3
Mounting the Stand . . . . .	2-4
Mounting the Camera Unit . . . . .	2-4
Connecting to the Power. . . . .	2-4

# System Configuration and Connection Flow

## 2

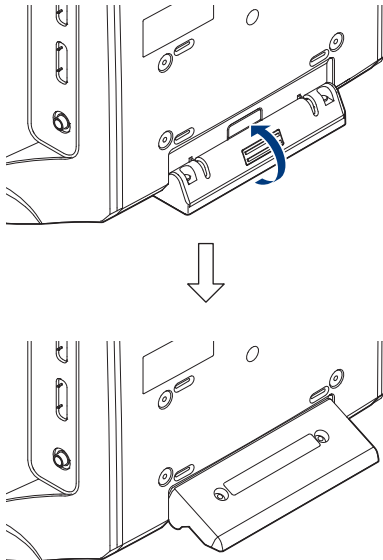
Installation and Connections



## Installing VHX-7000

**NOTICE** Install the microscope on a fixed flat surface. Otherwise, it may fall over and become damaged. Be sure to pull out the tilt stand.

**1** Pull out the tilt stand and lock it in place with the magnetic catch located at the lower back side of the microscope.



**2** Set up the microscope where observations are to be made.

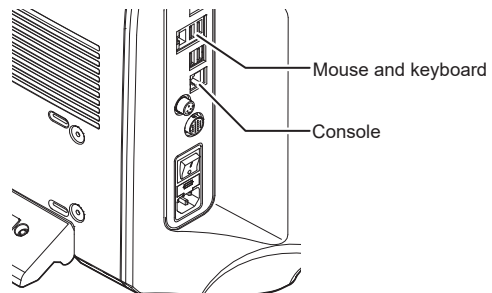
## Connecting the Console, Mouse, etc.

Connect the AC power cord set, console, mouse, and keyboard to the microscope. The connection ports are located at the lower left side of the microscope.

**NOTICE** Always turn the main power switch off before connecting or disconnecting the AC power cord set and console. Doing so with the power turned on may result in failure or damage.

**CAUTION**

- The AC power cable attached the microscope supports 100 to 120 V (only in Japan). Use one that meets the specification when this is used with another voltage. When this is used outside Japan, the power supply cord set is not provided with this. Use the cord set, which complies with the regulations and standards in the country or the region in which the VHX-7000 Series are used.
- When installing, connect the protective ground terminal of the AC power cord set to the protective ground conductor at the installation site. Failure to ground it may result in electric shock or other product failure.

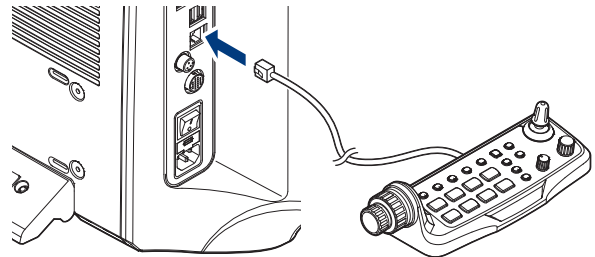


**2** Installation and Connections

### Connecting the console

Align the console connector to the orientation of the CONSOLE connection port on the left side of the microscope, and insert.

**CAUTION** Do not connect any other device, except for the supplied console, to the CONSOLE connector. Doing so may result in fires, electric shock, or product failure.

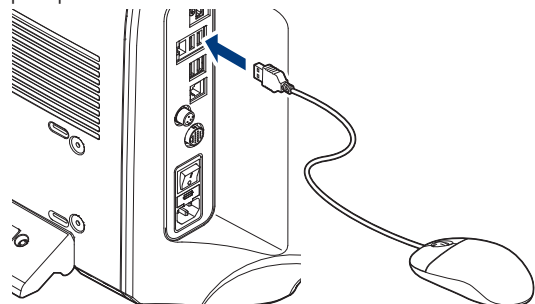


**To remove**  
Remove while pushing on the tab on the connector.

### Connecting the mouse and keyboard

Align the orientation of the mouse and keyboard connector and insert into the USB port located on the left side, or the lower left on the front panel of the microscope.

The mouse and keyboard can be connected to any of the eight USB ports provided.



**To remove**  
Hold the connector and pull.

## Mounting the Stand

Build and mount the stand.

For further details, refer to the VHX-S770E/S750E User's Manual or Instruction Manual for the actual stand being used.

## Mounting the Camera Unit

Connect the camera cable for the camera unit to this microscope. These connection ports are located on the lower right side of the microscope.

## When using lens for Fully-Integrated (FI) Head

**NOTICE**

- Always turn the main power switch off before connecting or disconnecting the Fully-Integrated (FI) Head. Doing so with the power turned on may cause the camera unit to fail or become damaged.
- Check the orientation of the connectors before connecting them. Otherwise the connector pins may bend and cause failures.

For more detail, refer to "Fully-Integrated (FI) Head VHX-7100 User's Manual".

## When using a High-Performance Camera

**NOTICE**

- Always turn the main power switch off before connecting or disconnecting the camera cable and lens/TRIPLE'R unit. Doing so with the power turned on may cause the camera unit to fail or become damaged.
- Check the orientation of the connectors before connecting them. Otherwise the connector pins may bend and cause failures.

### ● Mounting lenses

Mount lenses to be used on the stand.

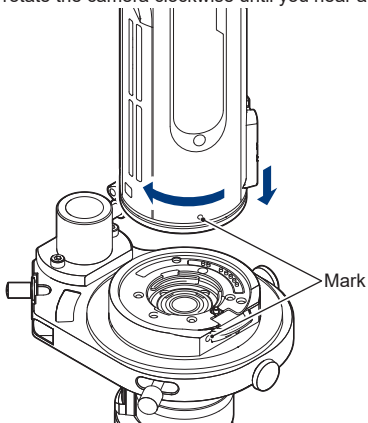
For further details, refer to the lens User's Manual or Instruction Manual.

### ● Mounting a High-Performance Camera

Mount a High-Performance Camera to a lens.

The following explanation is based on the VH-Z20T.

Align the O marks on the VH-Z20T and High-Performance Camera and rotate the camera clockwise until you hear a click.



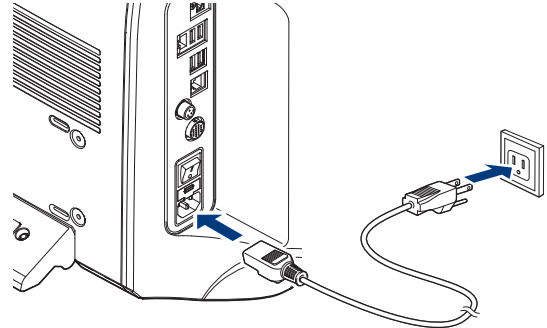
### ● Mounting a light unit for a High-Performance Camera

Mount a light unit for a High-Performance Camera (OP-88329) as necessary.

For more detail, refer to "Light unit for a High-Performance Camera (OP-88329) User's Manual".

## Connecting to the Power

- 1 Connect the AC power cord set to the AC power supply connection port on the left side of the microscope.
- 2 Plug the other end into a wall outlet.



## Basic Operation and Useful Functions

This chapter provides explanation using the following example:

- Digital microscope VHX-7000
- Fully-Integrated (FI) Head VHX-7100
- Free-angle observation system VHX-S770E

<b>Basic Operation</b> . . . . .	<b>3-2</b>
Turning the Microscope Power On . . . . .	3-2
Initializing the Stage . . . . .	3-2
Adjusting the Color Balance (White Balance) . . . . .	3-3
Adjusting the Brightness and Focus . . . . .	3-4
Move XY Motorized Stage . . . . .	3-5
Adjustment tips . . . . .	3-5
Observing Tilted Z-Axis . . . . .	3-6
Capturing (Saving) Images . . . . .	3-7
Reset to the initial settings . . . . .	3-7
Turning the Microscope Power Off . . . . .	3-7
<b>Easy mode</b> . . . . .	<b>3-8</b>
View . . . . .	3-8
Capture . . . . .	3-10
Measure . . . . .	3-10
<b>Navigation</b> . . . . .	<b>3-11</b>
Creating Navigation . . . . .	3-11
Specifying Observation Position on Navigation Image . . . . .	3-11
Moving vertically and horizontally . . . . .	3-11
<b>Advanced Operations</b> . . . . .	<b>3-12</b>
Change illumination angle, during or after capture . . . . .	3-12
Observe images without glare . . . . .	3-12
Observe images using high color gradation . . . . .	3-12
Observe images with an extended depth-of-field . . . . .	3-12
Observe images in 3D . . . . .	3-12
Observe a wide field-of-view under high magnification . . . . .	3-12

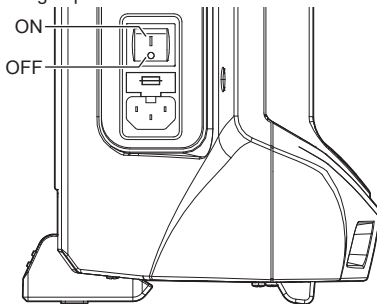
# Basic Operation

## Turning the Microscope Power On

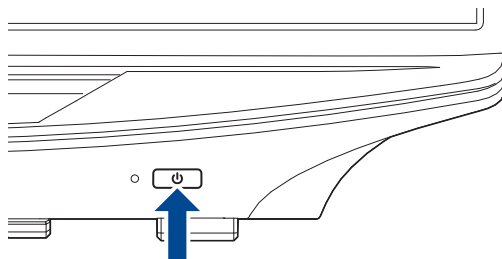
**Important** The stage will move at power on to confirm the origin.

- 1 Turn on the power switch of the stand.
- 2 Turn the main power switch on (lower left side of the microscope).

This switch is normally left on.  
To turn the power on or off, use the POWER switch located on the lower right of the front panel.  
Turn the main power switch off when moving the microscope to another location, or if the microscope is not to be used for prolonged periods.



- 3 Press the POWER switch on the lower right of the front panel.

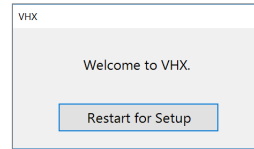


The microscope will turn on and the screen will appear.

## Language selection at initial startup

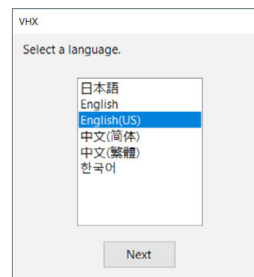
When starting up the microscope for the first time, the initial setup screen such as the display language will appear.

- 1 Click [Restart for Setup]



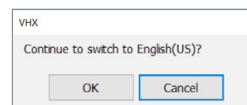
The microscope restarts and a screen for selecting a display language is displayed.

- 2 Select [English(US)] and click [Next].

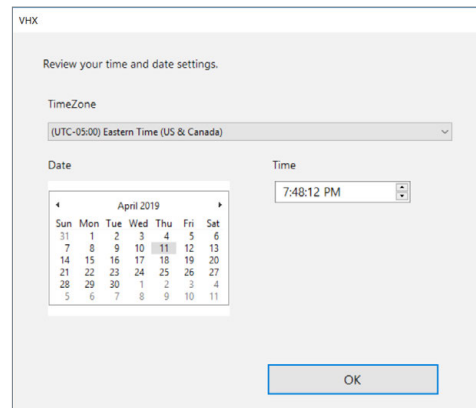


The confirmation screen appears.

- 3 Click [OK].



- 4 Set the time zone, date, time, and click [OK].



The microscope restarts and the screen is displayed in the selected language.



## Initializing the Stage

Perform the following Initialization if you are using the free-angle observation system VHX-S770E

- Up Z stage
- Down Z stage
- XYθ stage

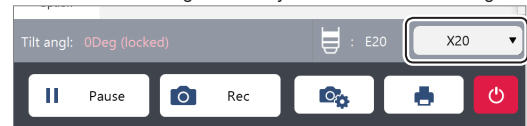
If the last operation was completed with the stage moved to the origin, initialization will not be required upon startup.

## Adjusting the Color Balance (White Balance)

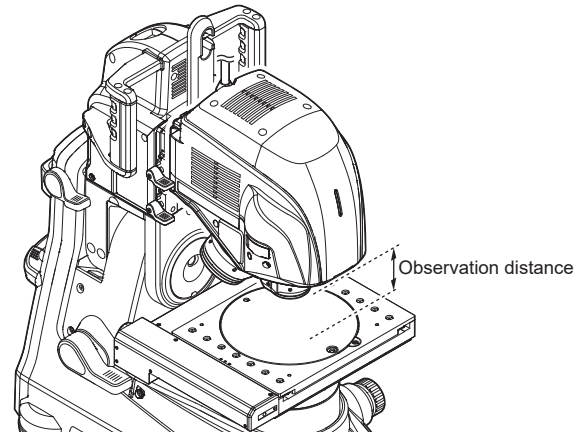
Adjust to obtain true color images.

### 1 Display a white object.

Select the desired magnification by information view lens magnification.



Place to display a white object on the stage with the observation distance according to the selected lens (distance from the lens edge to the object) and focus on the object.



#### ● When using lens for Fully-Integrated (FI) Head

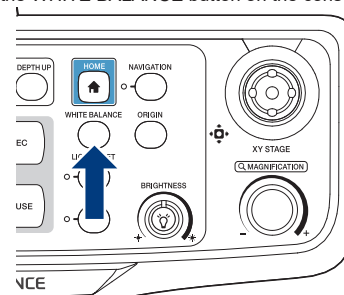
Lens model	Lens power	Observation distance
VHX-E20	20 to 100x	30 mm
VHX-E100	100 to 500x	24 mm
VHX-E500	500 to 2500x	6.3 mm
VHX-E2500	2500 to 6000x	1 mm

#### ● When using a High-Performance Camera

Lens model	Lens power	Observation distance
VH-Z00T (R)	0 to 50x	95 mm
VH-Z20T (R)	20 to 200x	25.5 mm
VH-Z20UT (UR)	20 to 200x	20.8 mm
VH-Z100T (R)	100 to 1000x	25 mm
VH-Z100UT (UR)	100 to 1000x	25 mm
VH-Z250T (R)	250 to 2500x	6.5 mm
VH-Z500T (R)	500 to 5000x	4.4 mm
VH-Z50T (L)	50 to 500x	85 mm
VH-ZST	20 to 2000x	15 mm

### 2 Adjust the color balance.

Press the WHITE BALANCE button on the console.



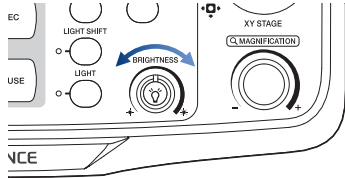
## Adjusting the Brightness and Focus

### 1 Display the object to be observed.

Place the object to be observed on the XYθ stage mounted to the VHX-S770E.

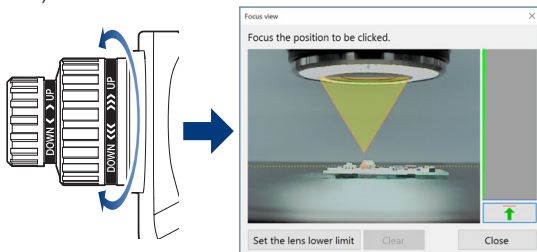
### 2 Adjust the brightness.

Adjust the brightness by turning the BRIGHTNESS dial on the console.



### 3 Adjust the focus.

Adjust the focus by turning the FOCUS dial on the console. Focus can also be adjusted using the auto focus function (Page 9-51).

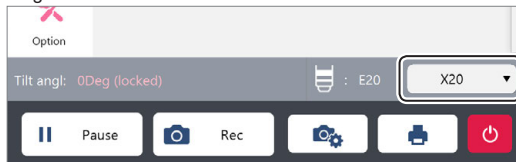


Turning the focus dial shows the [Focus view] dialog box on the screen.

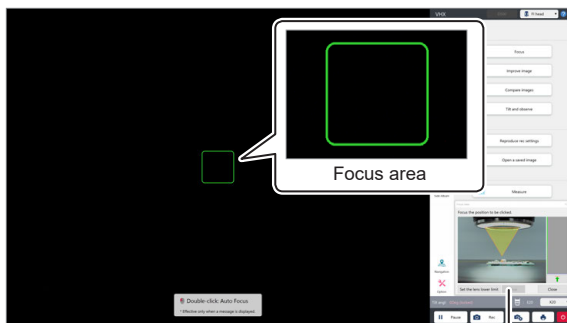
You can focus on the position clicked on the preview window. This also allows you to check the focus level on the screen, and thereby easily adjust the focus.

### 4 Adjust the zoom (magnification).

Select the desired magnification by information view lens magnification.



## Detailed focus adjustment



[Focus view] dialog box

Turning the focus dial shows the focus area and the [Focus view] dialog box on the screen.

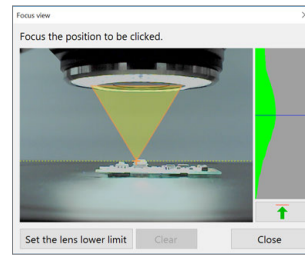
The focus level can be selected from among "S/M/L/XL".

The position of the focus area can be moved by mouseclicking on the screen.

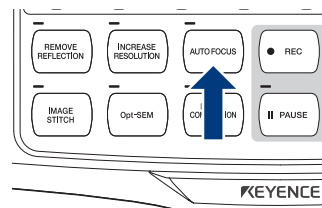
## Manual adjustment of focus position

Turning the focus dial shows a graph of focus level in the [Focus view] dialog box.

With this state, clicking  (To the focus position) brings the image to a best focal point.



## Auto focus




Pressing the [AUTO FOCUS] button on the console shows the [Focus view] dialog box and automatically brings images into focus.

The auto focus is also activated by double-clicking on the screen with the mouse while the [Focus view] dialog box appears on the screen.

**NOTICE** To prevent interference with the observation object, auto focusing is done by moving the Z-axis stage upwards. To avoid interference while using auto focus, be sure there is at least 3 mm (except VHX-E2500) between the lens and object.

## Wrap-up of focus adjustment operation

Focusing method	Type	Operation
Manual adjustment	Console	Move the focus adjustment dial up and down to scan the area you want to bring into focus.
	Mouse operation	<ol style="list-style-type: none"> <li>1. Move the focus adjustment dial up and down to scan the area you want to bring into focus.</li> <li>2. Click  (To the focus position) in the [Focus view] dialog box.</li> </ol>
Auto focus	Console	Press the [AUTO FOCUS] button of the console.
	Mouse operation	<ol style="list-style-type: none"> <li>1. Move the mouse wheel to show the [Focus view] dialog box.</li> <li>2. Click screen.</li> </ol>

## Move XY Motorized Stage

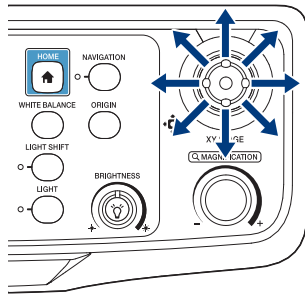
The methods mentioned below can be used to move the XY stage automatically in the X and Y directions.

- Moving the stage using the joystick on the console
- Moving the stage using the mouse



- **During image stitching and depth composition, the stage cannot be moved.**
- **The stage cannot be moved either when the camera image, such as 3D view, album and wide-view, is not displayed.**

## Moving the stage using the joystick

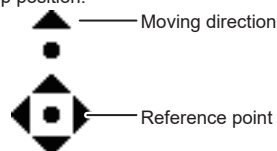


In the direction that the joystick is tilted, the displayed content of the observation window moves. According to the angle at which the joystick is tilted, the movement speed changes.

## Moving the stage using the mouse

Based on the mouse movements in the observation window, the observation area moves. Dragging the observation window causes the displayed area to move toward the dragging direction. Double-clicking in the observation window moves the double-clicked point to the center of window.

Clicking with the mouse wheel on the observation window causes the reference point's picture to appear at the clicked position. In the direction of the mouse cursor as viewed from the reference point, the applicable arrow (in one of the eight directions) appears and the displayed content moves accordingly. Movement speed varies depending on distance of the mouse cursor position from the reference point. To stop moving the stage, click with the mouse wheel again at your desired stop position.

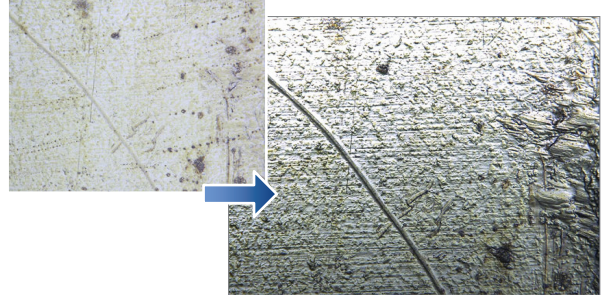


**During measurement, no movements can be made by dragging and double-clicking.**

## Adjustment tips

### Features with height differences appear flat

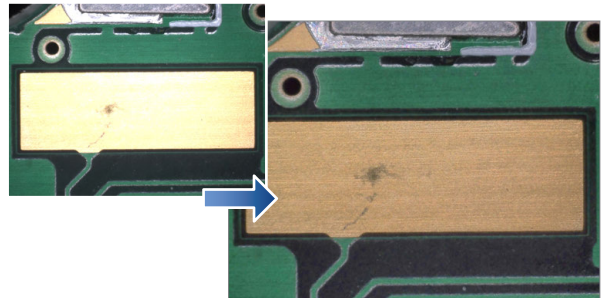
Use the [Lighting] function.



For details, refer to "Changing the Lighting Method" (Page 5-3).

### Areas with intense light reflection appear white

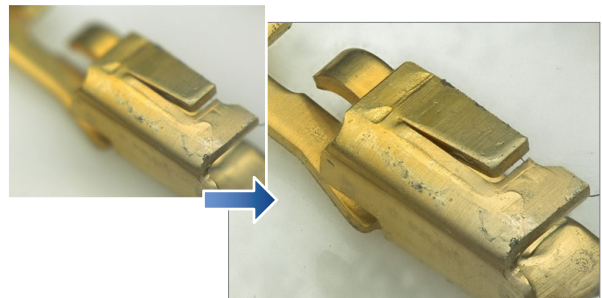
Use the [Remove reflection] function.



For details, refer to "Removing Glare (Reflected light Removal)" (Page 8-6).

### Some parts of the image are out of focus

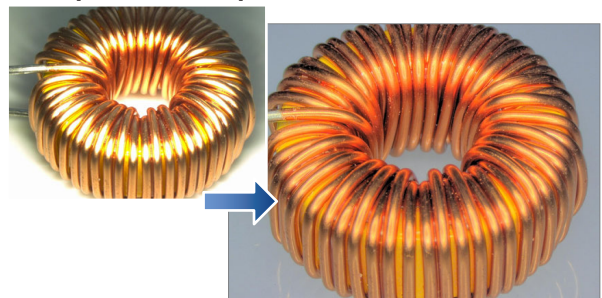
Use the [Depth composition] function.



For details, refer to "Types and Features of Depth Composition" (Page 9-2).

### Areas of image whiteout or blackout

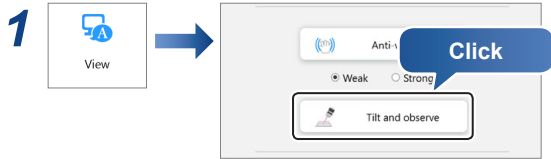
Use the [Increase resolution] function.



For details, refer to "Increase Resolution (HDR)" (Page 8-8).

## Observing while tilted

To observe with the Z-axis tilted, eucentric setting should be performed.

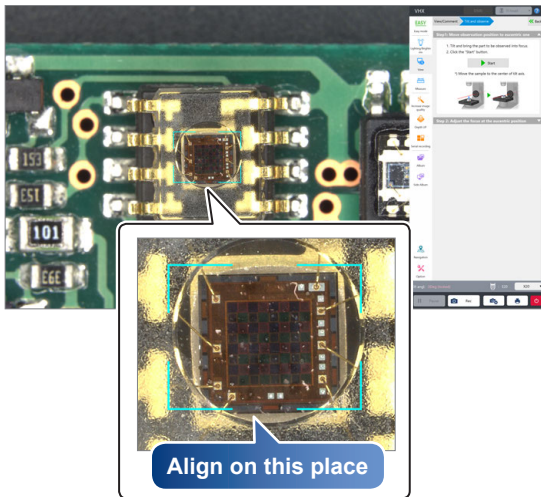


**2** Place the monochrome plate on the XYθ stage.

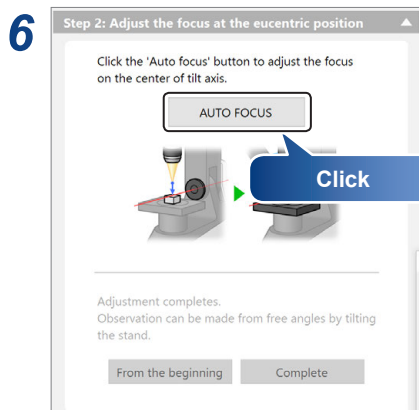
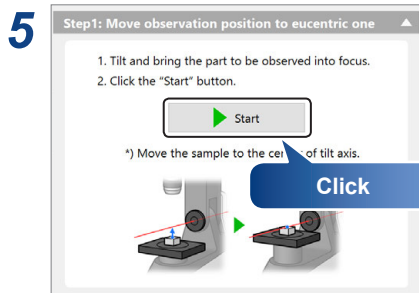
**3** Place the object on the XYθ stage.

**4** Tilt and bring the position to be observed into focus.

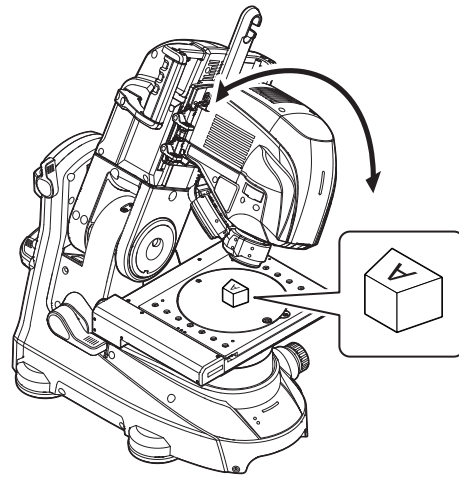
Adjust the position to be observed within the frame of the center of the screen.



☐ "Adjusting the Brightness and Focus" (Page 3-4)



**7** Observe the tilted image.



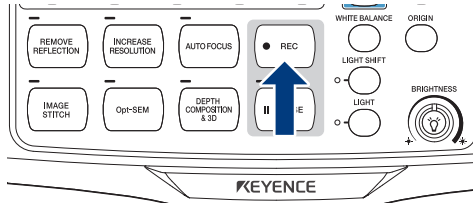
**Reference** If the High-Performance Camera is used, while the mounting angle of the camera is shifted by 90 degrees, the object changes its angle in the vertical direction according to the mounting angle, which allows you to observe the object more naturally.

## Capturing (Saving) Images

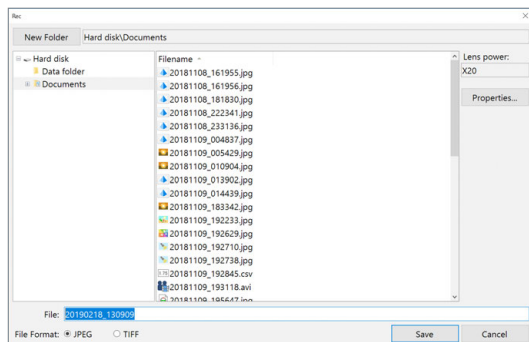
Capture (save) the displayed image and store it on the internal hard drive.

### Capturing (saving) images

#### 1 Press the "REC" button.



#### 2 Select the folder to save the image in and enter a file name.

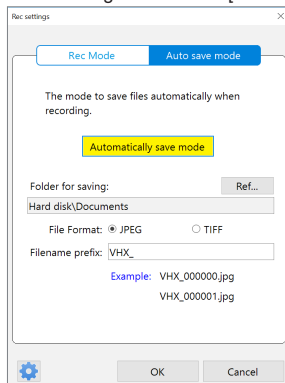


#### 3 Click [Save].

### Saving without entering a file name

After setting the automatically save mode (Page 4-5), the image is automatically saved by simply pressing the "REC" button.

You can change to the auto save when clicking the direct buttons of rec settings and turn on [Automatically save mode].

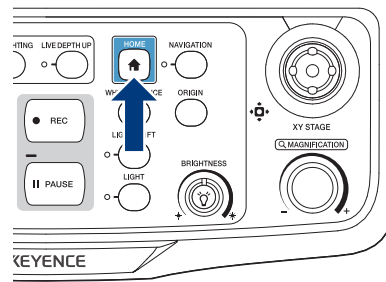


### Saving videos

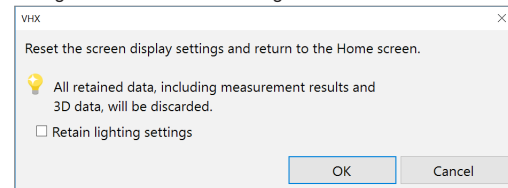
Select video recording (Page 4-6) from the "Option" of VHX MENU. Specify the conditions and click [Start Recording].

## Reset to the initial settings

The home button is convenient to go back to the initial settings after complicated operations such as the HDR and depth composition functions.



HOME button returns the setting to the initial state at startup. If [Retain lighting settings] is checked, the lighting and brightness will not be changed from the current setting.

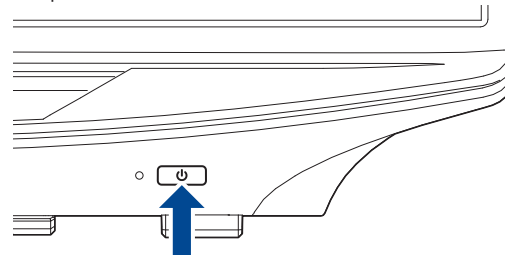


## Turning the Microscope Power Off

**Point** The action the system takes depends on the user settings (Page 12-9).

### Press the POWER switch on the lower right of the front panel

The power turns off.



### Clicking the Exit Button

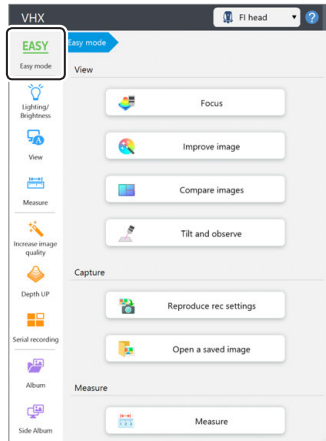
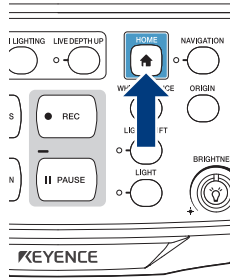
A menu of shut down options will appear. Select one and click [OK].

#### ● Shut down options

- Shut down : Turns off the power completely. (Default)
- Sleep : Places the microscope in the standby condition for quick startup.
- Restart : Restart the system.

# Easy mode

This allows you to easily call useful functions.  
Press the [HOME] button on the console or click the [Easy mode] on the VHX Menu.

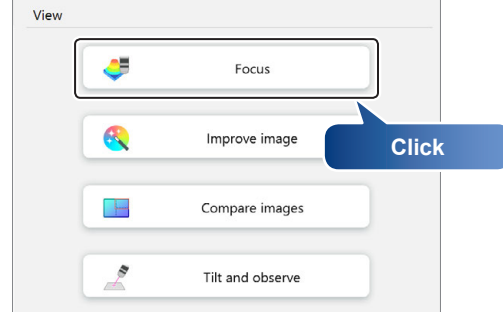


[Easy mode] list displays.

## View

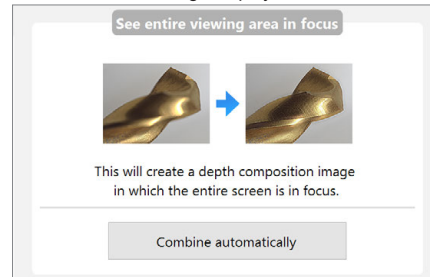
### Focus

Functions used to adjust the focus are described below.



### See entire viewing area in focus

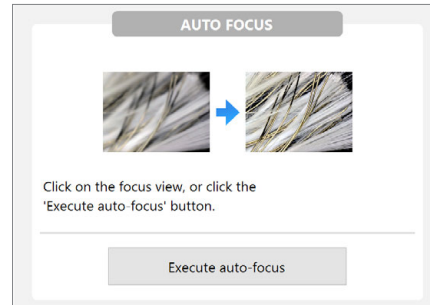
Create a depth composition image in which the entire screen is in focus. After that, the 3D image displays.



For more details, refer to □□ "Live Depth Composition" (Page 9-3).

### AUTO FOCUS

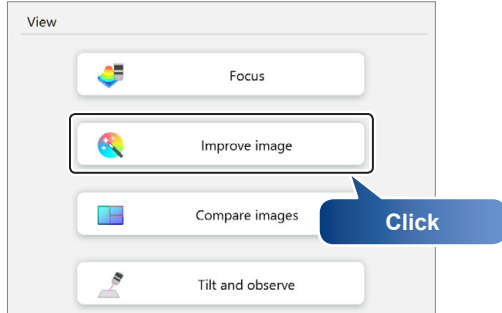
Execute the AUTO FOCUS to find the focus on the part.



For details of the fine adjustment, refer to □□ "Using Auto Focus" (Page 9-51).

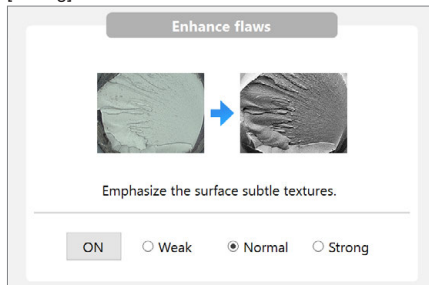
## Improving image

Functions used to improve the image quality are described below.



### Enhance flaws

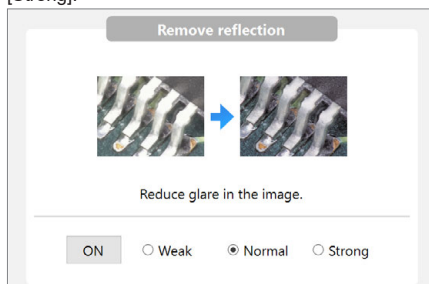
Optical Shadow Effect Mode observation can enhance a flaw of the object. Intensity effect of this function can be selected to [Weak], [Normal] and [Strong].



For details of the fine adjustment, refer to [“Optical Shadow Effect Mode”](#) (Page 8-2).

### Removing reflection

By using this function can reduce glare in the image. Intensity effect of this function can be selected to [Weak], [Normal] and [Strong].



For details of the fine adjustment, refer to [“Removing Glare \(Reflected light Removal\)”](#) (Page 8-6).

### Increase contrast

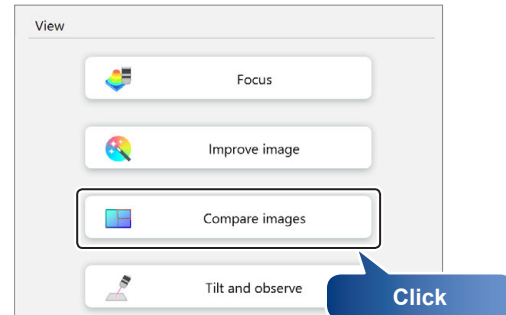
By using HDR observation can observe an optimized image. Intensity effect of this function can be selected to [Weak], [Normal] and [Strong].



For details of the fine adjustment, refer to [“Increase Resolution \(HDR\)”](#) (Page 8-8).

## Comparing images

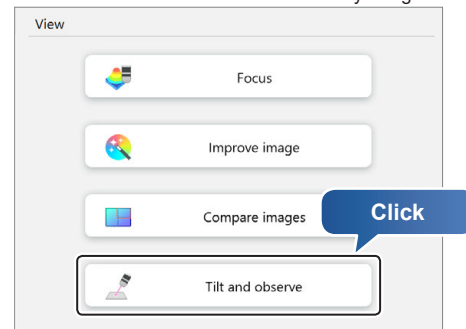
The observation window can be displayed as split screens. The split screen can be selected from the four types: vertical split, horizontal split, quarter split, and nine-way split. The split screen allows you to compare the images being shown with each other or with those stored in the VHX.



For more details, refer to [“Screen Split”](#) (Page 6-2).

## Tilting and observing

This allows the observation to be made by tilting the Z-axis.

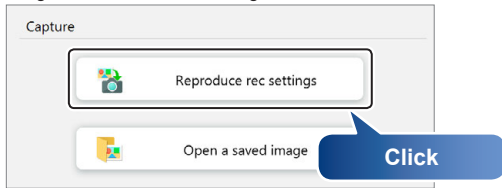


For more details, refer to [“Observing while tilted”](#) (Page 3-6).

## Capture

### Reproducing rec settings

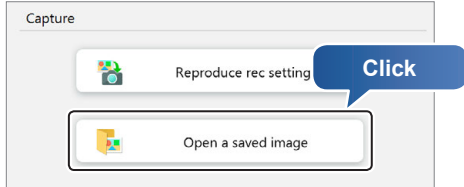
Display the side album, and read the camera setting from the saved images to set the same setting.



For more details, refer to □ "Side Album" (Page 11-15).

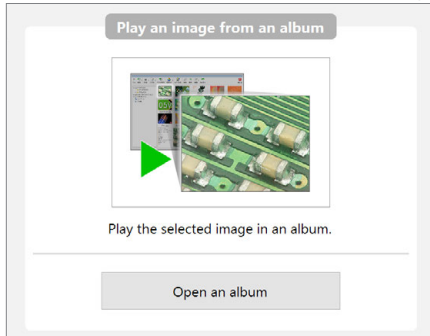
### Opening a saved image

Functions to load images from the album are gathered.



### Play an image from an album

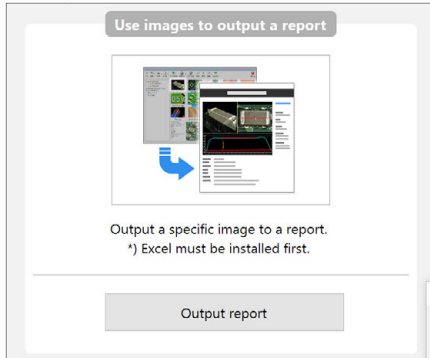
Open the album window to confirm the saved images on this device.



For more details, refer to □ "Album" (Page 11-2).

### Use images to output a report

An image selected on an album is output as a report.

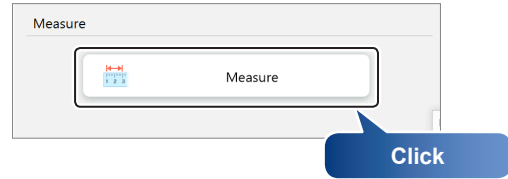


For more details, refer to □ "Report Output" (Page 11-3).

## Measure

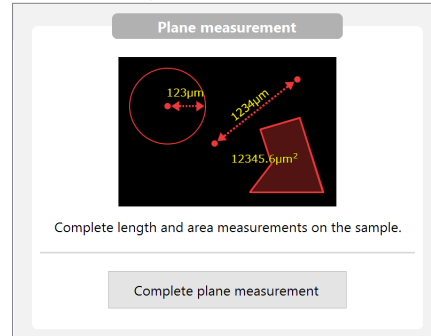
### Measure

Plane measurement and 3D measurement functions are described below.



### Plane measurement

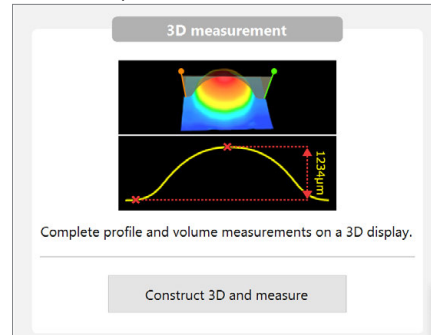
Measure the length and area of the sample.



For more details, refer to □ "Plane Measurement" (Page 7-2).

### 3D measurement

Display the 3D image of the depth composition image sample, and measure the profile and volume.



For more details, refer to □ "3D Profile Measurements (Optional)" (Page 9-26).

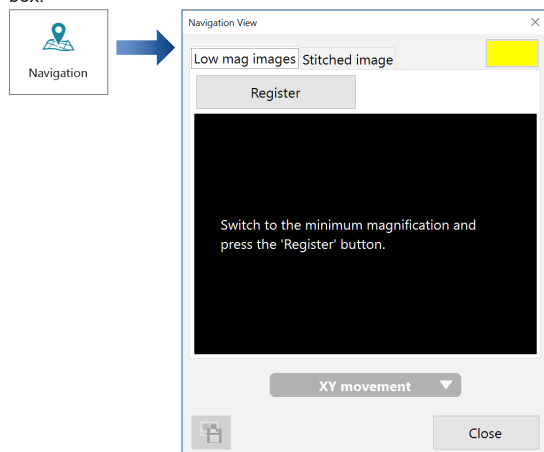


# Navigation

This functions registers low magnification images or stitched images to provide a navigation image of a wider field-of-view. You can move to a specified point on the image by clicking with the mouse on the [Navigation view] dialog box. With this function, you can understand intuitively what area of the whole part you are observing when viewing at higher magnification, which results in efficient observation.

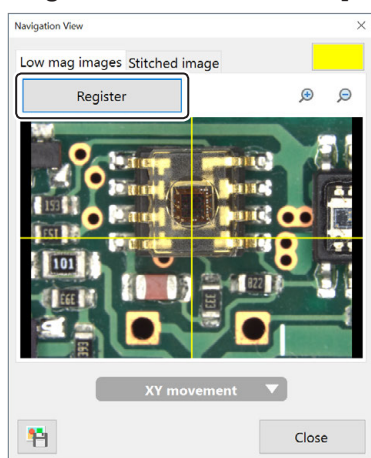
## Creating Navigation

Click [Navigation] on VHX MENU to show the [Navigation View] dialog box.

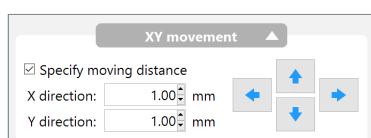


## Registering low magnification images

- 1 Specify the position to be registered and its magnification and click the [Register] button.

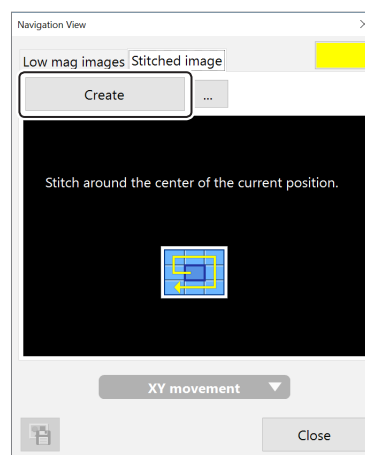


- 2 If you put a check on [Specify moving distance] after clicking [XY movement], you can specify an amount of movement of the stage with the up, down, right, and left buttons.



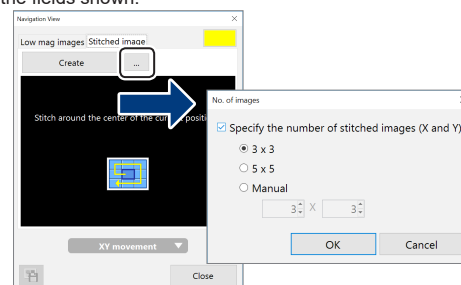
## Registering stitching images

- 1 Select the [Stitched image] tab in the [Navigation view] dialog box.
- 2 Click the [Create] button.



Centered on the current position, the XYθ stage is moved in a spiral pattern to be stitched.

**Reference** Clicking [...] can specify the stitching range by number of sheets in the [No. of images] dialog box. You can enter "3 x 3" and "5 x 5" with button operation. Other numbers also can be specified by entering them in the fields shown.



## Specifying Observation Position on Navigation Image

Click on a position you want to observe on the image in the [Navigation View] dialog box.

The XYθ stage moves to the position you clicked.

**Reference**

- By moving the mouse leftward while holding down its left button, the field of view of the navigation screen can be moved.
- Using the zoom in/out button, the navigation display can be zoomed in/out.
- Clicking [Save] enables you to display the [Rec] dialog box and to save the navigation image.

## Moving vertically and horizontally

You can move to a specified direction by clicking the horizontal and vertical arrows on the [Navigation View] dialog box.

# Advanced Operations

3

Basic Operation

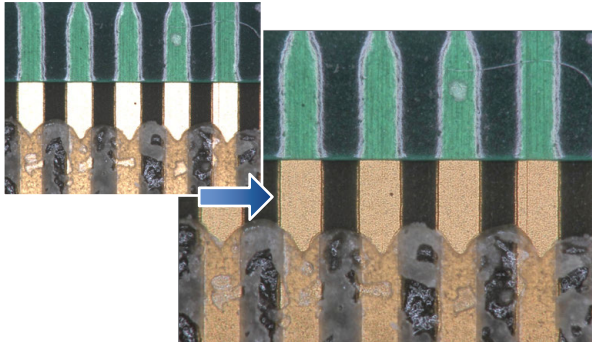
## Change illumination angle, during or after capture



For details, refer to □ "Changing the Lighting Method" (Page 5-3).

## Observe images without glare

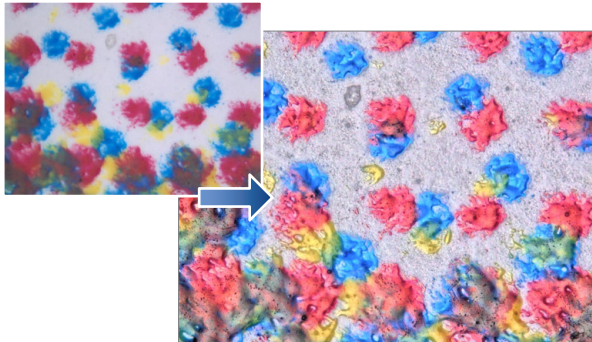
IC Pattern (200x)



For details, refer to □ "Removing Glare (Reflected light Removal)" (Page 8-6).

## Observe images using high color gradation

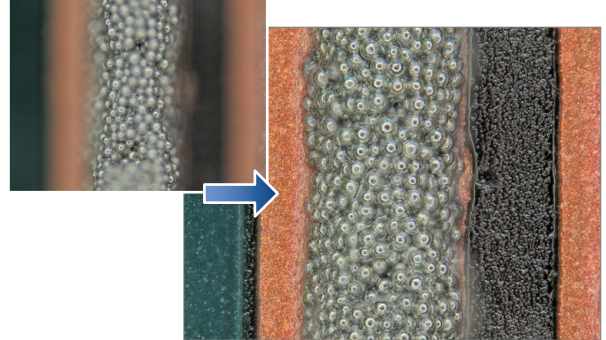
Dot printing (400x)



For details, refer to □ "Increase Resolution (HDR)" (Page 8-8).

## Observe images with an extended depth-of-field

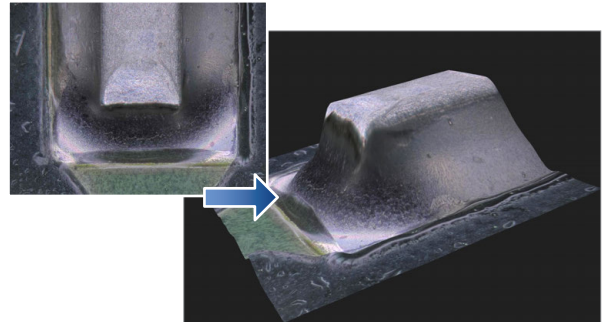
Solder paste (300x)



For details, refer to □ "Types and Features of Depth Composition" (Page 9-2).

## Observe images in 3D

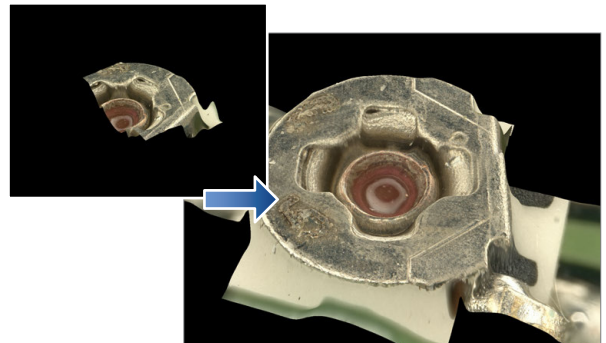
Solder (200x)



For details, refer to □ "View (3D display)" (Page 9-15).

## Observe a wide field-of-view under high magnification

Screw (200x)



For details, refer to □ "Automatic Image Stitching" (Page 10-2).

# 4

## Capturing and Saving Image

## How to Capture and Save Images

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# Capturing and Saving Still Images

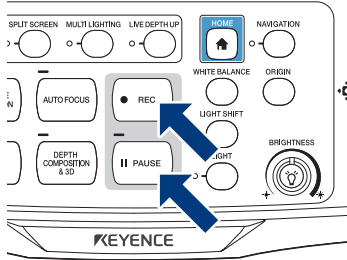
This section explains how to capture images.

Images can be captured and saved using the [REC] button on the console, or through the VHX MENU.

## Recording (Saving) from the Console

### 1 Press the [PAUSE] button on the console.

This pauses the image.



### 2 Press the [REC] button on the console.

This brings up the [REC] dialog box (Page 4-2).

**Reference**

- The resolution of the image will be set to the resolution set in [ ] "REC Settings" (Page 4-4) from the VHX MENU.
- It is possible to save images simply by pressing the [REC] button.
  - [ ] "Automatic Save Mode" (Page 4-5)
- If the REC button is pressed without pressing the [PAUSE] button, the current observation image is paused and the [REC] dialog box appears.

### 3 Select the folder to save the image in and enter a file name.

### 4 Click [Save].

This saves the image data and closes the [REC] dialog box.

## Recording (Saving) using the Direct Buttons

### 1 Click the [Pause] button.

This pauses the image.



### 2 Click the [Rec] button.

This brings up the [REC] dialog box (Page 4-2).

**Reference**

If the recording button is pressed without pressing the pause button, the current observation image is paused and the [REC] dialog box appears.

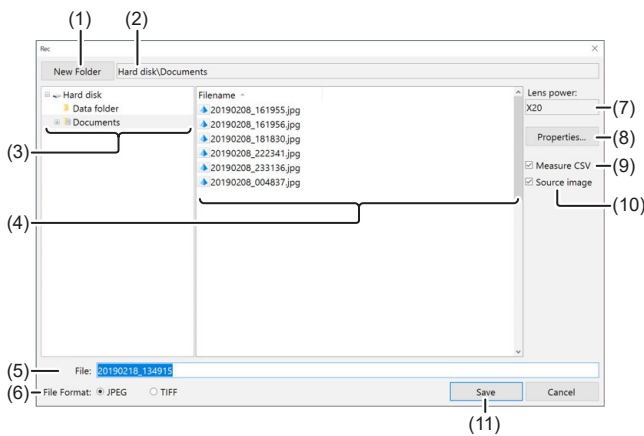
### 3 Select the folder to save the image in and enter a file name.

### 4 Click [Save].

This saves the image data and closes the [Rec] dialog box.

To playback the saved image, use [ ] "Album" (Page 11-2).

## Names and Functions on the [REC] Dialog Box



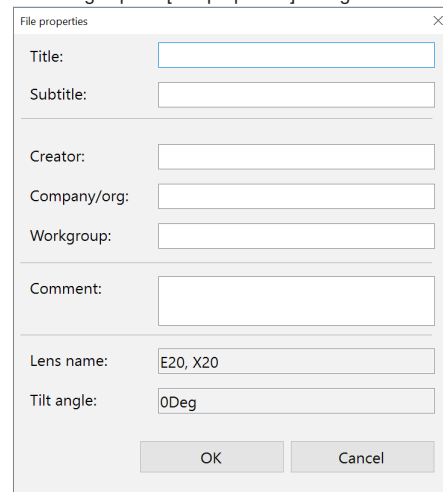
No	Name	Function
1	New Folder	Creates a new folder. ☐ "Creating a New Folder" (Page 4-3)
2	Folder location	Displays the folder containing the files being shown.
3	Folder tree	Displays the drives and folders. Click a folder to save the image in it.
4	Filename	Displays the files in the currently selected folder.
5	File name	Enter the file name to save the image.
6	File Format	Choose the format to save the image (either JPEG or TIFF). <ul style="list-style-type: none"> <li>• <b>JPEG (extension: jpg)</b> This is a common image file format. The data is compressed and saved. The file size for JPEG files is small compared to the image size.</li> <li>• <b>TIFF (extension: tif)</b> Saves the image data without compression. TIFF files offer better picture quality but have large file sizes which reduces the storage capacity.</li> </ul>
7	Lens power	Displays the lens magnification when capturing saved files.
8	Properties	Comments can be added to image files. ☐ "Entering Properties" (Page 4-3)
9	Measure CSV	If this option is checked, the image is saved as an image file with measurement data in CSV format. The CSV data can be extracted using the VHX-7000 Communication Software and imported into Excel, or other applications to complete further analysis. ☐ "Chapter 7 Measuring" (Page 7-1) ☐ "Extracting CSV Data" (Page 13-14)
10	Source image	If this option is checked, the image before measurement is saved as a "measurement source image".
11	Save	Saves the file.

## Entering Properties

Comments can be added to image files. The information entered here is saved as part of the image files recorded hereafter. Enter information in the properties as needed.

### 1 Click the [Properties] button.

This brings up the [File properties] dialog box.



### 2 Enter a title, subtitle, and any other information as needed.

Each field accepts up to 31 characters (comments can be up to 63 characters). Both double-byte or ASCII characters can be used.

### 3 Click [OK].

The settings are saved and the dialog box closes.

- ☐ Reference
  - The information entered in the property fields remain until the power is turned OFF and are reflected into all image files subsequently recorded. Restarting the microscope erases the information in the property fields.
  - The information set in the properties appears in the preview area (Page 11-5) of ☐ "Album" (Page 11-2).
  - Searches can be performed on the information entered in the property fields.

## Creating a New Folder

### 1 Click the folder where the new folder is to be created.

### 2 Click [New Folder].

A [New Folder] is created in the specified folder enabled for entering a folder name.

### 3 Enter a folder name and press the Enter key on the keyboard.

# REC Settings

Set recorded image size, automatic saving features. Perform recording settings and timer settings.

## REC Mode Settings

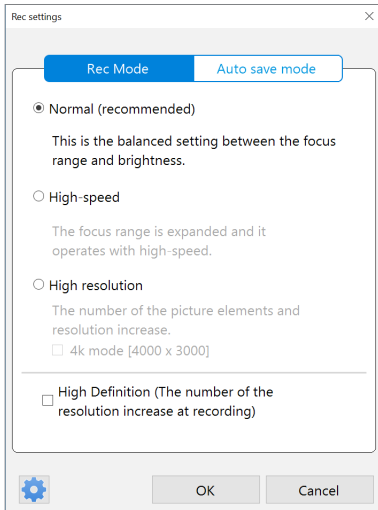
Select the resolution to use for recording images. Images can be recorded in higher picture quality than normal resolution by using the stage shift function.

**1** Click the  (REC settings) of the direct button.

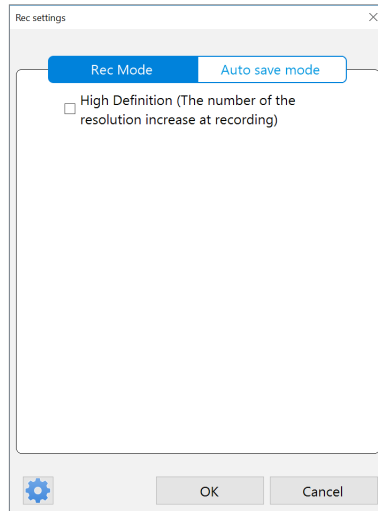


**2** Select [Rec Mode] to perform settings.

● In the case of the Fully-Integrated (FI) Head



● In the case of the High-Performance Camera



Set whether or not to use the stage shift function by checking ON/OFF [High Definition].

The saved resolution size becomes as follows:

- High definition ON: 6144 x 4608 pixels
- High definition OFF: 2048 x 1536 pixels

**3** Click [OK] to save the settings.

Rec Mode	Iris	Saved resolution size (pixel)	
		High Definition OFF	High Definition ON
Normal	Recommended value	2880 x 2160	12000 x 9000
High-speed	Close	2048 x 1536	-
High resolution (4k mode: OFF)	Open	2880 x 2160	12000 x 9000
High resolution (4k mode: ON)	Open	4000 x 3000	12000 x 9000

- Reference**
- Camera iris is adjusted automatically according to the recording mode.
  - If selecting [High Definition], the stage shift function is used at recording.

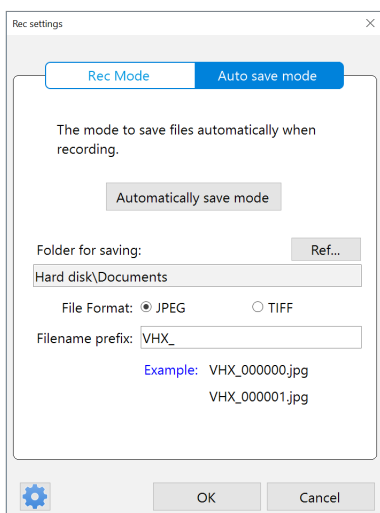
## Automatic Save Mode

Press the [REC] button on the console, or simply click the [Rec] button on the direct menu to record (save) images using the predefined file name, folder, and image format.

### 1 Click the (REC settings) button.



### 2 Select [Auto] to perform settings.



#### ● Folder for saving

Click [Ref...] and specify the folder to save image files in the [Select Folder] dialog box.

**Reference** To create a new folder, click [New Folder] in the [Select Folder] dialog box.  
 □ "Creating a New Folder" (Page 4-3)

#### ● File format

Select [JPEG] or [TIFF].

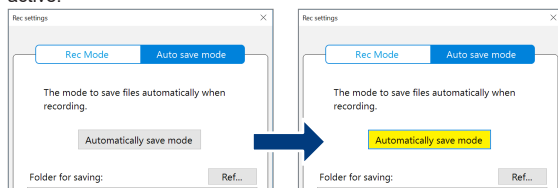
#### ● Filename prefix

The end of each file name is automatically numbered from 000000 to 999999 when the file is saved.  
 [File name prefix] can be up to 20 characters long. Both double-byte or ASCII characters can be used.

**Reference** The Auto Rec file names are named in following manner when [File name prefix] is entered as "VHX\_":  
 VHX\_000000  
 VHX\_000001  
 VHX\_000002.....

### 3 Click [Automatically save mode].

The button turns yellow indicating automatically save mode is active.



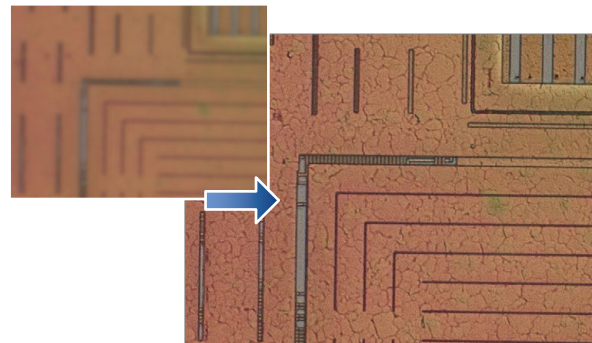
Clicking [Automatically save mode] again returns to Normal Rec mode.

## Fine Shot Settings

This function increases sharpness of images to record finer images with consideration for properties of the lens.

This function is most effective at a higher magnification area.

[Sensor (x1000)]



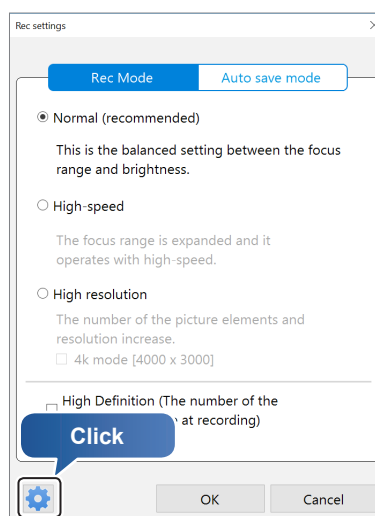
**Point** This is the function applied at pausing. Normally, it is set to ON.

If you want to disable fine shot, perform the following:

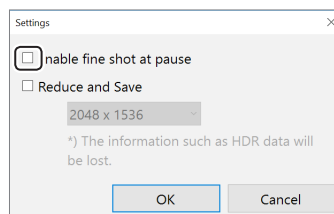
### 1 Click the (REC settings) button.



### 2



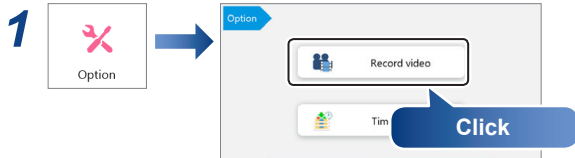
### 3 Turn off the check mark.



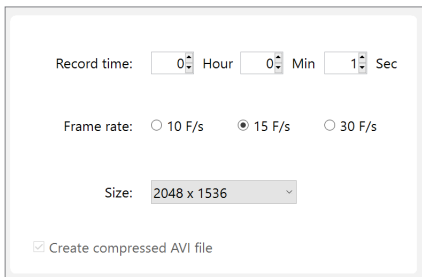
# Video Recording

Observed images can be recorded as digital video (AVI format) and played back.  
 Each image can be recorded in 640 x 480, 800 x 600, 2048 x 1536, 2880 x 2160-pixel resolution for up to three hours.  
 Saved video files can be played back on the VHX-7000 or a PC.

## Video Recording Settings



### 2 Perform video recording settings.



#### ● Frame rate

- 10 F/s .....Records 10 frames per second. (Fully-Integrated (FI) Head only)
- 15 F/s .....Records 15 frames per second.
- 30 F/s .....Records 30 frames per second. Videos are smooth even when recording fast-moving objects.
- 50 F/s .....Records 50 frames per second. (High-Performance Camera only)

**Point**

- The recording size will be set to “800 x 600” or “640 x 480” when the frame rate is set to 30F/s.
- The recording size will be set to only 640 x 480 when the frame rate is set to 50F/s.

#### ● Record time

The [Hour], [Min], and [Sec] can be specified.  
 The recording time is from 1 second to 3 hours.

**Point** To record at stable frame rates, set recording time to five seconds or more.

#### ● Size

Increasing the recording size improves the picture quality but shortens recording time.

#### ● Create compressed AVI file

If this option is checked, the file is compressed when the AVI file is created.  
 This reduces the file size.

## Frame rates and recording times

### ● In the case of the Fully-Integrated (FI) Head

Frame rate	Compressed/Uncompressed	Recording time		
		2880 x 2160	2048 x 1536	800 x 600
30 F/s	Uncompressed	-	-	1 sec to 5 min
	Compressed	-	-	1 sec to 30 min
15 F/s	Uncompressed	-	-	1 sec to 10 min
	Compressed	-	1 sec to 5 min	1 sec to 1 hour
10 F/s	Uncompressed	-	-	1 sec to 20 min
	Compressed	1 sec to 5 min	1 sec to 5 min	1 sec to 2 hours

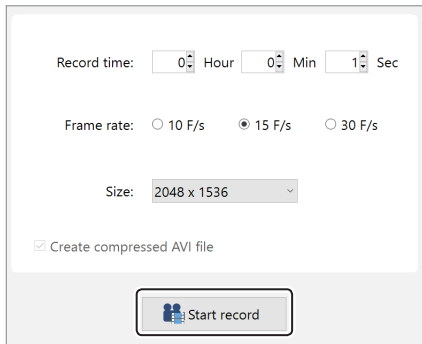
### ● In the case of the High-Performance Camera

Frame rate	Compressed/Uncompressed	Recording time		
		2048 x 1536	800 x 600	640 x 480
50 F/s	Uncompressed	-	-	1 sec to 10 min
	Compressed	-	-	1 sec to 50 min
30 F/s	Uncompressed	-	1 sec to 10 min	1 sec to 15 min
	Compressed	-	1 sec to 1 hour	1 sec to 1 hour and 30 min
15 F/s	Uncompressed	-	1 sec to 20 min	1 sec to 30 min
	Compressed	1 sec to 5 min	1 sec to 2 hours	1 sec to 3 hours

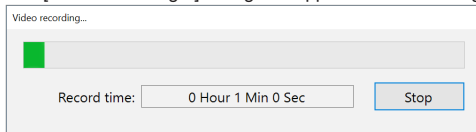


## Recording and Saving Videos

**1 Perform the video recording settings, then click [Start record].**



The [Video recording...] dialog box appears and recording starts.



When the recording is complete, the [Record video] dialog box opens.

**Reference** To exit while recording, click [Stop]. When a confirmation dialog appears, click [Yes] to save the partway recorded video.

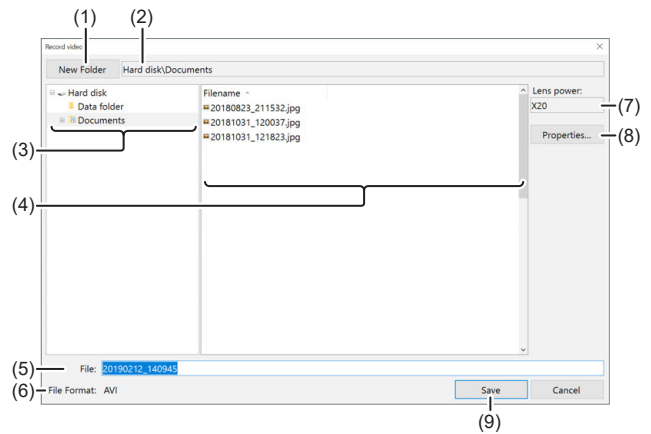
**2 Select the folder to save the video in and enter a file name.**

**3 Click [Save].**

The video data are saved and the [Record video] dialog box closes. To play the saved video, use "Album" (Page 11-2).

**Point** Clicking [No] discards the recorded video data.

## Names and Functions on the [Record video] Dialog Box

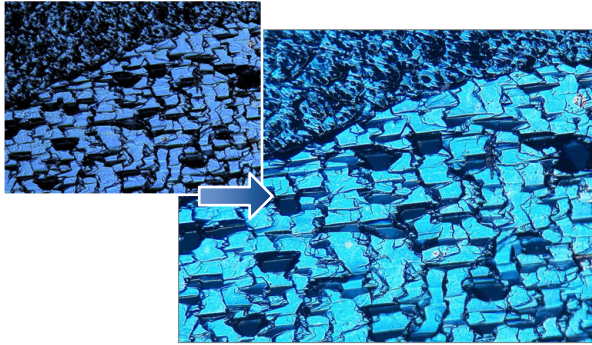


No	Name	Function
1	New Folder	Creates a new folder. "Creating a New Folder" (Page 4-3)
2	Folder location	Displays the folder containing the files being shown.
3	Folder tree	Displays the drives and folders. Click the folder to save the image in.
4	Filename	Displays the files in the currently selected folder.
5	File name	Enter the file name to save the image.
6	File format	Displays the format to save the image (AVI).
7	Lens power	Displays the lens magnification when capturing saved files.
8	Properties	Used to add comments to video files. "Entering Properties" (Page 4-3)
9	Save	Saves the file.

# Sharpening Image Mode

This function enhances contours in vivid color.

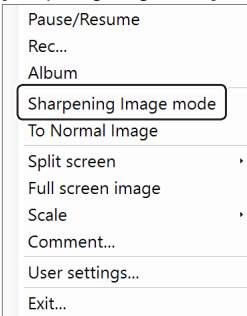
[Solar battery cell (500x)]



## 4

### Sharpening Image Mode Settings

Right-click the mouse over the observation window and select [Sharpening Image mode] from the pop up menu.



This applies vivid color enhancements and profile emphasis to the image.

#### ● Releasing [Sharpening Image mode]

From the right-click menu, select [Sharpening Image mode] again, or select [To Normal Image].

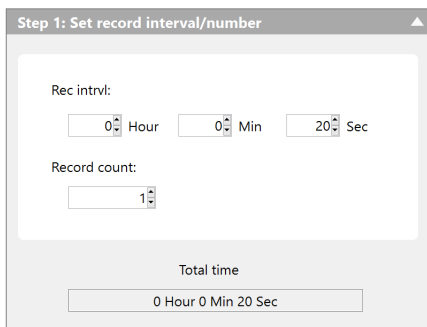
# Timer Record

The Timer Rec function automatically records images at preset intervals and times. This is useful when observing objects that change or grow by automatically recording at fixed time intervals.

- Point**
  - The minimum time for the record interval is 20 seconds, and the maximum time is 99 hours 59 minutes 59 seconds.
  - The record interval at least 1 minute is required at lighting ON/OFF link.
  - If the destination drive becomes full, timer recording ends.



## 2 Set record interval/number.



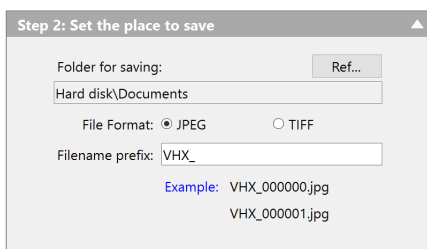
### ● Rec interval

Set the recording interval.  
From 20 seconds to 23 hours 59 minutes 59 seconds.

### ● Record count

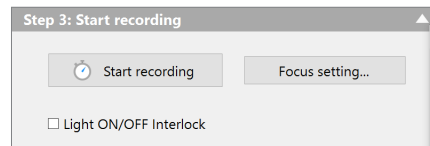
Set the number of recordings to make at the preset recording interval.  
1 to 9999 counts

## 3 Set the place to save.



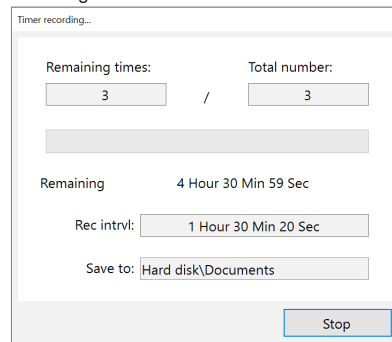
The setting content is the same as the automatically save mode.  
☐ "Automatic Save Mode" (Page 4-5)

## 4 This starts timer recording.



### ● Start recording

This starts timer recording. The message [Timer recording...] appears in the dialog while timer recording.

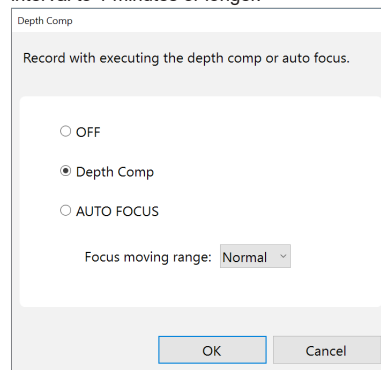


Clicking the [Stop] button stops timer recording. Recording data is saved to the hard disk until timer recording ends or is stopped.

The recording can be played back and deleted using the Album function (Page 11-2).

### ● Depth composition

During timer recording, depth composition or autofocus can also be used. When either of these functions are used, set the recording interval to 1 minutes or longer.



### ● Light ON/OFF Interlock

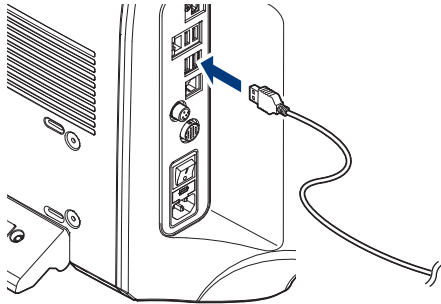
If the recording interval is 1 minutes or longer, setting this option turns the lamp on only while recording.

# Printer

Observed images can be printed directly, while recorded (saved) images can be selected for printing by using the album function.

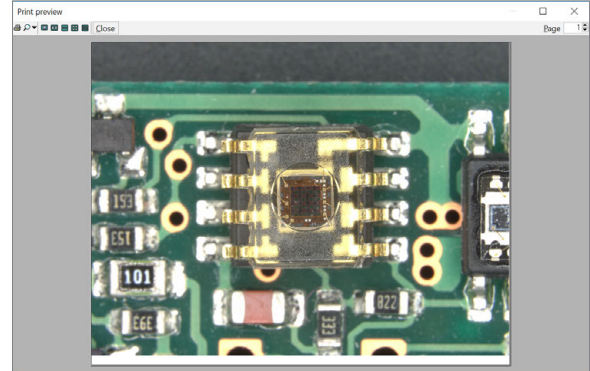
## Connecting the Printer

- 1 Connect USB cable to the printer and the USB port on the microscope.




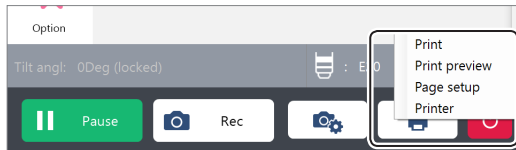
## Print preview

The [Print preview] dialog appears. This allows you to preview the printed image.



## Print Settings

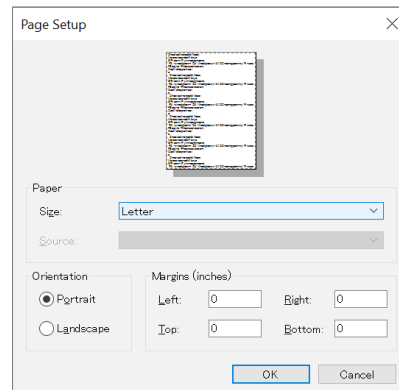
- 1 Click the  (Print settings) of the direct button.



The menu relating to print appears.

## Page Setup

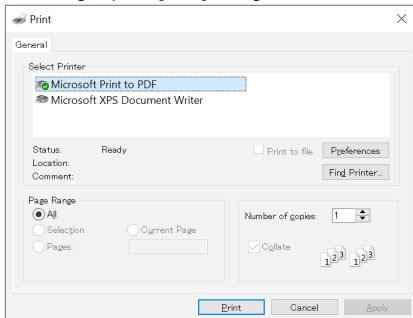
[Page setup] appears. Perform settings for the paper size or page orientation fitting to the connected printer.



**Reference** When printing images of this microscope, set [Orientation] to [Landscape]. If [Portrait] is selected, the image will be reduced to fit within the width of the paper.

## Print

This brings up the [Print] dialog box.



Specify the [Number of copies] and click [Print].

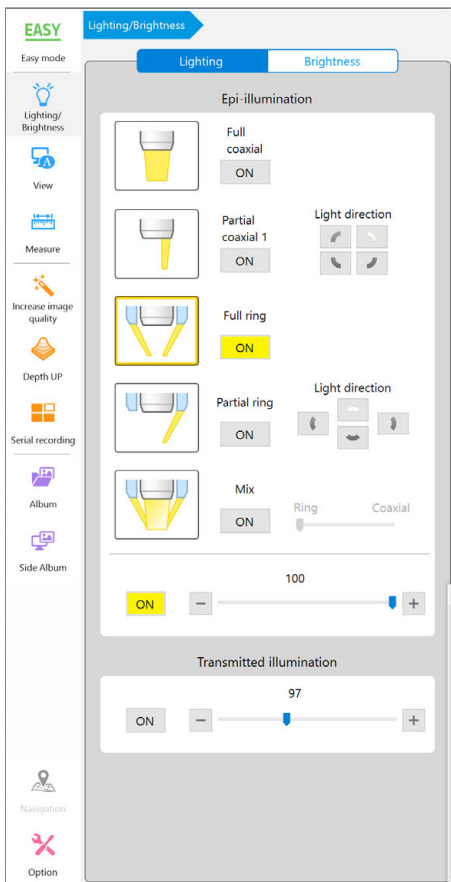
## Printer

The [Printer] screen appears. Select the printer to use. Normally, no changes are necessary.

# 5

## Lighting/Brightness Settings

## Lighting/Brightness Settings



<b>Switching Lighting ON/OFF</b> .....	<b>5-2</b>
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Adjusting Brightness on the Console .....	5-5
Adjusting the Brightness by VHX MENU. ....	5-5

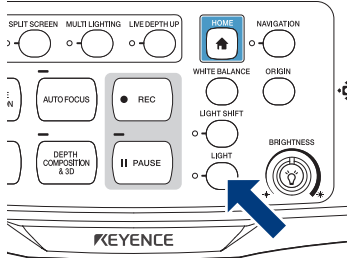
# Switching Lighting ON/OFF

This section explains how to turn the lighting on and off. The lighting on and off can be adjusted using the [Light ON/OFF] button on the console or through the [Lighting/Brightness] from the VHX MENU. Normally, the light is turned ON at maximum intensity. Adjustments should be made as necessary if an external light is being used for the observation.

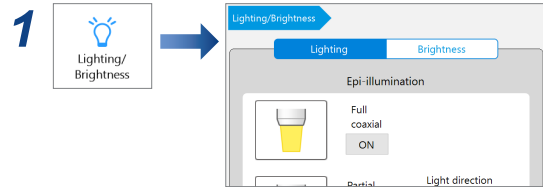
## Operation on the Console

### 1 Press the [Light] button on the console.

The LED on the [Light] button goes off, and lighting goes off. Pressing the LIGHT button again turns the top down light on.

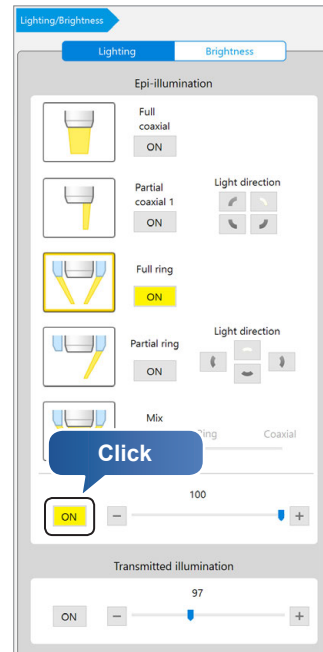


## Operation from the VHX MENU



**Reference** The screen display changes automatically according to the connected camera and lens. For more details, use the "Changing the Lighting Method" (Page 5-3).

### 2 Clicks the button and changes lighting on and off.



**Reference** Adjusts the brightness in 100 steps by the slider. Normally used in the MAX (rightmost) position.

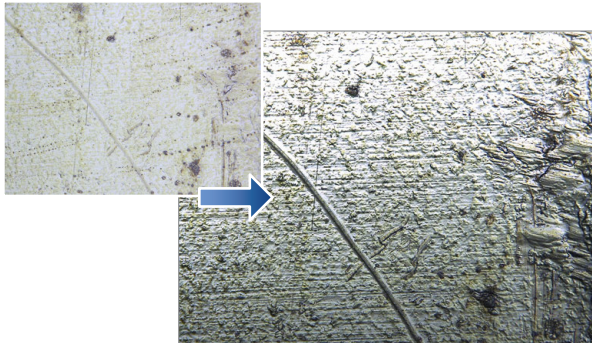
### ● Transmitted illumination

Set the transmitted illumination to ON or OFF. This adjusts the brightness in 256 steps by dragging the slider on the screen. Normally used in the MAX (rightmost) position.

# Changing the Lighting Method

## Effect of Lighting

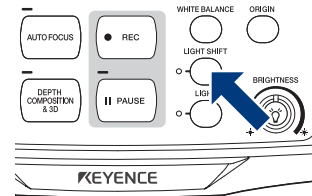
By changing how the light is applied, height differences of the object becomes more noticeable and clearer observation is possible.



## Light shift

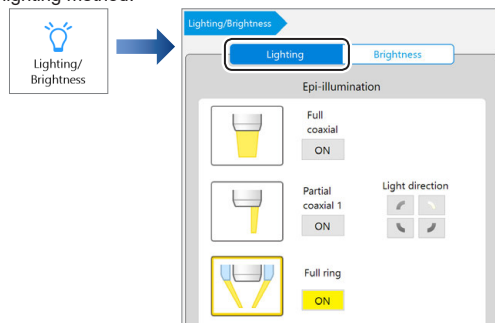
### ● Console

For each pressing the [LIGHT SHIFT] button, the lighting method changes.



### ● VHX MENU

Select the [Lighting] tab in the [Lighting/Brightness] menu, then select the lighting method.



## Differences by cameras, lenses, and options to be connected

The illumination selections may differ depending on the lens and options used. Lenses and lighting available for the microscope are as follows.

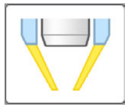
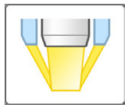
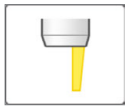
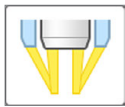
Camera	Lens	Ring illumination unit/dedicated ring	Lighting unit usage	Lighting type				
Fully-Integrated (FI) Head	VHX-E20	-	-	Full coaxial	Partial coaxial 1	Full ring	Partial ring	Mix
	VHX-E100	-	-	Full coaxial	Partial coaxial 1	Full ring	Partial ring	Mix
	VHX-E500	-	-	Full coaxial	Partial coaxial 1	Full ring	Partial ring	Mix
	VHX-E2500	-	-	Full coaxial	Partial coaxial 1	-	-	-
High-Performance Camera	VH-Z00R/T	-	-	Full ring	Partial ring	-	-	-
	VH-Z20R/T	-	-	Full ring	Partial ring	-	-	-
	VH-Z20UR/T	-	✓	Full coaxial	Full ring	Partial ring	Mix	-
	VH-Z50L/T	Not attached	✓	Full coaxial	Partial coaxial 1	Partial coaxial 2	-	-
		Attached	✓	Full coaxial	Partial coaxial 1	Full ring	Partial ring	Mix
	VH-Z100R/T	Not attached	✓	Full coaxial	Partial coaxial 1	Partial coaxial 2	-	-
		Attached	✓	Full coaxial	Partial coaxial 1	Full ring	Partial ring	Mix
	VH-Z100UR/UT	Not attached	✓	Full coaxial	Partial coaxial 1	Partial coaxial 2	-	-
		Attached	✓	Full coaxial	Partial coaxial 1	Full ring	Mix	-
	VH-Z250R/T	-	✓	Full coaxial	Partial coaxial 1	Partial coaxial 2	-	-
VH-Z500R/T	-	✓	Full coaxial	Partial coaxial 1	Partial coaxial 2	-	-	
VH-ZST	-	✓	Full coaxial	Partial coaxial 1	Full ring	Partial ring	Mix	



- To use ring illumination at VH-Z100R/T or VH-Z100UR/UT, ring illumination unit (OP-88164) is required.
- To use ring illumination with VH-Z50L/T, the Z50 ring illumination unit (OP-88135) is required.

## Lighting available at VHX-7000 and features

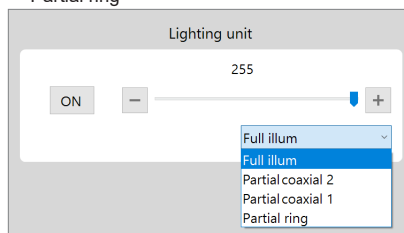
### Epi-illumination

Lighting	Feature
 <p>Full ring</p>	Dark-field observation is possible.
 <p>Partial ring</p>	Dark-field can be used to enhance and observe flaws, etc. Four types of light directions can be selected.
 <p>Full coaxial</p>	Bright-field observation is possible.
 <p>Partial coaxial 1</p>	Bright-field can be used to enhance and observe flaws, etc.
 <p>Partial coaxial 2</p>	Bright-field can be observed to limit the brightness of the center.
 <p>Mix</p>	The combination of the ring illumination and coaxial vertical can be adjusted.
 <p>Full illumination</p>	Lighting method varies according to the fiber cable used. General lighting: Full coaxial Lighting when using base unit: Mixing of Ring and Full coaxial
 <p>Partial illumination</p>	Lighting method varies according to the fiber cable used. General lighting: Partial coaxial 1 Lighting when using base unit: Partial ring
 <p>Ring</p>	Lighting method varies according to the fiber cable used. General lighting: Partial coaxial 2 Lighting when using base unit: Ring
<p>Partial coaxial</p>	

### Lighting unit

When using lighting unit, the following lighting methods can be used:

- Full illumination
- Partial coaxial 2
- Partial coaxial 1
- Partial ring



The [Lighting unit] setting appears when "Light unit for a High-Performance Camera" is connected.



# Adjusting Image Brightness

This section explains how to adjust image brightness.

Image brightness can be adjusted using [BRIGHTNESS] dial on the console, or [Lighting/Brightness] from the VHX MENU.

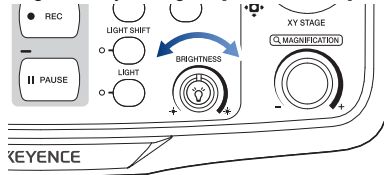
Normally, the brightness is adjusted using [BRIGHTNESS] dial on the console. To make detailed settings, use [Lighting/Brightness] from the VHX MENU.

## Adjusting Brightness on the Console

Adjust the brightness of the image by adjusting the shutter speed (Auto shutter).

If the object is dark, the controller will automatically increase the gain.

Adjust the brightness by turning the [BRIGHTNESS] dial on the console.



Turning right brightens the image and turning left darkens the image. With the brightness dial turned clockwise, the supercharge shutter function in the long exposure mode starts to work from a halfway rotated position.

## Adjusting the Brightness by VHX MENU

### Shutter speed

Set to use a fixed shutter speed.

- Increasing the shutter speed results in darker images but reduces the blur of moving objects.
- Reducing the shutter speed results in blurred images if the object is moving, but produces brighter images.

Auto	The shutter speed is automatically adjusted to the brightness setting. The shutter speed changes as the condition of the lighting or object changes.
Manual	Adjust the shutter speed. <ul style="list-style-type: none"> <li>• Fully-Integrated (FI) head: 0.06ms to 33ms</li> <li>• High-Performance Camera: 0.03 ms to 20 ms</li> </ul> Manual allows a more precise adjustment than preset. The shutter speed never changes even if the condition of the lighting or object changes.
Super-charge	Adjust the exposure time of the supercharge shutter. <ul style="list-style-type: none"> <li>• Fully-Integrated (FI) Head: 33 ms to 4 s</li> <li>• High-Performance Camera: 20 ms to 16 s</li> </ul>
Preset	Select the shutter speed. <ul style="list-style-type: none"> <li>• Fully-Integrated (FI) Head: 1/30 to 1/19000 seconds</li> <li>• High-Performance Camera: 1/60 to 1/19000 seconds</li> </ul> The shutter speed remains fixed even if the lighting condition of the object changes.

### Gain

Normally, the brightness is adjusted using the [BRIGHTNESS] dial on the console. Use the gain when you want to adjust the brightness according to the object or lighting while using a fixed shutter speed.

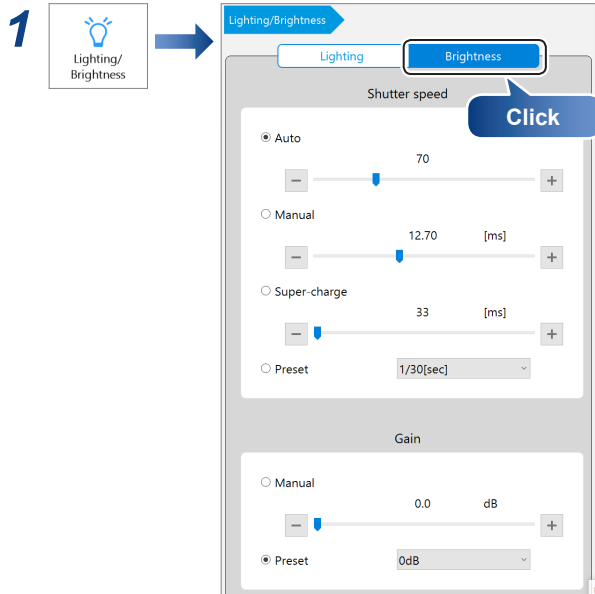
Manual	Adjust the gain amplification ratio. <ul style="list-style-type: none"> <li>• Fully-Integrated (FI) Head: 0 to 12 db</li> <li>• High-Performance Camera: 0 to 18 db</li> </ul> Manual allows a more precise adjustment than preset. The gain remains fixed even if the condition of the object or lighting changes.
Preset	Select the gain amplification ratio. <ul style="list-style-type: none"> <li>• Fully-Integrated (FI) Head: 0db/6db/12db</li> <li>• High-Performance Camera: 0db/6db/18db</li> </ul> The gain remains fixed even if the condition of the object or lighting changes.



Point

**Increasing the gain causes noise that can degrade the picture quality.**

## Shutter speed and gain adjustment



### 2 Perform brightness settings.

#### ● Shutter speed

For [Manual] or [Super-charge], adjust by dragging the slider.  
For [Preset], select a value from the list box.

**Point** When [Auto] is selected, the shutter speed behaves the same way the [BRIGHTNESS] dial does on the console. The [BRIGHTNESS] dial on the console always overrides the shutter speed set from the VHX MENU and sets the shutter speed to [Auto].

#### ● Gain

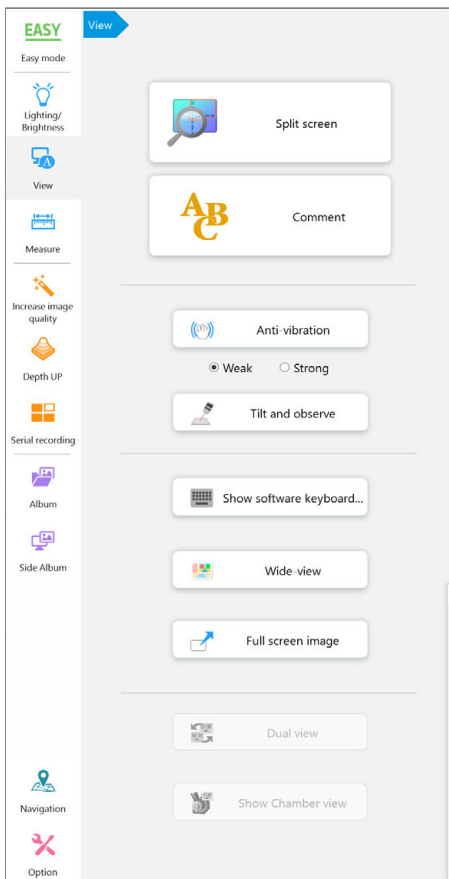
For [Manual], adjust by dragging the slider.  
For [Preset], select a value from the list box.

**Point** The [BRIGHTNESS] dial on the console always overrides the gain set from the VHX MENU and sets the gain to "Manual, 0 dB".

# 6

## View/Comments

## Viewing/Commenting Methods to Increase Communication Clarity



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# Split Screen /Zoom

## Screen Split

The observation window can be displayed as split screens. This allows you to view micro and macro view images of the target side by side, or compare a saved image to a live image side by side.

**Point** Only one of the split screens can be used for viewing the live observation screen.

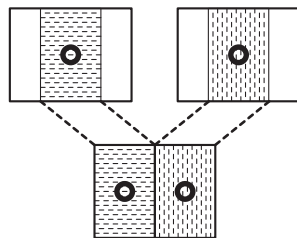
## Types of Split Screens

The split screen can be selected from the four types: vertical split, horizontal split, quarter split, and nine-way split. Split screens can be printed and saved.

- ☐ "Capturing and Saving Still Images" (Page 4-2)
- ☐ "Print Settings" (Page 4-10)

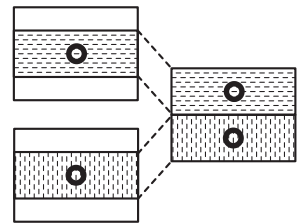
### Vertical Split

This tiles the screen on the left and right. Each screen displays 50% of their respective observation images from the center. In the paused state, you can zoom in/out an image with a mouse wheel and can change the display position by dragging an image.



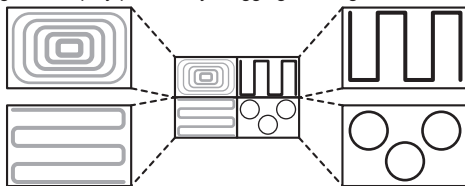
### Horizontal Split

This tiles the screen on the top and bottom. Each screen displays 50% of their respective observation images from the center. In the paused state, you can zoom in/out an image with a mouse wheel and can change the display position by dragging an image.



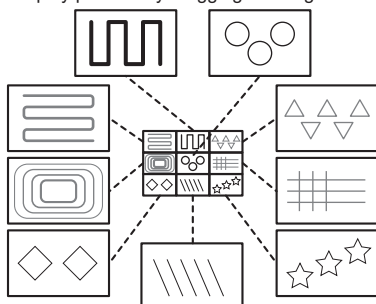
### Quarter Split

This tiles the screen into four portions. The overall image is reduced to a fourth and displayed. In the paused state, you can zoom in/out an image with a mouse wheel and can change the display position by dragging an image.



### 9-way Split

This tiles the screen into nine portions. The overall image is reduced to a ninth and displayed. In the paused state, you can zoom in/out an image with a mouse wheel and can change the display position by dragging an image.

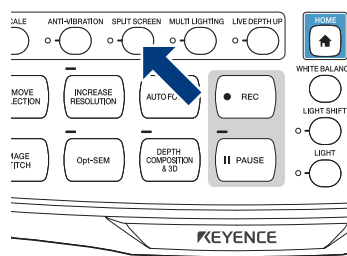


## Splitting Screen for Display

### 1 Enable the screen split on the console or VHX MENU.

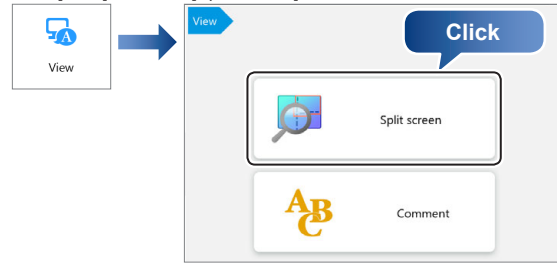
#### ● Operation on the Console

Press the [SPLIT SCREEN] button on the console.

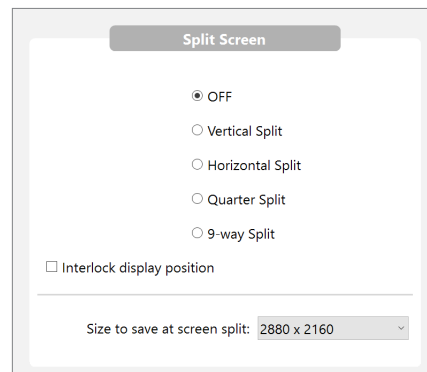


#### ● Operation from the VHX MENU

Click [View] and click [Split screen].



### 2 Select the type of split screen.



The screen appears in split.

- If a half split is selected, the left (or top) screen shows the center portion of the original image.
- For a quarter split (or 9-way split), the upper left of the screen shows the entire original image reduced to a fourth (or a ninth).

#### Reference

- Checking of [Interlock display position] is valid only when normal size (2048 x 1536) images are displayed in all screens.
- During the zoom view, you can move the display area at the [Wide-view] dialog box.

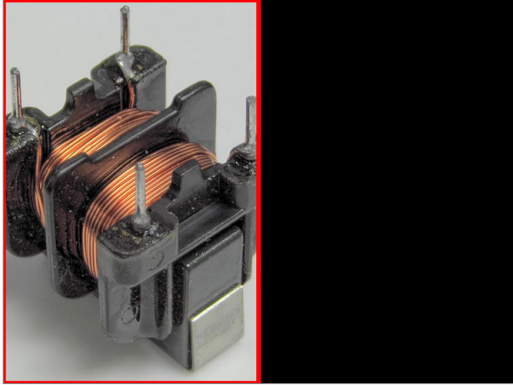
## Comparing Two Images

This section explains how to observe and compare two images using the vertical split.

### Comparing two views of the currently displayed image

#### 1 Select [Vertical Split] on the split screen tab.

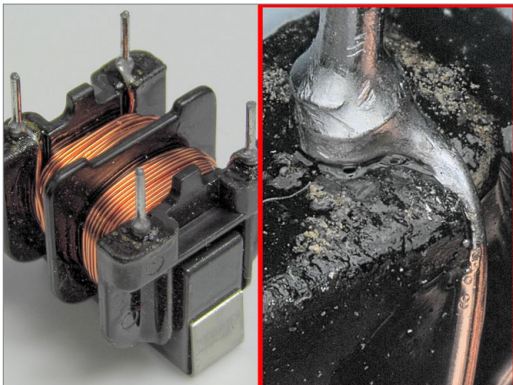
This tiles the screen on the left and right. The center portion of the original image is shown in the left screen. A red frame appears in the left screen to indicate the region under control.



#### 2 Click the right screen (black screen).

This selects the right screen. The left screen changes to a still image while the right screen starts displaying the live video image (the observation window).

#### 3 Display the image to compare against on the right screen.



Reference

- When clicking the left screen, the right screen changes to a paused image. The image inside the red frame is the target of control. When clicking the [Pause] from on-screen menu options or [Pause/Cancel Pause] at the right click menu, the screen returns to the live observation screen.
- To exit the split screen, select [OFF] from [Split screen].

### Comparing against a saved image

Split the screen and select an image from the album. You can also select and compare two stored images using both left and right screens.

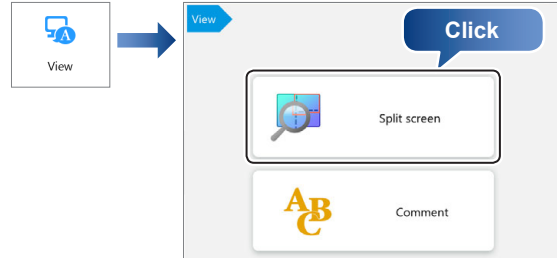
## Wheel Zoom

This function digitally enlarges the currently displayed image (Video digital zoom). This allows the image to be observed while it is enlarged.

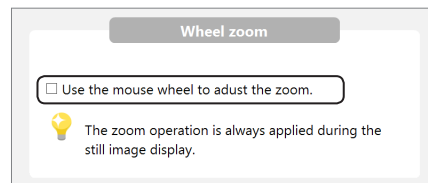
Point

The screen will become grainy as you increase the zoom factor. To obtain a cleaner image, use a high power lens.

1



#### 2 Select the [Use the mouse wheel to adjust the zoom.] check box.



You can enlarge images by controlling the mouse wheel while the pointer is on the observation window. When selecting the [Interlock display position] check box in the [Split screen] settings, all images are enlarged when image in the split screen is enlarged.

Reference

When changing the zoom ratio, the [Wide-view] dialog box will be displayed.

# Displaying Text and Markers (Comment)

Text comments and markers can be displayed on the observation window.


When an image is recorded (saved) with the comment display turned on, the image is saved with the comment.



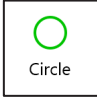
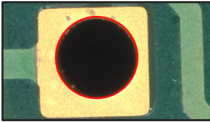



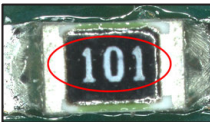

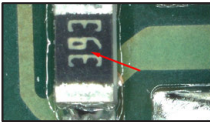
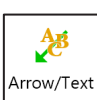

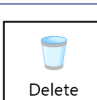

Comments can be [Normal Comments], which are erased when the power is turned OFF, or [Residual Comments] which are saved even if the power is turned OFF.

 **Point** When an image file is saved with comments, the text or comments cannot be edited.

## List of Comments

### Normal Comments

 **Reference** The total maximum number of normal comments that can be registered is 999.

Type	Drawing method	Displayed image
 Comment	Displays the comment in the location specified on the screen.	
 Circle	Draws a circle centered at the clicked point.	
 Rectangle	Draws a rectangle with one of its corners on the clicked point.	
 Ellipse	Draws an ellipse that starts at the clicked point.	
 Arrow	Draws a line that originates at the clicked point. The arrow appears at the origin.	
 Arrow/Text	Draws a line that originates at the clicked point. The arrow appears at the origin, and the comment appears at the end point.	
 Delete	Deletes the comment specified using the mouse. [Residual Comments] cannot be deleted.	-
 Del All	Deletes all normal comments. [Residual Comments] cannot be deleted.	-
Line color/ Thickness	Color and line width for drawing circles, rectangles, etc., can be set.	-

### Residual Comment

Type	Content	Display format
Comment	Displays the applicable text.	-
Date	Displays the date.	<ul style="list-style-type: none"> <li>• YYYY/MM/DD</li> <li>• YY/MM/DD</li> <li>• MM/DD/YYYY</li> <li>• MM/DD/YY</li> <li>• DD/MM/YYYY</li> <li>• DD/MM/YY</li> </ul>
Time	Displays the current time updated in real time.	hh:mm:ss
Lens name	Displays the lens type and power.	Lens [type]:x [power]
Magnification	Displays the magnification.	Magnification:x [magnification]
Tilt angle	Displays the inclination angle of the stage.	Inclination angle: [value] degree

### Hide

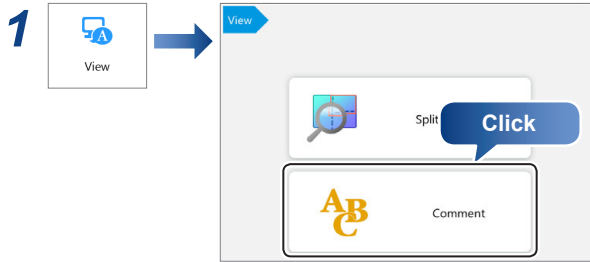
Hides all comments.

### Delete all comments

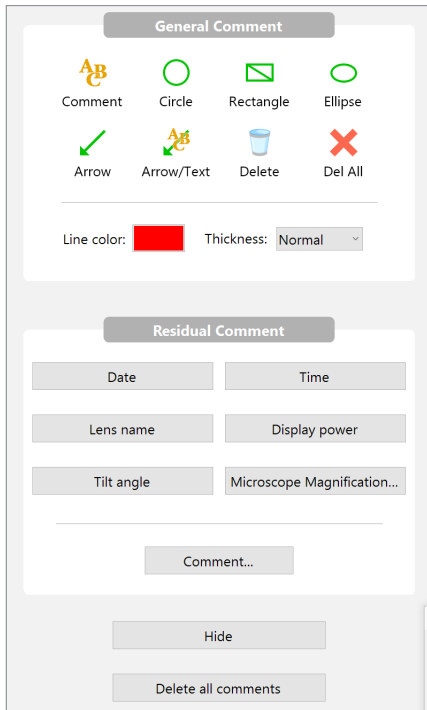
Deletes all comments.

## Entering and Specifying Comment Text and Markers

**Point** Normal comments are deleted when the power is turned off.



This area displays a menu for the Normal Comments and Residual Comments.



**2** Click the comment and marker (symbol) to enter from the Normal Comments.

The comment and marker is drawn on the observation window.

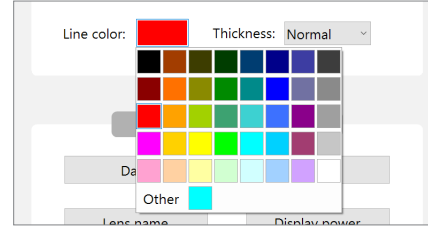
## Changing the line color and line width

The color and width of the lines used to draw the markers for circles, rectangles, and arrows can be set beforehand. Any markers added after making these changes reflect the specified color and width.

**Reference** To modify the color and width of markers already drawn, double-click the marker.

### Changing line color

Click the [Line color] button and select a color.



**Reference** If clicking [Other], any color can be created.

### Setting thickness (Line width)

Select from [Thin], [Normal], and [Thick].



## Normal comments

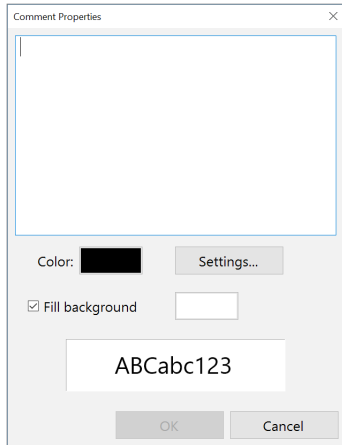
### Comments

Text can be entered and displayed as a comment on the observation window.

**Reference** If you want the same comment to always appear in the observation window, specify a residual comment (Page 6-7).

### Entering comments

- 1 Click [Comment] and enter the comment in the [Comment Properties] dialog box.



**Reference** Clicking [Settings] to set the comment font or size.

- 2 Click [OK] and click the position on the observation window to display the comment.

The comment appears.

- Reference**
- The comment can be moved by clicking with the left mouse button and dragging.
  - Double-clicking the currently displayed comment displays its [Comment Properties] allowing you to edit the comments and settings.

### Circle

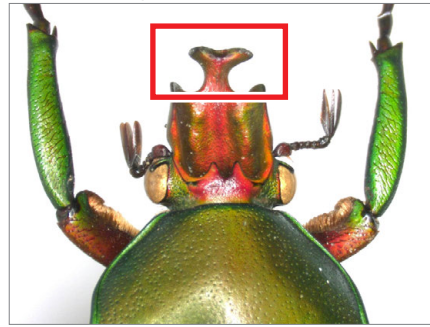
Drawing a circle marker on the observation window.  
**Click the [Circle] icon. On the observation window, click a point for the circle's center and then click a point on the circle's diameter.**



**Reference** The circle marker can be moved to another position by clicking on the circumference with the left mouse button and dragging.

### Rectangle

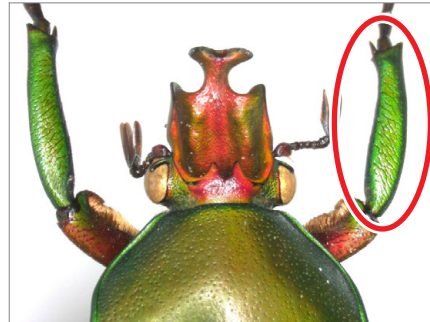
Drawing a rectangle marker on the observation window.  
**Click [Rectangle]. On the observation window, click two diagonal corners for the rectangle.**



**Reference** The rectangle marker can be moved to another position by clicking on the outline with the left mouse button and dragging.

### Ellipse

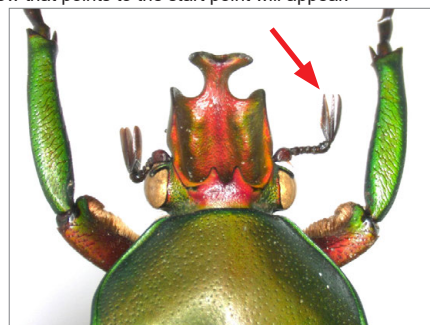
Drawing an ellipse marker on the observation window.  
**Click [Ellipse]. On the observation window, click two diagonal corners for a rectangle that will contain the ellipse.**  
 The ellipse is drawn.



**Reference** The ellipse marker can be moved to another position by clicking on the perimeter with the left mouse button and dragging.

### Arrow

Drawing an arrow marker on the observation window.  
**Click [Arrow]. On the observation window, click the start and end point for the arrow.**  
 An arrow that points to the start point will appear.



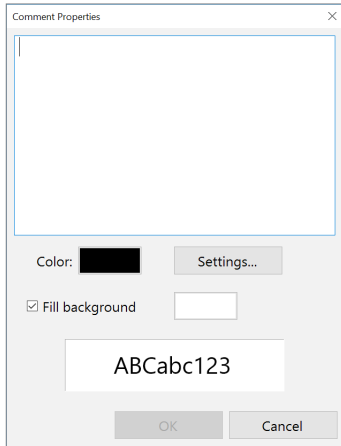
**Reference** The arrow marker can be moved to another position by clicking on the line with the left mouse button and dragging.



## Arrow/Text

Drawing arrow/text comments on the observation window.

- 1 Click [Arrow/Text] and enter the comment in the [Comment Properties] dialog box.



**Reference** Clicking [Settings] to set the comment "font".

- 2 Click [OK]. On the observation window, click the start and end point for the arrow.

An arrow marker that points to the start point and the comment will appear.

- Reference**
- The comment and arrow marker can be moved separately by clicking the left mouse button and dragging.
  - Double-clicking the currently displayed comment displays its [Comment Properties] allowing you to edit the comments and settings.

## Deleting normal comments

After the normal comments show up on the screen, selected comments or markings can be deleted.

### Deleting one specified normal comment

Click [Delete]. On the observation window, click the comment or marker to delete.

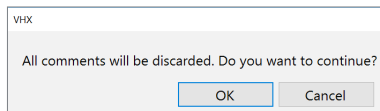
Click any of the text in the comment or on the line of the marker to delete only one item.

**Reference** Only normal comments can be deleted.

### Deleting all normal comments

Click [Del All].

The confirmation dialog box appears. Clicking [OK] deletes all normal comments.



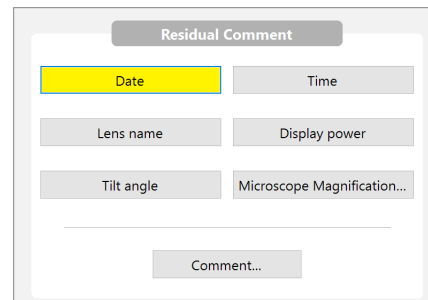
## Entering and Setting Residual Comments

Residual comments show both user-specified comments and information on the observation image, such as its lens name, date, time, etc.

For residual comments, the display contents and position are retained for each user setting. The display contents and position can be changed by changing user setups (Page 12-2).

- Reference**
- The comment can be moved by clicking with the left mouse button and dragging.
  - Double-click comments in view to set the residual comments font or size.
  - Hiding/showing residual comments can be changed by toggling selecting/deselecting the button.

Click the target button to display the residual comments on the observation window.



### Date display style

Double-clicking the displayed date allows you to edit the date display style.

Display style	Display examples
YYYY/MM/DD	2019/1/15
YY/MM/DD	19/1/15
MM/DD/YYYY	01/15/2019
MM/DD/YY	01/15/19
DD/MM/YYYY	15/01/2019
DD/MM/YY	15/01/19

### Comments

Entering text and displaying it as a comment on the observation window. The setting method is the same as the [Comment] of normal comments (Page 6-6).

## Hiding Comments

After comments are placed on the screen, they can be hidden.

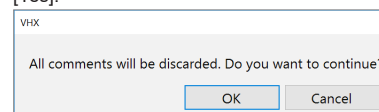
Clicking [Hide] hides all comments.

Clicking [Hide] again will display the comments.

## Delete All

Deletes all normal comments and residual comments.

Click [Delete all comments]. A confirmation dialog box will appear. Click [Yes].

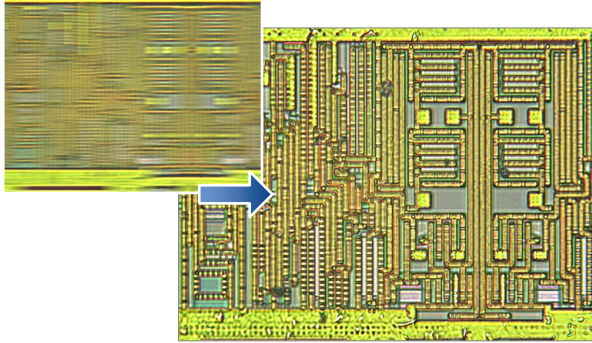


# Anti-vibration

This function corrects the shakiness (effects of vibration) that occurs when observing at high magnification or when performing handheld observation.

**Point** Anti-vibration cannot be used with the depth composition function. Cancel these functions before using the anti-vibration.

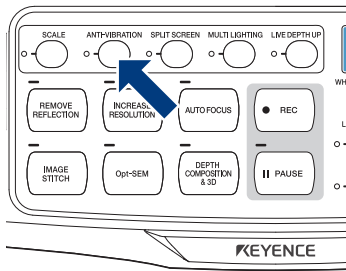
[IC pattern (3000x)]



## Anti-vibration mode Settings

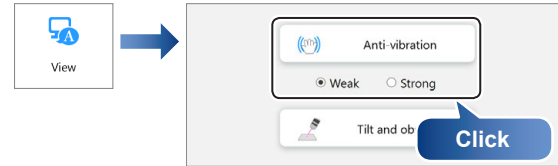
### ● Operation on the Console

Press the [ANTI-VIBRATION] button on the console.



### ● Operation from the VHX MENU

Click [View] and click [Anti-vibration].



During the anti-vibration mode, a white frame appears at the observation window perimeter. Select an anti-vibration "Weak/Strong" according to the level of vibration.

### ● Releasing [Anti-vibration] mode

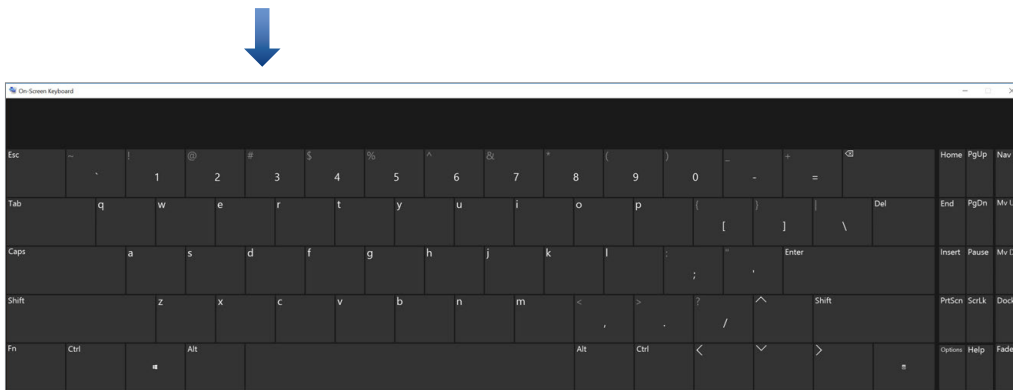
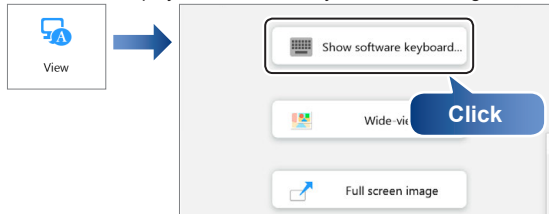
Press again the [ANTI-VIBRATION] button on the console or click [Anti-vibration] from the VHX MENU to release the selected state (yellow).

# Tilting and Observing

Observation can be made from free angles by tilting the stand.  
 ☞ "Observing while tilted" (Page 3-6)

## Show Software Keyboard

This function displays an on-screen keyboard for entering text such as filenames.



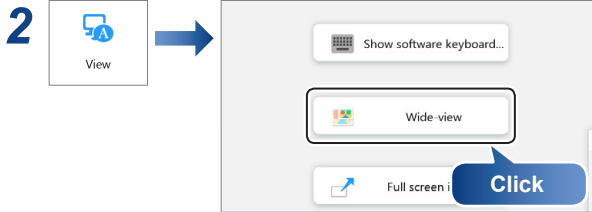
To close the software keyboard, click X in the upper right. The keyboard will remain on screen until it is closed.

# Wide-View

When the [Wide-view] dialog box is displayed, you can confirm which part is being zoomed in on when the zoom ratio of the observed image has been changed.

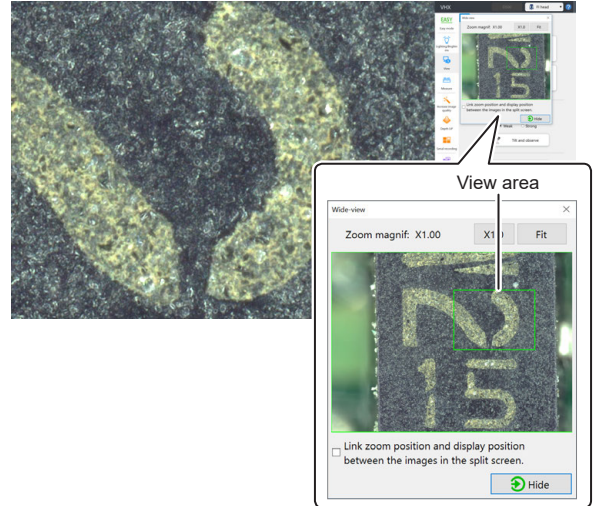
By dragging the green view area frame, you can also move the position to be observed (view area).

## 1 Display a live image or still image in the observation window.



The [Wide-view] dialog box appears.

## 3 While the image is being zoomed in on, drag the green view area frame to the position you would like to observe.



The view of observed image changes according to the view area frame.

When the [Link zoom position and display position between the images in the split screen.] check box is selected, all images are enlarged when the image in the split screen is enlarged.

"Wheel Zoom" (Page 6-3)

Reference

- When clicking [Fit], the observation window shows the entire image.
- When clicking [X1.0], the image is displayed in the actual size (100%).

# Full Screen Image

The VHX MENU on the right side of the screen can be closed to allow the observation window to occupy the entire screen.

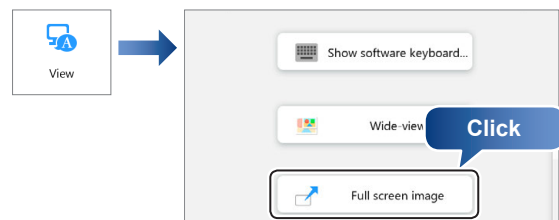
The observation window will expand to occupy all 3840 x 2160 pixels of the entire screen.

## ● Operation on the Screen

When clicking the button in the upper right of the screen, it changes to the full screen image.



## ● Operation from the VHX MENU

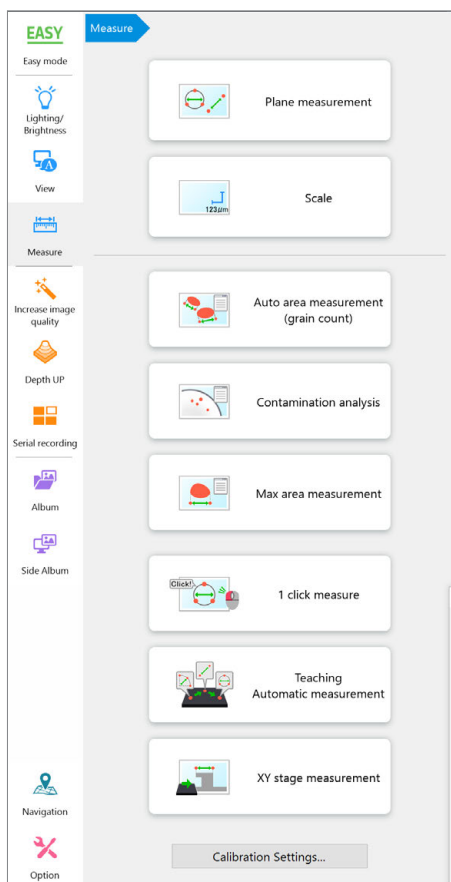


## ● Canceling the full screen image

Click X in the upper right of the screen.

# 7

## Measuring



## Various Kinds of Measurement Methods

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# Overview and Type of Measurements

















The VHX-7000 can measure lengths, angles, areas, and other items on recorded still images by specifying the points or areas to measure. Additionally, the VH-M100E manual XY measurement system allows you to measure dimensions while moving the observation object over a 100-mm square range.

## Measurement Types

### Plane Measurement

#### Main measurements





Measures the distance and length on recorded still images.

Tool	Function	Ref.
 2 Points	Measures the distance between two specified points.	7-10
 Radius	Measures the radius of a circle that passes through three specified points.	7-10
 Diameter	Measures the diameter of a circle that passes through three specified points.	7-10
 Angle 1	Measures the interior angle at a corner formed by three specified points, including a vertex.	7-11
 Angle 2	Measures the angle of the intersection created by two specified lines.	7-11
 Lines	Measures the distance between a reference line and any straight line.	7-12
 2 Centers	Measures the center distance between two specified circles.	7-12
 Parallel	Measures the shortest distance from a selected reference line to a line parallel to the reference line.	7-12
 Perp.	Measures the angle formed at a point where two specified lines intersect.	7-13
 Arc	Measures the length and angle of arc that passes through three selected points.	7-13
 Multi-pt	Measures the cumulative distance between multiple specified points.	7-13
 Free	Measures the distance between the start and end points of a free line.	7-14
 RGB	Measures the RGB values at specified measurement points.	7-14
 Count	Counts the number of specified measurement points.	7-14
 Delete	This procedure deletes measurement items displayed on the screen individually.	7-15
 Del All	This procedure deletes all measurement lines and results.	7-15





#### Area measurements

Measures the area on recorded still images.



##### Specifying the shape

Tool	Function	Ref.
 Polygon	Specify the area to measure as a polygon.	7-20
 Circle	Specify the area to measure as a circle.	7-21
 Free line	Specify the area to measure in freehand.	7-21
 Rectangle	Specify the area to measure as a rectangle.	7-21



##### Specifying brightness or color

Tool	Function	Ref.
 Brightness	Extracts and measures the area with the same brightness level as a specified point on the image.	7-22
 Color	Extracts and measures the area with the same color level as a specified point on the image.	7-23
 Filter	Removes granular components smaller than a specified size on a binary image.	7-23
 Fill	Fills holes smaller than a specified hole on the binary image.	7-23

##### Individual and block measurement tools

Tool	Function	Ref.
 Indv Mesr	Measures the area of specified or extracted areas individually.	7-24
 Blck Mesr	Measures the area of all specified or extracted areas in one operation.	7-24

##### Area deletion















Tool	Function	Ref.
 Delete	Deletes the measurement areas shown on the screen individually. Clicking on a line along the area deletes only the specified area. Clicking inside the area deletes the measurement results for the specified area. You can delete multiple specified areas within a range by dragging around the desired area from the upper left to the lower right.	-
 Reset	Resets the specified area and measurement results.	-

## XY stage measurement






The VH-M100E XY measurement system allows you to measure a target while moving the stage to expand the field of view.

 **Point** The separately sold “XY measurement application” (model VHX-H3M3) is required to do XY stage measurements. Perform the activation of this application beforehand.









### Measurement tool

Tool	Function	Ref.
	Measures the difference of X and Y coordinates of two specified points, and the distance between the start and end points.	7-68
	Measures each distance between the XY coordinates of multiple specified points, and the distance to the most recently specified point. This tool also measures the cumulative distance between all multiple points, and the cumulative angles formed with the origin.	7-68
	Measures the angle formed by an average line connecting two specified points and the X-axis. It also measures the deviation from average lines connecting multiple points (if more than two are specified).	7-69
	Measures a circle drawn by specifying three points on a circumference to provide the center coordinates (XY), diameter, and circularity.	7-69
	Measures the center distance between two circles.	7-70
	Calculates the interior angle of two sides specified in three points.	7-70
	Measures the coordinates and angle of an intersection formed by two average lines. Each average line is created by specifying two points.	7-71
	Measures the distance between an average line specified by two points and the vertical line from a specified point.	7-71
	Measures the distance from a specified point and an average line specified by two points.	7-72
	Measures the distance from a circle to a point where a perpendicular line dropped from the center of the circle intersects a specified line. The measured items are: shortest distance, longest distance, and distance to center.	7-72
	Measures the angle of a line with respect to a line perpendicular to a specified reference line, and displays the length of deviation per unit length.	7-73
	Measures the angle (parallelism) of a line with respect to a specified reference line, and displays the length of deviation per selected length.	7-73
	Deletes the measurement tools shown on the screen individually.	7-74
	Deletes all measurement tools shown on the screen.	7-74

### Point/Intersection Coordinate

Tool	Function	Ref.
	Measures the coordinates of the specified point.	7-74
	Measures the coordinates of the point at center distance between two specified points.	7-74
	Measures the coordinates of the intersection point of two lines.	7-75
	Measures the coordinates of the intersection point(s) of a line and circle.	7-75
	Measures the coordinates of the intersection point(s) of two circles.	7-76

### Specifying coordinate system

Tool	Function	Ref.
	Moves the origin. Shifts the XY coordinates in parallel by defining a point as the new origin.	7-66
	Rotates the XY coordinates without moving the origin. The X coordinate axis becomes the line that passes through the origin and a point specified as the new X coordinate axis.	7-66
	Rotates the XY coordinates centered on the origin so that the X coordinate axis is parallel to a line that passes through two specified points.	7-66
	Determines the XY coordinate axis by specifying a line using two points for the new X coordinate axis, and a third point for the new Y coordinate axis.	7-66
	Determines the XY coordinate axis by specifying the origin and one point along the X coordinate axis.	7-67
	Determines the Y coordinate axis by specifying two points along the X coordinate axis and two points that pass through the origin.	7-67
	Determines the Y coordinate axis the midpoint between two points specified along the desired X coordinate axis.	7-67
	Resets the coordinate determined by the coordinate axis system specification.	-

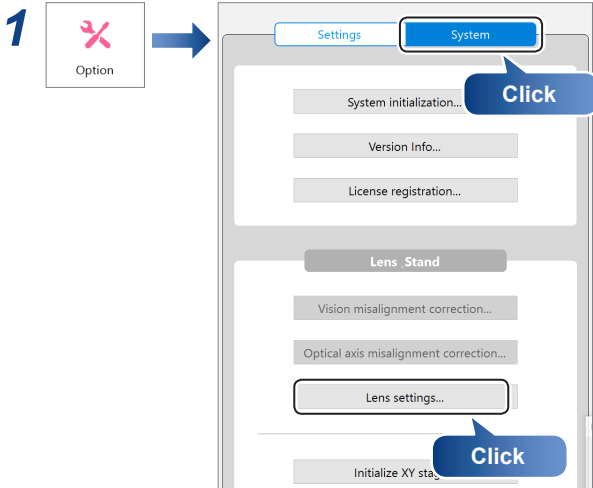
# Preparing to Measure

Before taking measurements, specify the lens type and power, and calibrate the microscope.

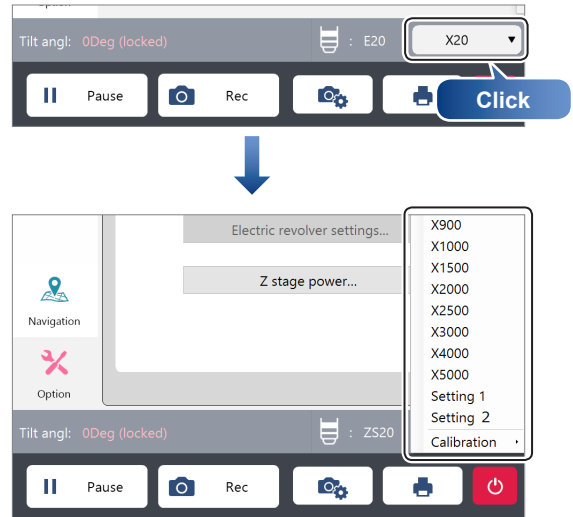
## Lens Setting

Specify the lens type and power if you are using a lens that does not have the automatic lens/zoom recognition function.

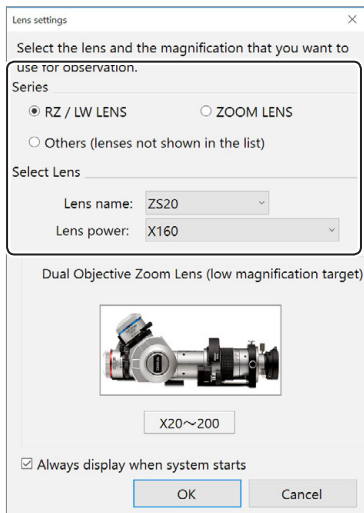
**Point** This procedure is required only when the High-Performance Camera is connected. The lens settings are not required when the Fully-Integrated (FI) Head is connected (the button cannot be selected).



**3** Click the magnification of the information view to select the lens magnification to be used.



**2** Select the lens in use and click [OK].





## Calibration

This function sets a conversion rate between a distance on image and its real distance ( $\mu\text{m}$ ) for measuring the image. Be sure to set this when you use a new lens for the measurement.

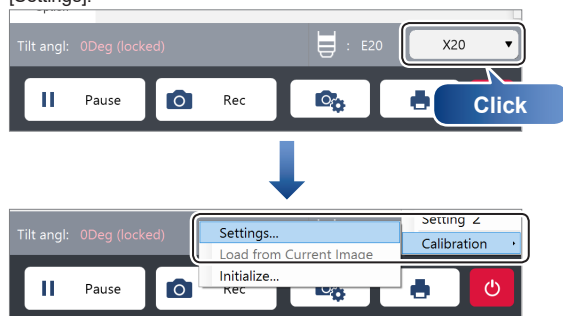
There are three methods for calibrating.

Methods	Positioning	Scale reading	Description
One-push auto calibration	Auto	Auto	Positioning and reading of the reference scale are automatically performed. The XY motorized stage is required.
Auto calibration	Manual	Auto	Reading of the reference scale is automatically performed. The lens magnification needs to be manually aligned with the corresponding scale graduation positions.
Manual calibration	Manual	Manual	Enter a known reference length ( $\mu\text{m}$ ) and click on the screen to indicate the equivalent length.

### How to Start Calibration

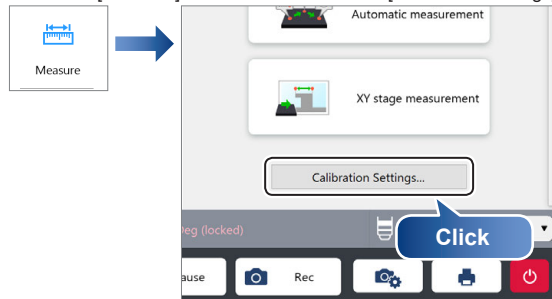
#### ● Start from the information view

Click the magnification of the information view to select [Calibration] → [Settings].



#### ● Start from VHX MENU

Select the [Measure] of VHX MENU and click [Calibration settings].



### Notes for calibration

#### ● Before starting calibration

The calibration cannot be performed while the following functions are activated:

- Optical Shadow Effect Mode, HDR
- Removing reflection (glare removal and ring removal)
- While the digital zooming is being used.
- While the split screen is active.
- While stitching images are displayed.
- Recording setting: Fine resolution [12000 x 9000]
- While the automatic area measurement function, the max area measurement, the contamination analysis, and the XY stage measurement are running.

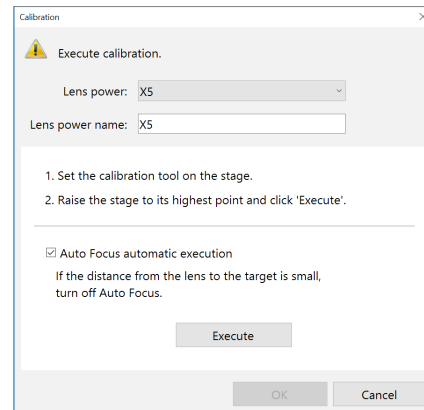
Deactivate these functions easily by pressing the [HOME] button on the console, and select [Calibration] - [Settings].

In addition, the settings of the calibration also cannot be modified while a calibration value of stored image is being used.

For the calibration value of stored image, refer to "Loading from a Saved Image" (Page 7-9).

#### ● At closing calibration

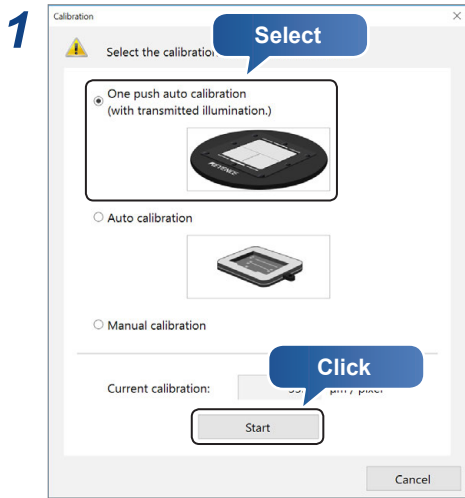
The calibration can be done continuously for multiple lens powers. If you do not press [OK] when closing the following dialog boxes, the results from the calibration do not become active.



## One-push auto calibration

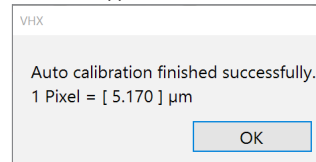
This calibration requires the use either of OP-87426, OP-87427, OP-88141, or OP-88142 reference scale (sold separately) to perform calibration automatically.

This function requires no detailed positioning of the stage and makes the calibration easier.



### 6 Click [Execute].

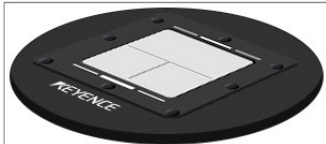
The calibration starts automatically. After completion, the message below will appear.



### 7 Click [OK].

This confirms and exits the calibration.

### 2 Place the reference scale on the stand.

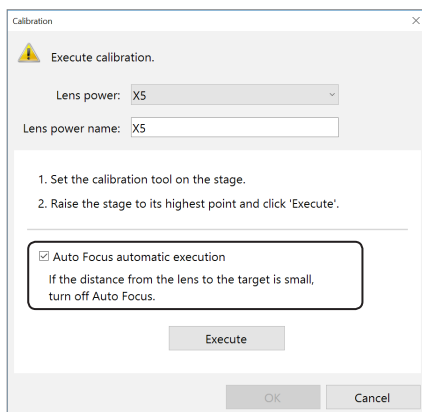


### 3 Remove the plate from the XYθ stage and place the reference scale.

### 4 Raise the XYθ stage as far as it can move up.

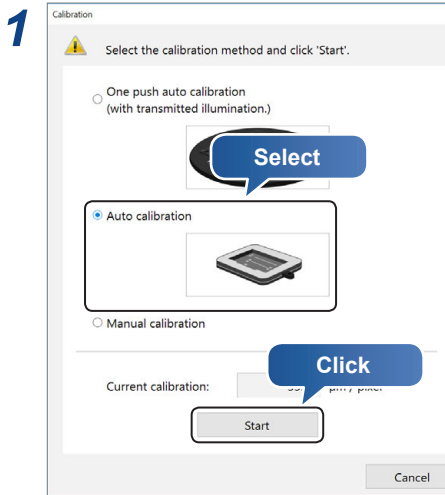
### 5 As needed, turn on the “Auto Focus automatic execution”.

**Point** Put a check on “OFF”, if the system is equipped with an illumination attachment or the distance between the lens and an object is small.

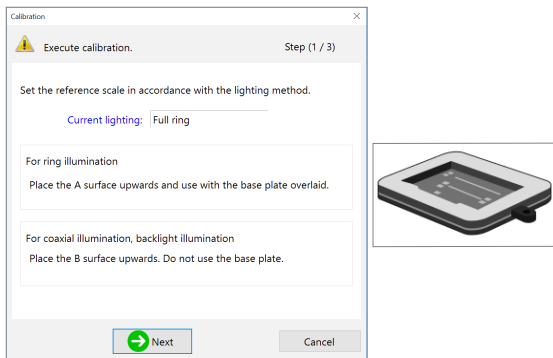


## Auto calibration

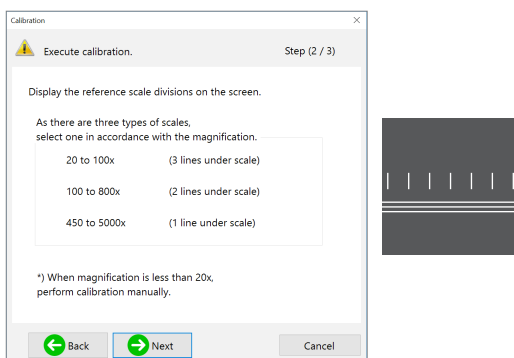
Auto calibration requires the use of either OP-87656 or OP-87657 reference scale (sold separately).



**2** Place the reference scale according to the lighting method, and click [Next].



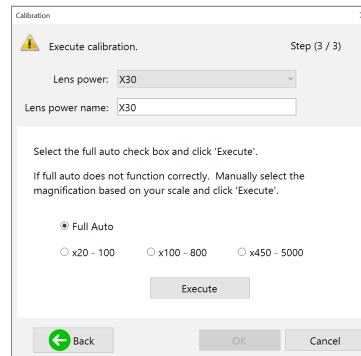
**3** Display the reference scale hash marks on the screen.



Adjust the focus and brightness to obtain contrast between black and white.

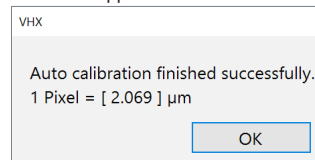
There are 3 types for the scale. Display the scale gradation that corresponds to the lens magnification.

**4** Select [Full Auto] and click [Execute].



[Full Auto] automatically determines the range of the power on the basis of the number of the horizontal lines. If calibration fails when using [Full Auto], select a lens power range from [x20 - 100], [x100 - 800], or [x450 - 5000] according to the displayed hash marks and the horizontal lines.

The calibration starts automatically. After completion, the message below will appear.

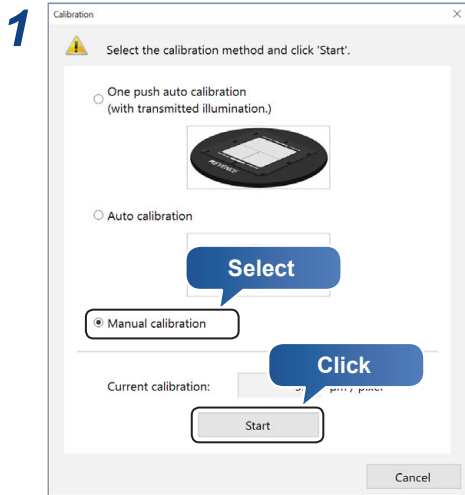


**5** Click [OK].

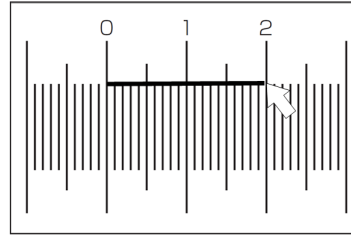
This confirms and exits the calibration.

## Manual calibration

Use the known dimensions of observable objects (ruler, carpenter's square, etc.) to manually set the calibration.

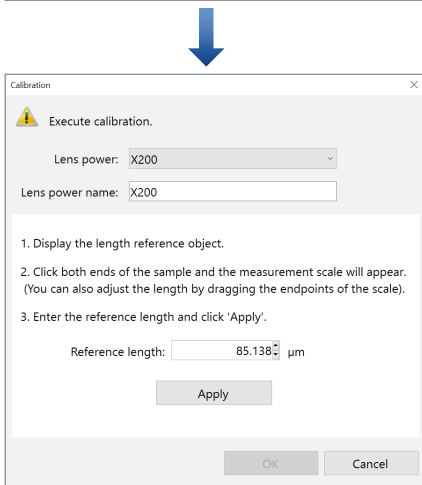


**4** Click the mouse at the end point of the reference length.

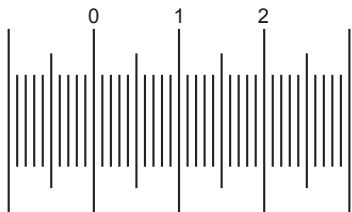


**Reference** To adjust the length of the scale, drag the end points.

**5** Enter [Reference length] and click [Apply].

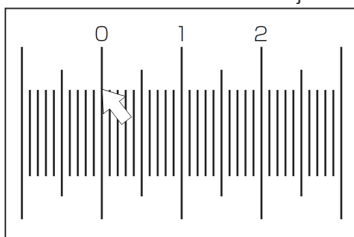


**2** Display the image of the length reference observable object (calibration scale).



**3** Click a start point along the scale.

The calibration scale can also be dragged on the screen and moved to the hash marks on the object.



## Loading from a Saved Image

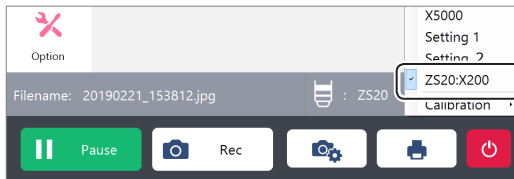
**Point** This function can only be performed with the high-performance camera (VHX-7020) is connected.

Calibration values are stored within every saved image. When the images are replayed from the album, the calibration values read from the images are ready for use, which allows additional measurement using the same calibration as when the image was captured.

### 1 Load the image to replay from [Album] of the VHX MENU.

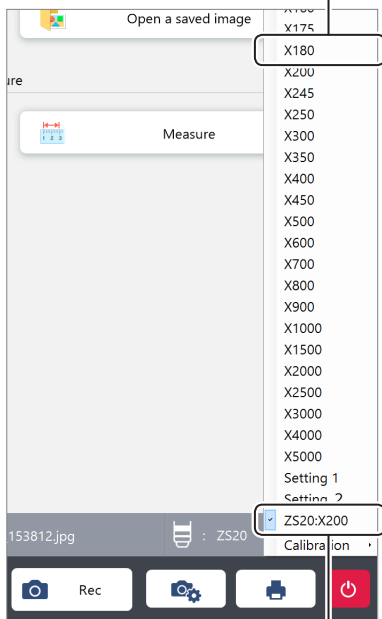
☐ "Playing Files" (Page 11-5)

### 2 Clicking the lens power of the information view allows you to see that [Lens of the replayed image:power] is selected.



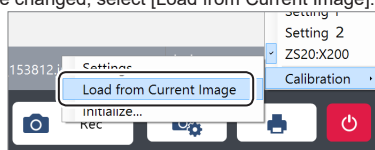
**Point** The calibration settings cannot be modified while the saved images are replayed. To modify the calibration settings, select the current lens power and open the calibration settings.

The calibration settings can be modified by selecting the current lens power.



Replayed image calibration value (at VH-Z20/ x200 recording image playback)

**Reference** To restore the calibration values of the image after once changed, select [Load from Current Image].

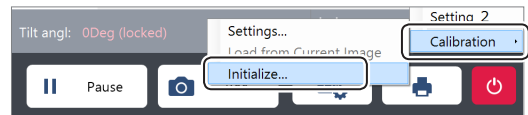
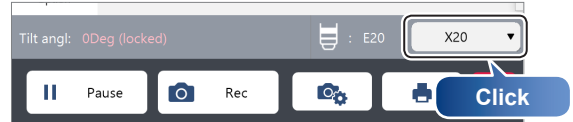


## Initializing calibration

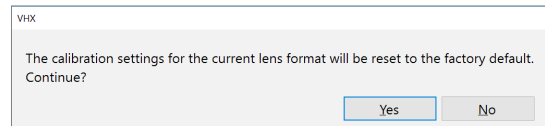
Initializing returns the calibration values to the factory-set values.

**Point** The calibration values for all lenses that were set are initialized by this process.

### 1 Click the magnification of the information view to select [Calibration] → [Initialize].



### 2 Click [Yes].



This initializes the calibration values.

## Setting the calibration password

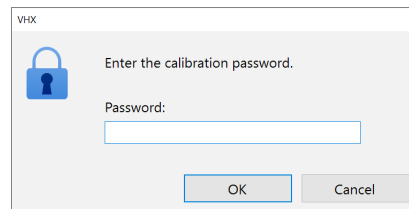
It is possible to set a password in order to set the calibration.

### 1 Set the calibration password.

☐ "Setting the calibration password" (Page 12-7)

### 2 Initialize the calibration settings.

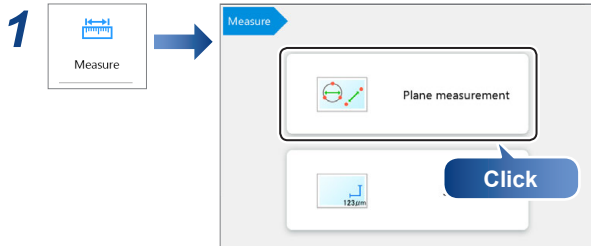
### 3 Enter the set password and click [OK].



# Main Measurements

These tools measure the distance between two points, angle, XY distance, and object count in the observation window. The measurement results are displayed in the observation window and measure result window, and can be saved in CSV format.

## Measuring Procedures



An icon for each measurement tool appears in the operation area.

### 2 Select the [Main measurements] tab, and click the icon for the desired measurement.

The icon turns yellow indicating it has been selected.

### 3 Specify the measurement points in the observation window.

The measurement result is displayed. Refer to the procedures for each measurement for operating details.

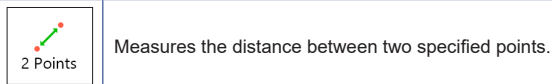
- Refer to [Icon] "Plane Measurement" (Page 7-2) for details on how to display measurement results in the observation window.
- Refer to [Icon] "Plane Measurement" (Page 7-2) for details on how to display measurement results in the [Measure Result] window.

- Reference**
- The measurement point and [Count] of following measurements can be measured up to 999 items: 2 Points, Multi-pt, 2 Centers, Radius, Diameter, Angle 1, Angle 2, Perp., Parallel.
  - Refer to [Icon] "Display Settings" (Page 7-16) for display settings.

## Measurement Items

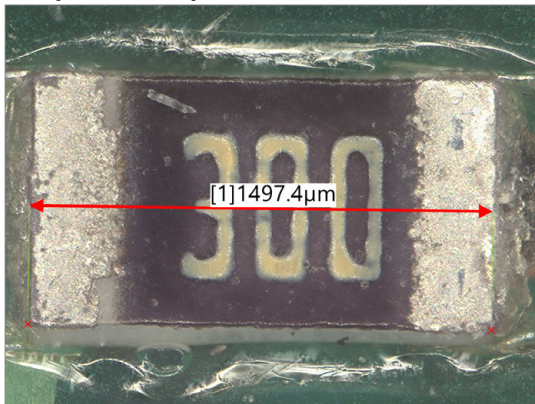
- Reference**
- If you make a mistake after clicking the start point, right-click to specify the correct start point.
  - Right-clicking at any point before confirming a series of points will undo the last point.
  - Display position of a label (subscript) can be specified after the determination of measurement position.

### Measuring the Distance Between Two Points

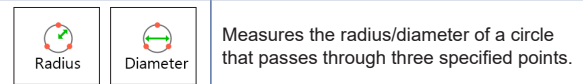


#### 1 Click [2 Points]. On the observation window, click the start and end point.

A line connecting the two clicked points and a label (subscript) will appear and the measurement results will appear on the screen and in the [Measure Result] window.

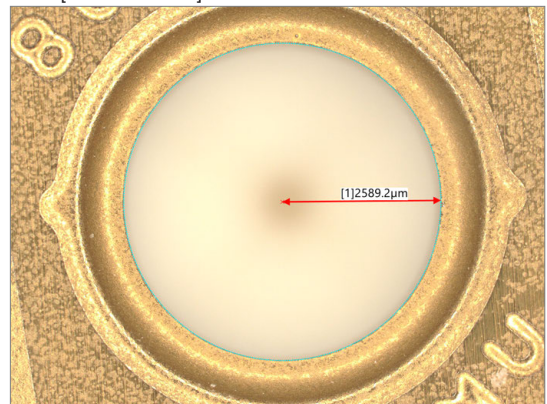


### Measuring the Radius (or Diameter) of a Circle



#### 1 Click [Radius] (or [Diameter]). On the observation window, click three points.

A circle passing through the three clicked points and a label (subscript) will appear. The circle, radius (diameter) and center will appear and the measurement results will appear on the screen and in the [Measure Result] window.



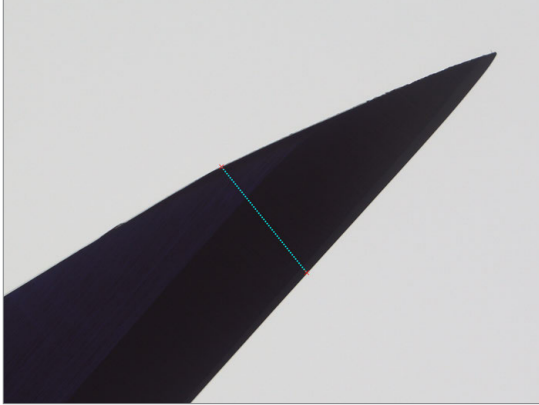
## Calculating an Angle (1)



Measures the interior angle at a corner formed by three specified points, including a vertex.

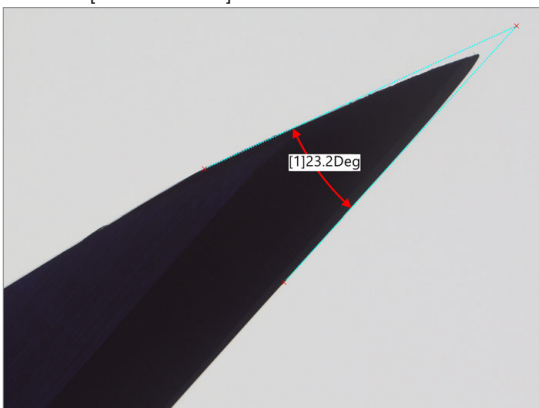
- 1 Click [Angle 1]. Click each side that form the interior angle.

A line connecting the two clicked points will appear.



- 2 Click the vertex.

A line connecting the three clicked points and a label (subscript) will appear, and the measurement results will appear on the screen and in the [Measure Result] window.



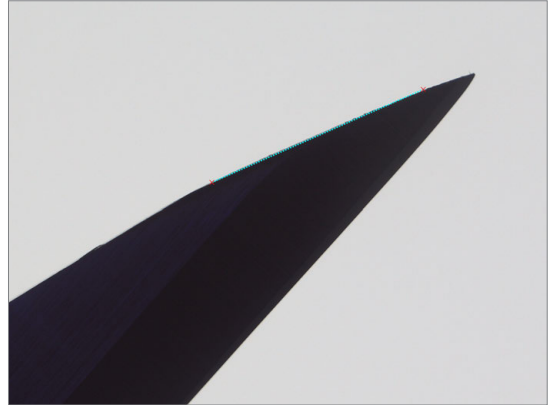
## Calculating an Angle (2)



Measures the angle of the intersection created by two specified lines.

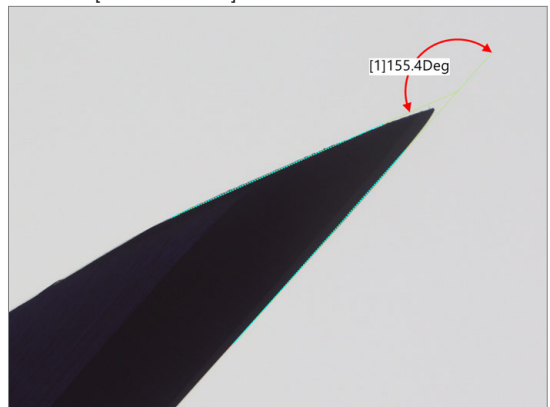
- 1 Click [Angle 2]. Select two points on the first side.

The clicked points and a line connecting the two clicked points will appear.



- 2 Select two points on the second side.

A line connecting the two clicked points and a label (subscript) will appear, and the measurement results will appear on the screen and in the [Measure Result] window.



Reference

An angle is measured in conformity to the label (subscript) position. Determine the label (subscript) position according to the angle you wish to measure.

## Measuring the Distance between Reference Line and Straight Line



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

This distance is effective for measuring the average distance of a line including a curve.

Check the "Auxiliary Functions" (Page 7-19) for a proper use.

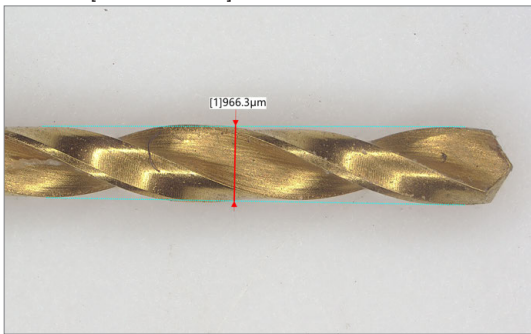
- 1 Click [Lines] and click two points on the line in sequence that you want to use as a reference line.

The reference line appears.



- 2 Click two points on the second line in sequence.

A vertical line drawn through the clicked two points and a perpendicular line from the reference line appears along with a label (subscript). The measurement result appears on the screen and in the [Measure Result] window.



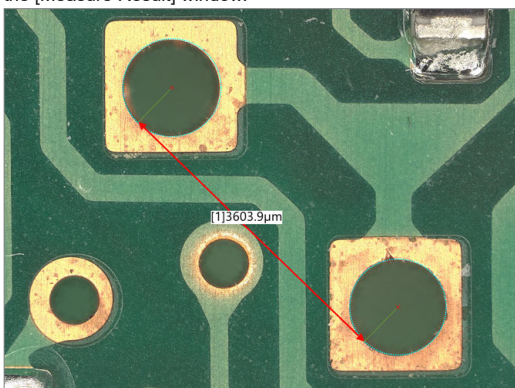
## Measuring the Center Distance between Two Circles



Measures the center distance between two specified circles.

- 1 Click [2 Centers]. Specify the circles to be the start point and end point, in that order, using three points.

The two circles will serve as a start point and end point, and a line connecting the centers of each circle and a label (subscript) will appear. The measurement results will appear on the screen and in the [Measure Result] window.



## Measuring the Distance between Two Parallel Lines



Measures the shortest distance from a selected reference line to a line parallel to the reference line.

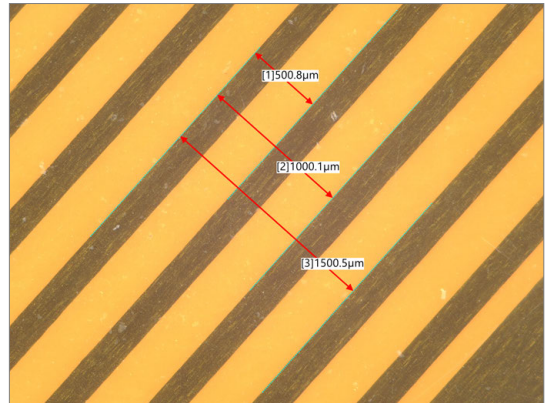
- 1 Click [Parallel]. Click two points along the line to be the reference line.

The reference line appears.



- 2 Click the position to measure.

A parallel line that passes through the clicked point and a perpendicular line from the reference line to the parallel line will appear along with a label (subscript). The measurement result appears on the screen and in the [Measure Result] window.



You can continue to specify measurement points relative to the same reference line.

To stop measuring parallel lines relative to the same reference line, double click the measurement point.



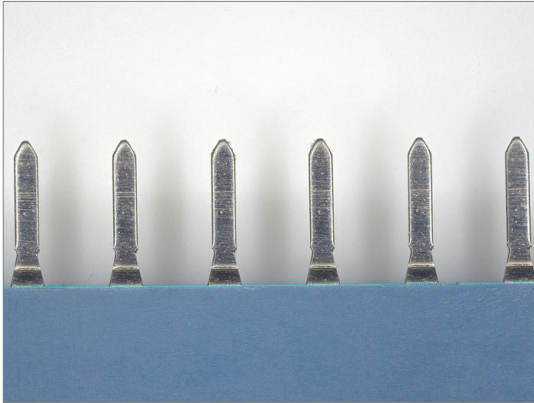
## Measuring the Length of a Perpendicular



Measures the angle formed at a point where two specified lines intersect.

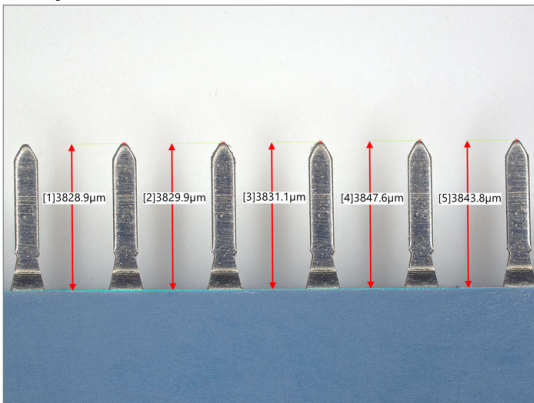
- 1 Click [Perp.] and click two points along the line to be the reference line.

The reference line appears.



- 2 Click the measurement position.

A line drawn through the clicked point and a perpendicular line from the reference line appears along with a label (subscript). The measurement result appears on the screen and in the [Measure Result] window.



You can continue to specify measurement points relative to the same reference line.

To stop measuring perpendicular lines relative to the same reference line, double click the measurement point.

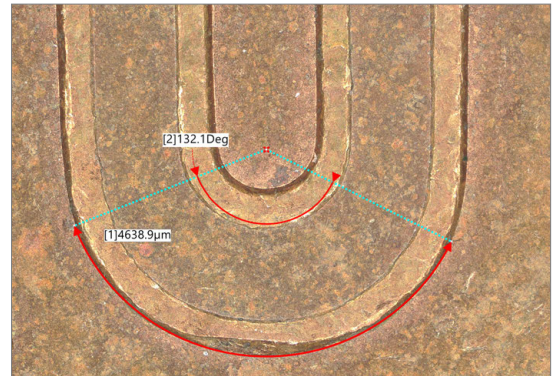
## Arc Measurement



Measures the length and angle of arc that passes through three selected points.

- 1 Click [Arc] and then click three points on the observation window.

The arc that passes through the three clicked points and a label (subscript) will appear and the measurement results will appear on the screen and in the [Measure Result] window.



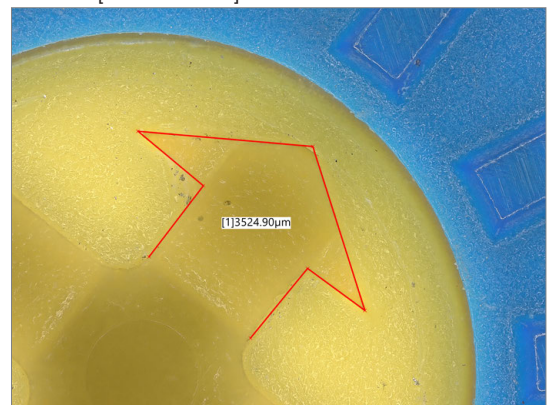
## Measuring the Distance between Multiple Points



Measures the cumulative distance between multiple specified points.

- 1 Click [Multi-pt]. On the observation window, click the start point and the points to pass through. Double-click on the end point.

A line connecting the multiple clicked points and a label (subscript) will appear. The measurement results will appear on the screen and in the [Measure Result] window.



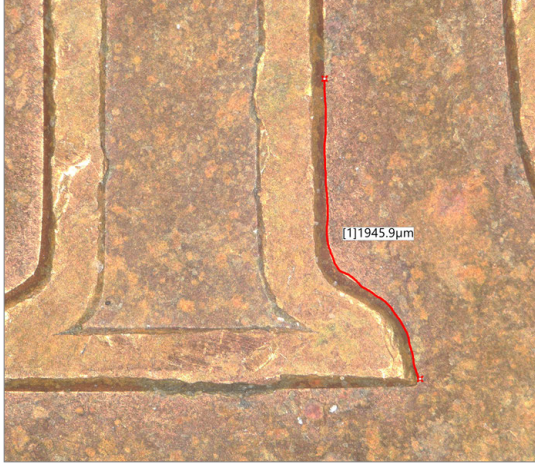
## Free Line Measurement



Measures the distance between the start and end points of a free line.

- 1 Click [Free] first, then move the mouse while holding down its left button from the start point to the end point in the observation window.

A free line connecting the clicked start and end points together with a label (subscript) will appear and the measurement results will appear on the screen and in the [Measure Result] window.



## Counting the Number of Points



Counts the number of specified measurement points.

- 1 Click [Count]. On the observation window, click the measuring points.

The clicked points will be indicated by an x. The measurement results appear on the screen and in the [Measure Result] window.



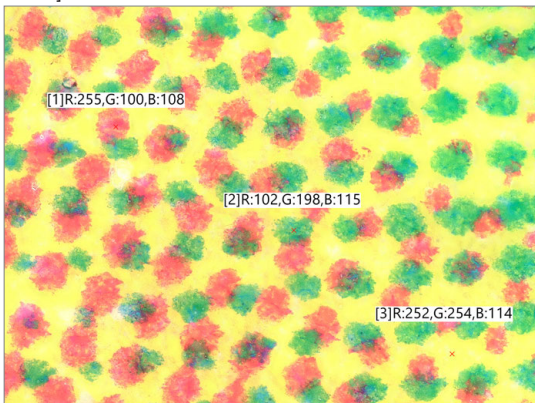
## Measuring RGB Value




Measures each value of RGB (brightness value) at specified measurement points.

- 1 Click [RGB]. On the observation window, click the measurement points.

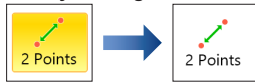
The clicked points will be indicated by an x and a label (subscript) that indicates the brightness of each RGB color. The measurement result appears on the screen and in the [Measure Result] window.



## Moving and Editing the Measurement Point

 **Point** Measurement points cannot be moved if the icon is selected. Deselect the icon by clicking it.

Deselect the icon by clicking it.




## Changing and editing measurement points and values.

- 1 Drag the measurement point or value to move or edit and drop it at the correct position.

## To move a line or an entire circle

- 1 Drag the line or circle and drop it at the correct position.


## Deleting

 **Delete** This procedure deletes measurement items displayed on the screen individually.

- 1 Click [Delete].
- 2 Click the line or point and draw a rectangle around the range to delete by dragging from the upper left to the lower right.

The selected measurement items are deleted.

## Deleting All

 **Del All** This procedure deletes all measurement lines and results.

- 1 Click [Del All].  
A confirmation dialog box appears.
- 2 Click [Yes].  
All measurement items and results are deleted.

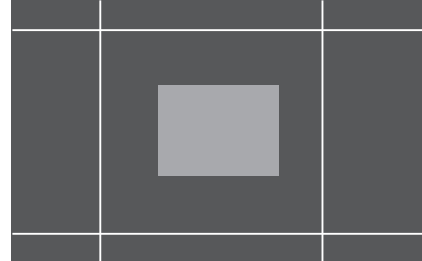
## XY Measurement and Display

This mode measures the horizontal and vertical distance of an object enclosed by user-specified horizontal (X axis) and vertical (Y axis) lines. It also measures the length between diagonal corners of the square formed by the lines.

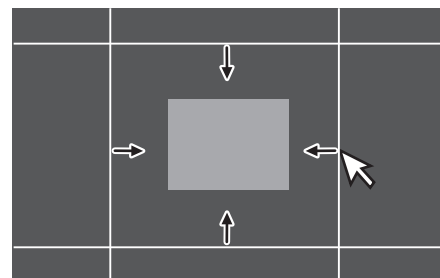
- 1 Click [XY Measure].



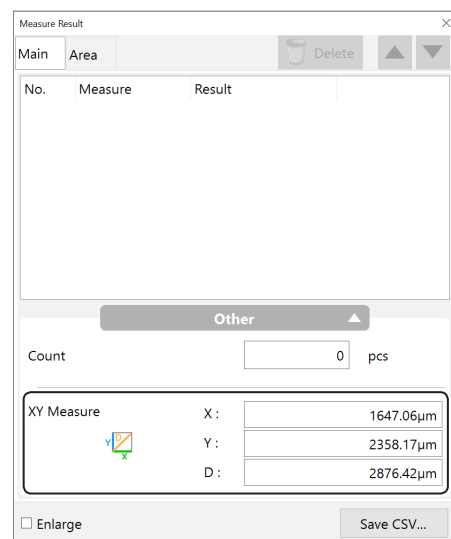
The [XY Measure] icon becomes selected. The screen displays an X-axis (horizontal axis) and a Y-axis (vertical axis).




- 2 Move the measurement lines to the desired position by dragging the X and Y axes and enclose the object to be measured.



- 3 The [XY Measure] area of the [Measure Result] window shows the object's horizontal distance (X), vertical distance (Y), and diagonal distance (D).



Refer to  "Plane Measurement" (Page 7-2) for details on how to display measurement results in the measure result window.

## Display Settings

Sets the measurement results display method etc.

Meas.result window     Display meas.value  
 Show meas.val(horizn)

## Measurement Result Window

This option shows or hides the [Measure Result] window which displays the measurement values as a list.

When this check box is selected, the [Measurement result] window is displayed.

### ● [Main] tab

Displays the measurement results of the main measurements.

No.	Measure	Result
1	2 Points	413.11µm
2	2 Points	2928.67µm
3	2 Points	3686.58µm

Count:  pcs

XY Measure: X:  Y:  D:

Enlarge   

Item	Function
No.	Corresponds to the label (subscript) displayed next to the measurement line.
Measure	Displays the measurement item.
Result	Displays the measurement result.
Others ▲ (▼)	Hides or shows [Count] and [XY Measure].
Count	Displays the number when using [Count].
XY Measure	<input type="checkbox"/> "XY Measurement and Display" (Page 7-15)
Enlarge	When checked, enlarges the text size.
Save CSV	Measurement results can be saved as CSV files.

### ● [Area] tab

Displays the measurement results of the area measurement.

No.	Area	Perimeter
1	8137967.31µm <sup>2</sup>	10657.45µm
2	2569029.68µm <sup>2</sup>	5981.33µm
3	6773947.77µm <sup>2</sup>	9716.67µm

Count:  pcs

Area: Total area:   
 Total region area:   
 Area ratio:  %

Enlarge   

Item	Function
No.	Corresponds to the label (subscript) displayed in the measurement area.
Area	Displays the measurement results of the area.
Perimeter	Displays the perimeter length of the region for the area measurement.
Others ▲ (▼)	Hides or shows [Count] and [XY Measure].
Count	Displays the number of the area measurement.
Area	Displays the area measurement total area, total region area, and area ratio.
Enlarge	When checked, enlarges the text size.
Save CSV	Measurement results can be saved as CSV files.

### ● [Delete] button

Delete the measurement result that is being selected in the [Main measurements] tab.  
 This cannot be used in the [Area] tab.

## Display Measurement Value

Hides or shows the measurement value on the label (subscript) displayed in the measurement area.

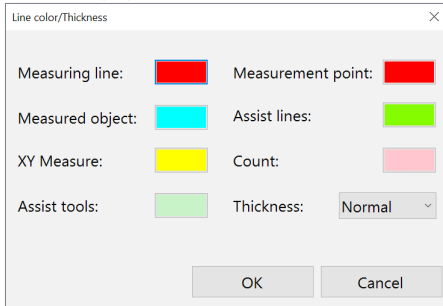
## Display measurement value horizontally

Hides or shows the label displayed horizontally in the measurement area. When clearing the check box, the label is displayed according to the direction of the measurement line.

## Line Color/Thickness

Sets the line color or thickness (thin/normal/thick) displayed on the image.

When changing the color, click the color button in the target item.

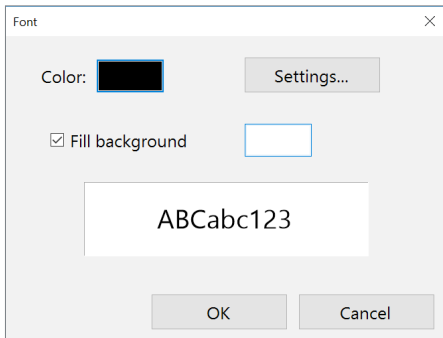


**Reference** If clicking the color button and clicking [Other], any color can be created.

## Font

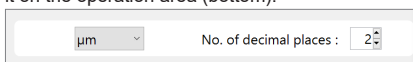
Sets the character (font) color, type, and background color displayed on the image.

When clearing the [Fill background] check mark, the background color is hidden.



## Unit and Number of Decimal

When changing the unit etc. displayed at the measurement results, set it on the operation area (bottom).



## Assist Tools

Elements you create using the assist tool are called assist elements. Assist elements do not create any measurements, instead, they are to be used as a reference point or a reference line when you set measurement lines.

Placing assist elements where there will be placing measurement points, enables you to set measurement lines more accurately and efficiently.

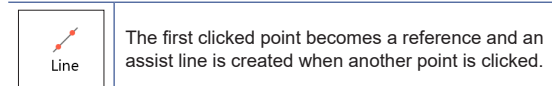
### Point



#### 1 Click [Point] and click a point in the observation window.

An assist point (X) appears at the clicked point.

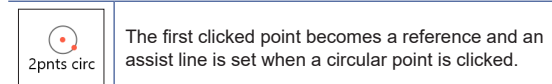
### Line



#### 1 Click [Line] and click two points in the observation window.

The assist line that passes through the clicked points appears.

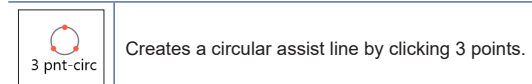
### 2 points circle



#### 1 Click [2pnts circ] and click two points in the observation window.

The first clicked point becomes a center as a reference and a circular assist line whose radius is the distance to another point is displayed.

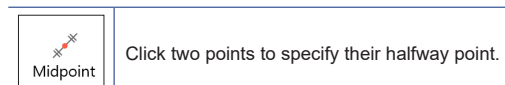
### 3 points circle



#### 1 Click [3 pnt circ] and click 3 points in the observation window.

The circular assist line that passes through the clicked 3 points appears.

### Midpoint



#### 1 Click [Midpoint] and click the start and end points in the observation window.

Assist points (X) appear at the starting point, ending point and middle point.

## Bisector



Specify two assist lines to specify an assist line at their halfway distance.

- 1 Click [Bisector] and click two points in the observation window.**  
An assist line appears.
- 2 Click two points in the observation window.**  
Another assist line appears.
- 3 Click a position to set the middle line position.**  
An assist line as a bisector appears.

## Perpendicular lines



Create a line which passes through two points, and a perpendicular line.

- 1 Click [Perp.] and then click two points on the observation screen.**  
The assist line that passes through the clicked points appears.
- 2 Click one point in the observation window.**  
A line that is perpendicular to the created assist line, and that connects the clicked point will appear.

## Parallel lines



Create a line which passes through 2 points, and a parallel line.

- 1 Click [Parallel] and then click 2 points on the observation screen.**  
The assist line that passes through the clicked points appears.
- 2 Click one point in the observation window.**  
A line that is parallel to the created assist line, and that connects the clicked point will appear.

## Intersection Cir-Cir



Sets 2 circular assist lines and makes their intersection points an assist point.

- 1 Click [IntrCrCr] and click 3 points in the observation window.**  
The circular assist line that passes through the clicked 3 points appears.
- 2 Click three points in the observation window.**  
Another circular assist line that passes through the three clicked points appears and assist points (X) appear at the intersections of two circles.

## Intersection Cir-Ln



Sets a circular assist line and a linear assist line, and makes their intersection point an assist point.

- 1 Click [IntrCrLn] and click 3 points in the observation window.**  
The circular assist line that passes through the clicked 3 points appears.
- 2 Click two points in the observation window.**  
The assist line that passes through the clicked points appears and the assist points (X) appear at the intersection points with the circular assist line.

## Intersection Ln-Ln

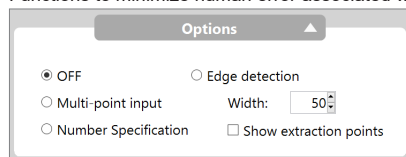


Specify two assist lines to set their intersections as auxiliary points.

- 1 Click [IntrLnLn] and click two points in the observation window.**  
The assist line that passes through the clicked points appears.
- 2 Click two points in the observation window.**  
Another assist line connecting the clicked points appears and assist point (X) appears at the intersections of the assist lines.

## Auxiliary Functions

Functions to minimize human error associated with measurement.



### Automatic edge detection

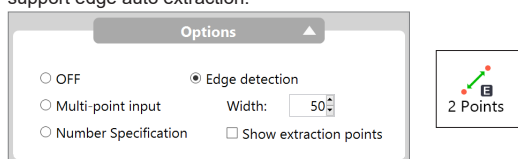
This function extracts the edges of the object and automatically corrects the measurement line.

The function minimizes human error.

Automatic edge extraction can be used for all assist tools and the following measurements: [2 Points], [Radius], [Diameter], [Angle 2], [Lines], [2 Cntrs], [Parallel], [Perp.].

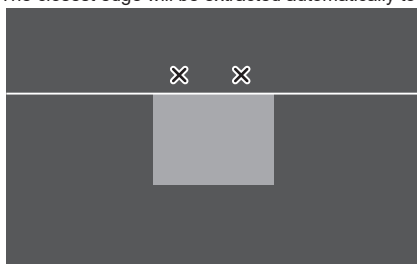
#### 1 Select [Edge detection] of [Options].

The letter "E" will appear on the icons for measuring modes that support edge auto extraction.



#### 2 Click two points along the line to use as the reference.

The closest edge will be extracted automatically to create the line.



Carry on with the procedures for the selected measurement item.

## Multiple point input

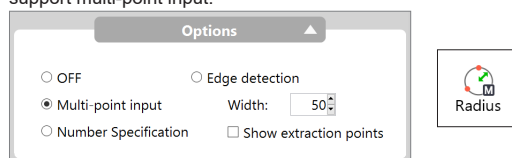
This function allows for multiple points to be selected to create a reference line, circle, etc. Using the least squares method, this function will display the best-fit line for these selected measurement points. Multiple point input can be used for tools except Point and Midpoint, and the following measurements:

[Radius], [Diameter], [Angle 2], reference line of [Perpendicular Line], reference line of [Parallel Line], [Lines], [2 Centers].

**Reference** The maximum number of multiple measurement points is 99.

#### 1 Select [Multi-point input] of [Options].

The letter "M" will appear on the icons for measuring modes that support multi-point input.



#### 2 Click points along the line (or circle) to measure.

#### 3 To stop multi-point input mode, double click the last measuring point.

For perpendicular lines or parallel lines, continue specifying measuring points.

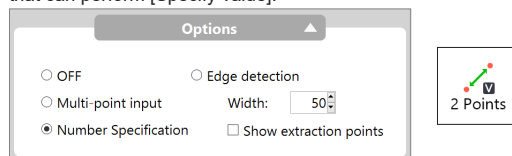
## Number Specification

Assist elements with a length and angle specified by number can be placed.

The number specification can be used by assist tools of [2 Points], [Radius], [Diameter], [Angle], and [Parallel].

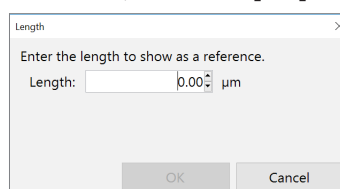
#### 1 Select [Specify value] of [Options].

The letter "V" will appear lower-right of the icons for assist elements that can perform [Specify value].



#### 2 Click the icon of the placed assist element.

#### 3 Enter the length (angle) to be displayed as a reference, and click [OK].



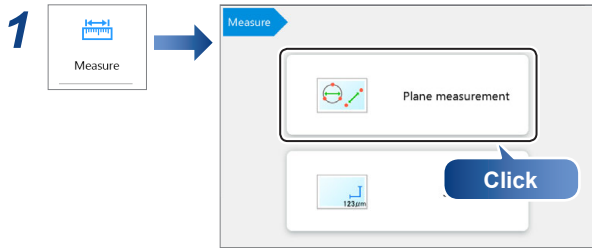
Carry on with the procedures for the selected assist tool.

# Area Measurements

This microscope can measure areas on the object specified as a circle or polygon. The user can define an area by drawing a free-line as well.

<b>NOTICE</b>	<p>If the lens being used does not feature the automatic lens/zoom recognition function, be sure to calibrate the microscope before performing any measurements.</p> <p>☞ "Calibration" (Page 7-5)</p>
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## Measuring Procedures



### 2 Select the [Area] tab, and click the icon for the desired measurement.

The icon turns yellow indicating it has been selected.

### 3 Specify the area to measure in the observation window.

Refer to the procedures for each measurement for operating details.

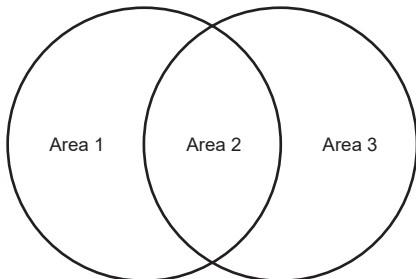
### 4 Click [Indv Mesr] and select the area to measure. Or, click [Blick Mesr].



The measurement is displayed.

- Refer to ☞ "Display Measurement Value" (Page 7-16) for details on how to display measurement results in the observation window.
- Refer to ☞ "Display Settings" (Page 7-16) for details on how to display measurement results in the measurement results window.

- |                  |  |
|------------------|--|
| <b>Reference</b> | <ul style="list-style-type: none"> <li>The total maximum number of area measurements is 999.</li> <li>If the measurement lines of circles and polygons used to specify areas overlap, the area is measured for each divided region.</li> </ul> |
|------------------|--|




## Measurement Items

This section explains how to specify areas for each area measurement. After specifying the area, click the [Indv Mesr] or [Blick Mesr] to view the measurement results.

- |                  |   |
|------------------|---|
| <b>Reference</b> | <ul style="list-style-type: none"> <li>If you make a mistake after clicking the start point, right-click to specify the correct start point.</li> <li>Right-clicking at any point before confirming a series of points will undo the last point.</li> </ul> |
|------------------|---|

## Measuring the Area of a Polygon

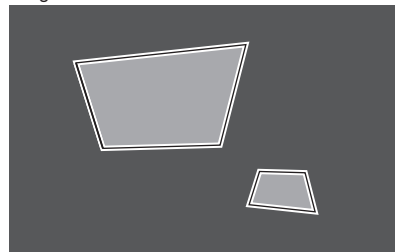
 Polygon	Specify the area to measure as a polygon.
--	---

### 1 Click [Polygon].

### 2 Enclose the area to measure by clicking vertex points.

### 3 Double-click on the last vertex.

The polygon to be measured will appear superimposed on the image.



- |                  |  |
|------------------|--|
| <b>Reference</b> | To change the area to measure, delete it and specify the area again. |
|------------------|--|

### 4 Click [Indv Mesr]

### 5 Click the polygon you wish to measure.

This displays the area of the polygon.

- |                  |   |
|------------------|---|
| <b>Reference</b> | Multiple measurement areas can be specified and measured in a single operation. |
|------------------|---|

To do this, click 



## Measuring the Area of a Circle



Specify the area to measure as a circle.

- 1 Click [Circle].
- 2 Click three points on the circumference of the circle that contains the area to be measured.  
A circle that passes through the three points will appear.  
 To change the area to measure, delete it and specify the area again.

- 3 Click Indv Mesr

- 4 Click the circle to measure.

This displays the area of the circle.

Multiple measurement areas can be specified and measured in a single operation.

To do this, click



## Measuring the Area of Rectangle



Specify the area to measure as a rectangle.

- 1 Click [Rectangle].
- 2 Drag the area to measure.  
A rectangle appears.  
 To change the area to measure, delete it and specify the area again.

- 3 Click Indv Mesr

- 4 Click the rectangular area to measure.

This displays the area of the rectangle.

Multiple measurement areas can be specified and measured in a single operation.

To do this, click



## Measuring the Area of a Free-Line Area



Specify the area to measure in freehand.

- 1 Click [Free line].
- 2 Drag the perimeter of the area to measure.  
The mouse trails specify the area.  
 To change the area to measure, delete it and specify the area again.

- 3 Click Indv Mesr

- 4 Click the free line area to measure.

This displays the area in the free line shape.

Multiple measurement areas can be specified and measured in a single operation.

To do this, click

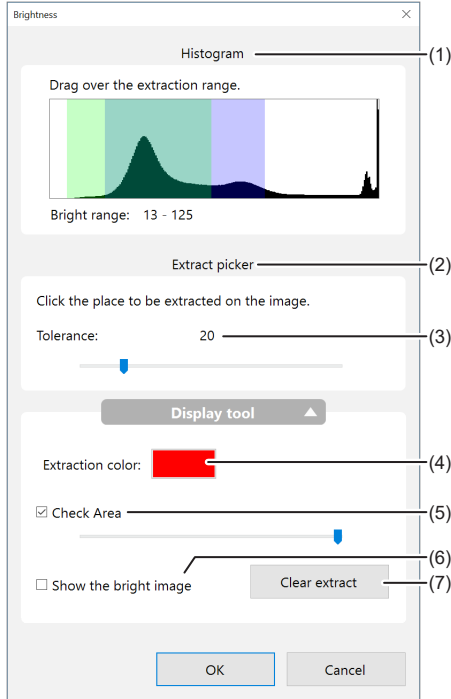


# Measuring the Areas Extracted Based on Brightness

This procedure measures the size of an area extracted based on the brightness of the object. You can use the Histogram or Extract picker to extract an area.

**1 Click** 

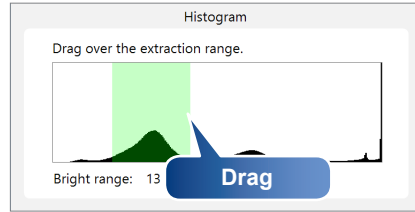
The [Brightness] dialog box appears.



No.	Name	Function
(1)	Histogram Extraction	The histogram displays brightness on the X axis, and the frequency (distribution) of pixels that exist per each level of brightness on the Y axis. The image is brighter as the scale moves to the right. Specify the range to extract by dragging the mouse. The parts of the image that match the specified brightness change to the specified extraction color. [ ] "Using the Histogram" (Page 7-22)
(2)	Extract picker	Specify a point and tolerance to use as the reference for the brightness level to measure. The Extract picker will then extract the areas with the same brightness level. The parts of the image that match the specified brightness change to the specified extraction color. [ ] "Using the Extract Picker" (Page 7-22)
(3)	Tolerance	When specifying the brightness level with the Extract picker, specify a brightness range between 0 to 128 gradations by dragging the slider.
(4)	Extract Color	Select the color to paint the area extracted by brightness.
(5)	Check Area	This button lightens the extraction color effect to allow checking of the specified area.
(6)	Show the bright image	If this option is checked, the image is shown as a bright image (monochrome).
(7)	Clear extract	Deletes all extracted ranges.

## Using the Histogram

**1** On the brightness distribution histogram, adjust the boundary by dragging the mouse.



The green-colored brightness range is extracted and displayed in the observation window using the extraction color.


- To start over from the beginning, click [Clear extract]. This will also clear the range display on the histogram. Specify the brightness range by dragging the mouse on the histogram.
- After extracting with the histogram, you can continue to extract with the Extract picker.

**2** Click [OK].

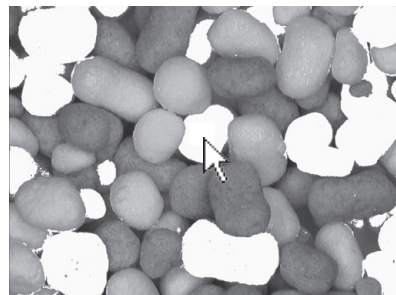
A binary image appears in the observation window.

## Using the Extract Picker


This method extracts areas within the same brightness range specified by the bright tolerance, where the center of tolerance is the brightness of the point picked (clicked) on the observation window.

-  **Click [Clear extract] to clear any unwanted brightness areas that have already been selected.**

**1** Click a point on the image to be selected.

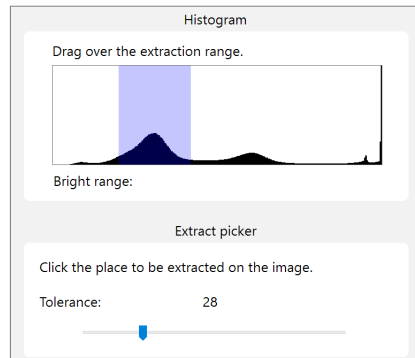


The extracted area is displayed in the observation window using the extraction color.

-  Multiple areas can be picked by repeating Step 1.

**2** Adjust [Tolerance] while viewing the image.

Dragging the bright tolerance slider to the right expands the area that will be extracted.



**3** Click [OK].

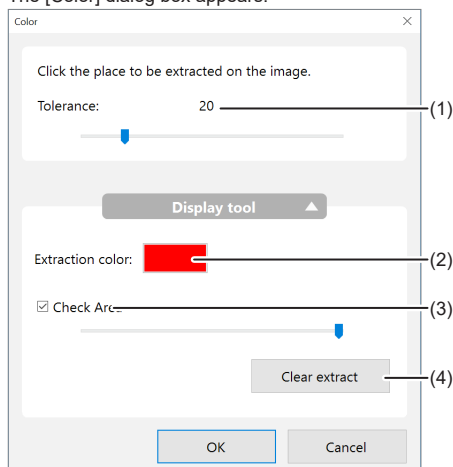
A binary image appears in the observation window.

## Measuring the Areas Extracted Based on Color

This method extracts areas within the same color range specified by the color tolerance, where the center of tolerance is the color of the point picked (clicked) on the observation window.


- 1 Click 

The [Color] dialog box appears.

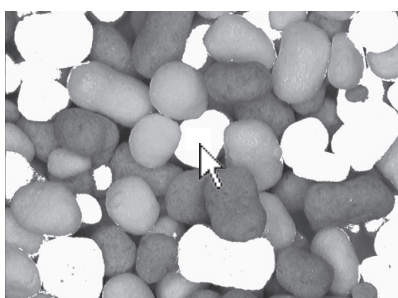


No.	Name	Function
(1)	Tolerance	When specifying the color level with the Extract picker, specify the color range width by dragging the slider.
(2)	Extract Color	Select the color to paint the area extracted by color.
(3)	Check Area	This button lightens the extraction color effect to allow checking of the specified area.
(4)	Clear extract	Deletes all extracted areas.


### Extracting area by color

-  **Point** Click [Clear extract] to clear any unwanted color areas that have already been selected.

- 1 Click a point on the image to be selected.



The extracted area is displayed in the observation window using the extraction color.

 Multiple areas can be picked by repeating Step 1.

- 2 Adjust [Tolerance] while viewing the image.

Dragging the [Tolerance] slider to the right expands the area that will be extracted.

- 3 Click [OK].

A binary image appears in the observation window.

## Filter

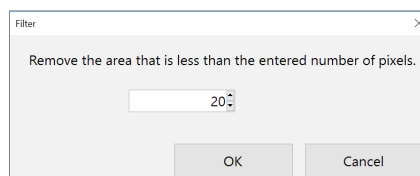
The filter removes small areas of white in the binary image by turning them black.

Use as necessary before doing an area measurement after using brightness or color extraction.

- 1 Click 

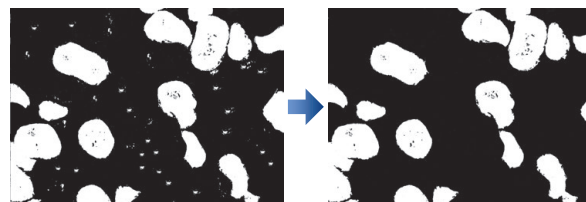
The [Filter] dialog box appears.

- 2 Adjust the number of pixels in the area to remove by clicking the ▲/▼ buttons. Click [OK] when done.



White areas in the image having fewer pixels than this setting will be removed.

### Example of an image corrected using [Filter].



## Fill

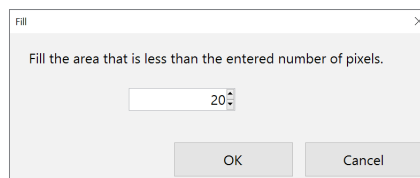
The fill tool fills the holes (black specs) in the white areas of the binary image by turning them white.

Use as necessary before doing an area measurement after using brightness or color extraction.

- 1 Click 

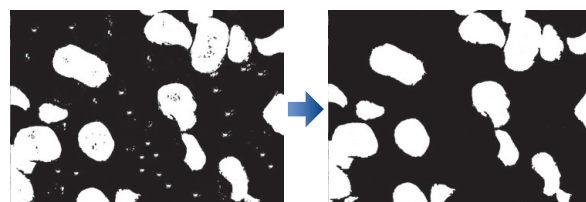
The [Fill] dialog box appears.

- 2 Adjust the number of pixels in the area to fill by clicking the ▲/▼ buttons. Click [OK] when done.



Black areas in the image having fewer pixels than this setting will be filled.

### Example of an image corrected using the fill tool



## Undoing filters and fills

These operations cannot be undone. You must start over by clicking reset button and doing the [Brightness] or [Color] extraction.

📖 "Measuring the Areas Extracted Based on Brightness" (Page 7-22)

📖 "Measuring the Areas Extracted Based on Color" (Page 7-23)

## Measuring the extracted area

### ■ Individual Measurement



**2** Click the area to measure.

The area and perimeter of the extracted area appears in the [Measure Result] window. To measure multiple areas, click the remaining areas.

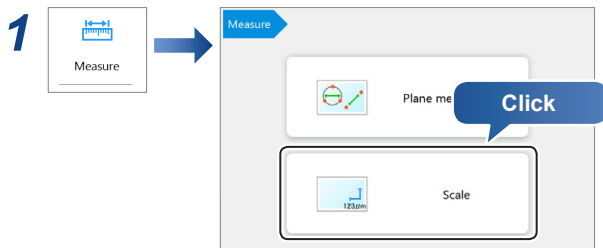
### ■ Block Measurement



The area and perimeter of all extracted areas appear in the [Measure Result] window. Numbers are assigned automatically.

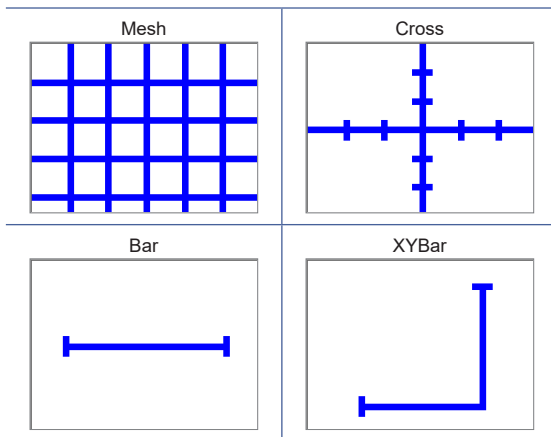
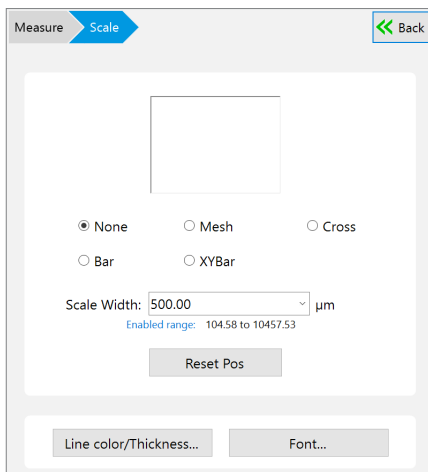
# Displaying a Scale

Displaying a scale on the observation window to serve as a reference during observation.



This brings up the scale setting items in the operation area.

## 2 Select the scale type.



## 3 Enter the reference length of the scale to display as [Scale width].

The scale and reference length appears on the observation window.



- The scale size changes automatically according to the lens magnification when the Fully-Integrated (FI) Head is connected.
- The scale size is determined automatically based on the selected lens magnification when the High-Performance Camera is connected. This must be matched with the lens power actually in use.
  - ☐ "Lens Setting" (Page 7-4)



- The range of input for the scale width differs depending on the lens and power used.
- The scale can be dragged up and down, and left and right.

### ● Reset Pos

This restores the scale and the position of the text on the scale to its original position.

### ● Line color/Thickness

This changes the color and width of the lines.
 

- ☐ "Line Color/Thickness" (Page 7-17)

### ● Font

This sets the background color, text color, and font used to display the scale.
 

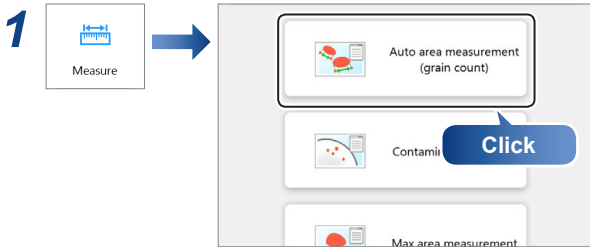
- ☐ "Font" (Page 7-17)

# Auto Area Measurement (Grain Count)

It is possible to automatically extract areas with the same brightness level and measure the area of the target object after shape formatting the extracted area.

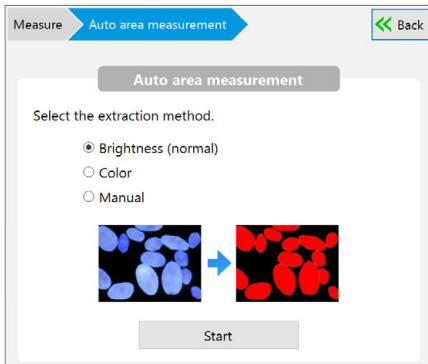
By saving the automatic area data file, it is possible to recreate the same settings and perform measurements as many times as you like when extracting/measuring other objects.

## Measurement Mode Selection



This brings up the automatic area measurement settings dialog in the operation area.

- 2 For measurement of an image file that has been saved, click [Album] from the VHX MENU.
- 3 Select the image to be measured and play it back.
- 4 Select the extraction mode (brightness/color/manual).

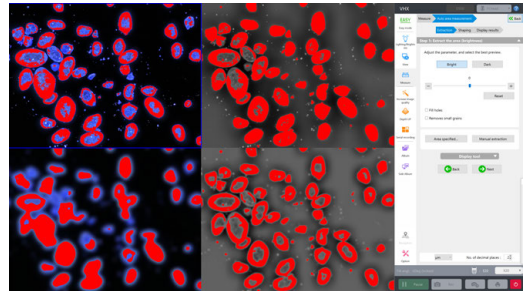


- **Brightness (normal)**  
This measures an area that was extracted based on the brightness of the object.
- **Color**  
This measures an area that was extracted based on the color of the object.
- **Manual**  
This sets the extraction parameters to manual and extracts/measures objects on the screen all at once.

## Step 1: Extract the area

- 1 **Click [Start].**  
This brings up the extraction parameter settings dialog in the operation area. The settings dialog may change depending on the extraction mode chosen.

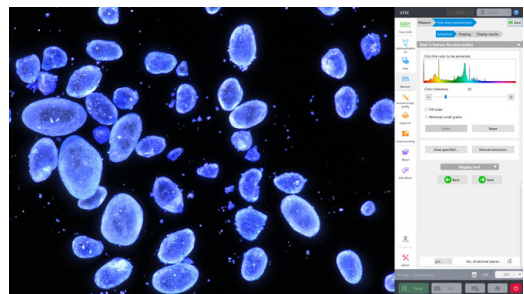
- **When the extraction mode is set to [Brightness]**



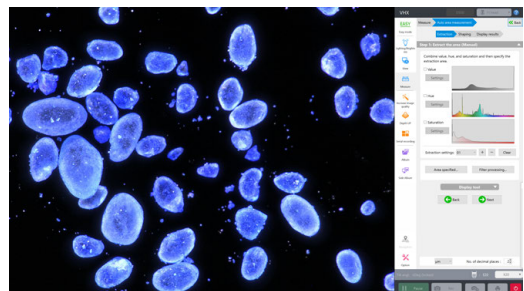
The following four types of images are displayed in the observation window.

Original Image (No processing)	Eliminate uneven brightness (weak) + Noise removal (weak)
Eliminate uneven brightness (weak) + Noise removal (strong)	Eliminate uneven brightness (strong) + Noise removal (medium)

- **When the extraction mode is set to [Color]**



- **When the extraction mode is set to "Manual"**



## 2 Specify the extraction parameters.

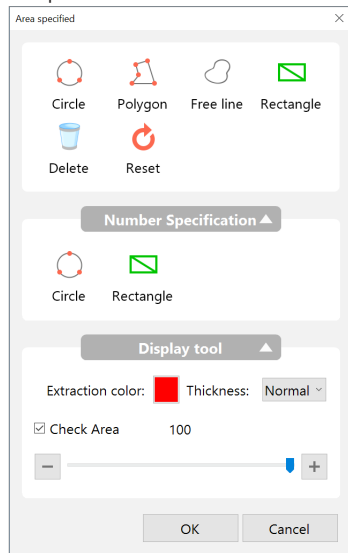
Refer to "Plane Measurement" (Page 7-2) for details on how to specify parameters for each extraction mode.

## 3 For extraction area specification, click [Area specified].

The [Area specified] dialog box appears.

## 4 Click the icon to specify the extraction area, set the extraction area on the observation window, and click [OK].

Multiple areas can be selected at once.



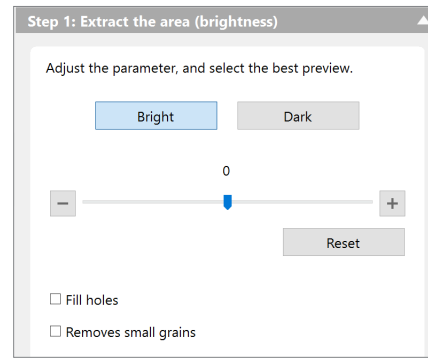
Item	Function
Circle	Click three points on the circumference of the circle that contains the area to be extracted.
Polygon	Enclose the area to be extracted by sequentially clicking each vertex point and double click to indicate the final vertex point.
Free line	Drag the mouse around the perimeter of the area to extract.
Rectangle	Drag the diagonally opposite corners of the rectangular area to extract.
Delete	Click the desired extraction area to delete a single one.
Reset	Deletes all extraction areas.
Number Specification (Circle/ Rectangle)	Enter the length to specify the extraction area.
Extract Color	Specify the color of extraction area lines.
Thickness	Specify the width of extraction area lines.
Check Area	This lightens the color of the extraction to allow checking of the specified area while comparing it to the original image.

## 5 When the extraction mode is set to [Brightness], select the most appropriate image from the four images in the image window and either click [Next] or double click the image itself. For other extraction modes, click [Next].

The object is extracted, and the measurement procedure continues on to "Measurement Types" (Page 7-2).

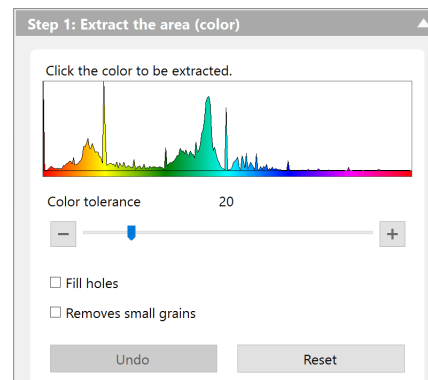
## Setting Extraction Parameters

### Brightness extraction



Item	Function
Bright	Extracts the bright area of the image.
Dark	Extracts the dark area of the image.
Threshold	Sets the range of the brightness level threshold value at -255 to 255. Drag the slider to the left and right to change the appearance of the four parts of the image.
Reset	Returns the threshold value to zero.
Fill holes	If this option is checked, all holes in the binary image are filled.
Removes small grains	When this option is checked, granular components with small areas are removed from the binary image.

### Color extraction



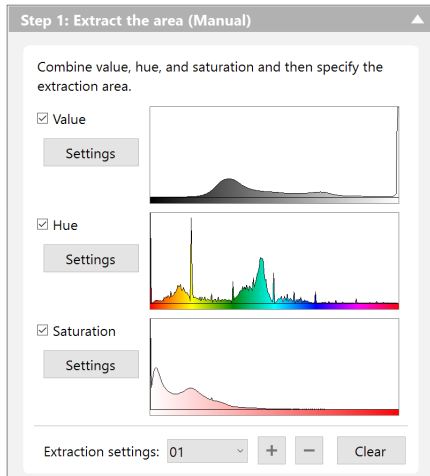
Item	Function
Histogram	When you click on the place in the image that contains the color you would like to measure, the blue area is displayed on the histogram and the measurement object is added.
Color tolerance	When specifying the color level with the Extract picker, specify the color range width by dragging the slider.
Fill holes	If this option is checked, all holes in the binary image are filled.
Removes small grains	When this option is checked, small granular components are removed from the binary image.

### Manual extraction

Using either the Histogram or Extract picker, the extraction range can be specified manually according to particular image brightness, hue, or saturation. The Histogram and Extract picker are operated on the dialog box displayed by clicking the corresponding button. [Filter processing] can also be used to allow the elimination of uneven brightness, noise removal, and outline extraction.  
 "Using the Histogram" (Page 7-22)  
 "Using the Extract Picker" (Page 7-22)

Extraction operation of value, hue and saturation

- 1 Select [Value], [Hue], [Saturation] check mark for settings, and click [Settings].

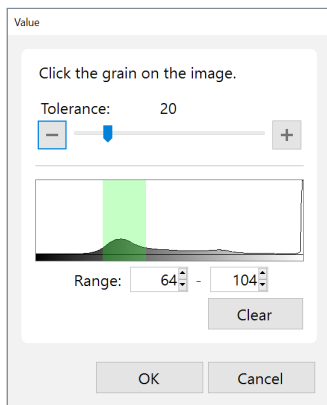


The corresponding dialog boxes will appear.

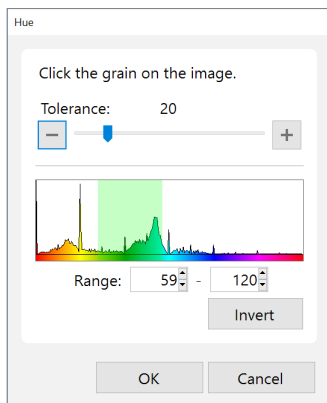
- 2 On each dialog box, specify the extraction range using either the Histogram or Extract picker and click [OK].

Only one extraction range is allowed for each.

● Value setting

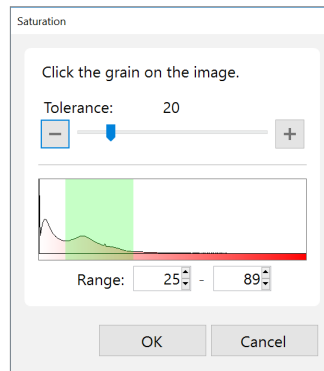


● Hue setting



**Reference** When you would only like to extract red hues, it is necessary to specify both the left and right edges on the histogram. However, this is not possible when specifying two areas separately. In this case, drag the mouse over the space outside the area you would like to extract and click [Invert].

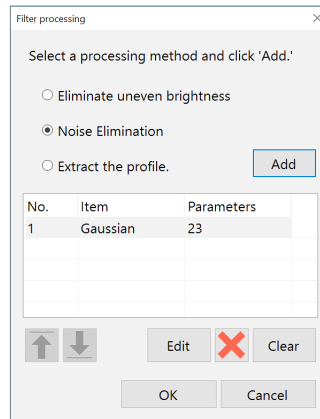
● Saturation setting



- 3 Click [+] of [Extraction settings].

On each dialog box, specify the most appropriate type of processing to extract the object. Up to 20 necessary extraction processing types can be added to the list box.

- 4 Click [Filter processing]. Select either [Eliminate uneven brightness], [Noise Elimination], or [Extract the profile] according to the aims of the filter processing, and click [Add].

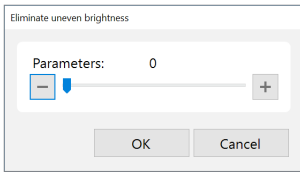


The corresponding dialog boxes will appear.



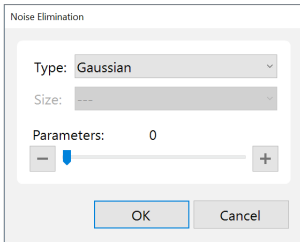
## 5 Set the filter processing parameters for each dialog box and click [OK].

### ● Eliminate uneven brightness



Use the slider to set the strength of eliminating the uneven brightness.

### ● Noise Elimination



#### ○ Type

There are many types of noise removal filters such as [Gaussian], [Median], [Average filter], [Max filter], [Min filter], and [Remove texture].

#### ○ Size

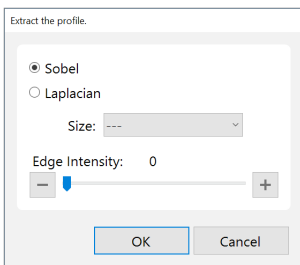
The filter processing size is specified for the [Median], [Average filter], [Max filter], and [Min filter].

- [3x3] The value of the central 3 x 3 pixel is calculated from the values of the pixels above, below, and to the left and right, and it is then replaced.
- [5x5] The value of the central 5 x 5 pixel is calculated from the values of the pixels above, below, and to the left and right, and it is then replaced.

#### ○ Parameters

Use the slider to set the strength of the noise removal. For [Gaussian] and [Remove texture], the texture strength can be set.

### ● Extract the profile



#### ○ Sobel

Enabled when you only want to enhance main edges.

#### ○ Laplacian

Performs enhancement that does not depend on edge direction.

#### ○ Size

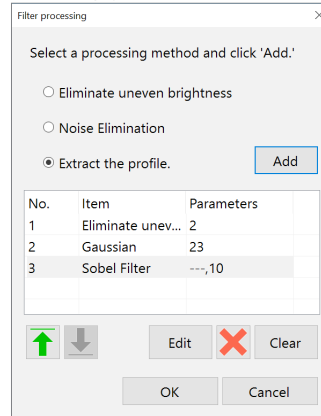
- [3x3] The value of the central 3 x 3 pixel is calculated from the values of the pixels above, below, and to the left and right, and it is then replaced.
- [5x5] The value of the central 5 x 5 pixel is calculated from the values of the pixels above, below, and to the left and right, and it is then replaced.

#### ○ Edge Intensity

The edge strength can be adjusted by using the slider.

## 6 Click [Add] and save the filter process.

On each dialog box, specify the most appropriate type of filter processing to extract the object. Up to 30 necessary filter processing types can be added to the list box.

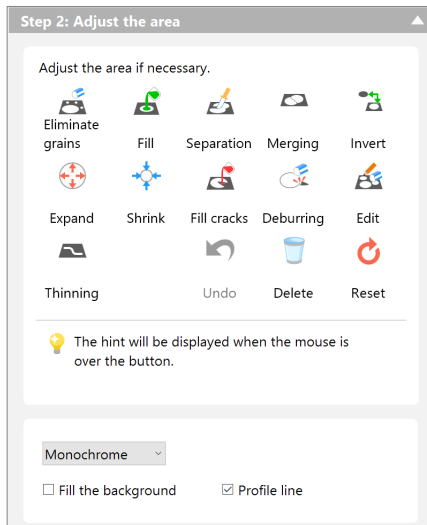


Filter processing types in the list box are applied to the image in descending order as they appear in the list box. Select the corresponding filter in the list box and click the [Edit] button to edit its contents.

## Step 2: Adjust the Area

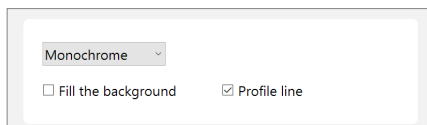
Adjust the shape of measured objects in the extracted area.

### 1 Click the icon for the adjustment items.



With shape formatting processing, it is possible to specify areas and perform shape formatting separately on each area. For more details on operation, refer to the following sections.

### 2 Set the view of the extraction area as necessary.



#### ● Monochrome/Mode

Select the extraction area display color.

- [Monochrome]: Only the extraction color is displayed.
- [Random Color]: Multiple random colors are displayed.

#### ● Fill the background

When this is enabled, the background is filled with the background color.

#### ● Profile line

This is enabled, an outline of the outer edge of the extracted area is displayed.

### 3 After shape formatting the extraction area, click [Next].

The measurement procedure continues on to "Measurement Types" (Page 7-2).

## Eliminate grains

This removes any granular components that are not part of the measurement object from either the entire screen or the specified area.

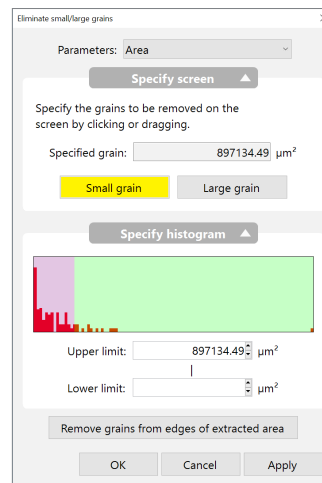


### 1 Click

The [Eliminate small/large grains] dialog box appears.

### 2 To specify the area for processing, drag with the mouse over the area you would like to select.

### 3 Select the deletion parameter (Area/Perimeter/Max diameter/Min diameter/Circularity/ Circle equivalent dia/Envelope curve (Area)/ Envelope curve (Perimeter)).



- The histogram represents the area/perimeter/max diameter/min diameter/circularity/circle equivalent dia/Envelope curve (Area)/ Envelope curve (Perimeter), and displays the frequency of occurrence (distribution) for each pixel on the vertical axis.
- When the [Remove grains from edges of extracted area] is selected (yellow), the grains in contact with the edge of extraction area will be removed. Use this function when the entirety of all the grains are not captured.

### 4 Click either [Small grain] or [Large grain] and click on the grains you want to delete in the image.

The size of the clicked grain is displayed under the [Clicked grains]. When [Small grain] is selected, grains smaller than the one clicked are highlighted as targets for deletion.

When [Large grain] is selected, grains larger than the one clicked are highlighted as targets for deletion.

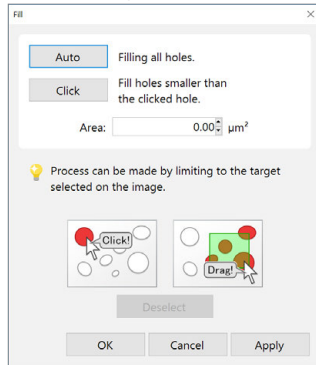
### 5 Click [OK].

## Fill

This fills any granular components that have less than a given area from either the entire screen or the specified area.



The [Fill] dialog box appears.



**2** To specify the area for processing, drag with the mouse over the area you would like to select.


**3** Enter the area you want to fill into the [Area] box.

**4** Click [Auto] to fill all holes.

The area of the largest hole in the area box is displayed and all holes are highlighted.

**5** To fill all holes that have less than a fixed area, click [Click] and then click on holes in the image.

**6** Regions with holes that have areas less than the clicked hole are highlighted.

 Reference Fine tuning of the fill area is possible by entering a value into the [Area] box.

**7** Click [Apply].

Holes are filled and highlighted regions change to the extraction color.

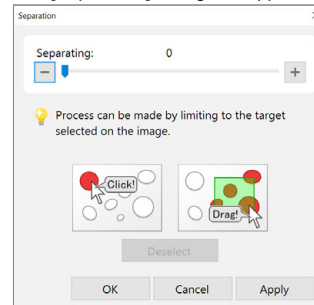
**8** Click [OK].

## Separation

This separates any granular components from either the entire screen or the specified area according a given degree of separation. This is more effective when fill processing is performed in advance.



The [Separation] dialog box appears.



**2** To specify the area for processing, drag with the mouse over the area you would like to select.

Only the grains within this area will be displayed in the extraction color.

**3** Specify the degree of separation with the slider.

Grains within the area will be separated by color according to the specified degree of separation.

**4** Click [Apply].

Separation processing is carried out and each respective color will change to the extraction color.

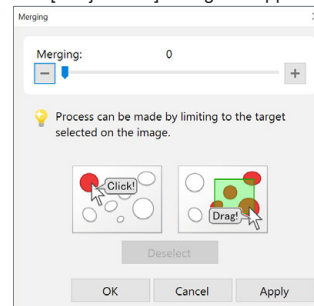
**5** Click [OK].

## Merging

This combines granular components on either the entire screen or the specified area.



The [Conjunction] dialog box appears.



**2** To specify the area for processing, drag with the mouse over the area you would like to select.

Only the grains within this area will be displayed in the extraction color.

**3** Adjust the combination degree with the slider.

Separated grains are combined and highlighted.

**4** Click [Apply].

Combination processing is carried out and the combined grains are changed to the extraction color.

**5** Click [OK].

## Invert

This inverts the area extracted on the screen.



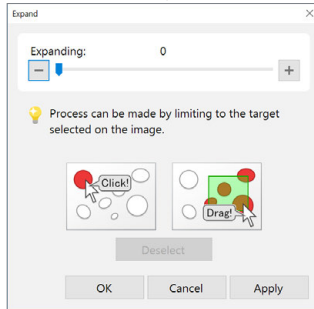
The extracted area is inverted.

## Expand

This expands granular components on either the entire screen or the specified area.



The [Expand] dialog box appears.



- 2 To specify the area for processing, drag with the mouse over the area you would like to select.**

Only the grains within this area will be displayed in the extraction color.

- 3 Adjust the expansion degree with the slider.**  
Applicable grains are expanded.

- 4 Click [Apply].**  
Expansion processing is carried out and applicable grains are changed to the extraction color.

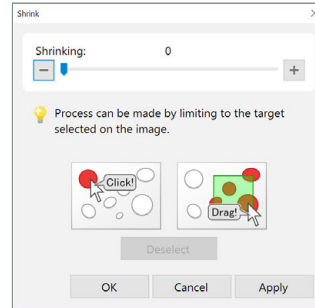
- 5 Click [OK].**

## Shrink

This contracts granular components on either the entire screen or the specified area.



The [Shrink] dialog box appears.



- 2 To specify the area for processing, drag with the mouse over the area you would like to select.**

Only the grains within this area will be displayed in the extraction color.

- 3 Adjust the contraction degree with the slider.**  
Applicable grains are contracted.

- 4 Click [Apply].**  
Contraction processing is carried out and applicable grains are changed to the extraction color.

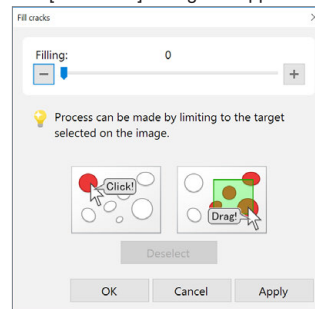
- 5 Click [OK].**

## Fill Cracks

This fills any missing parts of granular components on either the entire screen or the specified area.



The [Fill cracks] dialog box appears.



- 2 To specify the area for processing, drag with the mouse over the area you would like to select.**

Only the grains within this area will be displayed in the extraction color.

- 3 Adjust the degree of missing parts with the slider.**  
Applicable grains are highlighted.

- 4 Click [Apply].**  
Fill missing parts processing is carried out and applicable grains are changed to the extraction color.

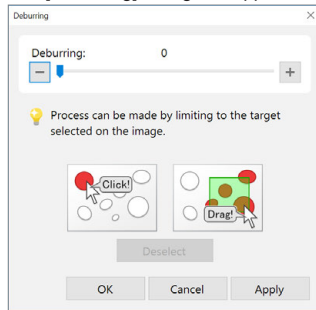
- 5 Click [OK].**

## Deburring

This trims any protrusions from granular components on either the entire screen or the specified area.



The [Deburring] dialog box appears.



**2 To specify the area for processing, drag with the mouse over the area you would like to select.**

Only the grains within this area will be displayed in the extraction color.

**3 Adjust the degree of trimming with the slider.**

Applicable grains are highlighted.

**4 Click [Apply].**

Trim processing is carried out and applicable grains are changed to the extraction color.

**5 Click [OK].**

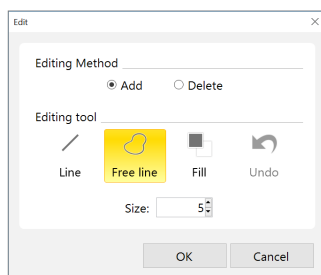
## Editing

This allows manual editing of the specified area.



The [Edit] dialog box appears.

**2 Select the editing method (Add/Delete).**



**3 Click the edit icon and then click [OK] after image editing is complete.**

Tool	Function
Line	Drag the mouse and draw a line from the start point to the end point to add/delete an area.
Free line	Drag the mouse and draw a free shape from the start point to the end point to add/delete an area.
Fill	Drag the mouse and draw a rectangle having the start and end points as its opposite corners to add/delete an area.
Undo	This returns to the previous editing state.
Size	This specifies the line width of the added/deleted area.

## Thinning

Thin the grain into line.



The grain becomes a thin line.

## Deleting

This deletes individual extraction areas.



**2 Click the extraction area or drag the mouse over the area you would like to delete.**

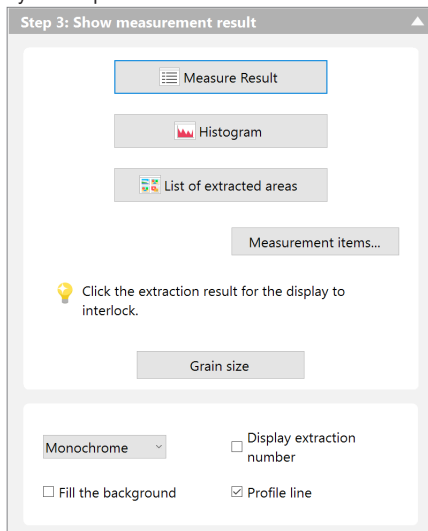
For each click, a single area will be deleted.

## Restart Shape Formatting

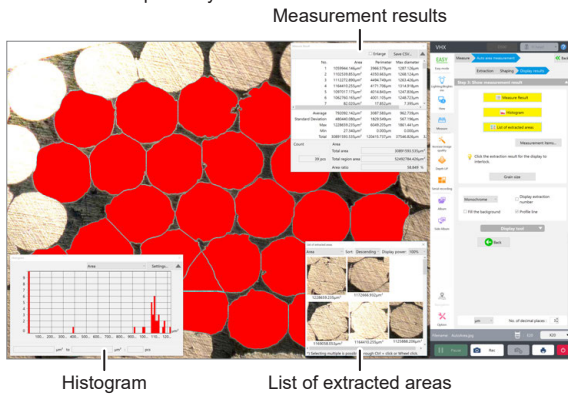
Click [Undo] to return to the previous shape formatting editing state. Click [Reset] to start over from the original shape formatting.

## Step 3: Show Measurement Result

After formatting the extraction area, click [Next] to bring up the result display in the operation area.



Click [Measure Result], [Histogram], or [List of extracted area] to display each window respectively.



## Setting measurement items

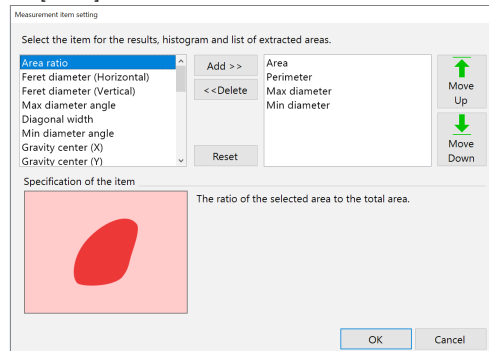
Click [Measurement items] to bring up the [Measurement item setting] dialog box.

In this dialog box, measurement items shown under [Measure Result], [Histogram], and [List of extracted area] are able to be selected.

### Selecting measurement items

The left list box contains items not displayed and the right list box contains items displayed.

- Clicking [Add] moves the selected measurement item from the left box to the right box.
- Clicking [Delete] moves the selected measurement item from the right box, back to the left box.
- Clicking [Move Up] or [Move Down] changes the order of the selected measurement item in the right box.
- The measurement item at the top of the right box is displayed in the Histogram and Extracted Image List.
- Click [Reset] to reset the box to the default values.



### Types of measurement items

A description of the selected measurement item in the list box is displayed in [Item Description].

#### Area

The area of the graphic.

#### Area ratio

The ratio of the selected area to the total area.

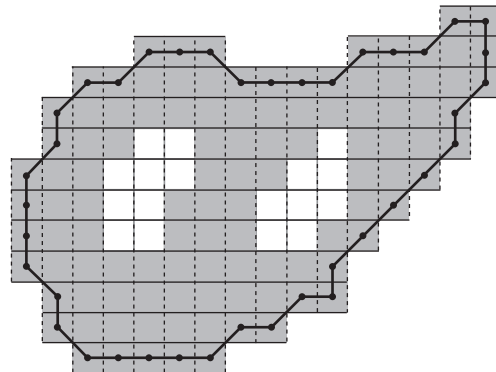
#### Perimeter

The length of the perimeter of the figure. This is calculated as the length of the line that passes through the center of the pixels that make up the inner perimeter.

#### Calculation method

This is the perimeter of the specified particle.

It is calculated as the length of the line that connects the centers of the pixels along the internal perimeter of the specified particle (the length of the black line in the figure below).



This is calculated while taking the length of the vertical or horizontal line of a pixel as 1, and the length of the diagonal line from a pixel to the diagonally adjacent pixel as  $\sqrt{2}$ . The value for the figure above is as follows:

Particle perimeter = 45.2132

**Reference** When the particle consists of a single pixel, the particle perimeter becomes 0.0.

**Feret diameter (Horizontal)**

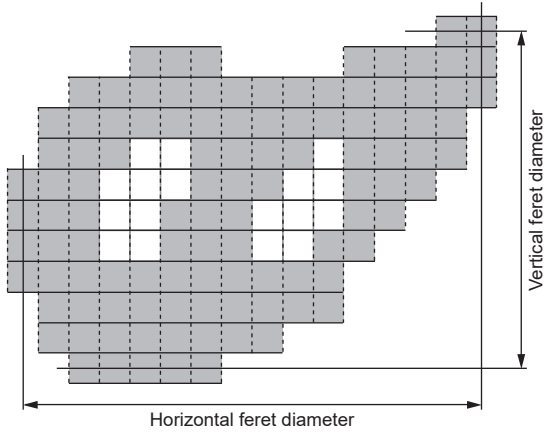
The horizontal length (number of pixels) of a rectangle circumscribed around the figure.

**Feret diameter (Vertical)**

The vertical length (number of pixels) of a rectangle circumscribed around the figure.

$$\text{Feret diameter (Horizontal)} = \max_{p \in P} px - \min_{p \in P} px$$

$$\text{Feret diameter (Vertical)} = \max_{p \in P} py - \min_{p \in P} py$$



The values for the figure above are as follows:  
Horizontal Feret diameter = 16  
Vertical Feret diameter = 12

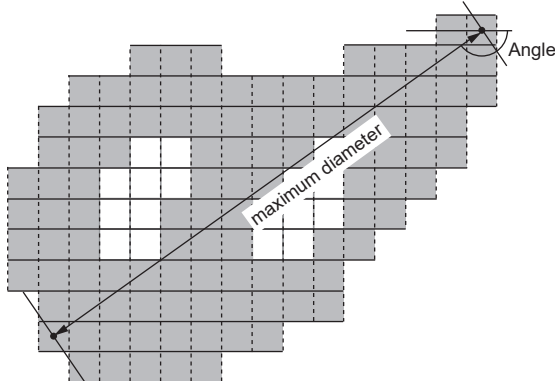
**Maximum diameter**

The maximum length between any two points that lie on the inner perimeter of the figure.

$$= \max_{p, q \in C} \sqrt{(px - qx)^2 + (py - qy)^2}$$

**Maximum diameter angle**

The angle between a line along the maximum diameter and the X-axis. The maximum diameter is the maximum distance between any two pixels on the inner perimeter of the particle. Distance is counted as the Euclidean distance between the centers of the two pixels.



The values for the figure above are as follows:  
Maximum diameter = 17.204651  
Maximum diameter angle = 144.46°

**Minimum diameter**

This is the minimum possible distance between two parallel lines on either side of the particle. It is calculated as the distance between the pixels that each of the two lines touches.

**Minimum diameter angle**

The angle between a line along the minimum diameter and the X-axis.

**Minimum diameter angle =**

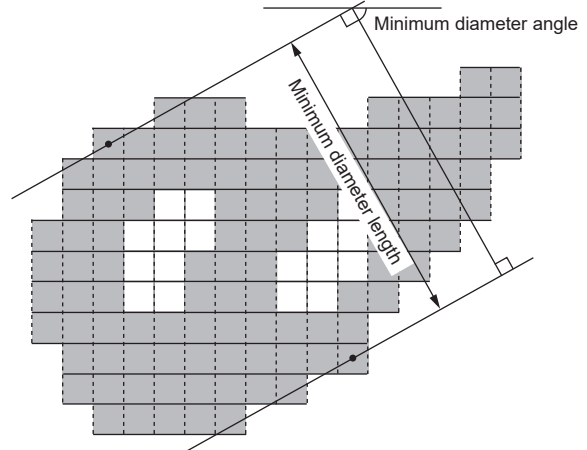
$$\min_{0 \leq \alpha < \pi} \{ \max_{c \in C} (c_X \cos \alpha - c_Y \sin \alpha) - \min_{c \in C} (c_X \cos \alpha - c_Y \sin \alpha) \}$$

**Minimum diameter =**

$$\max_{c \in C} (c_X \cos \beta - c_Y \sin \beta) - \min_{c \in C} (c_X \cos \beta - c_Y \sin \beta)$$

$\beta = -$  (minimum diameter angle)

First, the minimum diameter angle is determined with a precision of 0.1 degrees. Then the minimum diameter is determined based on the distance between the two pixels that touch the two lines that enclose the particle at that angle (as shown below).



The values for the figure above are as follows:

Minimum diameter = 10.841152  
Minimum diameter angle = 63.4°

**Reference** When the particle consists of a single pixel, the values are as follows:  
Maximum diameter = 0.0  
Maximum diameter angle = 0.0  
Minimum diameter = 0.0  
Minimum diameter angle = 0.0

**Diagonal width**

This is the distance between two parallel lines that sandwich the particle and are parallel to the line along the maximum diameter. It is calculated as the distance between the pixels that each of the two lines touches.

**Gravity center X/Y**

The coordinates of the center of gravity of the figure.

$$\text{The X coordinate of the center of gravity} = \left( \sum_{p \in P} px \right) / \text{Area}$$

$$\text{The Y coordinate of the center of gravity} = \left( \sum_{p \in P} py \right) / \text{Area}$$

Area is the particle area.

**Circle equivalent dia**

This is the diameter of a circle with the same area as the figure. It is sometimes referred to as the Heywood diameter.

The circle equivalent diameter for the figure can be shown as:

**Circle equivalent diameter of the specified particle =**

$$\sqrt{\frac{4 \cdot \text{Area}}{\pi}}$$

Area is the particle area.

● **Circularity**

When the figure is a perfect circle, the maximum value is one. As it becomes long and thin, this value approaches zero. The degree of circularity of the figure can be shown as:

$$\text{The degree of circularity of the specified particle} = \frac{4\pi \cdot \text{Area}}{\text{Perimeter}^2}$$

Area is the particle area.  
Perimeter is the particle perimeter.

**Reference** When the particle consists of a single pixel, degree of circularity of the specified particle becomes 1.0.

● **Envelope curve (Area)**

This is the ratio between the area of the figure and its convex envelope area. This approaches one as the figure is less bumpy. Convex envelope ratio (Area) = Area of the figure ÷ Convex envelope area

● **Envelope curve (Perimeter)**

This is the ratio between the perimeter of the figure and its convex envelope perimeter. This approaches one as the figure is less bumpy. Convex envelope ratio (Perimeter) = Area of the figure ÷ Convex envelope area

**Reference** Note: A convex envelope is defined as: A convex polygon that tightly encloses the figure.  
Convex envelope area : The area of the envelope enclosing the figure  
Convex envelope perimeter: The perimeter of the envelope enclosing the figure

● **1st moment (X-axis)**

The primary moment of the figure on the X-axis.

● **1st moment (Y-axis)**

The primary moment of the figure on the Y-axis.  
**The primary moment of the specified particle on the X-axis =**

$$\sum_{p \in P} px$$

**The primary moment of the specified particle on the Y-axis =**

$$\sum_{p \in P} py$$

● **2nd moment (X-axis)**

The second moment of the X-axis of the graphic.

● **2nd moment (Y-axis)**

The second moment of the Y-axis of the graphic.  
**The second moment of the specified particle on the X-axis =**

$$\sum_{p \in P} p^2x$$

**The second moment of the specified particle on the Y-axis =**

$$\sum_{p \in P} p^2y$$

● **Product of inertia**

The synergistic moment of the X/Y-axis of the graphic.  
**The product of inertia of the specified particle on the X and Y axes**

$$= \sum_{p \in P} px \cdot py$$

● **Gravity 2nd moment (X-axis)**

This is the center of gravity secondary moment of the figure on the X-axis. G is the center of gravity of the figure.

● **Gravity 2nd moment (Y-axis)**

This is the center of gravity secondary moment of the figure on the Y-axis. G is the center of gravity of the figure.

**The center of gravity secondary moment of the specified particle on the X-axis**

$$= \sum_{p \in P} (px - gx)^2$$

**The center of gravity secondary moment of the specified particle on the Y-axis**

$$= \sum_{p \in P} (py - gy)^2$$

(gx, gy) are the coordinates of the center of gravity.

● **Gravity product of inertia**

The center of gravity product of inertia of the figure on the X and Y axes. G is the center of gravity of the figure.

**The center of gravity product of inertia of the specified particle on the X and Y axes**

$$= \sum_{p \in P} (px - gx) \cdot (py - gy)$$

● **Inertial moment**

**The moment of inertia of the specified particle**

$$= \frac{\sum_{p \in P} \{(px - gx)^2 + (py - gy)^2\}}{\text{Area}^2}$$

Normalization is achieved by dividing by the square of the area. (gx, gy) are the coordinates of the particle's center of gravity. Area is the particle area.

● **2nd moment major axis**

This is the length of the figure's secondary moment major axis. Normalization is achieved by dividing by the area.

$$= \frac{(I_{XX} + I_{YY}) + \sqrt{(I_{XX} - I_{YY})^2 + 4I_{XY}^2}}{2\text{Area}}$$

● **2nd moment minor axis**

This is the length of the figure's secondary moment minor axis. Normalization is achieved by dividing by the area.

$$= \frac{(I_{XX} + I_{YY}) - \sqrt{(I_{XX} - I_{YY})^2 + 4I_{XY}^2}}{2\text{Area}}$$

$I_{XX}, I_{YY}$  is the center of gravity secondary moment.

$I_{XY}$  is the center of gravity product of inertia.

Area is the particle area.

● **2nd moment angle**

The second moment principal axis angle of the selected area.

$$= \frac{1}{2} \tan^{-1} \frac{2I_{XY}}{I_{XX} - I_{YY}}$$


$I_{XX}, I_{YY}$  is the center of gravity secondary moment.

$I_{XY}$  is the center of gravity product of inertia.

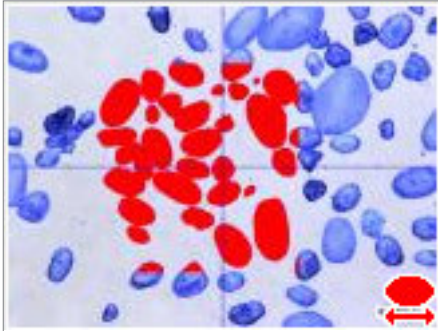


## The automatic area data file

By saving the file after performing automatic area measurement, you can store a copy of the settings file that allows you to repeat the measurement (automatic area data file) at a later time.

After it is saved,  is displayed in the lower right corner of the thumbnail of the automatic area data file.

When retrieving an automatic area data file from an album, it is possible to change/modify the measurement.



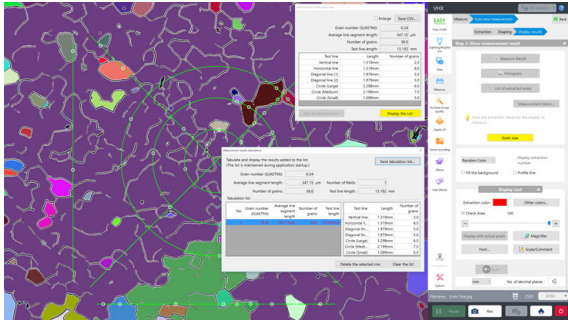
## About Scale/Comment

Markers or comments for the measurement results can be displayed by clicking [Scale/Comment]. When a comment is displayed, the comment is attached to the image when it is saved. A scale is displayed on the observation window to serve as a reference.

- "Displaying Text and Markers (Comment)" (Page 6-4)
- "Displaying a Scale" (Page 7-25)

## Grain size analysis

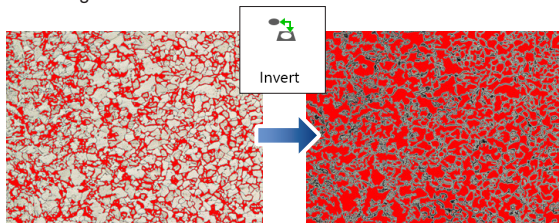
According to JIS-G0551, ISO-643 and ASTM-E1382, grain size is measured.  
 The evaluation method for grain size can be either the cutting method and the counting method.  
 Measurement results of multiple images can be stored in a CSV file in batch.



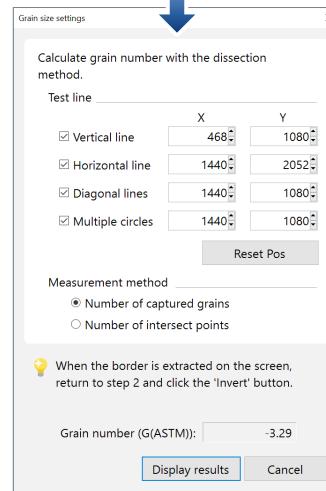
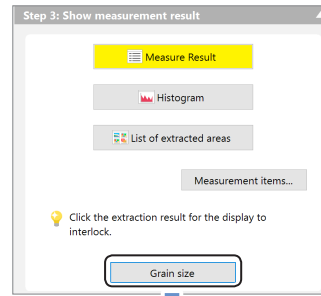
## Grain size analysis of one image

### 1 Perform automatic area measurement and displays the measurement result.

Extract target should not be boundaries between grains but grains. If the target is boundary, return to the automatic area measurement and select "Invert" (Page 7-32) from the extraction area shape formatting.

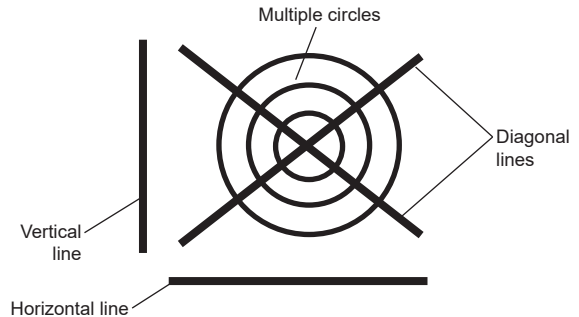


### 2 Click [Grain size], and set the measurement method at [Grain size settings].



#### ● Selecting test line

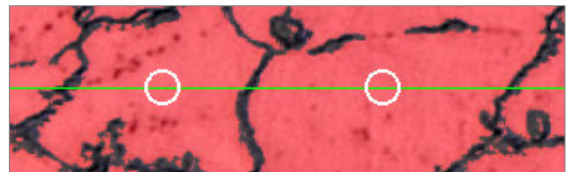
[Vertical line], [Horizontal line], [Diagonal line], and [Multiple circles] are available for the test line. Grains on the test line are measured.



The test line can be moved by mouse drag while the grain size settings dialog appears.

#### ● Measurement method

##### ○ Number of captured grains



The number of grains on the test line are counted.

##### ○ Number of intersect points



The number of intersect points between the test line and grain field (grain boundaries) are counted.

### 3 Use the [Show result] button to check the counting results.

When the measuring method is the number of captured grains, the number of captured grains is shown instead of intersect points.

Measurement results (grain size)

Enlarge

Grain number (G(ASTM)):

Average line segment length:   $\mu\text{m}$

Number of grains:

Test line length:  mm

Test line	Length	Number of grains
Vertical line	4.706mm	4.5
Horizontal line	4.706mm	2.5
Diagonal line (1)	7.059mm	5.5
Diagonal line (2)	7.059mm	7.5
Circle (Large)	11.765mm	14.0
Circle (Medium)	7.845mm	9.0
Circle (Small)	3.920mm	4.0

#### ● Grain number (G(ASTM))

The number is calculated with the standardized formula. The larger number indicates smaller grain size.

$$G = (-6.643856 \log_{10} L) - 3.288$$

L = Average line segment length (mm)

#### ● Average line segment length

Average line segment length = length/(Number of intersect points or Number of captured grains)

This shows an average length per one grain.

The larger number indicates larger grain size.

#### ● Number of intersect points

This number is the total number of intersect points on each test line. This appears on the screen when the measurement mode is the number of intersect points.

#### ● Number of grains

This number is the total number of captured grains on each test line. This appears on the screen when the measurement method is "Number of captured grains".

#### ● Test line length

This is the sum total of test lines.

### 4 Clicking [Add to tabulation list] adds the measurement results to the tabulation list.

Clicking [Display the List] shows the tabulation list to which measurement results are already added.

Measurement results (tabulation)

Tabulate and display the results added to the list. (The list is maintained during application startup.)

Grain number (G(ASTM)):

Average line segment length:   $\mu\text{m}$  Number of fields:

Number of grains:  Test line length:  mm

Tabulation list

No.	Grain number (G(ASTM))	Average line segment length	Number of grains	Test line length	Test line	Length	Number of grains
1	-3.29	1001.25 $\mu\text{m}$	47.0	47.059mm	Vertical line	4.706mm	4.5
					Horizontal li...	4.706mm	2.5
					Diagonal lin...	7.059mm	5.5
					Diagonal lin...	7.059mm	7.5
					Circle (Large)	11.765mm	14.0
					Circle (Medi...	7.845mm	9.0
					Circle (Small)	3.920mm	4.0

## Grain size analysis of multiple images

1 Perform the grain size analysis for the first image, and add the results to the tabulation list.

2 Terminate the grain size analysis for the first image.

Although the following message appears this time, click [Yes], which does not discard the tabulation list.

VHX

Discard the current measurement result?

3 Perform the grain size analysis for the second image, and add the results to the tabulation list.

4 After the results of required number of images accumulated, the results can be saved in a CSV file by clicking [Save tabulation list...].

Measurement results (tabulation)

Tabulate and display the results added to the list. (The list is maintained during application startup.)

Grain number (G(ASTM)):

Average line segment length:   $\mu\text{m}$  Number of fields:

Number of grains:  Test line length:  mm

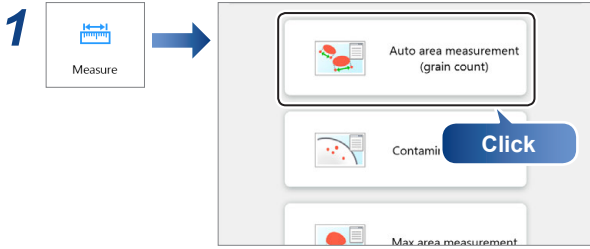
Tabulation list

No.	Grain number (G(ASTM))	Average line segment length	Number of grains	Test line length	Test line	Length	Number of grains
1	-3.29	1001.25 $\mu\text{m}$	47.0	47.059mm	Vertical line	4.706mm	4.0
2	-3.58	1107.27 $\mu\text{m}$	42.5	47.059mm	Horizontal li...	4.706mm	2.0
3	-3.29	1001.25 $\mu\text{m}$	42.5	47.059mm	Diagonal lin...	7.059mm	5.5
					Diagonal lin...	7.059mm	7.0
					Circle (Large)	11.765mm	12.0
					Circle (Medi...	7.845mm	8.0
					Circle (Small)	3.920mm	4.0

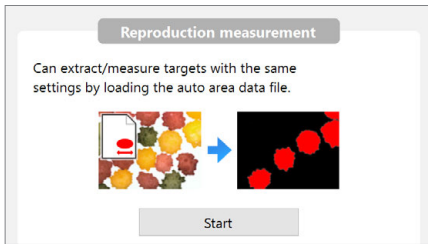
- Clicking [Delete the selected row] deletes data in the selected line.
- Clicking [Clear the list] deletes all data in the tabulation list.

## Reproduce measurements

It is possible to extract/measure an object under the same settings as a specified automatic area data file.

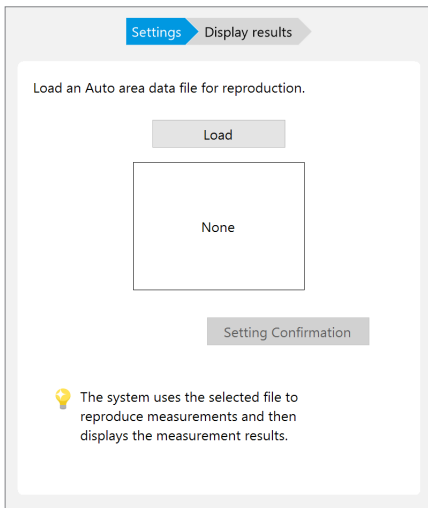


**2** Click [Start] of the reproduction measurement.



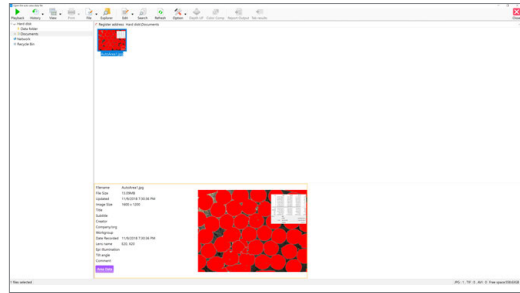
The settings dialog for the measurement repetition file appears.

**3** Click [Load].

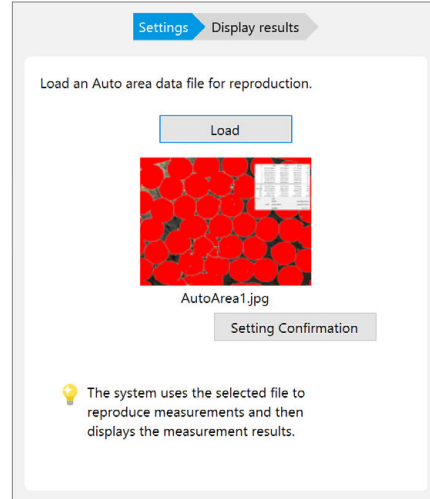


An album ([Open the auto area data file] window) will then appear.

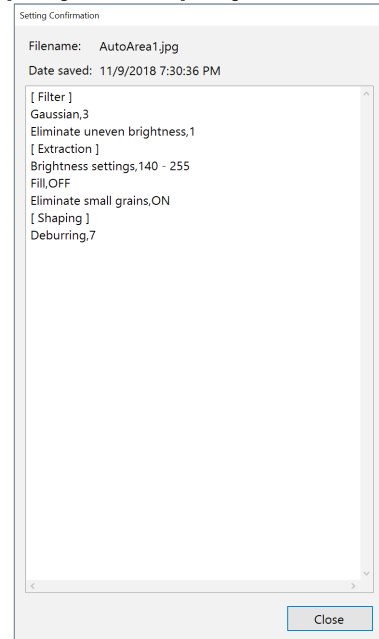
**4** From the album, select the automatic area data file for measurement recreation and run it.



The image thumbnail loaded appears.



**Reference** Click [Setting Confirmation] to check the contents of the [Setting Confirmation] dialog box.

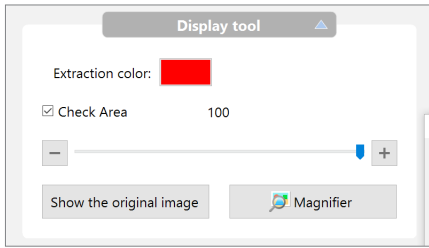


**5** Click [Next].

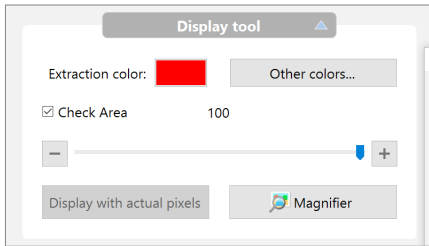
The automatic area data file settings are applied to the measurement object image and the measurement results are displayed.

# Display Tool

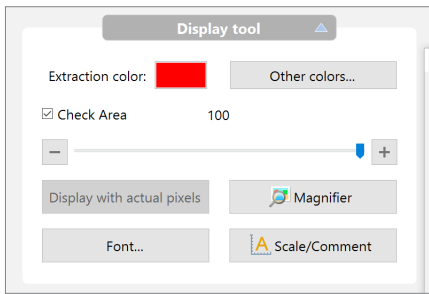
● [Step 1: Extract the area] display tool

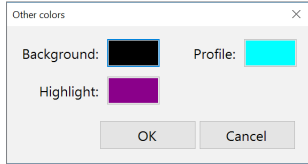
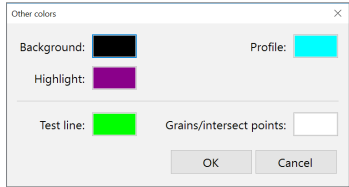


● [Step 2: Adjust the area] display tool



● [Step 3: Show measurement result] display tool



Tool	Function
Extract color	Select the color to paint the area extracted by brightness.
Other colors	<p>Select a color.</p> <ul style="list-style-type: none"> <li>In the case of [Step 2: Adjust the area]                              </li> <li>In the case of [Step 3: Show measurement result]                              </li> </ul>
Check Area	If this option is checked, the color of the extraction is lightened and you can check the specified area while comparing it to the original image.
Show the original image	This is displayed when the extraction mode is set to [Brightness]. If this button is pressed, the lower left, upper right, and lower right images are also displayed as original images.
Magnifier	When this is clicked, a [Magnifier] window is displayed on the observation window. The [Magnifier] window displays a magnified view of part of the observation window image, centered on the mouse position. This allows checking of fine details of the image in the observation window. You can choose a magnification of 2 to 5 times.
Display actual pixels	This command displays images the observation window with pixels in original magnification.
Font	☞ "Font" (Page 7-17)
Scale/Comment	☞ "Displaying a Scale" (Page 7-25) ☞ "Displaying Text and Markers (Comment)" (Page 6-4)

# Contamination Analysis

According to ISO-16232 and VDA 19, contamination, such as cleanliness level, is analyzed.

This analysis splits an object into multiple areas and records each area separately, thereby allowing for analysis of contamination over a wider area. The number of extracted grains and their cleanliness levels are displayed and stored in a CSV file for each class (B to K) based upon the max. diameter. The measurement can also be analyzed based on arbitrary sizing that does not match the standardized method.

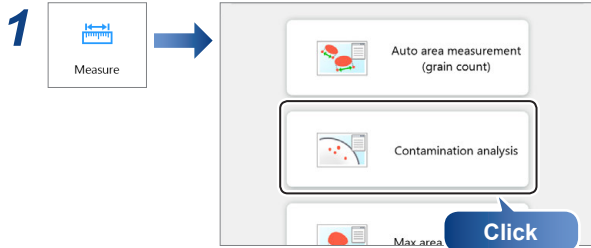
Interval	1	2	3	4	5	6	7	8	9	10	11
Max diameter(μm)	0 - 5	5 - 15	15 - 25	25 - 50	50 - 100	100 - 150	150 - 200	200 - 400	400 - 600	600 - 1000	1000 -
Count	122.0	39.0	41.0	28.0	18.0	2.0	1.0	3.0	1.0	1.0	0.0

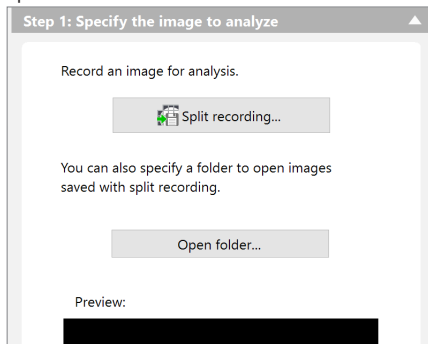
2/16/2019 5:19:51 PM		Maximum size:	694.9μm
Display object:	All	Extraction area:	902.24mm <sup>2</sup>
Count:	256.0	Calibration:	10.932μm/pixel

No.	Filename	Category	Max di...	Area	Inter...	Min di...	Maximu...	Average ...
126	VHX_000009j...	Other	24.4μm	597.54μm <sup>2</sup>	3	10.9μm	2.24	183
127	VHX_000009j...	Other	0.0μm	119.51μm <sup>2</sup>	1	0.0μm	1.00	169
128	VHX_000009j...	Other	15.5μm	478.04μm <sup>2</sup>	3	10.9μm	1.41	171
129	VHX_000009j...	Other	0.0μm	119.51μm <sup>2</sup>	1	0.0μm	1.00	171
130	VHX_000009j...	Other	32.8μm	717.05μm <sup>2</sup>	4	21.9μm	1.50	181
131	VHX_000009j...	Other	440.0μm	64176.27μm <sup>2</sup>	9	271.9μm	1.62	175

## Step 1: Specify the image to analyze

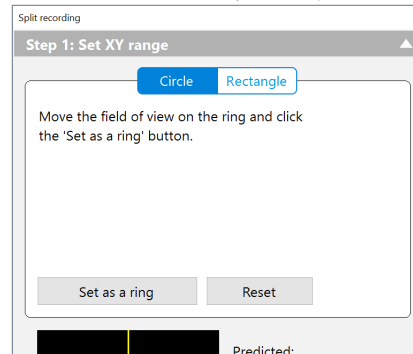


This brings up the contamination analysis settings dialog in the operation area.

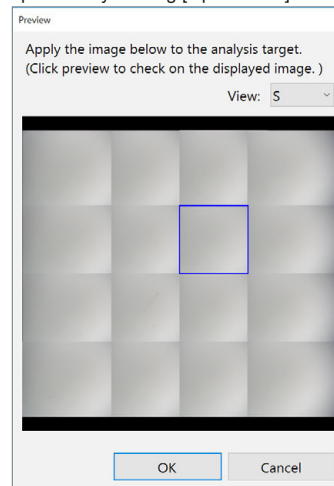


## 2 Specify the area for measurement.

- Specify the split recording to define the area which will be measured. For more details, refer to [F1] "Screen Split" (Page 6-2).



- If any split recorded data already exists, the results can be specified by clicking [Open folder].



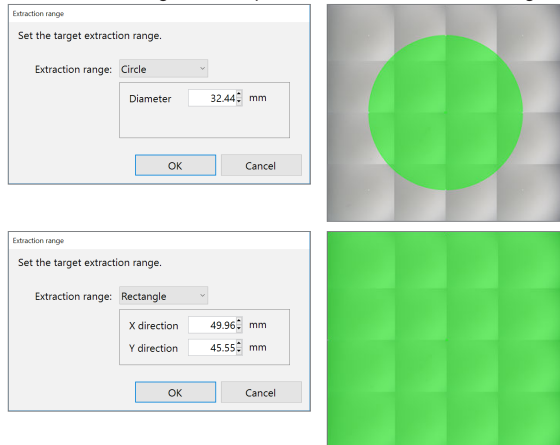
After images are loaded, the image of the measurement result can be enlarged to check by clicking the preview window. The size of the preview image can be selected from S, M, and L.

## 3 Click [Next] to go to the settings of the extraction parameters.

## Step 2: Set the extraction parameters

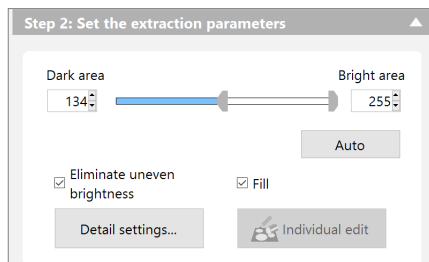
### 1 Specify the extraction range and click [OK].

The extraction range can be specified to be a circle or a rectangle.



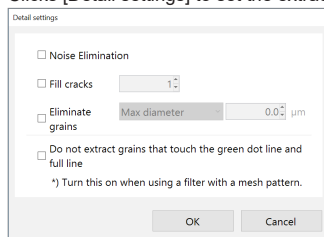
### 2 Use the slider to adjust the threshold so as to extract only the object.

**Point** If the extraction range is inappropriate, click [Extraction range] in the preview window to set it again.



Areas darker than the threshold specified at [Dark area] and brighter than the threshold specified at [Bright area] are detected.

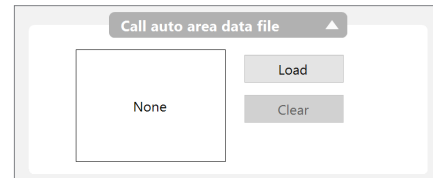
- Clicking the [Auto] button returns the thresholds to the values calculated automatically.
- [Eliminate uneven brightness] and [Fill] can adjust the extract target.
- Clicks [Detail settings] to set the extract target detail.



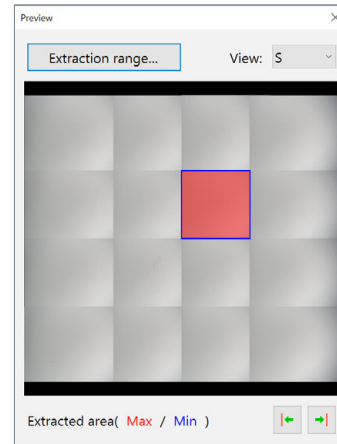
Noise Elimination	Eliminates noises.
Fill cracks	Fills cracks in grains. The intensity can be adjusted within the range from 1 to 10.
Eliminate grains	Eliminates targets whose max.diameter is smaller than the specified value.

\* Turn on [Do not extract the grain that touches the green dot line and full line] when using the filter with mesh.

- Previous extraction conditions can be loaded from the results of the automatic area measurement.



### 3 Click the preview window and check that extraction settings are appropriate.



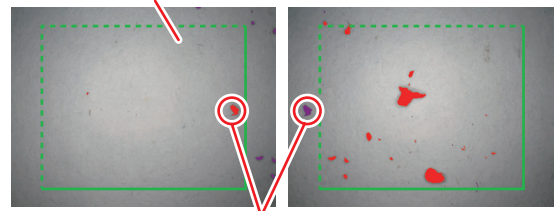
The grain extraction areas are displayed with the maximum area colored in red, and the minimum areas colored in blue.

The image on the screen can be switched by clicking the image on the preview window or using the arrow buttons at the bottom of the preview window.

Only the area in the green frame line displayed on the screen is measured (so that the measurements in the neighboring images do not double-count any particles).

Area where the image in the green frame can be seen tied on the neighboring stages. The place outside the green frame is overlap width region.

Grains including both neighboring images are sure to be counted on either part.



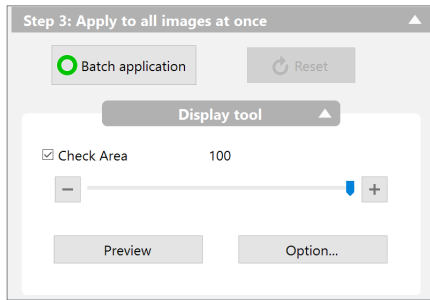
The same grain appears on the right and left images.

- Left image: In the green frame → to be counted
  - Right image: Out of the green frame → not counted
- Grains to be excluded are shown highlighted.

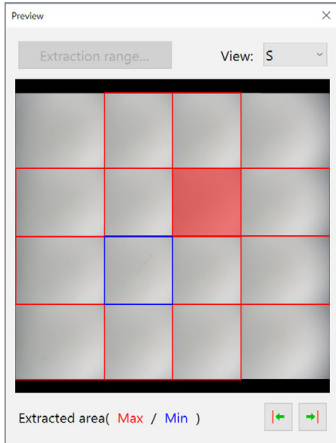
- - - - - Grains on the dotted line are measured.
- ——— Grains on the solid line are excluded.

## Step 3: Apply to all images at once

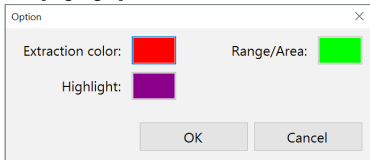
### 1 Click [Batch application] to measure all images.



- Areas where measurement targets exist are shown with red frames on the [Preview] window when clicking [Preview].

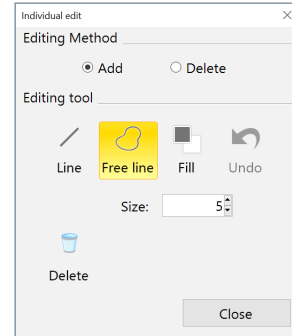
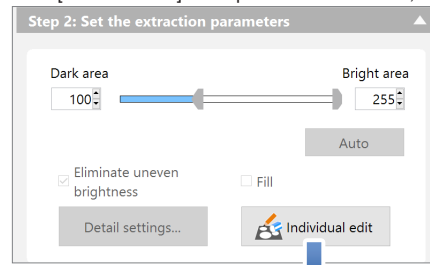


- Clicking [Option] can change [Extraction color], [Range/Area], and [Highlight] color.



### 2 Adjusting the extraction results for each area.

Click [Individual edit] of Step 2 to edit the results, as required.



Refer to "Editing" (Page 7-33) of the auto area measurement for the individual edit.

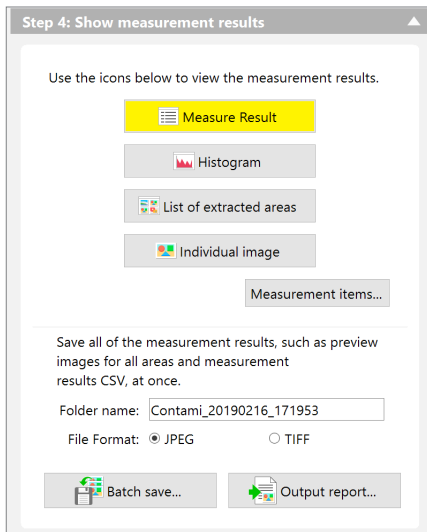
- **Point**
  - Adjustment of the threshold at this step is applied to the area being displayed. To apply to all extracted areas, press the [Batch application] again.
  - Click [Reset] to return to the status before clicking [Batch application] at first. You can do adjustment again including ON/OFF of [Eliminate uneven brightness] etc.

### 3 After shape formatting the extraction area, click [Next].

This brings up the result display menu in the operation area.



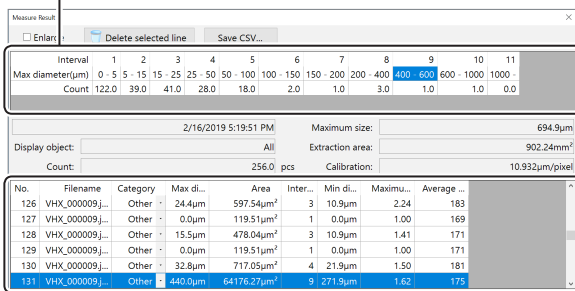
## Step 4: Show the measurement results



Click [Measure Result], [Histogram], [List of extracted area], or [Individual Image] to display each window respectively.

### Measurement results

The number of grains in each size class and their cleanliness levels are displayed.



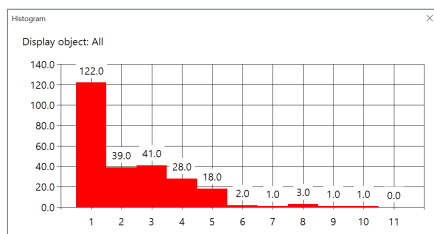
Information on the extracted grains of respective split measured files are displayed.

### Precautions when selecting ISO output format

For the ISO output format, surface areas and weights can be entered. The entered values can be output in a CSV file.

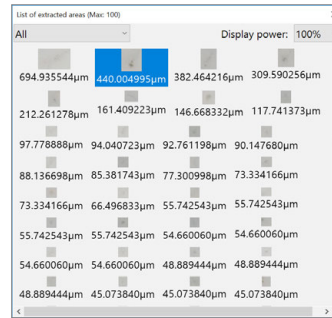
When [Standard] is checked, the number of the extracted grains is converted into the number of grains per 1000 cm<sup>2</sup> and displayed. The extraction results are regarded as the results in the specified area in the [Surface area], and convert it into the area per 1000 cm<sup>2</sup>. Input the proper value in [Surface area].

### Histogram



The number of grains in each size class is displayed.

### List of extracted areas



The extracted images list is displayed to top 100. The displayed images can be selected from [All/Metal/Fiber/Others]. The size can be selected from [100%/200%/300%/400%/500%].

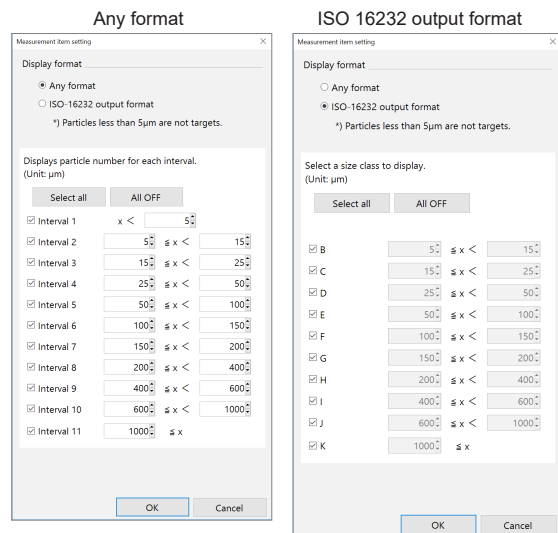
### Individual image



This window is used for enlarging each split image. The size can be selected from [M/L/Actual size].

### Measurement item setting

Click [Measurement items] to select a measurement target.



To measure with arbitrary intervals instead of ISO-specified intervals, select [Arbitrary interval].

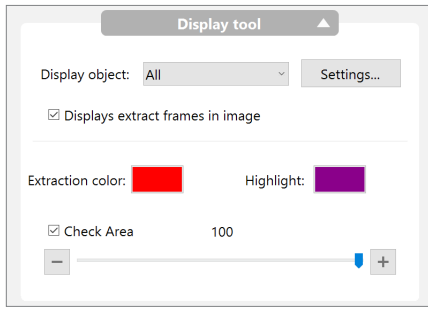
### Save measurement results

- Clicking [Batch save] displays the [Select Folder] window. The measurement results including split recording results will be saved according to [Folder name] and [File format] when selecting the image saving destination to click [OK].
- An Excel format report will be output when clicking [Output report].

**Point** Excel needs to be installed beforehand when executing [Output report]. For more details, refer to "Temporarily Disabling System Protection" (Page 12-3).

**Reference** Results saved with [Batch save] can be loaded from [Album] to use for checking the contamination analysis. Although results saved with the [Rec] button are saved as an image tethered with the measurement values, some operations, such as enlarged display of target grains on the measurement result window, cannot be done with these results.

## Display tool

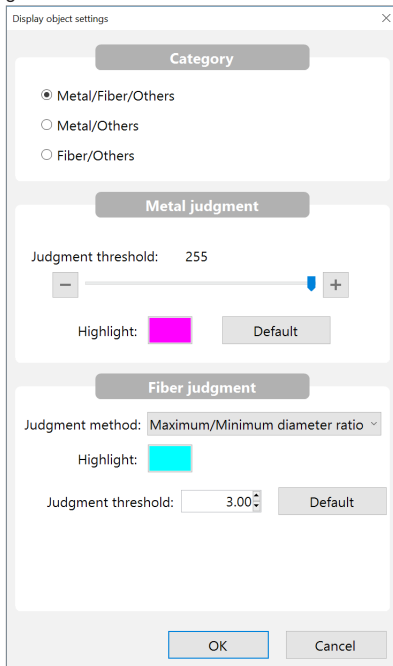


### ● Display object

Grains to be displayed on the screen can be switched by the option selected from among [All/Fiber/Other than fibers/Metal/Others].

### ● Settings

Display the [Display object settings] window, and set how extracted grains are viewed.



#### ○ Category

Select the classification of the extract target.

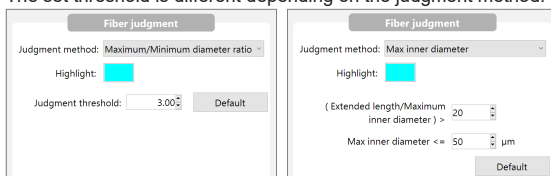
#### ○ Metal judgment

Set the threshold for metal judgment and highlight (display color). The brightness with judgment threshold or more will be judged as metal.

#### ○ Fiber judgment

Set judgment method (maximum inner diameter/maximum/minimum diameter ratio), highlight (display color), and threshold to be judged as fiber.

The set threshold is different depending on the judgment method.



### ● Displaying extract frame on image

Unchecking this option shows no frame on the extract results.

### ● Check Area

Putting a check on this option gives a color to the extraction target to check.

You can lighten the extract color by moving the slider, which allows you to view the original image.

## Cleanliness level

[Cleanliness level] is displayed only when ISO output format is selected and [Standard] is checked.

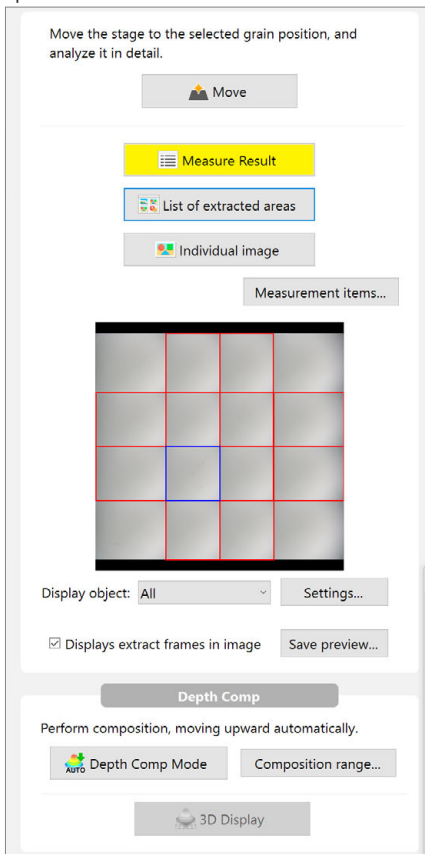
[Cleanliness level] displayed in the [Measure result] window follows the table below.

If the number of grains greater than 16 x 10<sup>6</sup>, "..." will appear.

Cleanliness level	Number of grains (n) per 1000 cm <sup>2</sup>
00	0
0	0 < n <= 1
1	1 < n <= 2
2	2 < n <= 4
3	4 < n <= 8
4	8 < n <= 16
5	16 < n <= 32
6	32 < n <= 64
7	64 < n <= 130
8	130 < n <= 250
9	250 < n <= 500
10	500 < n <= 1000
11	1 x 10 <sup>3</sup> < n <= 2 x 10 <sup>3</sup>
12	2 x 10 <sup>3</sup> < n <= 4 x 10 <sup>3</sup>
13	4 x 10 <sup>3</sup> < n <= 8 x 10 <sup>3</sup>
14	8 x 10 <sup>3</sup> < n <= 16 x 10 <sup>3</sup>
15	16 x 10 <sup>3</sup> < n <= 32 x 10 <sup>3</sup>
16	32 x 10 <sup>3</sup> < n <= 64 x 10 <sup>3</sup>
17	64 x 10 <sup>3</sup> < n <= 130 x 10 <sup>3</sup>
18	130 x 10 <sup>3</sup> < n <= 250 x 10 <sup>3</sup>
19	250 x 10 <sup>3</sup> < n <= 500 x 10 <sup>3</sup>
20	500 x 10 <sup>3</sup> < n <= 1 x 10 <sup>6</sup>
21	1 x 10 <sup>6</sup> < n <= 2 x 10 <sup>6</sup>
22	2 x 10 <sup>6</sup> < n <= 4 x 10 <sup>6</sup>
23	4 x 10 <sup>6</sup> < n <= 8 x 10 <sup>6</sup>
24	8 x 10 <sup>6</sup> < n <= 16 x 10 <sup>6</sup>

## Detail analysis mode

Clicking [Detail analysis mode] displays the preview image on the operation area.



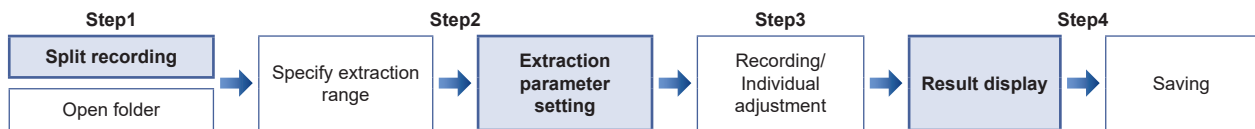
The stage can be moved to the position of selected extract frame to confirm the extract results.

The depth composition image or 3D can also be displayed in the depth composition mode at its position.

For more details about the depth composition, refer to [☐](#) "Quick Composition and 3D" (Page 9-2).

# Contamination analysis according to VDA

Contamination analysis follows the steps below.



In the contamination analysis based on VDA, the split recording and result display are different from the normal contamination analysis. Also, the default of the extraction parameter setting is the standard value prescribed by VDA.

## Split recording

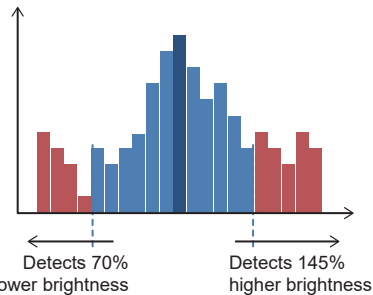
In split recording, the images are captured with the brightness fixed so that the brightness setting does not change during contamination capture. Since the brightness during capture is prescribed in VDA, select [VDA mode] in the screen of setting the brightness.

**Point** [VDA mode] can only be selected when [Image format] is [Normal]. When [HDR], [Glare removal] or [Optical Shadow Effect Mode] is selected, [VDA mode] cannot be selected.

## Setting extraction parameters

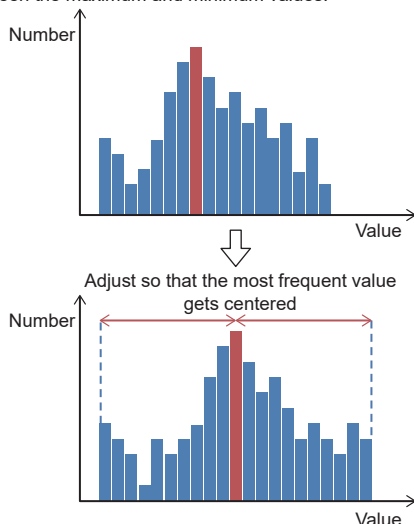
In [VDA mode], the extraction parameter default is a prescribed value defined by the VDA standard.

- Dark area : A value which is 70% of the most frequent value.
- Bright area : A value which is 145% of the most frequent value.



In [VDA mode], [Eliminate uneven brightness] is always ON. It cannot be changed.

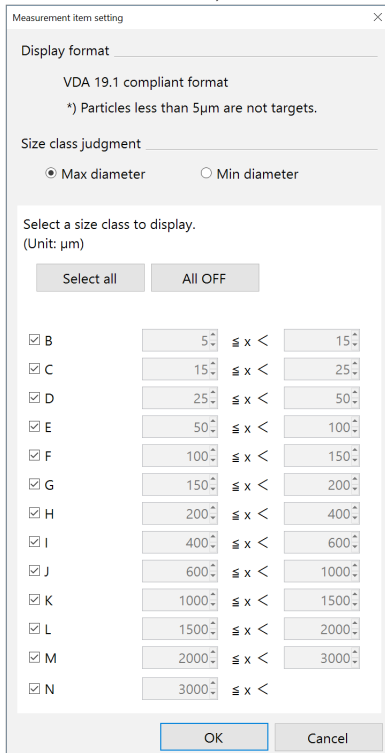
When [VDA mode] is selected, the brightness will be adjusted automatically, and the capture starts. When the pixel brightness histogram has been created, the brightness is adjusted so that the most frequent value (brightness that has the greatest number of pixels) comes to the middle of the brightness range between the maximum and minimum values.



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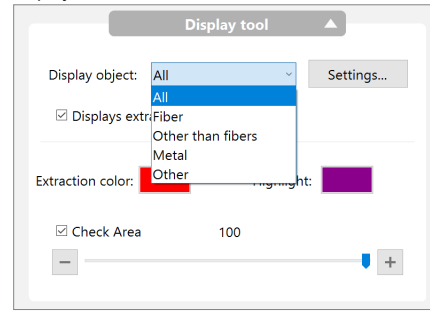
## Result display

In [VDA mode], the size class can be determined as either [Max diameter] or [Min diameter].  
 Also in [VDA mode], L to N will be additionally displayed in the choices for the size class.  
 (Therefore, normally the Max diameter and Min diameter are not displayed as selections, the size class is determined automatically with the Max diameter being selected. Also the size class which can be selected at that time is B to K.)

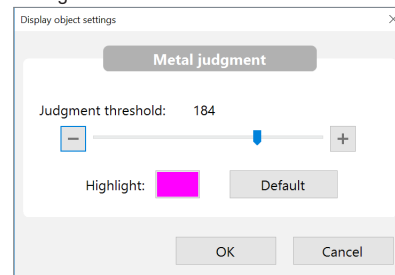


## Display setting

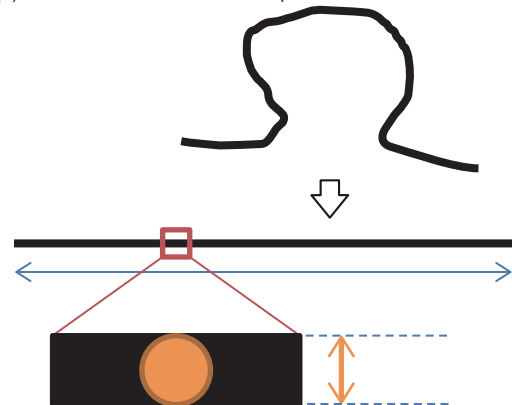
As the display target, [Fiber] and [Other than fibers] can be selected. ([Other] and [Metal] can also be selected)  
 In [Other than fibers], the targets which belong to [Metal] or [Other] are displayed.



Only the threshold for metal can be changed for the display target setting.



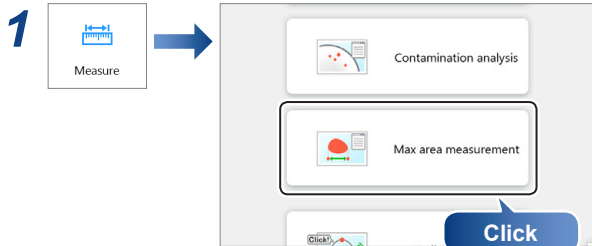
Fibers are judged according to the following standard.  
 If a target meets either criteria it is categorized as fiber:  
 (1) Extended length + Maximum inner diameter > 20  
 (2) Maximum inner diameter ≤ 50 µm



# Maximum Area Measurement

Within the specified area, among the specified brightness threshold values, the one with the largest area is extracted and the [Circumscribed rectangle (smallest area)], [Circumscribed rectangle (Feret diameter)], [Circumscribed rectangle (arbitrary)], and [Maximum/minimum diameter] can be measured. Multiple areas are able to be set with varying threshold values.

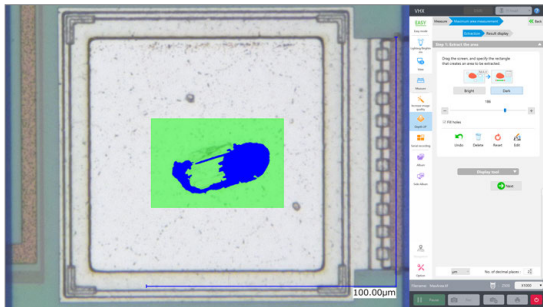
## Step 1: Extract the area



This brings up the maximum area measurement settings dialog in the operation area.

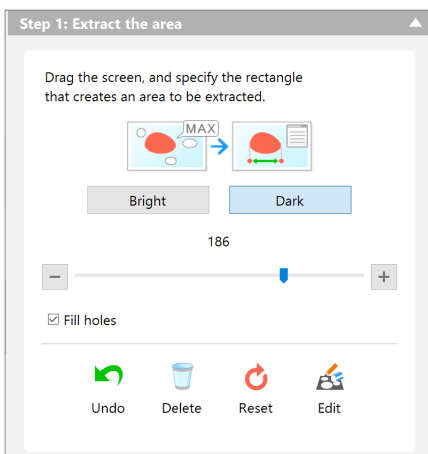
### 2 Drag the mouse in the observation window to specify a rectangular region to become the measurement area.

The measurement area will be green and the region with the maximum area within the measurement area is displayed in the selected area color.



Reference Right click the measurement area to delete it.

### 3 Specify each parameter required to extract the target area from the measurement area.

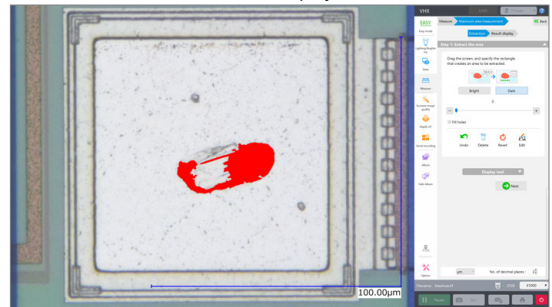


Item	Function
Bright	Extracts the bright area of the image.
Dark	Extracts the dark area of the image.
Threshold (Slider)	Sets the range of the brightness level threshold value at 0 to 255.

Item	Function
Fill holes	If this option is checked, all holes are filled in the binary image.
Undo	The shape formatting is returned to the previous editing state.
Delete	This deletes individual extraction areas. "Deleting" (Page 7-33)
Reset	The shape formatting starts from the beginning.
Edit	This allows manual editing of the specified area. "Editing" (Page 7-33)

### 4 Click the extracted area on the screen.

The extraction is confirmed and displayed in the extraction color.

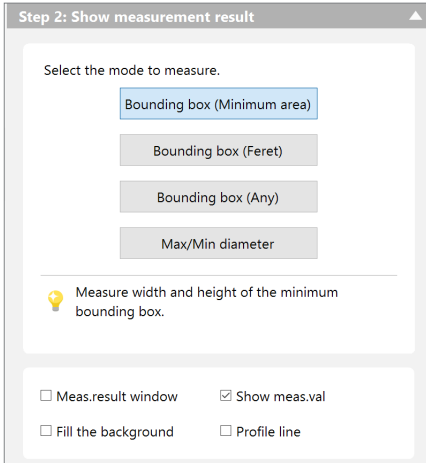


### 5 Repeat steps 2 to 4 to add additional areas.

### 6 Click [Next].

## Step 2: Show measurement result

### 1 Specify the measurement mode.



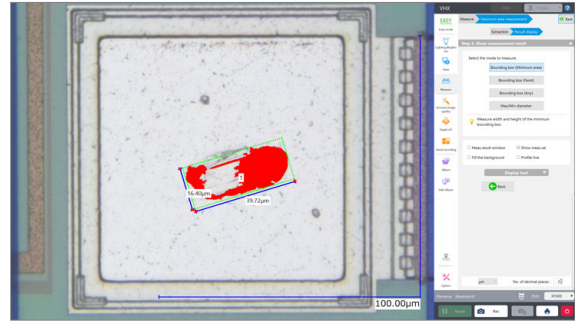
Measurement results are displayed in the observation window. When the measurement mode is changed, the results displayed in the measurement results window are also updated.

- Refer to [“Measurement Result Window”](#) (Page 7-16) for details on how to display measurement results in the measurement results window.
- Refer to [“Display Measurement Value”](#) (Page 7-16) for details on how to display measurement values in the observation window.

## Measurement Modes

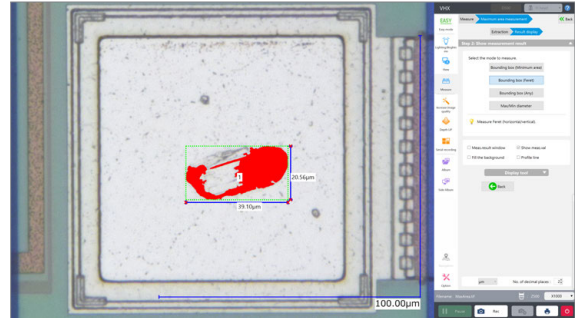
### ● Bounding box (Minimum area)

Measures the width and height of the circumscribed rectangle with the smallest area.



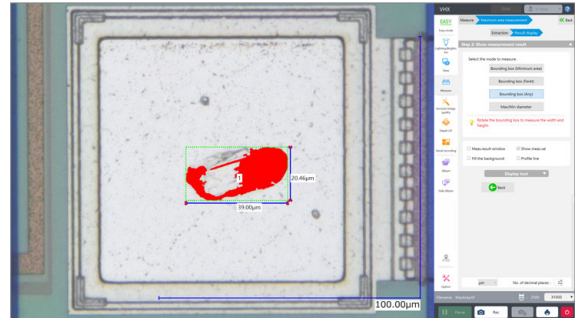
### ● Bounding box (Feret)

Measures the Feret diameter (horizontal/vertical).



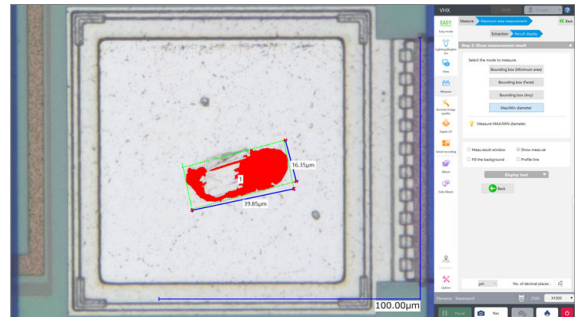
### ● Bounding box (Any)

Measures the width and height of any circumscribed rectangle that is dragged with the mouse.



### ● Max/Min diameter

Measures the maximum and minimum diameters.



## Display tool

It is possible to change the color of items such as areas, measurement lines, or text on the observation window, or display the magnifier window to check fine image details. For more details, refer to [“Display Tool”](#) (Page 7-41).

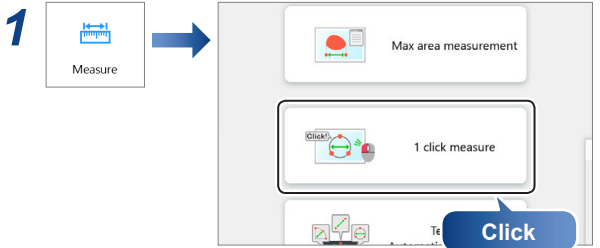
# One-Click Automatic Measurement

It is possible to create a measurement template and use it to repeat a single measurement with a single click.

## Step 1: Prepare measurement template

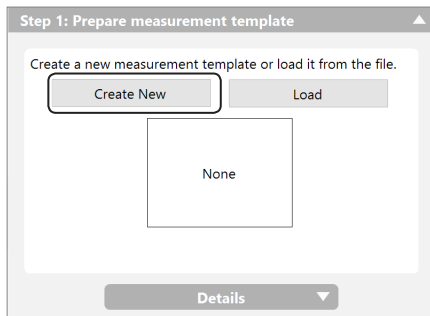
### Creating a New Template

**Point** Only templates with a recording size 2048 x 1536 or 2880 x 2160 pixels can be created.



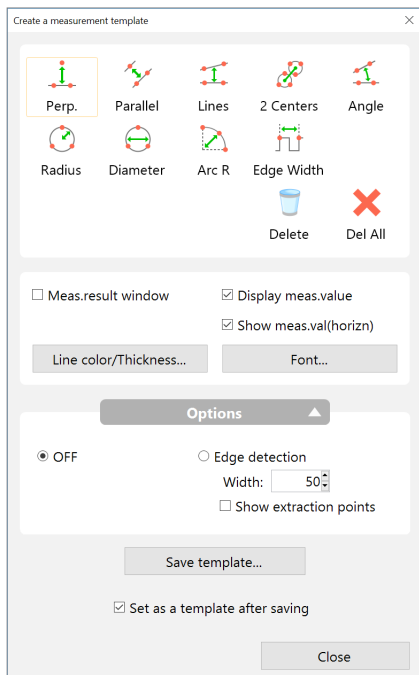
This brings up the one-click automatic measurement settings dialog in the operation area.

### 2 Click [Create New].



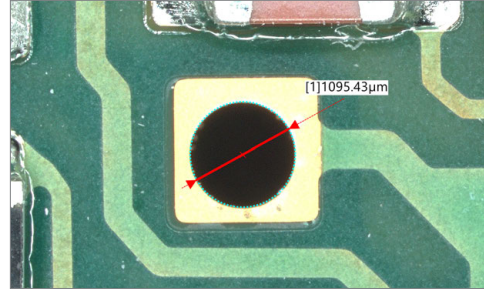
The [Create a measurement template] dialog box appears.

### 3 Click the icon for the desired measurement.



### 4 Specify the measurement points in the observation window and set the measurement object.

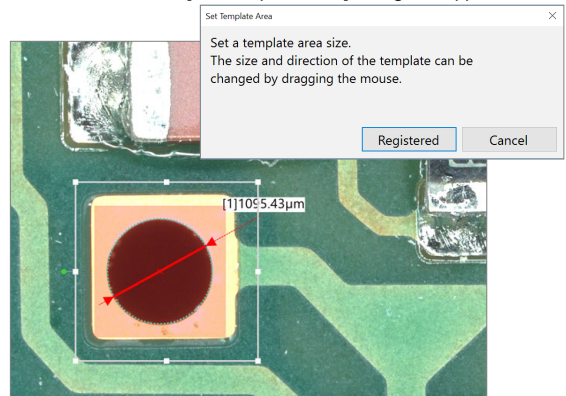
The measurement result is then displayed. A maximum of 99 measurement objects can be set within a single template.



- The measurement operation is the same as "Main Measurements" (Page 7-10).
- [Arc R] is equivalent to [Radius]. It measures the radius of an arc that passes through three specified points. This can be used to measure the radius of an angle when no complete circles are present on the screen.
- [Edge Width] is equivalent to [2 Points]. It measures the distance between two specified vertices.
- When [Edge detection] is selected, edges of the object are extracted and an appropriate measurement line is automatically generated.
- For details on the display of measurement results and settings related to lines, text, and colors within images, refer to "Display Settings" (Page 7-16).

### 5 Click [Save template].

The template area will become transparent, zoom in and rotate handles will appear. At the same time the [Set Template Area] dialog box appears.



**Point** When [Set the template automatically after saving] is selected, a thumbnail is displayed in the operation area.

7 Measure



## 6 If necessary, adjust the template size and orientation and click [Registered].

The [Rec] dialog box appears.

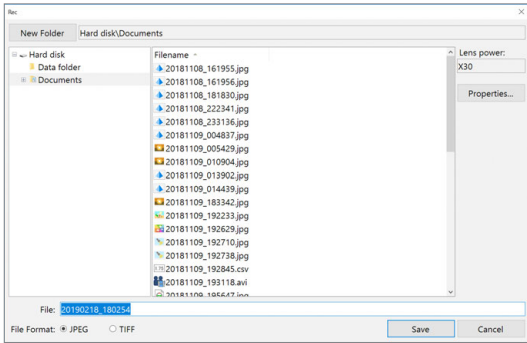
**Point** If the measurement object protrudes out from the template area, the following message will be displayed. Please ensure that the measurement object is contained within the template area.

VHX

The measured object does not fit within the template area. Adjust the template area.

OK

## 7 Enter the file name and click [Save].



The measurement template area is displayed in the operation area and Step 2 is enabled.

**Step 1: Prepare measurement template**

Create a new measurement template or load it from the file.

Create New    Load

20181105\_173709.jpg

Details

---

**Step 2: Measure**

Click the place to measure on the screen.

ClickMeas    Delete    Reset

Measure the same position as the template

## Template Recalling

1 →

This brings up the one-click automatic measurement settings dialog in the operation area.

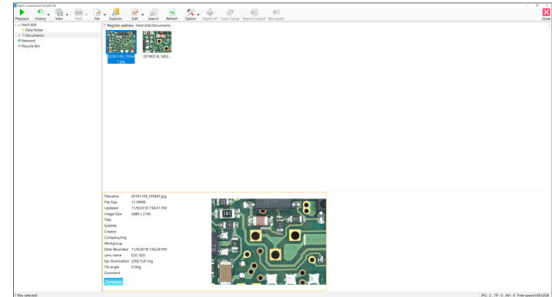
## 2 Click [Load].

**Step 1: Prepare measurement template**

Create a new measurement template or load it from the file.

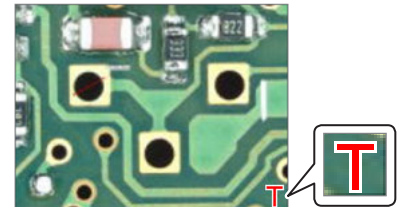
Create New    Load

The [Album] window will come up.



## 3 Select the appropriate template file and click [Playback].

**Reference** For template files, a small "T" is displayed in the corner of the thumbnail.



The measurement template area is displayed in the one-click automatic measurement screen and Step 2 is enabled.

**Step 1: Prepare measurement template**

Create a new measurement template or load it from the file.

Create New    Load

20181105\_173709.jpg

Details

---

**Step 2: Measure**

Click the place to measure on the screen.

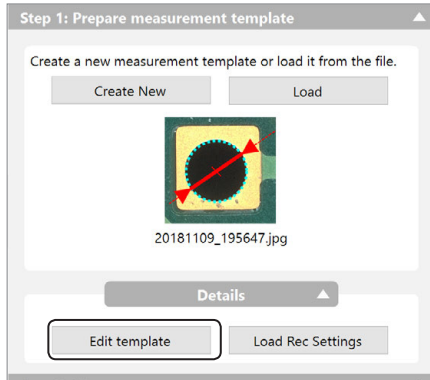
ClickMeas    Delete    Reset

Measure the same position as the template

## Editing a Template

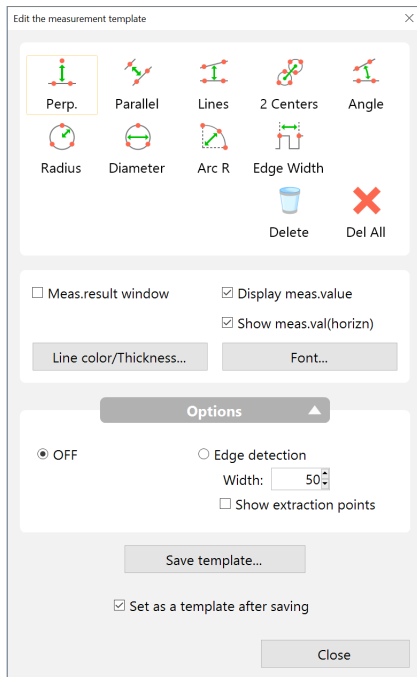
It is possible to edit a previously created template file.

### 1 Display the details menu to click [Edit template].



The [Edit the measurement template] dialog box appears. The template for editing is displayed in the image window.

### 2 Add, delete, or move measurement points on the measurement object.



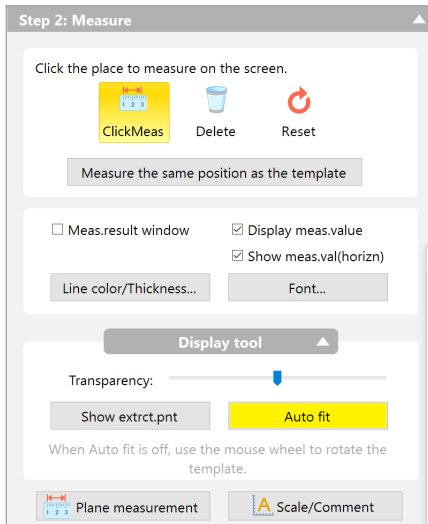
## Load Rec Settings

This loads the recording settings from an existing saved image and applies the same recording settings.

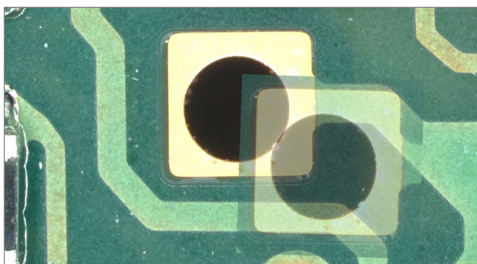
## Step 2: Measure

Click the place you want to measure on the image to perform the measurement.

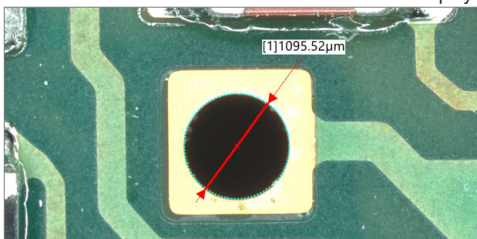
- 1 Click [Album] from the VHX MENU.**  
The [Album] window will come up.
- 2 Select the image file for measurement and click [Playback].**
- 3 Click [Click Mesr.].**



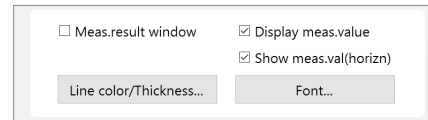
- 4 Move the mouse to the position in the image that you would like to measure.**
- 5 The area of the image surrounding the cursor is magnified and a transparent template is displayed.**



- 6 Click the position you would like to measure.**  
Automatic measurement is carried out according to the template measurement lines and measurement results are displayed.

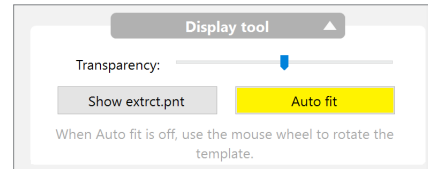


## Display Settings



The measurement results display can be set. For more details, refer to "Display Settings" (Page 7-16).

## Display tool



- Transparency**  
Transparency of the template can be adjusted by using the slider.
- Show edge-extraction points**  
The extracted point is displayed when selecting the button (yellow).
  - Extracted point used during measurement: Yellow
  - Extracted point not used during measurement: Red
- Auto fit**  
If this option is selected (yellow), template rotational correction is automatically performed when the mouse cursor is placed over the image to be measured.

## Delete

Deletes individual measurement lines and results.

- 1 Click [Delete].**
- 2 Click the measurement line you would like to delete.**

## Reset

Deletes all measurement lines and results.

- 1 Click [Reset].**
- 2 Click [Yes].**

## Measure the same position as the template

Clicking the button to measure automatically using the same position as the template.

## Plane Measurement/Scale/Comment

- 1 Click [Plane measurement] or [Scale/Comment].**  
This allows editing and adding comments to the results of measurements.  
 "Main Measurements" (Page 7-10)

# Teaching Auto Measurement

Set measurement positions (template) for multiple places, and merge them into a single measurement task that can be saved (teaching). The measurement will be made in batch based on each template registered at a given position. The measurement can be made without changing the settings whenever the measurement positions change.

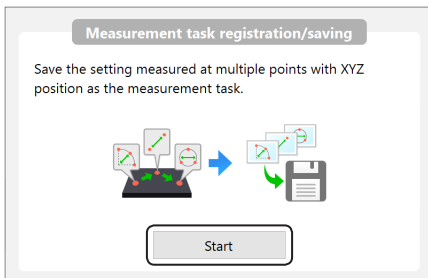
**Reference** This is the function to enable one-click automatic measurement for multiple instances to be memorized (teaching) as the measurement task.

## Measurement task registration/saving



This brings up the teaching automatic measurement settings dialog in the operation area.

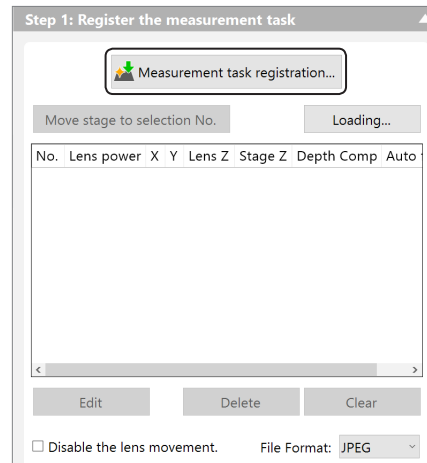
### 2 Click [Start] of [Measurement task registration/saving].



The measurement task registration screen appears.

## Step 1: Register the measurement task

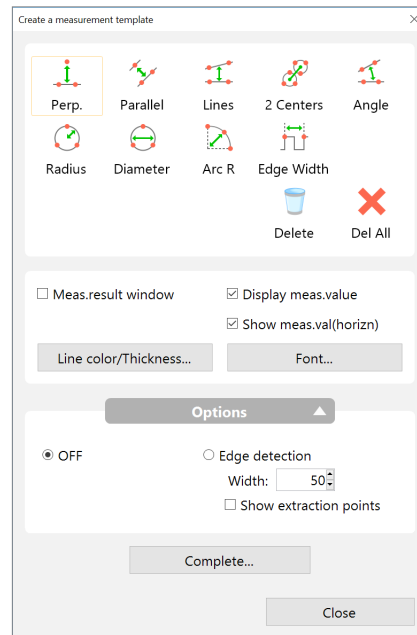
### 1 Click [Measurement task registration].



- Point
- If [Disable the Z coordinate] is selected, the measurement will be made without measuring the object Z coordinate.
- For a file format, [JPEG] or [TIFF] can be selected. The file format cannot be changed in one measurement task.

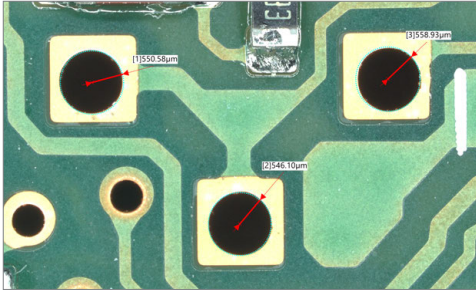
The [Create a measurement template] dialog box appears.

### 2 Click the icon for the desired measurement.



### 3 Specify the measurement points in the observation window and set the measurement object.

The measurement result is then displayed. A maximum of 99 measurement objects can be set within a single template.

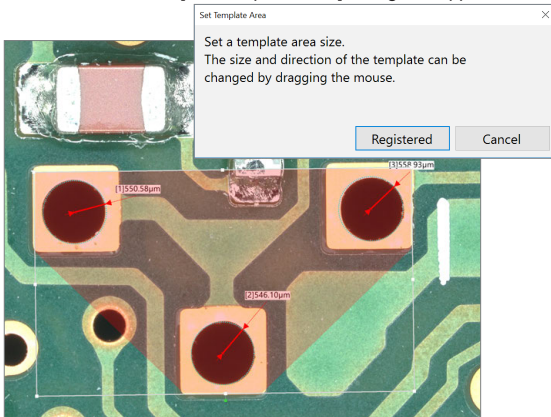


- Reference**
- The measurement operation is the same as “One-Click Automatic Measurement” (Page 7-52).
  - For details on the display of measurement results and settings related to lines, text, and colors within images, refer to “Display Settings” (Page 7-16).

### 4 Click [Complete].

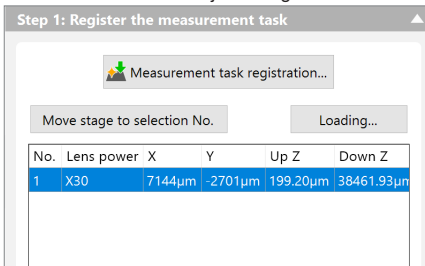
The template area will become transparent, zoom in and rotate handles will appear.

At the same time the [Set Template Area] dialog box appears.

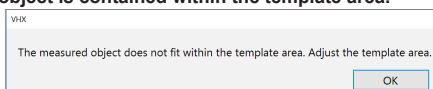


### 5 If necessary, adjust the template size and orientation and click [Registered].

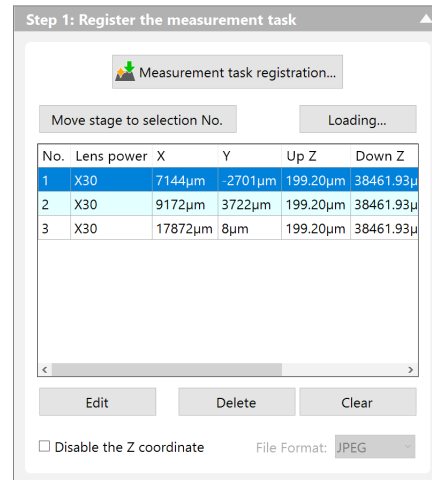
The set measurement object is registered.



- Point**
- If the measurement object protrudes out from the template area, the following message will be displayed. Please ensure that the measurement object is contained within the template area.



### 6 Repeat Step 1 to 5 to register multiple measurement tasks to the work-flow.

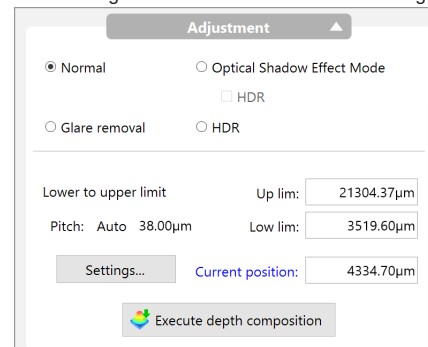


- Point**
- Clicking [Move stage to selection No.] moves the stage to the position when the measurement task in selection is set.
  - The measurement task with different magnification can be registered when connecting the Fully-Integrated (FI) Head.
  - The measurement task with different magnification can not be registered when connecting the High-Performance Camera.

### 7 Click [Next].

#### Adjustment

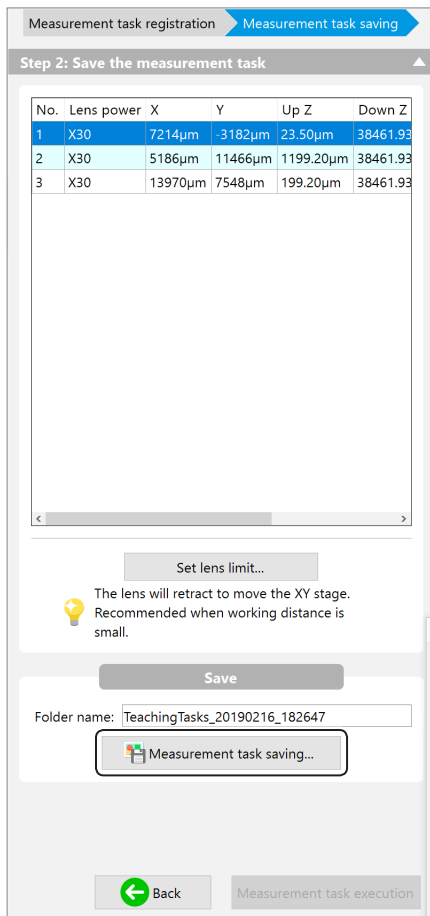
Set the image where the measurement task is registered.



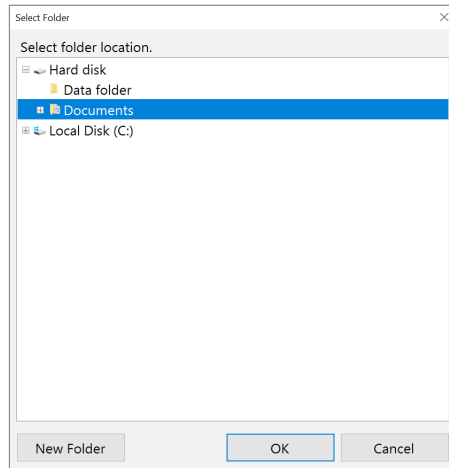
- The image recording method to register the measurement task (normal/glare removal/HDR/Optical Shadow Effect Mode) can be selected.
- Click [Execute depth composition] when using the depth composition image for the image to register the measurement task. For more details, refer to “Quick Composition and 3D” (Page 9-2).

## Step 2: Save the measurement task

### 1 Click [Measurement task saving].



### 2 Select the folder to be saved and click [OK].



**Reference** Saving the measurement task enables clicking [Measurement task execution]. Click the button to confirm whether the measurement task is registered correctly.

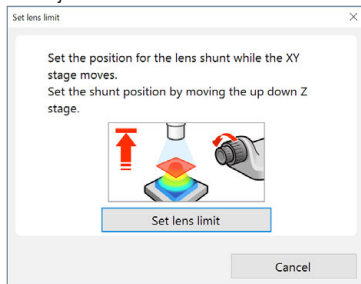
The [Select Folder] dialog box appears.

**Reference** Selecting the list changes the image displayed on the observation window into one when registering the measurement task.

### ● Set lens limit

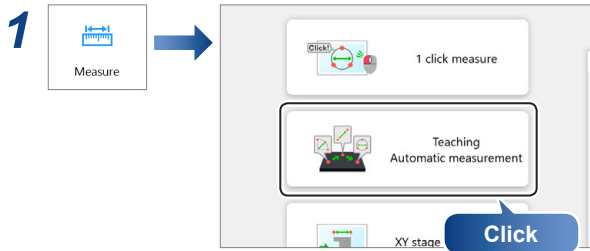
Select [Set lens limit] (yellow) when using the lens with short focal length.

Click [Set lens limit] after moving the Z stage to the position which the object does not touch the lens.



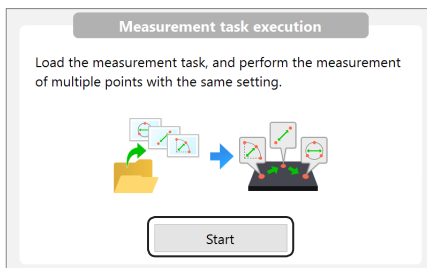
Clicking [Set lens limit] again can clear the settings. [Set lens limit] can be set after loading the measurement task.

## Measurement task execution



This brings up the teaching automatic measurement settings dialog in the operation area.

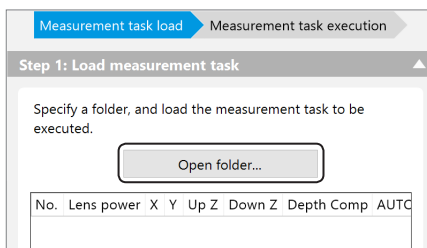
### 2 Click [Start] of [Measurement task execution].



The measurement task execution screen appears.

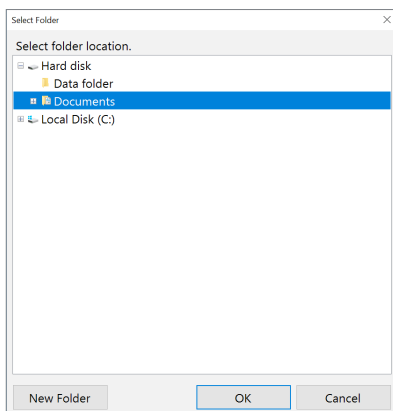
## Step 1: Load measurement task

### 1 Click [Open folder].

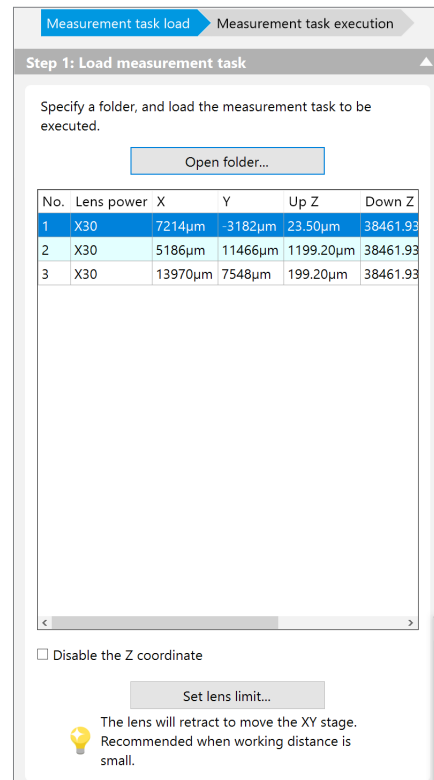


The [Browse For Folder] dialog box appears.

### 2 Select the folder where the measurement task is saved and click [OK].



The measurement task is loaded.



Point

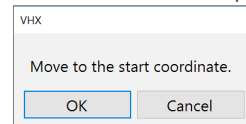
- If [Disable the Z coordinate] is selected, the measurement will be made without measuring the object Z coordinate.
- [Set lens limit] can be made after loading the measurement task. For more details, refer to ["Set lens limit"](#) (Page 7-58).

Reference

Selecting the list changes the image displayed on the observation window into one when registering the measurement task.

### 3 Click [Next].

The confirmation window appears.

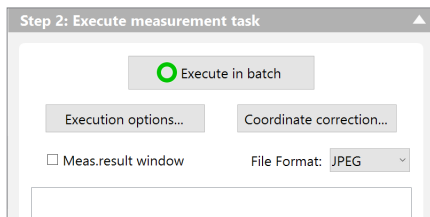


### 4 Click [OK].

The stage moves to the start coordinate position.

## Step 2: Execute measurement task

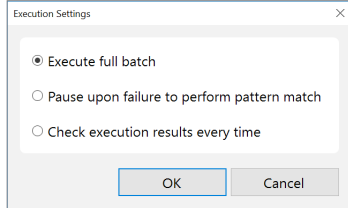
### 1 Click [Execute in batch].



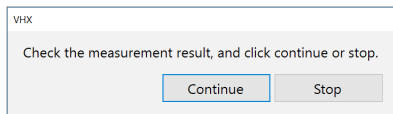
The measurement is made following the template registered in the measurement task.

### Execution option

Select the measurement method for the teaching measurement.



- Selecting [Execute in batch up to end] executes all measurements of the templates registered in the measurement task.
- Selecting [Pause if failing to perform pattern match] stops the measurement when the measurement does not match with the image registered in the template.
- Selecting [Check execution results every time] displays the confirmation screen each time a measurement with one template finishes.

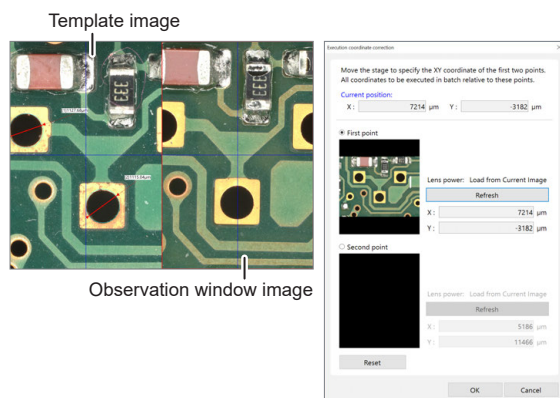


### Coordinate correction

The position to execute the measurement (coordinate) can be corrected.

The coordinate at measurement is corrected based on the template No.1 and No.2 registered in the measurement task.

Move the object position of the observation window (right side: red frame) so that it becomes the same position as the image registered in the template (left side) to click [Update].



Select [Second point] to perform the same settings. Confirm the displayed thumbnail images to click [OK], and all coordinates of the measurement executed in batch are corrected.

### Measurement result window

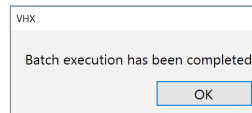
Sets to show or hide the measurement result window.

☐ "Measurement Result Window" (Page 7-16)

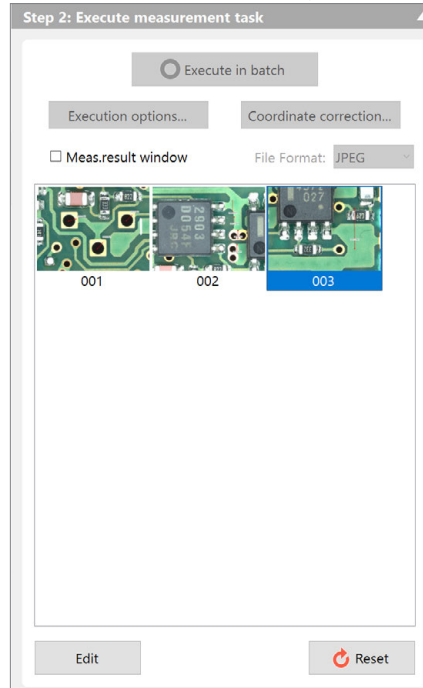
### File format

Select the image format (JPEG/TIFF) to save in batch execution.

### 2 Once the measurement is completed, click [OK].



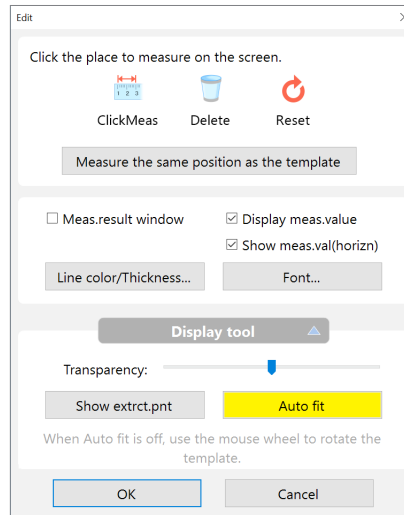
The measurement results are displayed with thumbnail images.



☐ Reference Double-clicking the thumbnails to display the target measurement results in the observation window.

### Editing

You can display the [Edit] dialog box to edit the measurement results.



The editing operation is the same as the one-click automatic measurement.

☐ "Step 2: Measure" (Page 7-55)

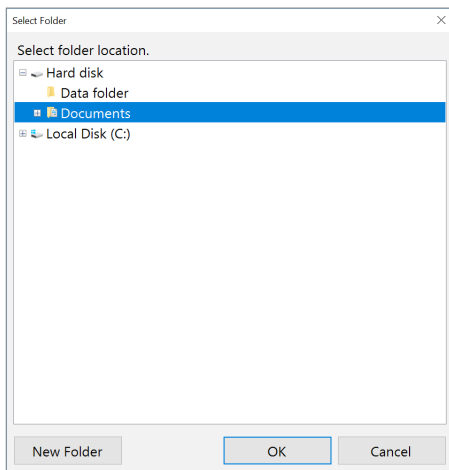
### Reset

Discard the measurement results to return to the status before performing [Execute in batch].



**3** Click [Save measurement result].

The [Select Folder] dialog box appears.

**4** Select the folder to be saved and click [OK].

# XY Stage Measurement (Optional)

The VH-M100E XY measurement system or the VHX-S770E large free-angle observation system allows you to measure objects while moving it over a wide range (100 x 100 mm) in the XY direction.

**Point** The optional VH-M100E XY measurement system or VHX-S770E and VHX-H3M3 XY measurement software are required. The VHX-H3M3 XY measurement software requires one license per product.

## Installation and Connections

### Activation of the XY measurement software “VHX-H3M3”

Execute the activation according to “XY measurement software VHX-H3M3 License registration procedure”.

### Installation and connections for the VH-M100E XY measurement stage

Install and connect the VH-M100E XY measurement stage by following the supplied user’s manual.

When connecting to VHX-S770E, the connection with VH-M100E is not required.

## Preparing to Measure

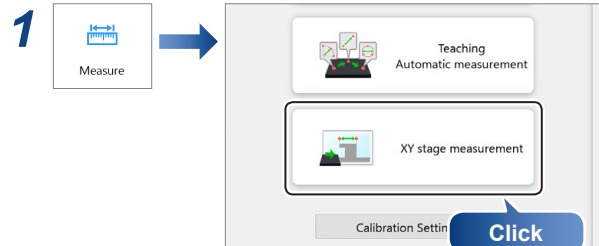
### 1 When connecting to the High-Performance Camera, perform the lens settings.

☐ “Lens Setting” (Page 7-4)

### 2 Execute calibration.

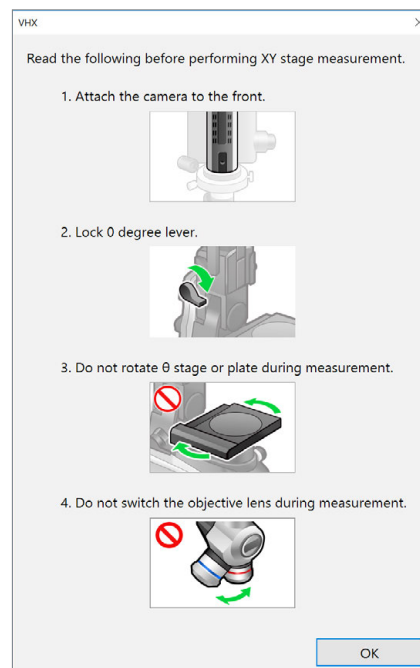
☐ “Calibration” (Page 7-5)

## XY Stage Measurement Procedures

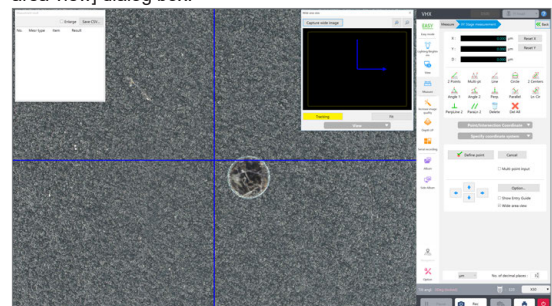


The confirmation window appears.

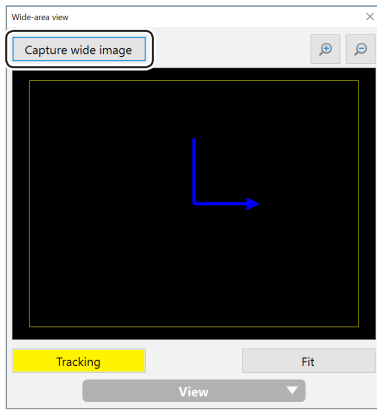
### 2 Perform the confirmation according to the screen, and click [OK].



The XY stage measurement window appears along with the [Wide-area view] dialog box.



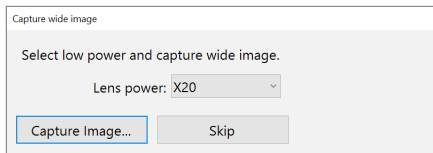
**3** Click [Capture wide image] on the [Wide-area view] dialog box.



The [Capture wide image] dialog box appears.

**Reference** You can turn off [Capture a wide image when measurement starts] by  "Using the Extract Picker" (Page 7-22).

**4** Set the lens magnification to its lowest magnification, select the current lens magnification from the [Lens power] list box, and click [Capture Image].

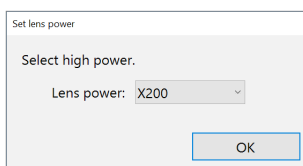


**Reference**

- Selecting [Lens power] changes the lens automatically when using the Fully-Integrated (FI) Head VHX-7100.
- It is not necessary to select the lens magnification for a lens with the automatic lens/zoom recognition function as the lens power is detected automatically.

The [Set lens power] dialog box appears.

**5** Set the lens power to high power and select the current lens power from the [Lens power] list box.



**Reference**

- Selecting [Lens power] changes the lens automatically when using the Fully-Integrated (FI) Head VHX-7100.
- It is not necessary to select the lens magnification for a lens with the automatic lens/zoom recognition function as the lens power is detected automatically.

**6** Click [OK].

The [Set lens power] dialog box closes.  
The microscope will change to measurement mode.

**7** Sets option settings as necessary.

Setup the options for display color, line width, image auto save, and startup settings as necessary.  
 "Measurement Types" (Page 7-2)

**8** Perform coordinate system settings.

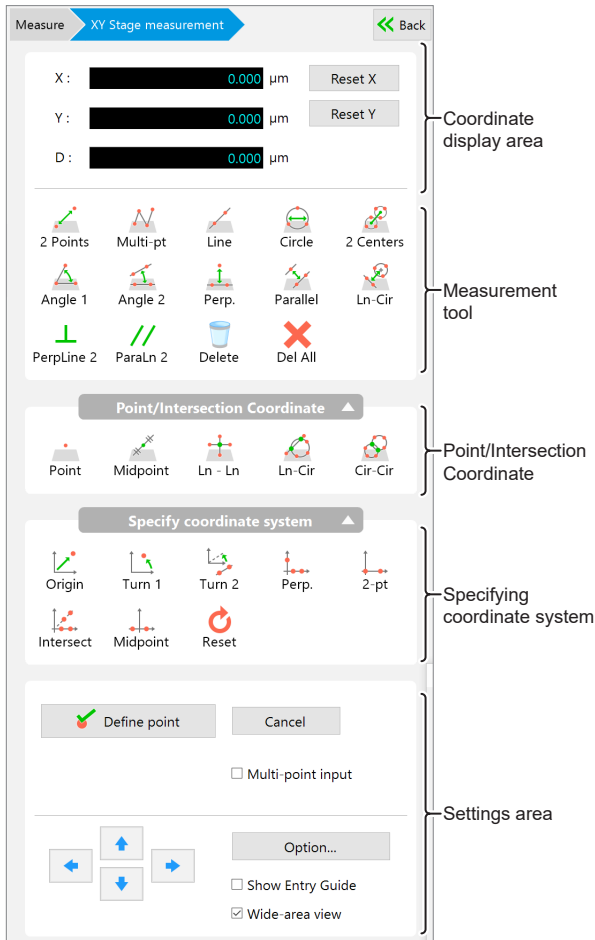
Setup the XY coordinate axes based on the image of the object. Even if the camera and the object are at an angle, it is possible to capture the XY coordinates correctly by correcting the angularity of the XY plane.  
For more details, refer to  "Measurement Types" (Page 7-2).

**9** Select the measurement tool and do the measurement.

For more details, refer to  "Moving and Editing the Measurement Point" (Page 7-15).

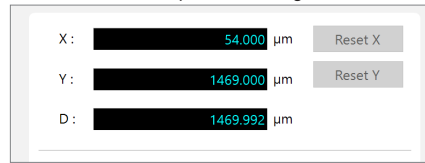
- Reference**
- To save the measurement as a numeric value, click [Save as CSV] on  "Measurement Result Window" (Page 7-16).
  - To save the measurement trail and data (CSV), click [Save Mesr Ln] on  "Measuring the Areas Extracted Based on Color" (Page 7-23).

## XY Stage Measurement Menu



## Coordinates area

This area shows the coordinate and distance of the cross point in the center of the screen to a predefined origin.



### Reset X/Reset Y

These buttons clear the X or Y coordinates of the center of the cross line in the center of the current screen to zero.

## Measurement tool

Displays the measurement tool menu.

☐ "Moving and Editing the Measurement Point" (Page 7-15)

## Point/Intersection Coordinate

Then calls up the point/intersect coordinates menu. (Page 9-94)

☐ "Measurement Types" (Page 7-2)

## Specifying coordinate system

The specifying coordinate system menu appears.

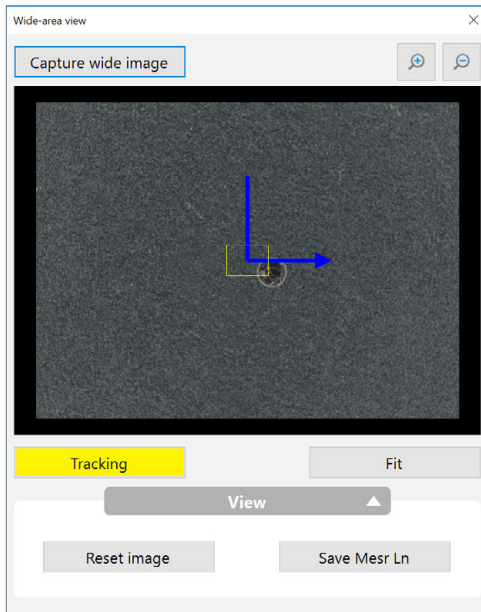
☐ "Measurement Types" (Page 7-2)

## Settings area

This area is used to enter and confirm measurement points, and to set options such as display color, and units and decimal places used when measuring.

Item	Function
Define point	This defines the specified XY stage position as a measurement point. The point is at the center of the cross lines on the screen.
Cancel	This button clears the last point defined by the [Define point] button. The last point cannot be cleared if the measurement is completed.
Multi-point input	When this option is checked, the least square method is used to define multiple entered points as a line or circle. ☐ "Line Color/Thickness" (Page 7-17)
Allow button	The stage moves to the direction you clicked.
Option	This button presents settings for line color and width, units, etc. ☐ "Using the Extract Picker" (Page 7-22)
Show Entry Guide	When this option is checked, the [Guide] dialog box is displayed.
Wide-area view	When this option is unchecked, the [Wide area view] dialog box is hidden.

## Wide-Area View Dialog Box



The wide image area displays images recorded at low magnification power, and connects and displays images as measurement points are defined. When observing under high power, the wide image area displays a general view of the area under observation along with measurement numbers.

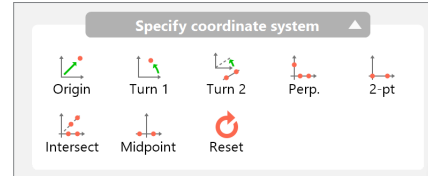
Item	Function
Capture wide image	Captures a wide image.
	Zooms in or out of the image.
Tracking	When clicking [Tracking] while zoomed in on an image, the observation area (yellow frame) will scroll automatically.
Fit	Clicking [Fit] while zoomed in or out on an image cancels the zoom and displays the entire image.
Reset image	Deletes the image. Measurement results are not deleted.
Save Mesr Ln	Saves the measurement trails and measurement data (CSV) displayed. The image size is 2048 x 1536.

## Specifying Coordinate System

Setting the XY stage origin and X/Y-axis coordinate axes.

**Point** This procedure must be done before using the measurement tools. Measured values cannot be corrected.

There are seven types of tools for specifying coordinates.



Coordinates can be set in six different ways. Select a method based on the object to be used to make the setting.

- [Origin] → [Turn 1]
- [Origin] → [Turn 2]
- [2-pt]
- [Perp]
- [Midpoint]
- [Intersect]

### Setting tool summary

Tool	Function	Reference target
	Moves the origin. Shifts the XY coordinates in parallel by defining a point as the new origin.	7-17
	Rotates the XY coordinates without moving the origin. The X coordinate axis becomes the line that passes through the origin and a point specified as the new X coordinate axis.	7-27
	Rotates the XY coordinates centered on the origin so that the X coordinate axis is parallel to a line that passes through two specified points.	7-30
	Determines the XY coordinate axis by specifying a line using two points for the new X coordinate axis, and a third point for the new Y coordinate axis.	7-34
	Determines the XY coordinate axis by specifying the origin and one point along the X coordinate axis.	7-25
	Determines the Y axis and Origin by specifying two points on the X axis and two points on a line that passes through the origin.	7-32
	Determines the Y coordinate axis the midpoint between two points specified along the desired X coordinate axis.	7-33

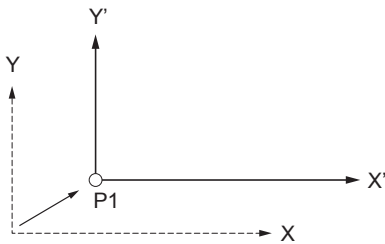
- Point**
  - Clicking [Reset] initializes the coordinate specifying and makes the clicked position the origin. The horizontal line on the screen becomes the X-axis, and the vertical line becomes the Y-axis.
  - Restarting the system resets the coordinate specifying.

## Using the coordinate specifying tools

### Origin



Moves the origin. Shifts the XY coordinates in parallel by defining a point as the new origin.



- 1 Click [Origin].
- 2 Move the XY stage to align the center of the cross line over the position to set as the origin.

- 3 Click [Define point].

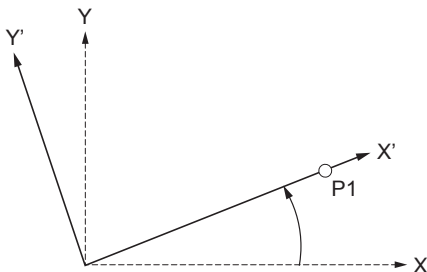
The current position becomes the origin and the stage coordinate display becomes zero.

**Reference** If the origin is defined after correcting the coordinates with another setting tool, corrections in the rotating direction will not change the origin.

### Turn 1



Rotates the XY coordinates without moving the origin. The X coordinate axis becomes the line that passes through the origin and a point specified as the new X coordinate axis.

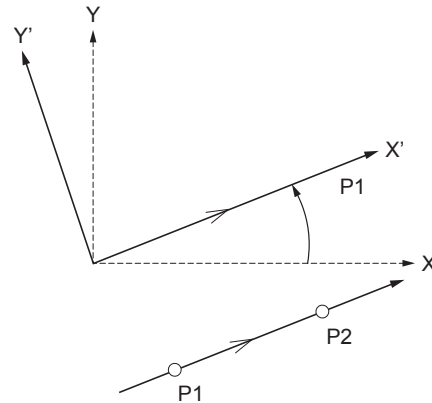


- 1 Click [Turn 1].
- 2 Move the XY stage to align the center of the cross line over a point on the X axis.
- 3 Click [Define point].

### Turn 2



Rotates the XY coordinates centered on the origin so that the X coordinate axis is parallel to a line that passes through two specified points. Use this tool if the new reference line for the coordinate axis does not go through the origin.



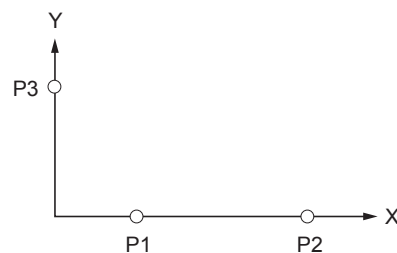
- 1 Click [Turn 2].
- 2 Move the XY stage to align the center of the cross line over a point on the new reference line for the X axis.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point on the new X-axis reference line and click [Define point].

**Reference** When specifying the parallel line, you can perform  "Multiple Point Input" (Page 7-76).

### Perpendicular



Determines the XY coordinate axis by specifying a line using two points for the new X coordinate axis, and a third point for the new Y coordinate axis.



- 1 Click [Perp].
- 2 Move the XY stage to align the center of the cross line over one point on the X axis.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point on the X-axis and click [Define point].

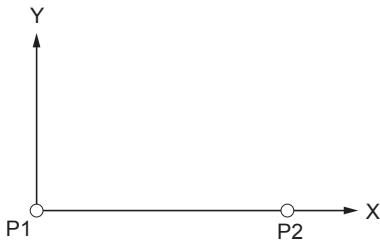
**Reference** When specifying the X-axis, you can perform  "Multiple Point Input" (Page 7-76).

- 5 Align the center of the cross line over the point on the Y-axis and click [Define point].

**2 Points**



Determines the XY coordinate axis by specifying the origin and one point along the X coordinate axis.

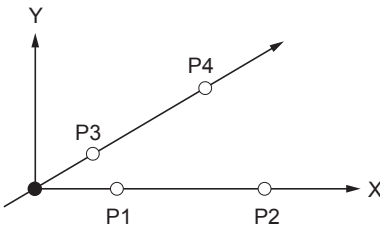


- 1** Click [2-pt].
- 2** Move the XY stage to align the cross line center over the position to set as the origin.
- 3** Click [Define point].
- 4** Move to the point on the X-axis and click [Define point].

**Intersect**



Determines the Y axis and Origin by specifying two points on the X axis and two points on a line that passes through the origin.



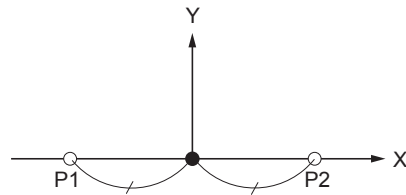
- 1** Click [Intersect].
- 2** Move the XY stage to align the center of the cross line over one point on the X axis.
- 3** Click [Define point].
- 4** Align the center of the cross line over the second point on the X-axis and click [Define point].
- 5** Align the center of the cross line over the first point on the line that passes through the origin and click [Define point].
- 6** Align the center of the cross line over the second point on the line that passes through the origin and click [Define point].

"Multiple Point Input" (Page 7-76) can be used when specifying the X-axis and origin.

**Midpoint**



Determines the Y coordinate axis the midpoint between two points specified along the desired X coordinate axis.



- 1** Click [Midpoint].
- 2** Move the XY stage to align the center of the cross line over one point on the X axis.
- 3** Click [Define point].
- 4** Align the center of the cross line over the second point on the X-axis and click [Define point].

## Measuring with the XY Stage (Measurement Tool)

### 2 Points



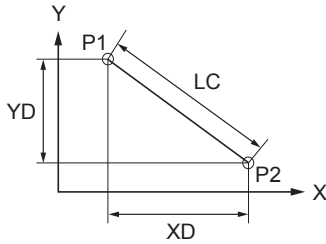
Measures the difference of X and Y coordinates of two specified points, and the distance from the first point to the second point.

#### ● Points to specify

2 points: P1, P2

#### ● Measured items

Distance: distance between coordinates of P1 and P2. LC  
 X-coord diff: difference in X-coordinates of P1 and P2. XD  
 Y-coord diff: difference in Y-coordinates of P1 and P2. YD



- 1 Click [2 Points].
- 2 Move the XY stage to align the center of the cross line over the first point.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point and click [Define point].  
 This defines the point and displays the results in the measurement results window.

### Multi-Points



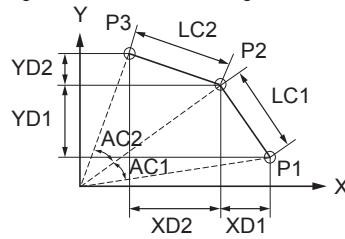
For each of the multiple points specified, this tool measures the interior angle and distance between the last defined point and the origin.  
 At the end of the measurement, the cumulative distance and total of the interior angles are measured.

#### ● Points to specify

Multi-points: P1, P2...

#### ● Measured items

Distance: distance between P1 and P2.  
 X-coord diff: difference in coordinates of P1 and P2. XD  
 Y-coord diff: difference in coordinates of P1 and P2. YD  
 Angle: interior angle of lines that connect P1 and the origin and P2 and the origin. AC  
 Cumulative distance: cumulative value of distance. LC1 + LC2 + ...  
 Cumulative angle: cumulative value of angles. AC1 + AC2 + ...



- 1 Click [Multi-pt].
- 2 Move the XY stage to align the center of the cross line over the first point.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point and click [Define point].  
 Repeat this for as many points as required.
- 5 To stop specifying points, click [Define multi-point input].  
 This defines the point and displays the results in the measurement results window.



## Line



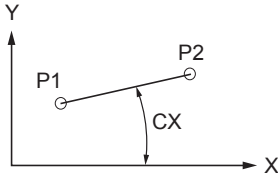
Measures the angle of a line that connects two specified point, or an approximated line of multiple points, to the Xcoordinate axis. If multiple points were entered, the straightness of the line is also measured.

### ● Points to specify

P1, P2 (multi-point input allowed)

### ● Measured items

Angle: angle of line connecting P1 and P2 to the X coordinate axis. CX  
Straightness: straightness of an approximated line of multiple points.



- 1** Click [Line].
- 2** Move the XY stage to align the center of the cross line over the first point.
- 3** Click [Define point].
- 4** Align the center of the cross line over the second point (angle vertex point) and click [Define point].

This defines the point and displays the results in the measurement results window.

Reference When specifying the line, you can perform  "Multiple Point Input" (Page 7-76).

## Circle



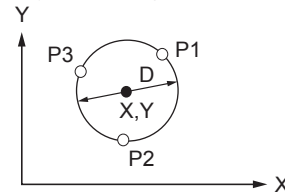
Measures a circle drawn by specifying three or more points on a circumference to provide the center coordinates (XY), diameter, radius, and circularity.

### ● Points to specify

P1, P2, P3 (multi-point input allowed)

### ● Measured items

X-coord: X coordinate of center of circle that passes through the three points P1, P2, and P3.  
Y-coord: Y coordinate of center of circle that passes through the three points P1, P2, and P3.  
Radius: radius of the circle that passes through the three points P1, P2, and P3. D/2  
Diameter: diameter of the circle that passes through the three points P1, P2, and P3. D  
Circularity: circularity of the average line of multiple points.



- 1** Click [Circle].
- 2** Move the XY stage to align the center of the cross line over one point on the circumference.
- 3** Click [Define point].
- 4** Align the center of the cross line over the second point on the circumference and click [Define point].
- 5** Align the center of the cross line over the third point on the circumference and click [Define point].

This defines the point and displays the results in the measurement results window.

Reference When specifying the circle, you can perform  "Multiple Point Input" (Page 7-76).

## 2 Centers



Measures the center distance between two circles.

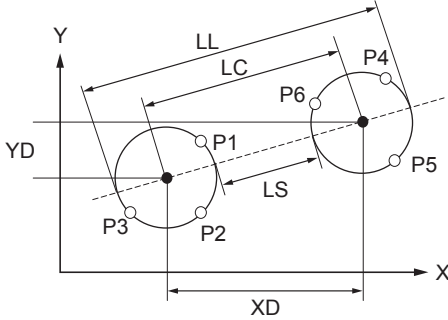
### Points to specify

First circle: P1, P2, P3 (multi-point input allowed)  
 Second circle: P4, P5, P6 (multi-point input allowed)

### Measured items

Measures the first and second circles for:

- Distance: center distance. LC
- Shortest distance: shortest distance on the circumferences. LS
- Longest distance: farthest distance on the circumferences. LL
- X-coord diff: difference between X coordinates of centers. XD
- Y-coord diff: difference between Y coordinates of centers. YD



- 1 Click [2 Cntrs].
- 2 Move the XY stage to align the center of the cross line over the first point on the circumference.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point on the circumference and click [Define point].
- 5 Align the center of the cross line over the third point on the circumference and click [Define point].

This defines the first circle.

- 6 Repeat steps 2 to 5 to specify the circumference of the second circle.

This defines the second circle and displays the results in the measurement results window.

Reference When specifying the circle, you can perform "Multiple Point Input" (Page 7-76).

## Angle 1



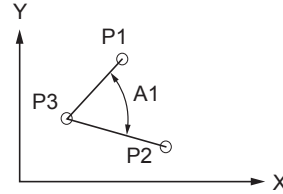
Calculates the interior angle by specifying three points.

### Points to specify

3 points: P1, P2, P3

### Measured items

Angle: interior angle of two lines formed by P1, P2, and P3. A1



- 1 Click [Angle 1].
- 2 Move the XY stage to align the center of the cross line over the first point.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point and click [Define point].
- 5 Align the center of the cross line over the third point and click [Define point].

This defines the point and displays the results in the measurement results window.

## Angle 2



Measures the coordinates and angle of the intersection of two lines.



If the two lines do not actually intersect, the tool will measure the coordinates and interior angle at the imaginary intersection if the lines were extended.

### ● Points to specify

P1, P2, P3, P4 (multi-point input allowed)

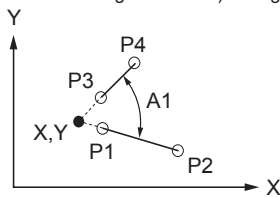
### ● Measured items

Angle : interior angle of line connecting P1 and P2, and line connecting P3 and P4. A1

X-coord : X coordinate of intersection of line connecting P1 and P2, and line connecting P3 and P4.

Y-coord : Y coordinate of intersection of line connecting P1 and P2, and line connecting P3 and P4.

Distance : Distance from intersection (of line connecting P1 and P2 and line connecting P3 and P4) to origin.



**1** Click [Angle 2].

**2** Move the XY stage to align the center of the cross line over the first point of one side.

**3** Click [Define point].

**4** Align the center of the cross line over the second point on one side and click [Define point].

**5** Repeat this for the first and second points on the second side.

This displays the results in the measurement results window.

When specifying the side, you can perform "Multiple Point Input" (Page 7-76).

## Perpendicular Lines



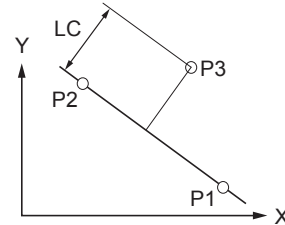
Measures the distance from a reference line specified by two points to an arbitrary point.

### ● Points to specify

P1, P2, P3 (multi-point input allowed for P1 and P2)

### ● Measured items

Distance: distance between line connecting P1 and P2, and P3. LC



**1** Click [Perp.].

**2** Move the XY stage to align the center of the cross line over the first point on the reference line.

**3** Click [Define point].

**4** Align the center of the cross line over the second point on the reference line and click [Define point].

This defines the line.

When specifying the line, you can perform "Multiple Point Input" (Page 7-76).

**5** Align the center of the cross line over the point to which you wish to measure the distance of, and click [Define point].

This displays the results in the measurement results window. Repeat step 5 to measure the distance between additional points and the reference line defined in step 4.

To stop measuring perpendicular lines, click [Define multi-point input].

## Parallel Lines



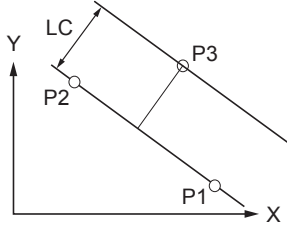
Measures the distance from a specified point to an average line specified by two or more points.

### ● Points to specify

P1, P2, P3 (multi-point input allowed for P1 and P2)

### ● Measured items

Distance: distance between line connecting P1 and P2, and P3. LC



**1** Click [Parallel].

**2** Move the XY stage to align the center of the cross line over the first point on the reference line.

**3** Click [Define point].

**4** Align the center of the cross line over the second point on the reference line and click [Define point].

This defines the line.

Reference When specifying the line, you can perform  "Multiple Point Input" (Page 7-76).

**5** Align the center of the cross line over the point to which you wish to measure the distance of, and click [Define point].

This displays the results in the measurement results window. Repeat step 5 to measure the distance between additional points and the reference line defined in step 4.

To stop measuring parallel lines, click [Define multipoint input].

## Line to Center Distance



Measures the distance from a circle to a point where a perpendicular line dropped from the center of the circle intersects a specified reference line.

### ● Points to specify

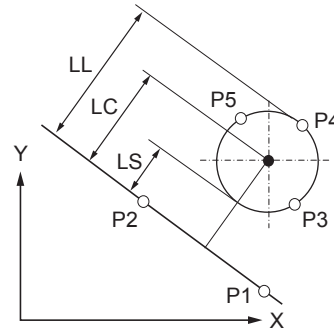
Line: P1, P2 (multi-point input allowed)

Circle: P3, P4, P5 (multi-point input allowed)

### ● Measured items

Measures these items with respect to the point where a perpendicular line dropped from the center of the circle intersects the reference line:

- Distance: distance to center. LC
- Longest distance: distance to farthest point on the circumference. LL
- Shortest distance: distance to shortest point on the circumference. LS



**1** Click [Ln-Cir dist].

**2** Move the XY stage to align the center of the cross line over the first point on the reference line.

**3** Click [Define point].

**4** Align the center of the cross line over the second point on the reference line and click [Define point].

This defines the reference line.

**5** Align the center of the cross line over the first point on the circumference of the circle and click [Define point].

**6** Align the center of the cross line over the second point on the circumference and click [Define point].

**7** Align the center of the cross line over the third point on the circumference and click [Define point].

This defines the circle and displays the results in the measurement results window.

Reference When specifying the line or circle, you can perform  "Multiple Point Input" (Page 7-76).

## Perpendicularity



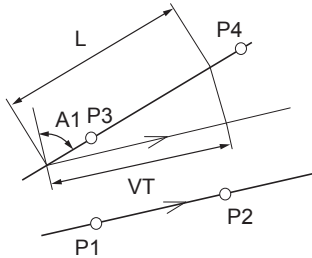
Measures the perpendicularity of the measurement line with respect to a reference line, and the projected length of an evaluation length of the measurement line projected on the reference line.

### Points and values to specify

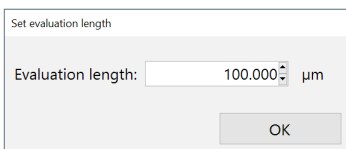
Reference line: P1, P2 (multi-point input allowed)  
 Measurement line: P3, P4 (multi-point input allowed)  
 Evaluation length: L (numeric entry)

### Measured items

Angle : interior angle of a perpendicular line to the reference line, and the measurement line. A1  
 Length : length of the Evaluation Length line L, projected on the reference line. VT



- 1 Click [PerpLn 2].
- 2 Move the XY stage to align the center of the cross line over the first point on the reference line.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point on the reference line and click [Define point].  
 This defines the reference line.
- 5 Align the center of the cross line over the first point on the measurement line and click [Define point].  
 This defines the measurement line. The [Set evaluation length] dialog box appears.
- 6 Align the center of the cross line over the second point on the measurement line and click [Define point].
- 7 Enter the evaluation length and click [OK].



This displays the results in the measurement results window.

Reference When specifying the line, you can perform  "Multiple Point Input" (Page 7-76).

## Parallelism



Measures the angle (parallelism) of the measurement line with respect to a reference line, and the length of a measurement line based on an evaluation length thereof, projected on a line perpendicular to the reference line.



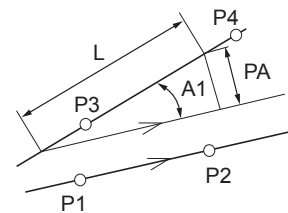
**If the two lines do not actually intersect, the measurement will take place as long as an extension of the lines does intersect. The measurement input mode cannot be canceled if the extended segments of the line fail to intersect.**

### Points and values to specify

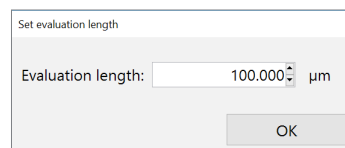
Reference line: P1, P2 (multi-point input allowed)  
 Measurement line: P3, P4 (multi-point input allowed)  
 Evaluation length: L (numeric entry)

### Measured items

Angle : interior angle of the reference line and the line to measure. A1  
 Length : length of evaluation length L, projected on a line perpendicular to the reference line. PA



- 1 Click [ParaLn 2].
- 2 Move the XY stage to align the center of the cross line over the first point on the reference line.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point on the reference line and click [Define point].  
 This defines the reference line.
- 5 Align the center of the cross line over the first point on the measurement line and click [Define point].  
 This defines the measurement line. The [Set evaluation length] dialog box appears.
- 6 Align the center of the cross line over the second point on the measurement line and click [Define point].
- 7 Enter the evaluation length and click [OK].



This displays the results in the measurement results window.

Reference When specifying the line, you can perform  "Multiple Point Input" (Page 7-76).

## Deleting



Delete the selected measurement line.

## Deleting All



Deletes all measurement lines.

## Point/Intersection Coordinate

### Point (Point/Intersect coordinates)



Finds the coordinates of a specified point.

#### ● Points to specify

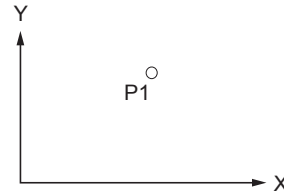
Point P1

#### ● Measured items

X-coord: X coordinate of point.

Y-coord: Y coordinate of point.

Coordinate D: Distance in a straight line from origin.



**1** Click [Point].

**2** Move the XY stage over the point.

**3** Click [Define point].

This defines the point and displays the results in the measurement results window.

### Midpoint (Point/Intersect Coordinates)



Measure the coordinates of the midpoint of two specified points.

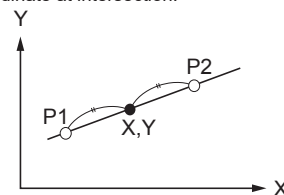
#### ● Points to specify

Points: P1, P2

#### ● Measured items

X-coord: X coordinate at intersection.

Y-coord: Y coordinate at intersection.



**1** Click [Midpoint].

**2** Move the XY stage over the point.

**3** Click [Define point].

**4** Repeat steps 2 and 3 for the second point.

This defines the midpoint and displays the results in the measurement results window.

## Line-Line (Point/Intersect Coordinates)



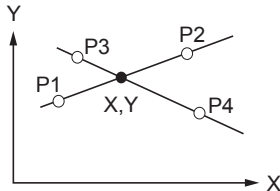
Measure the coordinates of the intersection of two specified lines.

### ● Points to specify

First line: P1, P2 (multi-point input allowed)  
 Second line: P3, P4 (multi-point input allowed)

### ● Measured items

X-coord: X coordinate at intersection.  
 Y-coord: Y coordinate at intersection.



- 1** Click [Ln - Ln].
- 2** Move the XY stage to align the intersection of the cross line over the first point on the line.
- 3** Click [Define point].
- 4** Align the intersection of the cross line over the second point on the line and click [Define point].  
 This defines the line.
- 5** Repeat steps 2 to 4 for the two points on the second line.

When specifying the line, you can perform  "Multiple Point Input" (Page 7-76).

## Line to Circle Intersection (Point/Intersect Coordinates)



Measures the coordinates of the intersection of a specified line and circle.



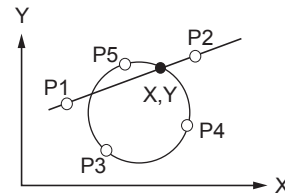
**Although the line and circle do not actually intersect, the measurement will take place as long as an extension of the line does intersect.**

### ● Points to specify

Line: P1, P2 (multi-point input allowed)  
 Circle: P3, P4, P5 (multi-point input allowed)

### ● Measured items

X-coord: X coordinate at intersection.  
 Y-coord: Y coordinate at intersection.



- 1** Click [Ln-Cir].
- 2** Move the XY stage to align the intersection of the cross line over the first point on the line.
- 3** Click [Define point].
- 4** Align the intersection of the cross line over the second point on the line and click [Define point].  
 This defines the line.
- 5** Align the center of the cross line over the first point on the circumference and click [Define point].
- 6** Align the center of the cross line over the second point on the circumference and click [Define point].
- 7** Align the center of the cross line over the third point on the circumference and click [Define point].

This defines the circle and displays the results in the measurement results window.

When specifying the line or circle, you can perform  "Multiple Point Input" (Page 7-76).  
 This tool measures the intersection closest to P5 (or the last point defined if entering multiple points).

## Circle to Circle Intersection (Point/Intersect Coordinates)



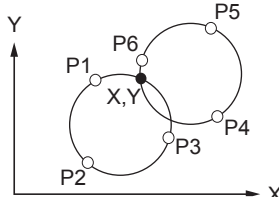
Measures the intersection of two circles.

### Points to specify

First circle: P1, P2, P3 (multi-point input allowed)  
 Second circle: P4, P5, P6 (multi-point input allowed)

### Measured items

X-coord: X coordinate at intersection.  
 Y-coord: Y coordinate at intersection.



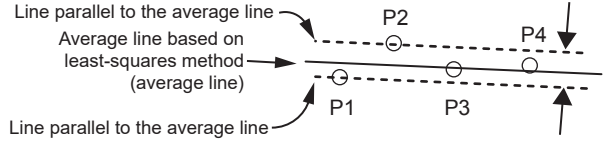
- 1 Click [Cir-Cir intrsct].
- 2 Move the XY stage to align the center of the cross line over the first point on the circumference.
- 3 Click [Define point].
- 4 Align the center of the cross line over the second point on the circumference and click [Define point].
- 5 Align the center of the cross line over the third point on the circumference and click [Define point].  
 This defines the first circle.
- 6 Repeat steps 2 to 5 for the three points on the circumference of the second circle.

Reference When specifying the circle, you can perform  "Multiple Point Input" (Page 7-76).

## Multiple Point Input

### Multi-point input for lines

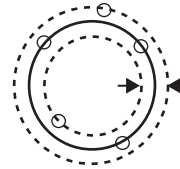
This method of input draws an average line of multiple points obtained using the least-squares method. Measurements are done with this average line. Additionally, the total distance (straightness) of the two points farthest above and below (or right and left) the average line is also measured. (The straightness of a line entered in two points will be zero.)



In example above, the straightness is the total of the distance between P1 and the average line, and P2 and the average line.

### Multi-point input for circles

This method of input draws an average circle of multiple points obtained using the least-squares method. The total distance (circularity) between the circle's closest and farthest points from its center and the average circle is measured. (The circularity of a circle entered in three points will be zero.)



### Multi-point input procedure

#### 1 Select the [Multi-pt input] check box.

The letter "M" will appear on the measuring tool icons that support multi-point input.



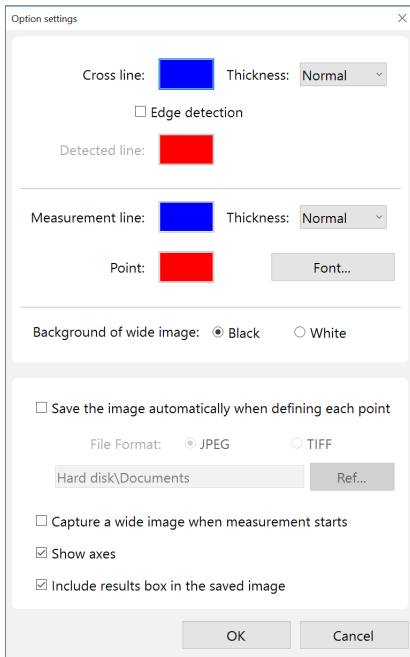
#### 2 Click a measurement tool icon to select it.

"Measuring with the XY Stage (Measurement Tool)" (Page 7-68)

To stop using multi-point input and specify another line or circle, click [CompMulti]. To stop using multi-point input and stop measuring, click [Define multi-point input].



## Option Settings



### ● Cross line

These options change the line color and width. The color of the cross line can be changed when it detects an edge in the image.

### ● Measurement line

These options set the line color and width, color of the measurement point, and text format used to display measurement numbers.

### ● Background of wide image

Select a color (black or white) for the portions the image does not occupy in the [Wide-area view] dialog box.

### ● Save the image automatically when defining each point

If this option is checked, the image is saved to the hard disk as each point is defined. Select the auto save option and the image format for saving, then click [Ref...] and specify the destination folder.

### ● Capture a wide image when measurement starts

Check this option to capture a wide image when [XY stage measurement] starts.

### ● Show axes

This option displays the XY axes in the "Wide-area view" dialog box. The intersection of the X and Y axes indicates the origin.

### ● Include results box in the saved image

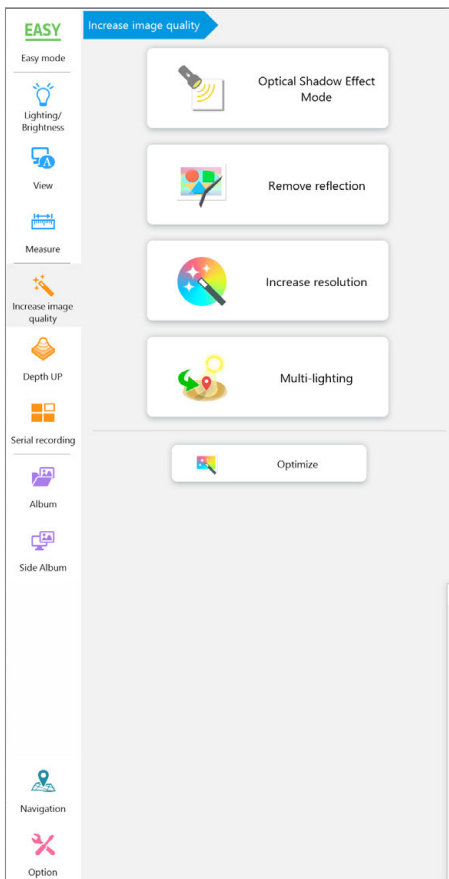
This option saves an image of the currently displayed measurement results dialog with the observation image.

## MEMO

# 8

## Increase Image Quality

## How to Improve Images Easily



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# Optical Shadow Effect Mode

This function allows the user to observe subtle, surface details that otherwise could not be seen.

## About Optical Shadow Effect Mode

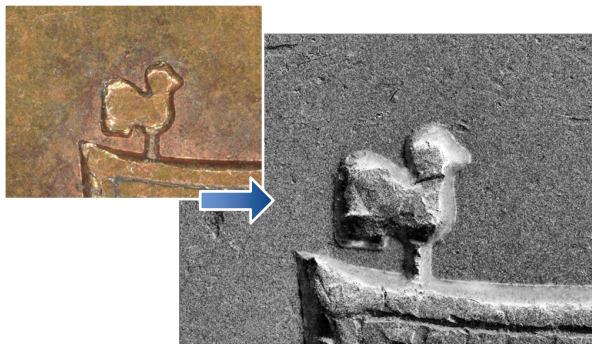
This captures multiple frames of an image in varying lighting angles. Surface details normally difficult to observe can be accurately recorded since the shadow differences are enhanced. You can also confirm flaw states by combining with color images.

**Point**

The Optical Shadow Effect Mode function cannot be used with the following functions. Cancel these functions before using the Optical Shadow Effect Mode function:

- Anti-vibration
- Live depth composition
- Reflected light removal
- Relief

[10 yen coin (150x)]



## Optical Shadow Effect Mode Settings

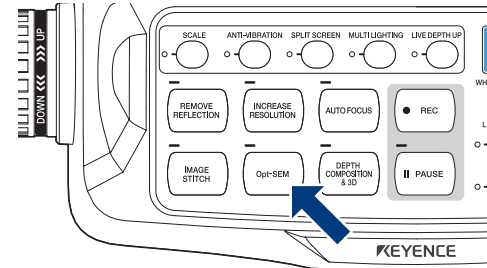
### 1 Adjust the position of the object to be observed and adjust the focus.

☐ "Adjusting the Brightness and Focus" (Page 3-4)

### 2 Enable Optical Shadow Effect Mode on the console or VHX MENU.

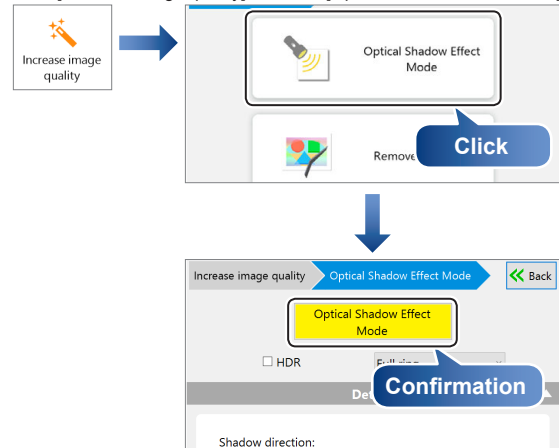
#### ● Operation on the Console

Press the [Opt-SEM] button on the console.



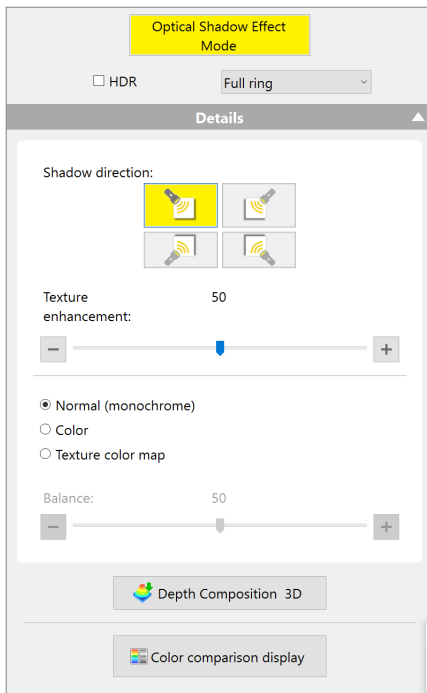
#### ● Operation from the VHX MENU

Click [Increase image quality] and click [Optical Shadow Effect Mode].



The Optical Shadow Effect Mode image appears in the observation window and the detail setting screen appears.

### 3 Adjust Optical Shadow Effect Mode details.



Item	Function
HDR	When this check box is selected, the HDR effect will be added to the Optical Shadow Effect Mode image. <input type="checkbox"/> "About HDR" (Page 8-8)
Full ring / Full coaxial	Select the lighting method used in the Optical Shadow Effect Mode image. The lighting which can be selected varies according to the connected camera unit/lens.
Shadow direction	Select the lighting direction when displaying an Optical Shadow Effect Mode image. The direction which can be selected varies according to the lighting method. (If the Fully-Integrated (FI) head is used, only "Upper-left/Upper-right/Lower-left/Lower-right" can be used regardless of the lighting method.) <ul style="list-style-type: none"> <li>In the case of ring illumination                              </li> <li>In the case of coaxial vertical                              </li> </ul>

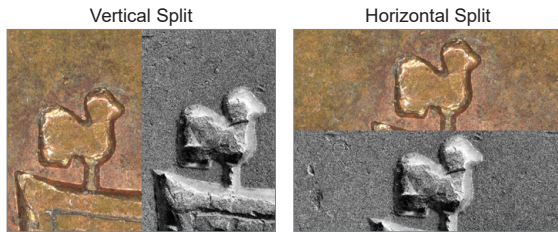
Item	Function	
Normal (monochrome)/ Color/ Texture color map	Select the Optical Shadow Effect Mode image display method. In the case of color/flaw color map, display balance with the Optical Shadow Effect Mode image can be adjusted. <ul style="list-style-type: none"> <li>Normal (monochrome)                              </li> <li>Color                              </li> <li>Texture color map                              </li> </ul>	
	[Depth Composition & 3D]	This produces a <input type="checkbox"/> "Quick Composition and 3D" (Page 9-4) display using the Optical Shadow Effect Mode image.

## Color comparison display

Comparison display can be made easily between the color image and Optical Shadow Effect Mode image.

### 1 Click [Color comparison display].

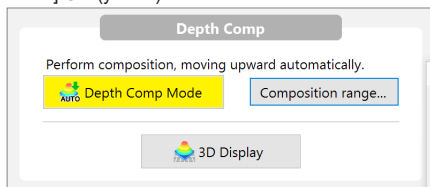
The observation windows appear by [Vertical Split] or [Horizontal Split].



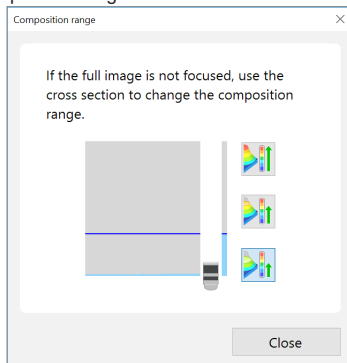
**Point** If moving the position of the color image when the color comparison display is active, the Optical Shadow Effect Mode image will refresh after moving.

### 2 Enable depth composition mode, if required.

If a part of image is out of focus, depth composition can also be applied. If the depth composition is required, turn [Depth Comp Mode] ON (yellow).



**Reference** • Click [Composition range] to select the depth composition range.



• A 3D image can be displayed based on the Optical Shadow Effect Mode image.  
 "View (3D display)" (Page 9-15)

#### ● About Scale/Comment

Markers or comments can be displayed by clicking [Scale/Comment]. When a comment is displayed, the comment is attached to the image when it is saved. A scale is displayed on the observation window to serve as a reference.

- "Displaying Text and Markers (Comment)" (Page 6-4)
- "Displaying a Scale" (Page 7-25)

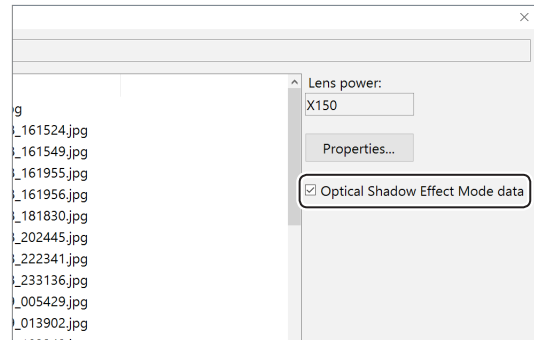
### 3 To exit the color comparison display, click [Back].

## Saving the Optical Shadow Effect Mode image

### 1 Press the [REC] button or click [Rec] from the on-screen menu options.

The [Rec] dialog box appears.

### 2 Select the [Optical Shadow Effect Mode data] check box.



### 3 Select the folder and file format to be saved, and enter the filename, and click [Save].

## Turning off Optical Shadow Effect Mode

#### ● Operation on the Console

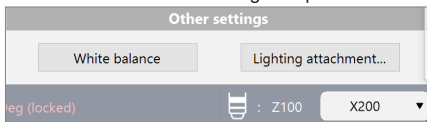
Press the [Opt-SEM] button again on the console.

#### ● Operation from the VHX MENU

Click [Optical Shadow Effect Mode] to release the activated state (yellow).

## Other settings

These can be set when turning off Optical Shadow Effect Mode.

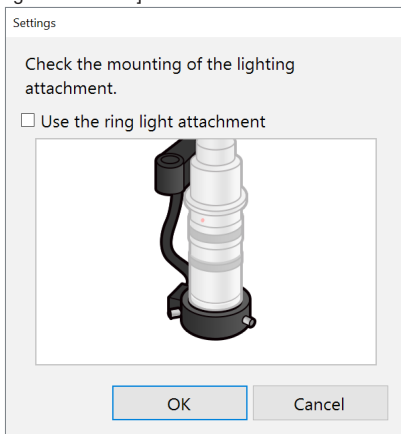


### ● White balance


Because Optical Shadow Effect Mode is used with the illumination methods switched, white balance must be adjusted properly for each illumination method. If no white balance is adjusted, click [WHITE BALANCE] to set.

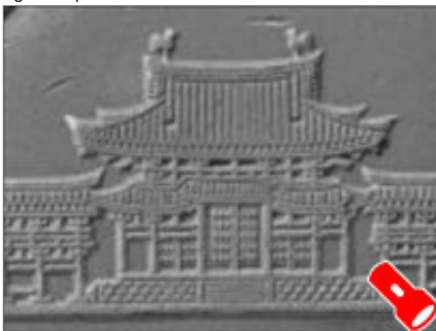
### ● Lighting Attachment

When using VH-Z100R/T and VH-Z100UR/UT, Optical Shadow Effect Mode settings by the ring illumination unit (OP-88164) can be made. Confirm the lighting attachment mounting, and turn on [Use the ring light attachment].



## About Optical Shadow Effect Mode data file

After it is saved,  is displayed in the lower right corner of the thumbnail of the Optical Shadow Effect Mode data file. You can manipulate the image and change the shadow direction by playing the Optical Shadow Effect Mode data file from an album.



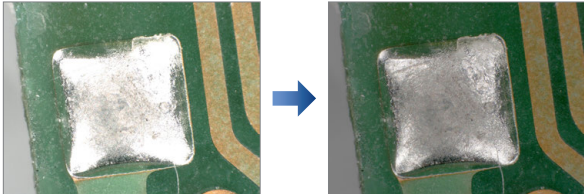
# Removing Glare (Reflected light Removal)

This function easily removes glare from an object that reflects light heavily.

**Point** These functions cannot be used together with the following functions.

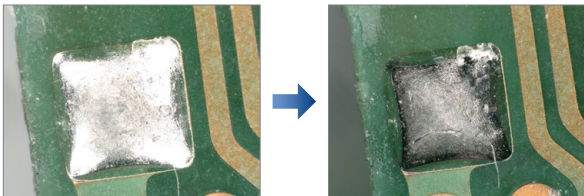
- HDR function
- Live depth composition
- Relief

## Glare removal



This function prevents a part of image from becoming excessively bright by composing multiple images having different sensitivities.

## Ring removal



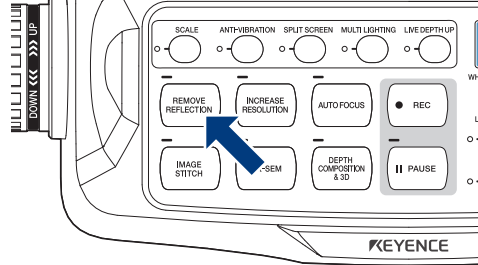
This function prevents a part of image from becoming excessively bright by composing multiple images with varying directions of ring illumination. Depending on the objects, this function may provide clearer images than those with the glare elimination.

**Point** This function cannot be used with lens provided only with full coaxial illumination.

## Remove Reflection Settings

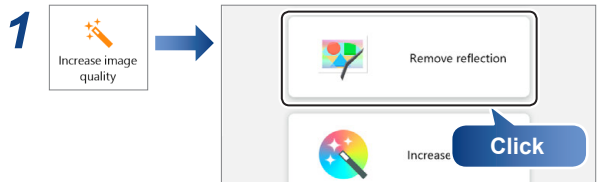
### ● Operation on the Console

Press the [REMOVE REFLECTION] button on the console.



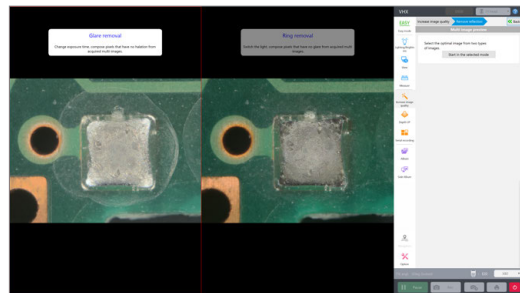
Either [Glare removal] or [Ring removal] will be activated, depending on your selection.

### ● Operation from the VHX MENU



The screen to select [Glare removal] or [Ring removal] appears.

### 2 Select the best image, and click [Start in the selected mode].

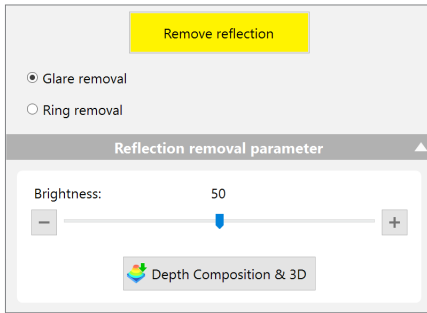


The reflected light removal image automatically adjusted appears in the observation window and [Reflection removal parameter] appears.



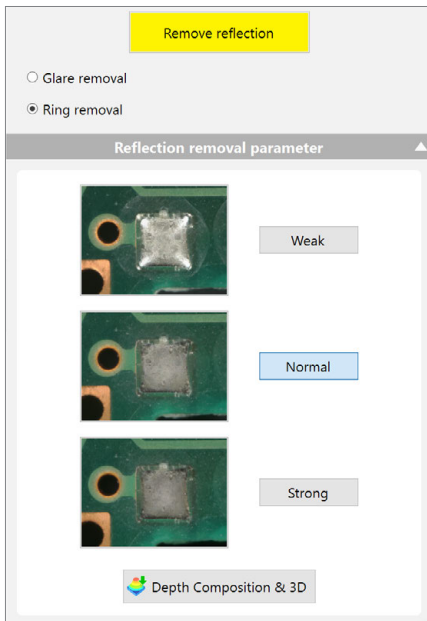
## Adjusting reflected light removal

### ● Glare removal



Item	Function
Brightness	Adjusts the image brightness.
[Depth Composition & 3D]	This produces a □□ "Quick Composition and 3D" (Page 9-4) display using the glare removal image.

### ● Ring removal



Item	Function
Weak/medium/strong	Effect level can be selected. The ring elimination is shown with a still image and the image is renewed every time when the stage movement is detected.
[Depth Composition & 3D]	This produces a □□ [Quick composition and 3D] (Page 9-5) display using the ring removal image.

## Turning off reflected light removal

### ● Operation on the Console

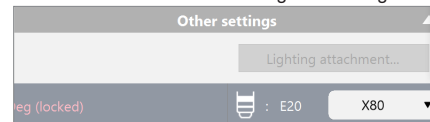
Press the [REMOVE REFLECTION] button again on the console.

### ● Operation from the VHX MENU

Click [REMOVE REFLECTION] to release the activated state (yellow).

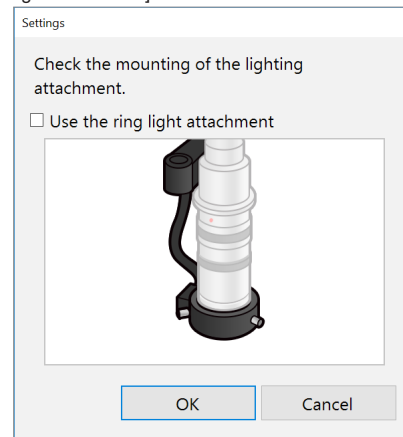
## Other settings

These can be set when releasing reflected light removal.



### ● Lighting Attachment

When using VH-Z100R/T and VH-Z100UR/UT, the reflected light removal settings by the ring illumination unit (OP-88164) can be made. Confirm the lighting attachment mounting, and turn on [Use the ring light attachment].



# Increase Resolution (HDR)

Parts that are difficult to inspect under normal observation can be observed in great detail with the HDR function.

## About HDR

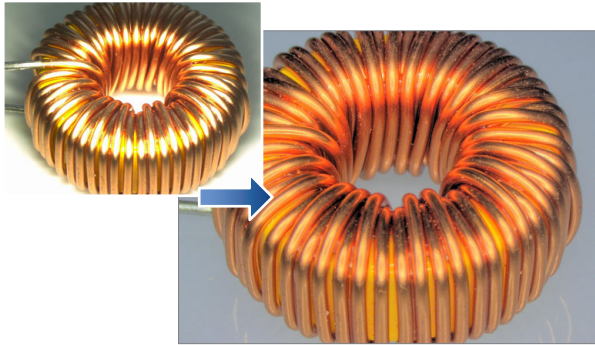
The HDR function captures multiple frames of an image in varying degrees of brightness by varying the shutter speed. These are composed into a single high-resolution image. Capturing a broader brightness spectrum provides better observation of objects that cause glare. It also increases the level of detail seen in the image by increasing the levels of color gradation.

**Point** The HDR function cannot be used with the following functions. Cancel these functions before using the HDR function:

- Reflected light removal
- Live depth composition
- Relief

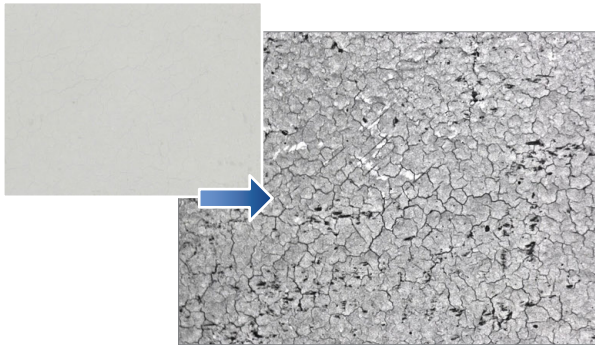
### Objects that cause glare

[Coil (20x)]



### Objects with few gradation levels.

[Inkjet paper (300x)]



## HDR Settings

**Point** While the HDR function is in effect, some features will not be available.

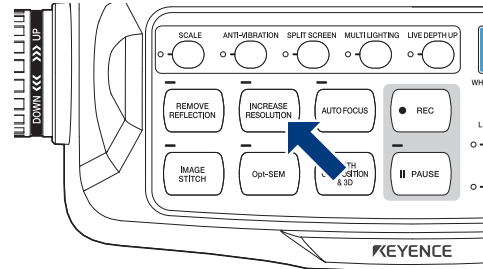
### 3 Adjust the position of the object to be observed and adjust the focus.

☐ "Adjusting the Brightness and Focus" (Page 3-4)

### 4 Enable HDR on the console or VHX MENU.

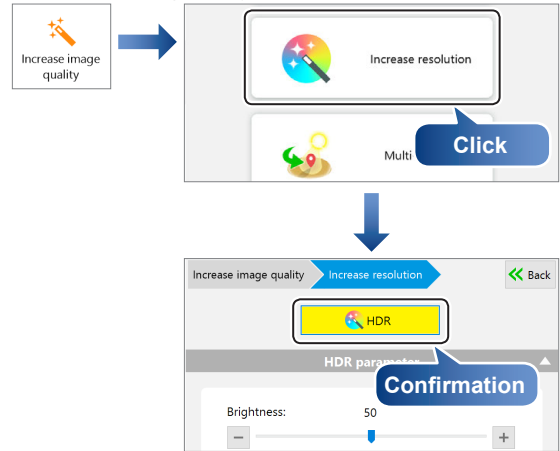
#### Operation on the Console

Press the [INCREASE RESOLUTION] button on the console.



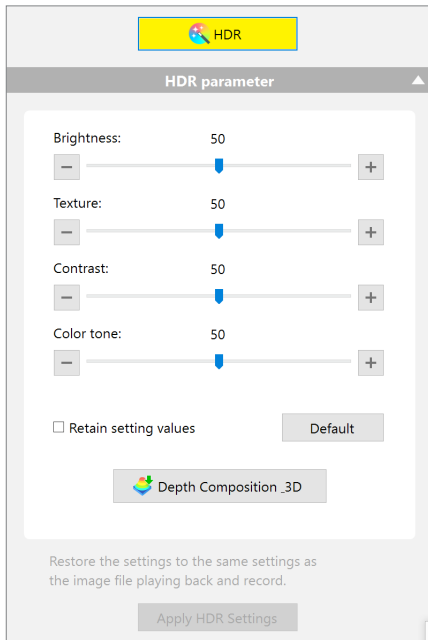
#### Operation from the VHX MENU

Click [Increase image quality] and click [Increase resolution].



The HDR image automatically adjusted appears in the observation window and the [HDR parameters] appears.

**5** Drag the sliders left or right as needed to adjust each item.



Item	Function
Brightness	Adjusts the image brightness.
Texture	Adjusts the image texture.
Contrast	Adjusts the contrast of the image.
Color tone	Adjusts the color intensity of the image.
Retain setting values	The HDR parameters are held even after the HDR are terminated.
[Default]	Clicking the button returns the settings to the automatically set values.
[Depth Composition & 3D]	This produces a [ ] "Quick Composition and 3D" (Page 9-4) display using the HDR image.

### Apply HDR Settings

This allows the user to apply previously used HDR settings onto a new image.

**Point** These functions are only available when the saved HDR files are played from the [Album].

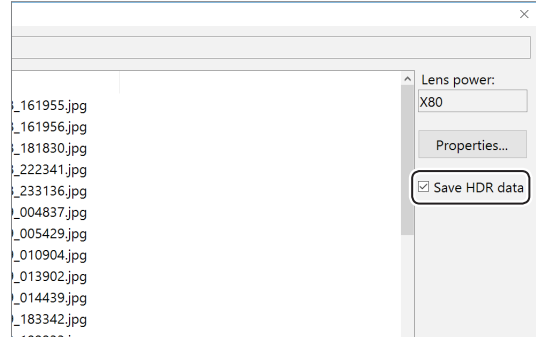
- 1 Set a new target on the stage for observation.
- 2 Play the HDR image (Page 11-5) with the desired settings using the album function and click the [Apply HDR Settings] button. Images will now be recorded with the same settings.

### Saving HDR images

- 1 Press the [REC] button or click [Rec] from the on-screen menu options.

The [Rec] dialog box appears.

- 2 Select the [Save HDR Info] check box.



- 3 Select the folder and file format to be saved, and enter the filename, and click [Save].

### Turning off the HDR function

- Operation on the Console

Press the [INCREASE RESOLUTION] button again on the console.

- Operation from the VHX MENU

Click [HDR] to release the activated state (yellow).

# Changing Illumination Direction (Multi-lighting)

You can change the direction of illumination and observe fine features that cannot be seen usually. The light direction can be changed later, which allows you to find defects after capture.

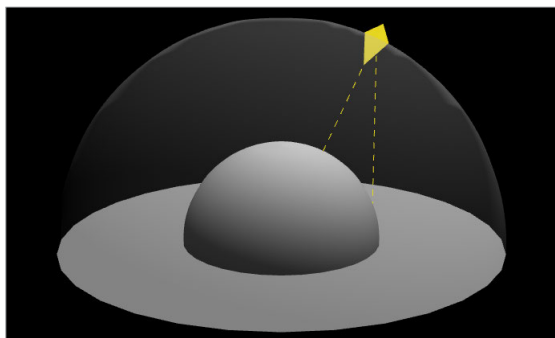
## Multi-lighting

This function can freely change the direction of illumination after recording. This function allows you to observe changes in details that could not be seen before.



The multi-lighting can be combined with other imaging features.

<b>Image format</b>	Normal, Glare removal, and HDR
<b>Type of illuminations</b>	Coaxial vertical, Partial coaxial, Combined, and Ring illumination
<b>Depth composition</b>	With or Without

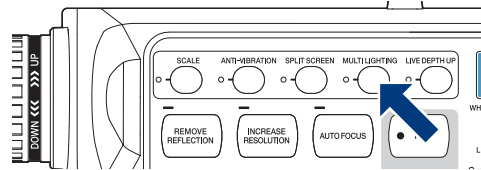


## Start multi-lighting

### 1 Enable the multi-lighting by console or VHX MENU.

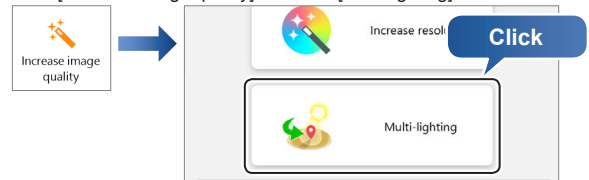
#### ● Operation on the Console

Press the console [Multi-lighting] button.



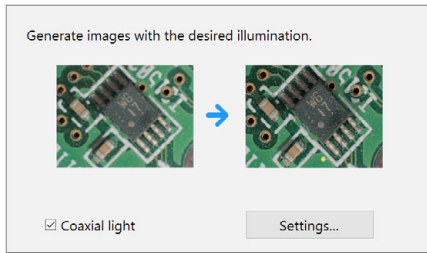
#### ● Operation from the VHX MENU

Click [Increase image quality] and click [Multi-lighting].

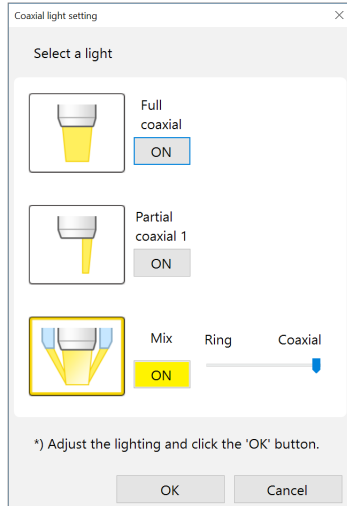


The Multi-lighting setting screen appears.

## 2 Select a lighting type.

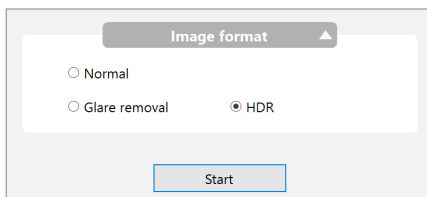


- If only the ring illumination is used, clear the [Coaxial light] check box.
- To change the coaxial light type, click [Settings] to show the [Coaxial light setting] dialog box. For the combined illumination, adjust the balance between ring and coaxial light.



**Point** If [Full coaxial], [Partial coaxial 1], or [Mix] is selected, it can be displayed brighter than situation at the normal ring illumination. Adjust the brightness properly by the [BRIGHTNESS] dial on the console.

## 3 Select [Image format], and click [Start] after adjusting the brightness.



### Image format

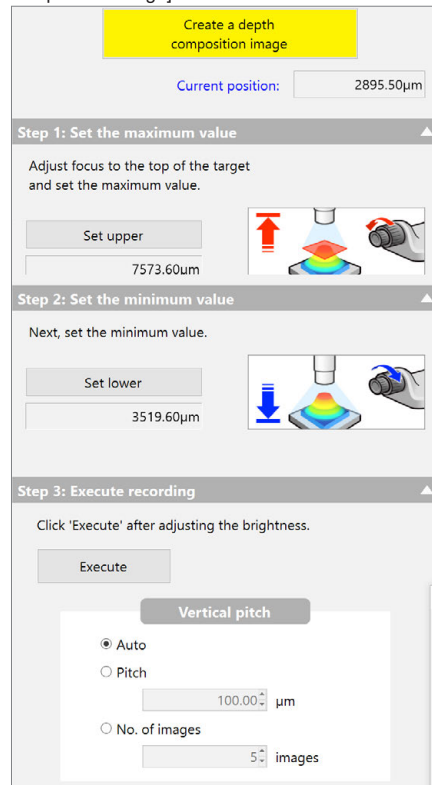
- Generally, [Normal] is selected.
- To make height differences on surface and gradation of surface clearer, select [HDR].
    - "Increase Resolution (HDR)" (Page 8-8)
  - To perform composition while suppressing surface glare, select [Glare removal].
    - "Removing Glare (Reflected light Removal)" (Page 8-6)

**Point**

- Because the multi-lighting function is used with the illumination methods switched, white balance must be adjusted properly for each illumination method. If no white balance is adjusted, click [WHITE BALANCE] to set.
- When using VH-Z100R/T and VH-Z100UR/UT, the multi-lighting by the ring illumination unit (OP-88164) can be made. Click [Lighting attachment] to perform settings.
  - "Lighting Attachment" (Page 8-7)

## 4 Enable depth composition, if required.

If a part of image is out of focus, depth composition can also be applied. If the depth composition is required, turn [Create a depth composition image] ON.



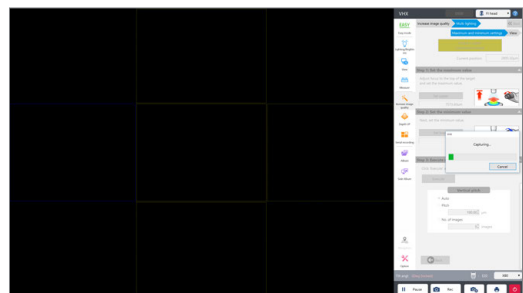
Move the FOCUS dial up and down to the upper limit of the object, and click [Set upper]. Then, move to the lower limit of the object, and click [Set lower].

**Reference** The behavior of depth composition can be tuned finely by [Vertical pitch]. The movement pitch by [Pitch], or number of images to be composed by [No. of images] can be specified.

## 5 Click [Execute].

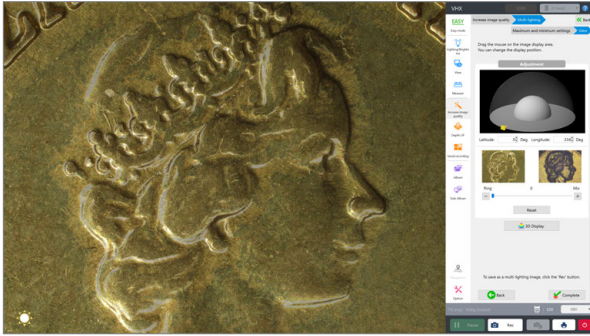
The multi-lighting will start.

**Reference** When creating depth composition images, the depth composition is done for each illumination direction.



After completion, the multi-lighting image appears in the observation window.

## Checking results



### Light direction

Clicking the image changes the illumination direction. The illumination indicator provides a reference for the direction of illumination.

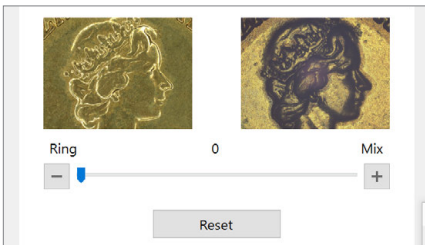
- Clicking the lower right of the screen shows an image



- Clicking the center of the screen shows an image illuminated



### Type of illuminations



An image illuminated from straight above can be converted to the full coaxial or coaxial combined illumination image. The balance of the ring illumination and coaxial vertical can be adjusted by the slider.

### Reset

The lighting way can be reset to the initial state.

### 3D Display

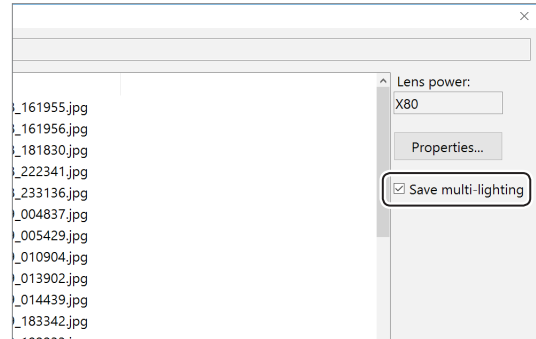
This can be selected only when creating the depth composition images. The 3D image is displayed based on the multi-lighting recording image. [View \(3D display\)](#) (Page 9-15)

### Complete

Shift to the still image status. Some operations such as measurement can be performed for the recorded images.

## Saving the multi-lighting image

- Press the [REC] button on the console or click [Rec] from the on-screen menu options. The [Rec] dialog box appears.
- Select the [Save multi-lighting] check box.



- Select the folder and file format to be saved, and enter the filename, and click [Save].

### Point

Record images together with the multi-lighting information. Playback from the album allows you to check results with different illumination direction.

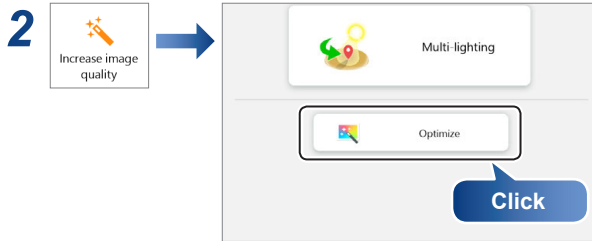
# Selecting an Image from 9 Different Settings (Optimize)

This feature presents the image under 9 different settings in a 9-way split screen. It allows you to select the setting (processing) best suited to the application. Selecting the image selects the most effective setting.

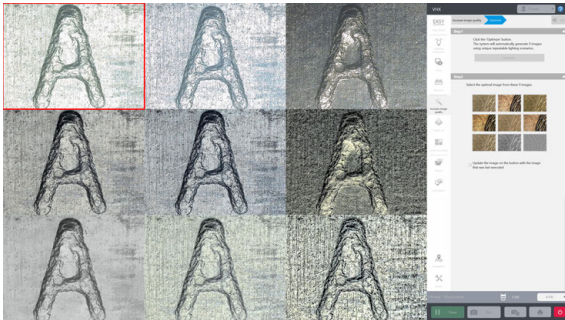
## Selecting the Best Image

### 1 Adjust the brightness, magnification, and focus.

☐ “Changing the Lighting Method” (Page 5-3)

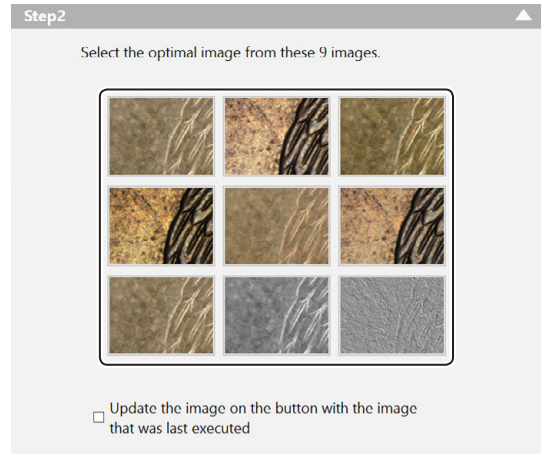


The image is displayed in the observation window and operation view under 9 different settings.



☐ Reference To display the observed image on the side icons of images in the operation view, check the [Update the image on the button with the image that was last executed] option of side icon images.

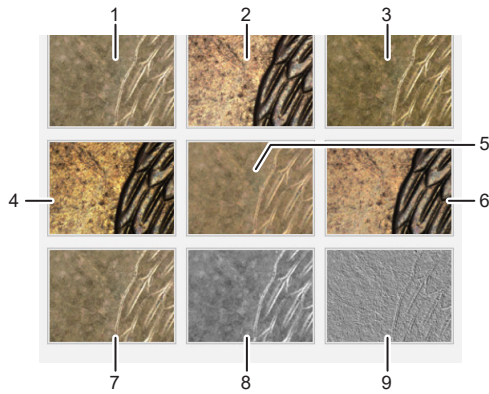
### 3 Double-click the best image in the observation window.



This displays the image in the full area of the window.

☐ Reference Clicking one of the 9 images on the [Optimize] tab displays the observed image using those settings.

## Settings of the 9 image types



No.	Type	Description of the Settings
1	Normal mode	For observing using normal settings.
2	Normal mode + Light shift	For observing with partial illumination. This emphasizes the minute height differences on the object.
3	Sharpening Image mode	For observing with vivid color enhancements and profile emphasis.
4	Sharpening image mode + Light shift	For observing with partial illumination. This emphasizes the minute height differences on the object and allows observing with vivid color enhancements and profile emphasis.
5	Glare removal	Removes glare caused by reflected light from the target object.
6	Glare removal + Light shift	For observing with partial illumination and removing glare caused by reflected light from the target object.
7	Edge enhance	Edge enhancement makes scratches and minute features easy to observe by emphasizing the edges in the image.
8	Monochrome	This effect allows observation without the influences of color.
9	Relief	The relief effect highlights areas of the image where the brightness changes, making it easy to observe scratches and minute features.

**Reference**

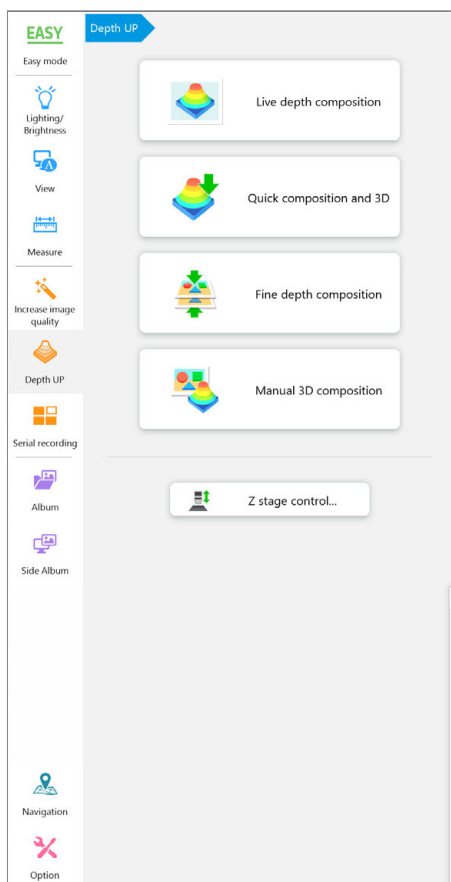
For details of the settings, refer to the following:

- Light shift                    "Changing the Lighting Method" (Page 5-3)
- Sharpening Image mode   "Sharpening Image Mode" (Page 4-8)
- Glare removal              "Removing Glare (Reflected light Removal)" (Page 8-6)
- Edge enhance               "Edge enhance" (Page 12-10)
- Monochrome               "Monochrome" (Page 12-10)
- Relief                         "Relief" (Page 12-10)



# 9

## Depth UP



## How to Improve Images Easily and Observe in 3D

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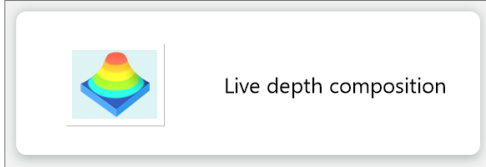
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# Types and Features of Depth Composition

This chapter explains how to obtain images focused on the object, and provides an overview of each method and their features.

## Live Depth Composition

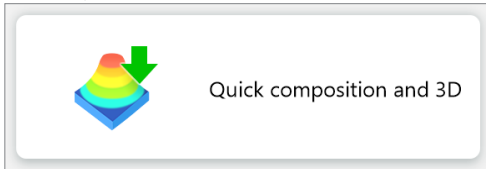
When moving the observation field, depth composition will be performed automatically and a fully-focused image will be displayed. This method eliminates any additional operation to complete depth composition and provides a new observation style that does not require focus adjustment.



☐ "Live Depth Composition" (Page 9-3)

## Quick Composition and 3D

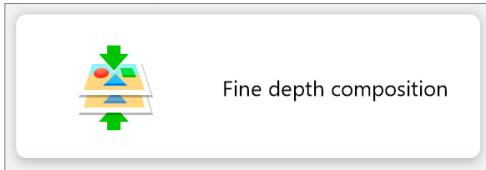
This function can generate images with the depth composition and 3D image composition functions at high speed and can be combined with the effects of glare removal and HDR.



☐ "Quick Composition and 3D" (Page 9-4)

## Fine Depth Composition

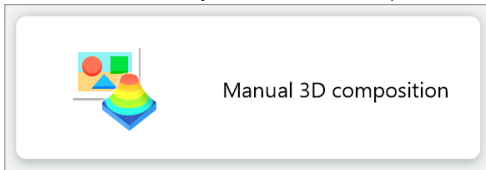
This method captures the image in focus at different heights, performs depth composition in fine resolution, and constructs and displays 3D images. Compared to [Quick composition and 3D], the image can be observed in higher picture quality.



☐ "Fine Depth Composition" (Page 9-9)

## Manual 3D Composition

The manual 3D composition can be started from an arbitrary Z position. This composition does not include unnecessary areas because you move the focus dial manually to determine the composition range.



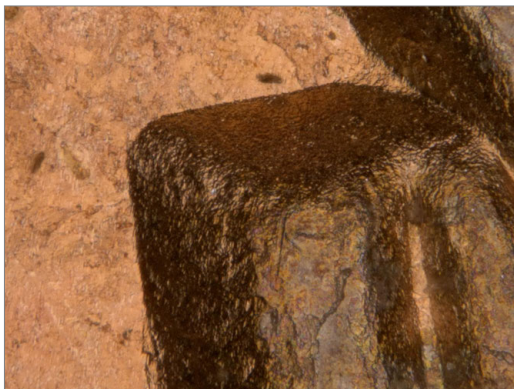
☐ "Manual 3D Composition" (Page 9-13)

# Using Depth Composition

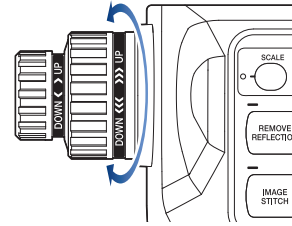
## Live Depth Composition



Images are acquired at different focal planes instantly and the depth composition image is displayed automatically.



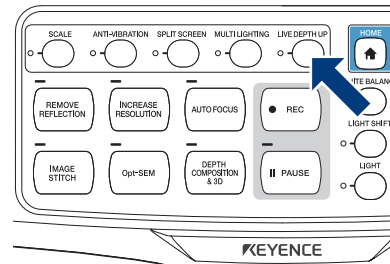
- 1 Adjust the focus to the lowest point of the object using the FOCUS dial on the console.



- 2 Start the live depth composition on the console or VHX MENU.

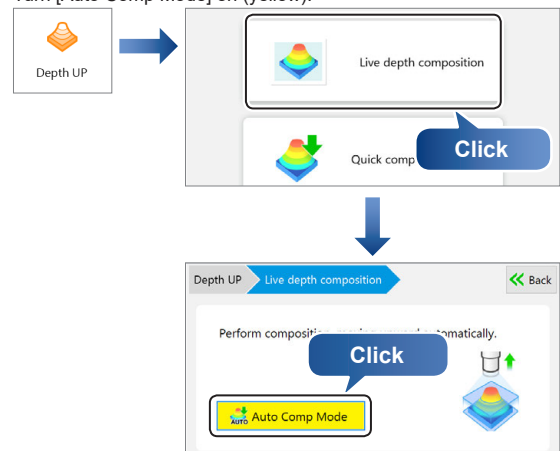
### ● Operation on the Console

Press the [Live depth composition] button on the console.



### ● Operation from the VHX MENU

Click [Depth UP] and click [Live depth composition].  
Turn [Auto Comp Mode] on (yellow).



The Z-axis stage moves and the depth composition image is displayed in the observation window.

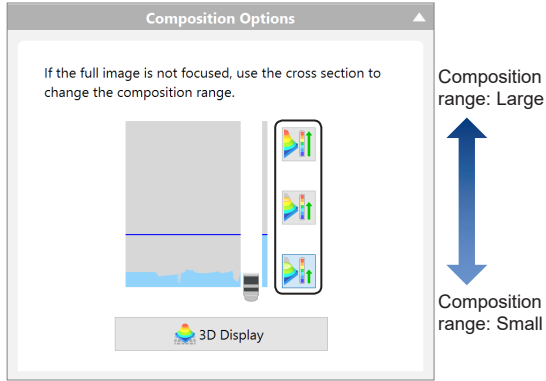
- Reference
- To save the depth composition image, press the [REC] button on the console or click [Rec] on the on-screen menu options.
  - To turn OFF the live depth composition function, click [Auto Comp Mode] again to clear the selected state (yellow).

### Point

The live depth composition can be performed only when using VHX-S770E/S750E/S660E/S650E/S600E/S550E/S500E.

### 3 When the composition range is insufficient, you can adjust the the range to one of three levels with the adjusting button.

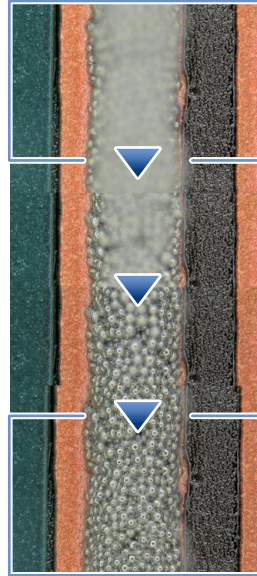
**Point** When the depth composition completes, a guide indicating the object silhouette appears on the right side of lens' movement adjusting button. If the upper limit is not above the silhouette, you may broaden the composition range by pressing the lens' movement adjusting button.



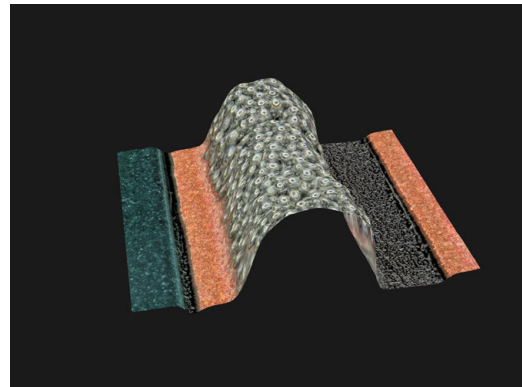
To display the 3D image, click [3D Display].  
 "View (3D display)" (Page 9-15)

## Quick Composition and 3D

Depth composition is performed by simply moving the focus from the lowest point to the highest point of the area to be observed. By moving the focus at a fixed speed, height information is available when the image is in focus which makes 3D observation possible.



Using the powered Z-axis to move the lens height from the bottom to the top, produces a depth composition image.



## Moving the Z-axis automatically

The Z-axis motorized stage, such as VHX-S770E/S750E, is required.

- Point** If the lens being used does not have the automatic lens/zoom recognition function, the magnification must be set before executing composition. Specify the lens power to use in the status bar.
- ☐ “Preparing to Measure” (Page 7-4)

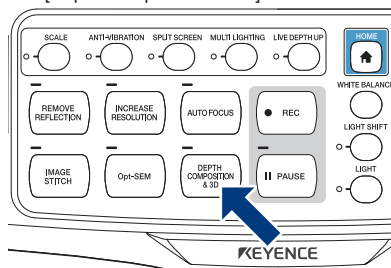


### Simple mode

#### 1 Start [Quick composition and 3D] on the console or VHX MENU.

##### ● Operation on the Console

Press the [Depth Composition & 3D] button on the console.

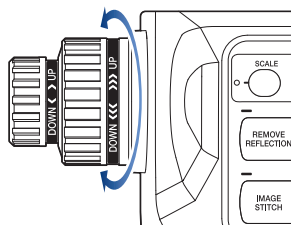
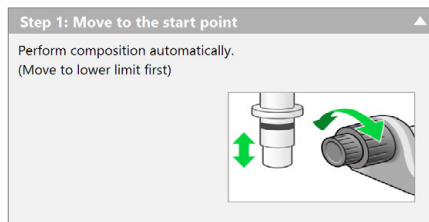


##### ● Operation from the VHX MENU

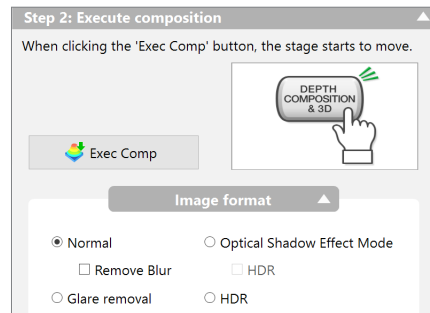
Click [Depth UP] and click [Quick composition and 3D].



#### 2 Adjust the focus to the lowest point of the object using the FOCUS dial on the console.



#### 3 Select [Image format], then click [Exec Comp].



##### ● Image format

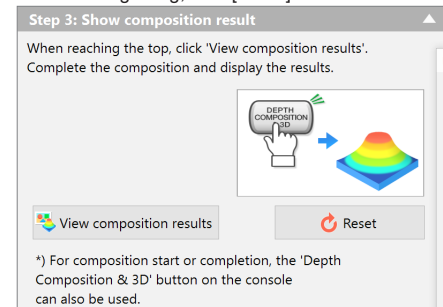
Generally, [Normal] is selected.

- To display clearly surface details like subtle flaws that otherwise could not be seen normally, select [Optical Shadow Effect Mode].
  - ☐ “Optical Shadow Effect Mode” (Page 8-2)
- To perform composition while suppressing surface glare, select [Glare removal].
  - ☐ “Removing Glare (Reflected light Removal)” (Page 8-6)
- To make height differences on surface and gradation of surface clearer, select [HDR].
  - ☐ “Increase Resolution (HDR)” (Page 8-8)
- If the Fully-Integrated (FI) Head is used and blur is found because of the surface glare, select the [Remove Blur] check box.

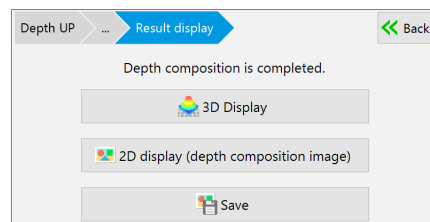
**Reference** You can also set [HDR], [Glare removal] and [Optical Shadow Effect Mode] in advance before executing [Quick composition and 3D].

When the depth composition is complete, the depth composition image appears in the observation window.

- Reference**
- When the recording attains to the top of the sample, press the [Depth Composition & 3D] button on the console, or click [View composition results] to complete the depth composition.
  - To stop midway and redo the depth composition from the beginning, click [Reset].



#### 4 Confirm the depth composition results.



- To display the 3D View, click [3D Display].
  - ☐ “View (3D display)” (Page 9-15)
- Clicking [2D display (depth composition image)] discard the 3D data to display the depth composition image.
- If [HDR] is selected in [Image format], the HDR parameter can be adjusted.
  - ☐ “HDR Settings” (Page 8-8)
- To save the depth composition image, click [Save].

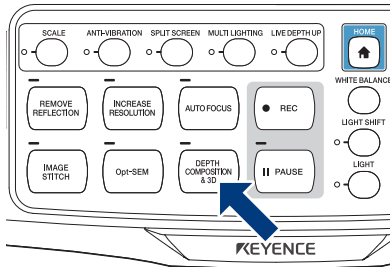
#### 5 Click [Back].

**Detail mode**

**1 Start [Quick composition and 3D] on the console or VHX MENU.**

**Operation on the Console**

Press the [Depth Composition & 3D] button on the console.

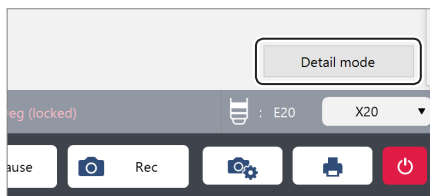


**Operation from the VHX MENU**

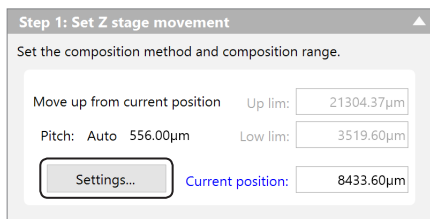
Click [Depth UP] and click [Quick composition and 3D].



**2 Click [Detail mode].**

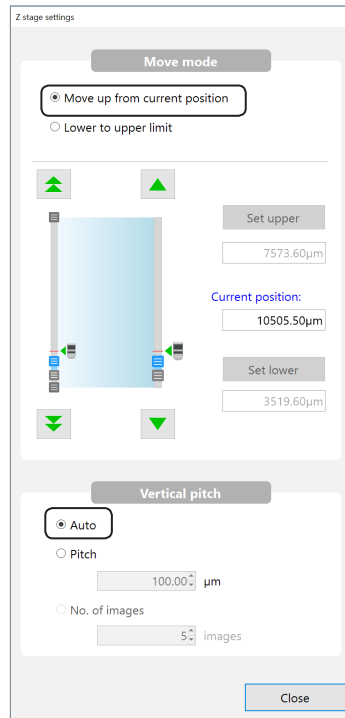


**3 Click [Settings].**



The [Z stage settings] dialog box appears.

**4 Select [Move up from current position] for the move mode and [Auto] for the vertical pitch.**



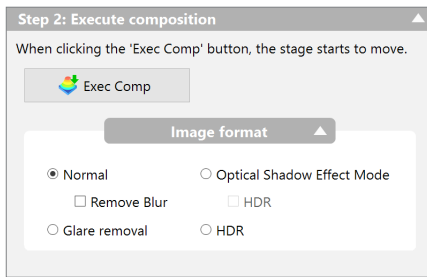
**Reference**

- You can also select [Lowlimit to Uplimit] at [Move mode]. Set the Z stage movement position by [Set upper] and [Set lower].
- [Vertical pitch] can be set by [Pitch] or [No. of images].

**5 Click [Close].**

The [Z stage settings] dialog box closes.

## 6 Select [Image format], then click [Exec Comp].



### Image format

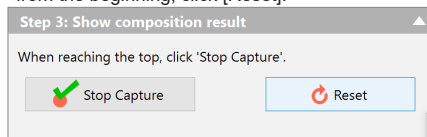
Generally, [Normal] is selected.

- To display clearly surface details like subtle flaws that otherwise could not be seen normally, select [Optical Shadow Effect Mode].  
☐ "Optical Shadow Effect Mode" (Page 8-2)
- To perform composition while suppressing surface glare, select [Glare removal].  
☐ "Removing Glare (Reflected light Removal)" (Page 8-6)
- To make height differences on surface and gradation of surface clearer, select [HDR].  
☐ "Increase Resolution (HDR)" (Page 8-8)
- If the Fully-Integrated (FI) Head is used and blur is found because of the surface glare, select the [Remove Blur] check box.

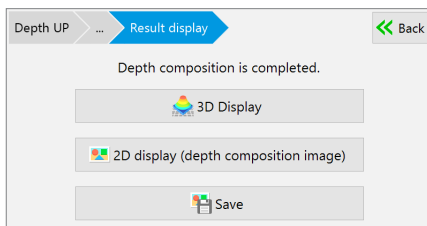
**Reference** You can also set [HDR], [Glare removal] and [Optical Shadow Effect Mode] in advance before executing [Quick composition and 3D].

When the depth composition is complete, the depth composition image appears in the observation window.

- Reference**
- When the recording attains to the top of the sample, press the [Depth Composition & 3D] button on the console, or click [Stop Capture] to complete the depth composition.
  - To stop midway and redo the depth composition from the beginning, click [Reset].



## 7 Confirm the depth composition results.



- To display the 3D View, click [3D Display].  
☐ "View (3D display)" (Page 9-15)
- Clicking [2D display (depth composition image)] discard the 3D data to display the depth composition image.
- If [HDR] is selected in [Image format], the HDR parameter can be adjusted.  
☐ "HDR Settings" (Page 8-8)
- To save the depth composition image, click [Save].

## 8 Click [Back].

## Moving the Z-axis manually

Manual motion is available when the Z-axis motorized stage is not connected.

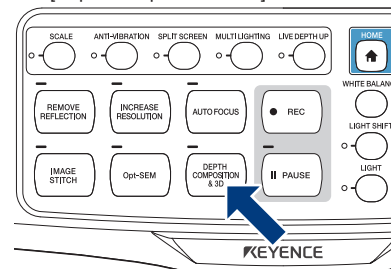
**Point** If the lens being used does not support the automatic lens/zoom recognition function, it must be registered before executing composition. Specify the lens power to use in the information view.  
☐ "Preparing to Measure" (Page 7-4)



## 1 Start [Quick composition and 3D] on the console or VHX MENU.

### Operation on the Console

Press the [Depth Composition & 3D] button on the console.

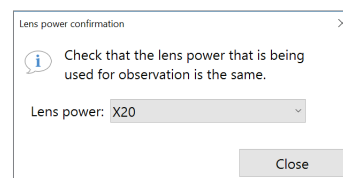


### Operation from the VHX MENU

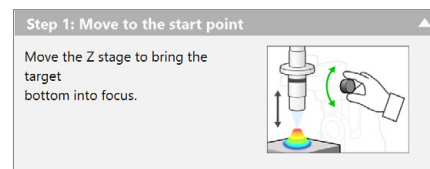
Click [Depth UP] and click [Quick composition and 3D].



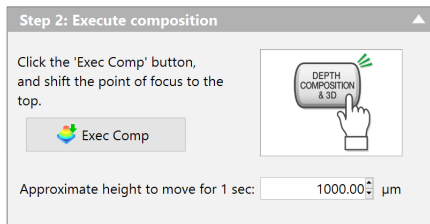
## 2 Confirm the lens magnification, and click [Close].



## 3 Adjust the focus to the lowest point on the object.



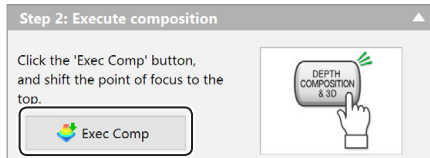
## 4 Set height range for the sample.



### Approximate height to move for 1 second

Enter the approximate speed for the lens movement.  
Enter a value according to the Z-axis height to be moved manually.

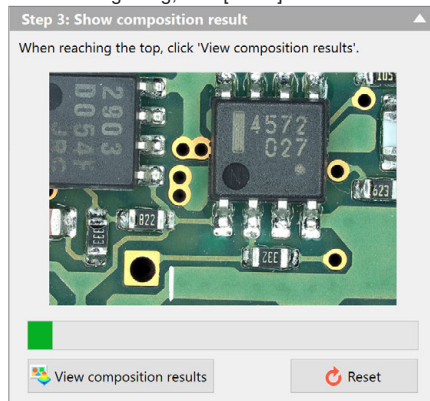
## 5 Click [Exec Comp] and move the lens from the bottom plane of the sample to the top plane.



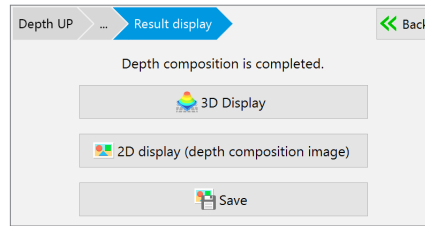
Move it with the speed set at step 4.

Reference

- A progress bar will appear. Move the stage while the progress bar is moving.
- When the recording attains to the top of the sample, click [View composition results] to complete the depth composition.
- To stop midway and redo the depth composition from the beginning, click [Reset].



## 6 Confirm the depth composition results.



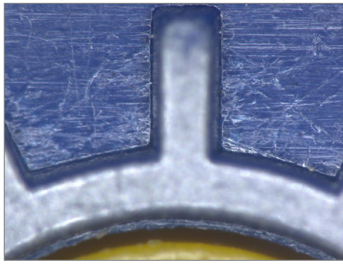
- To display the 3D View, click [3D Display].  
☐ "View (3D display)" (Page 9-15)
- Clicking [2D display (depth composition image)] discard the 3D data to display the depth composition image.
- If [HDR] is selected in [Image format], the HDR parameter can be adjusted.  
☐ "HDR Settings" (Page 8-8)
- To save the depth composition image, click [Save].

## 7 Click [Back].

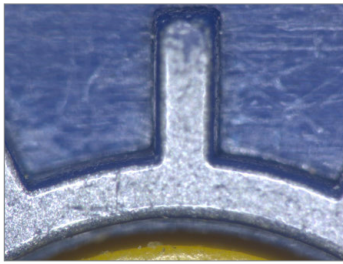


## Fine Depth Composition

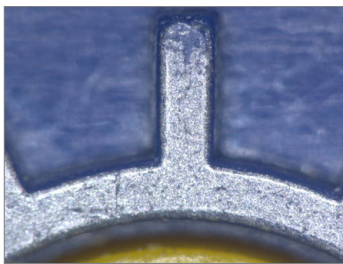
This method captures multiple images in focus at different heights, performs depth composition to produce a single, focused image and then composes and displays a 3D image. Even if the Z axis is moved manually, the height information is explicit so that images can be composed in high picture quality.



1st shot

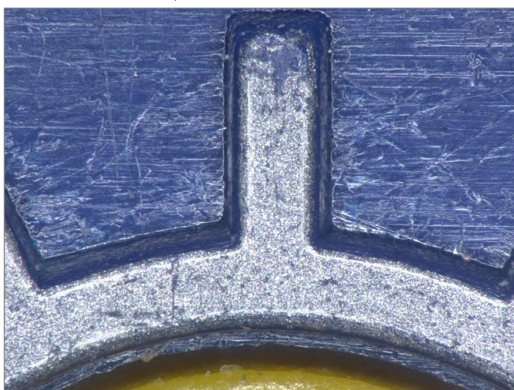


2nd shot



Last shot

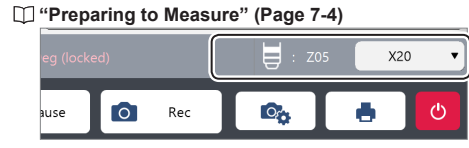
After depth composition...



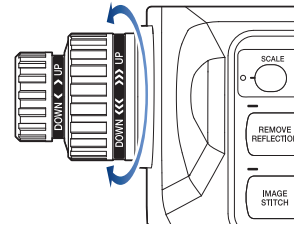
## Moving the Z-axis automatically

The Z-axis motorized stage, such as VHX-S770E/S750E, is required.

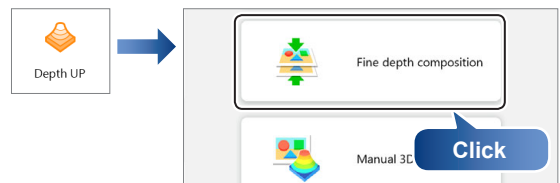
- Point** If the lens being used does not support the automatic lens/zoom recognition function, it must be registered before executing composition. Specify the lens power to use in the status bar.



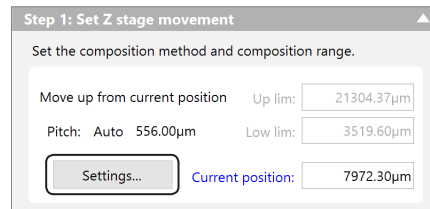
- Adjust the focus to the lowest point of the object using the FOCUS dial on the console.



- Click [Depth UP] from the VHX MENU and click [Fine depth composition].

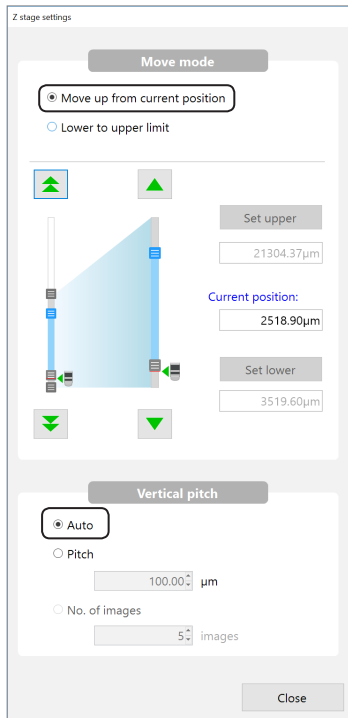


- Click [Settings].



The [Z stage settings] dialog box appears.

#### 4 Select [Up from current] for the Move mode and [Auto] for the vertical pitch.

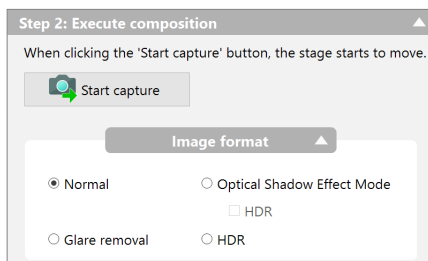


- Reference**
- You can also select [Lowlimit to Uplimit] at [Move mode]. Set the Z stage movement position by [Set upper] and [Set lower].
  - [Vertical pitch] can be set by [Pitch] or [No. of images].

#### 5 Click [Close].

The [Z stage settings] dialog box closes.

#### 6 Select [Image format], then click [Start capture].



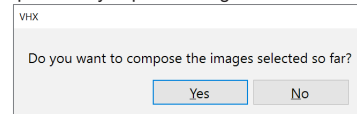
#### Image format

- Generally, [Normal] is selected.
- To make height differences on surface and gradation of surface clearer, select [HDR].
    - “Increase Resolution (HDR)” (Page 8-8)
  - To perform composition while suppressing surface glare, select [Glare removal].
    - “Removing Glare (Reflected light Removal)” (Page 8-6)
  - To display clearly surface details like subtle flaws that otherwise could not be seen normally, select [Optical Shadow Effect Mode].
    - “Optical Shadow Effect Mode” (Page 8-2)

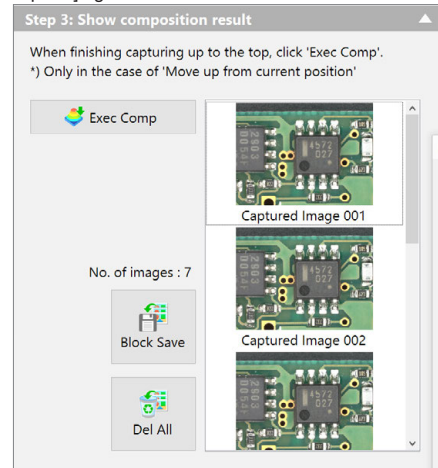
**Reference** You can also set [HDR], [Glare removal], or [Optical Shadow Effect Mode] in advance before executing [Fine depth composition].

When the depth composition is complete, the depth composition image appears in the observation window.

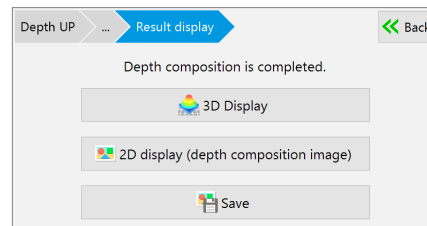
- Reference**
- When the recording attains to the top of the sample, click [Exec Comp]. When a confirmation dialog appears, click [Yes] to execute the depth composition by captured image.



- You can perform the batch saving/all deleting for the captured image. After deleting all, click [Start capture] again.



#### 7 Confirm the depth composition results.



- To display the 3D View, click [3D Display].
  - “View (3D display)” (Page 9-15)
- Clicking [2D display (depth composition image)] discard the 3D data to display the depth composition image.
- If [HDR] is selected in [Image format], the HDR parameter can be adjusted.
  - “HDR Settings” (Page 8-8)
- To save the depth composition image, click [Save].

#### 8 Click [Back].

**Reference** To recreate the depth composition image, click [Back]. Delete all the captured images before recreating the depth composition image.

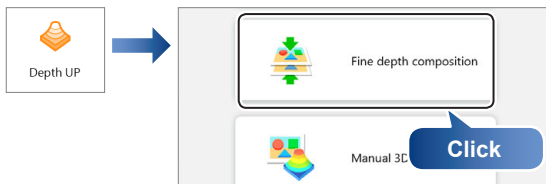
## Moving the Z-axis manually

Move the Z-axis manually when the Z-axis electric stage is not connected.

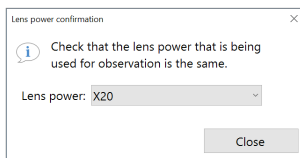
**Point** If the lens being used does not support the automatic lens/zoom recognition function, it must be registered before executing composition. Specify the lens power to use in the status bar.  
 ☐ “Preparing to Measure” (Page 7-4)



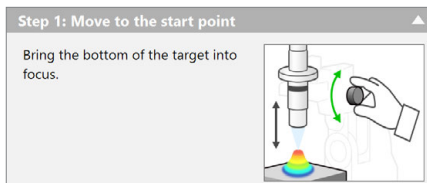
- 1 Click [Depth UP] from the VHX MENU and click [Fine depth composition].



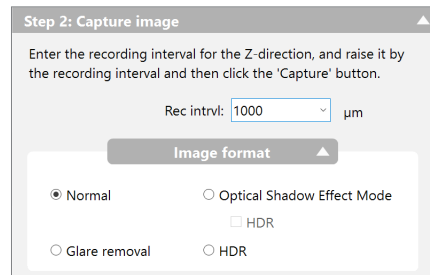
- 2 Confirm the lens magnification, and click [Close].



- 3 Adjust the focus to the lowest point on the object.



- 4 Set [Rec interval], and select [Image format].



- **Rec interval**

To account for depth-of-field variation caused by the magnification used, enter an appropriate recording pitch.

- **Image format**

Generally, [Normal] is selected.

- To make height differences on surface and gradation of surface clearer, select [HDR].  
 ☐ “Increase Resolution (HDR)” (Page 8-8)
- To perform composition while suppressing surface glare, select [Glare removal].  
 ☐ “Removing Glare (Reflected light Removal)” (Page 8-6)
- To display clearly surface details like subtle flaws that otherwise could not be seen normally, select [Optical Shadow Effect Mode].  
 ☐ “Optical Shadow Effect Mode” (Page 8-2)

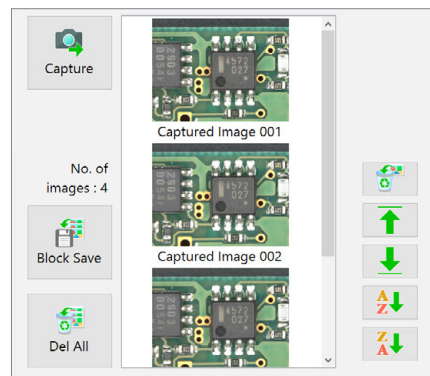
**Reference** You can also set [HDR], [Glare removal], or [Optical Shadow Effect Mode] in advance before executing [Fine depth composition].

- 5 Press the [REC] button on the console, or click [Capture].

This will save the current image.

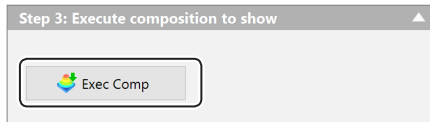
- 6 Move the lens by the amount specified as the recording pitch in step 4.

- 7 Repeat steps 5 and 6 until you have captured the highest point of the object in focus.

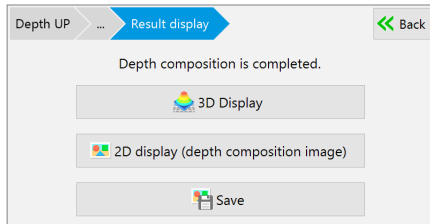


Item	Function
Block Save	Names the captured images and save them in a batch. The destination folder, file name prefix, and image format can be specified.
Delete All	Deletes all captured images.
	Deletes the selected images. Multiple selection is available.
	Moves the capturing position for the selected image up or down.
	Sorts the images by name in ascending or descending order.

## 8 Click [Exec Comp].



## 9 Confirm the depth composition results.



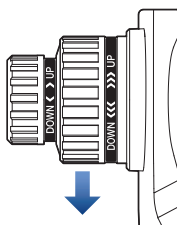
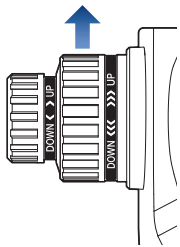
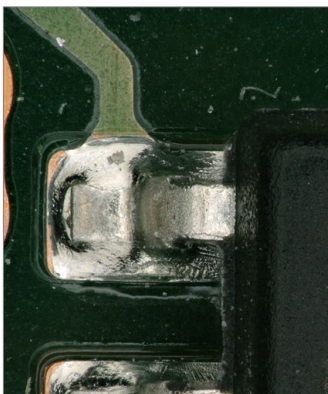
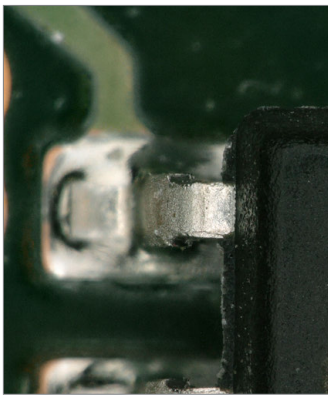
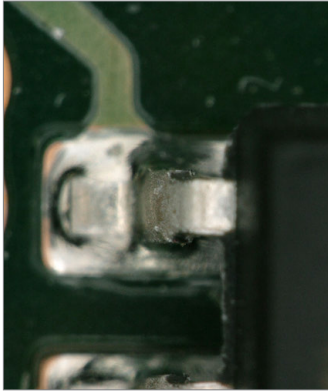
- To display the 3D View, click [3D Display].  
 "View (3D display)" (Page 9-15)
- Clicking [2D display (depth composition image)] discard the 3D data to display the depth composition image.
- If [HDR] is selected in [Image format], the HDR parameter can be adjusted.  
 "HDR Settings" (Page 8-8)
- To save the depth composition image, click [Save].

## 10 Click [Back].

**Reference** To recreate the depth composition image, click [Back]. Delete all the captured images before recreating the depth composition image.

## Manual 3D Composition

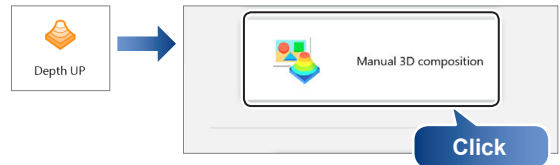
The depth composition can be started easily and quickly from any position you want. You do not need to adjust the start point. Use the console to move the Z stage so as to bring every part of the image into focus. 3D images can also be created this way.



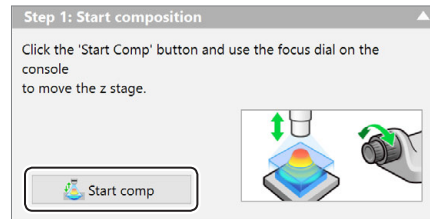
### Reference

- This function is not applicable to manual Z stages.
- This function cannot be used together with the [HDR] or [Glare removal].

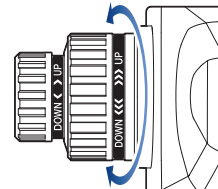
### 1 Click [Depth UP] from the VHX MENU and click [Manual 3D composition].



### 2 Click [Start composition].



### 3 Move the focus dial up and down within a range you want to compose.

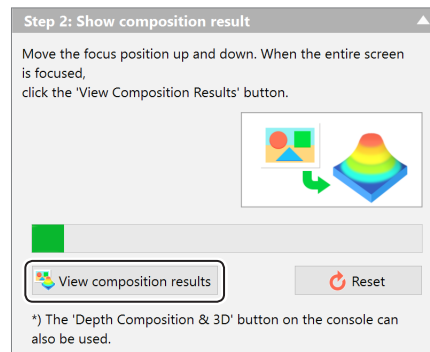


You may move up and down repeatedly.

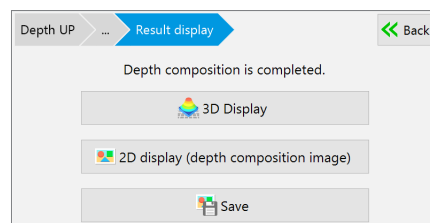
### Reference

- A progress bar will appear. Move the stage while the progress bar is moving.
- To stop midway and redo the depth composition from the beginning, click [Reset].

### 4 Click [View composition results].



### 5 Confirm the depth composition results.



- To display the 3D View, click [3D Display].  
□ "View (3D display)" (Page 9-15)
- Clicking [2D display (depth composition image)] discard the 3D data to display the depth composition image.
- To save the depth composition image, click [Save].

### 6 Click [Back].

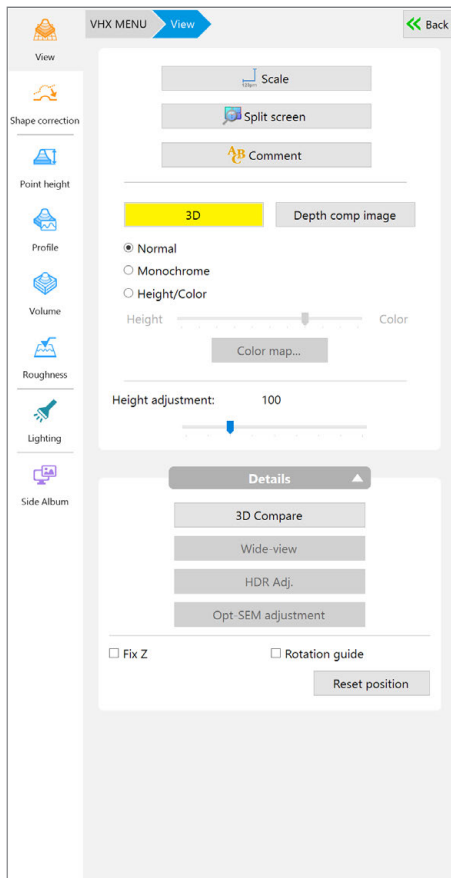
### Reference

- To recreate the depth composition image, click [Back]. Delete all the captured images before recreating the depth composition image.

# 3D MENU

The 3D view allows you to play, display, and observe compiled 3D images and 3D image data saved in the album.

Displaying an image in 3D provides powerful observation from various directions to reveal scratches (dents), foreign matter (protrusions), and dirt (surface irregularities) otherwise difficult to detect in a 2D image.



## View

Sets the 3D image display method.

### ● Display settings

- ☐ "Playing Back and Saving 3D Images" (Page 9-15)
- ☐ "Playing Back and Saving 3D Images" (Page 9-15)
- ☐ "Playing Back and Saving 3D Images" (Page 9-15)

### ● Details

- ☐ "Details (3D Compare/Wide-View/Display Adjustment/Fix Z/Rotation Guide)" (Page 9-19)



## Shape correction

This function corrects the tilt of a 3D image for display.

- ☐ "Playing Back and Saving 3D Images" (Page 9-15)
- ☐ "Playing Back and Saving 3D Images" (Page 9-15)



## Point height

This function can measure a height of 3D images by simple operations.

- ☐ "3D MENU" (Page 9-14)



## Profile

3D measurements allow you to measure cross-sections of 3D images.

- ☐ "3D MENU" (Page 9-14)



## Volume

This function allows you to measure volumes and surface areas of 3D images.

- ☐ "3D MENU" (Page 9-14)



## Roughness

Roughness of 3D images can be measured.

- ☐ "Names and Functions in the Window" (Page 9-26)
- ☐ "Playing Back and Saving 3D Images" (Page 9-15)



## Lighting

This function allows you to perform observation by applying virtual lighting on the 3D image.

- ☐ "3D MENU" (Page 9-14)



## Side Album

This function allows you to display the side album to select images to be viewed on the observation window. This is the same function as the side album on the VHX MENU.

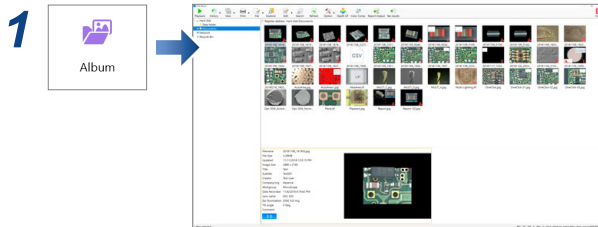
- ☐ "Side Album" (Page 11-15)

# View (3D display)

## Playing Back and Saving 3D Images

### Playing Back 3D Images

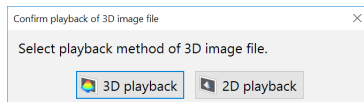
3D playback automatically displays a 3D image. 3D images saved in the album are played in 3D.



### 2 Select any 3D image from the images stored in the album to click [Playback].

The [Confirm playback of 3D image file] dialog box appears.

### 3 Click [3D playback].



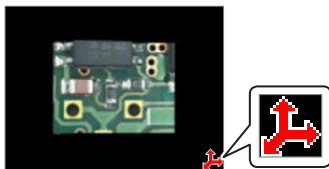
#### Point

If the [3D image file] of [Show confirmation message for the playback method] is turned off in the Album [Options], the 3D playback will start without displaying [Confirm playback of 3D image file].

☞ "Playing Files" (Page 11-5)

#### Reference

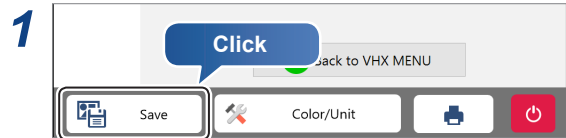
- The 3D symbol appears on thumbnails for 3D images.  
The 3D symbol appears in the preview information window.



- To exit the [3D display], click [Back to VHX MENU] at the bottom right of the screen.
- If you select [2D playback], the front view of the recorded (saved) image is shown. A 3D image can also be played as a 2D image if it was saved while being rotated, zoomed, or shown with a scale in 3D view.

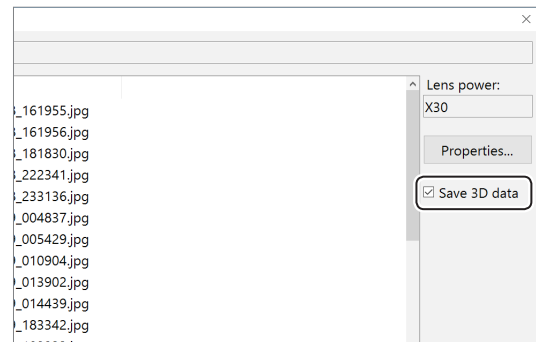
### Saving 3D Images

Saving the image observed in 3D to the hard disk.



The [Rec] dialog box appears.

### 2 Select the [Save 3D data] check box.



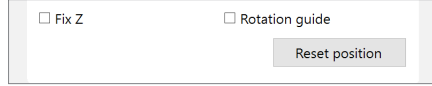
### 3 Enter the file name and click [Save].

## Manipulating the 3D View

3D images can be rotated, zoomed in and out, and moved by using the wheel button on the mouse. All operations are executed using the center of the screen as the reference point.

**Point**

If the image falls outside the view while manipulating it, click [Reset position] or double-click the right mouse button. This will return the view to its initial state.

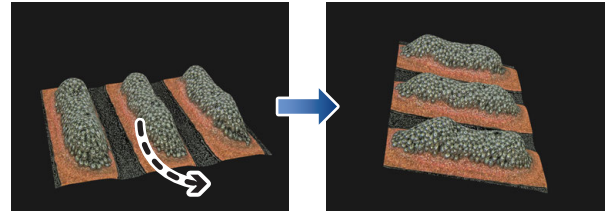


**Reference**

The speed used to turn, zoom, and move an image is proportional to the speed at which the mouse is dragged.

### Turn

To turn the image, hold the left mouse button down and drag it up, down, left, right, or diagonally. If you release the button while dragging the mouse, the image turns continuously. (To stop turning continuously, click the left mouse button.)

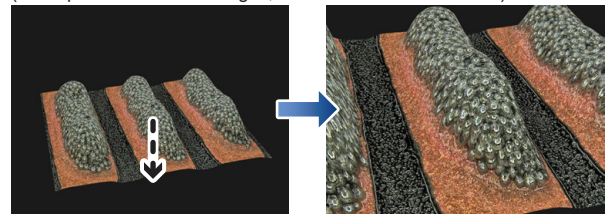


### Zoom in

To zoom in on an image, drag the mouse down while holding the wheel button down.

If you release the button while dragging the mouse, the view will continue zooming in.

(To stop continuous zooming in, click the left mouse button.)

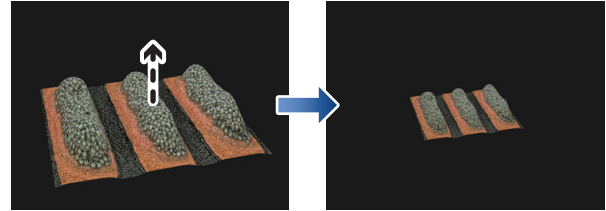


### Zoom out

To zoom out of an image, drag the mouse up while holding the mouse wheel button down.

If you release the button while dragging the mouse, the view will continue zooming out.

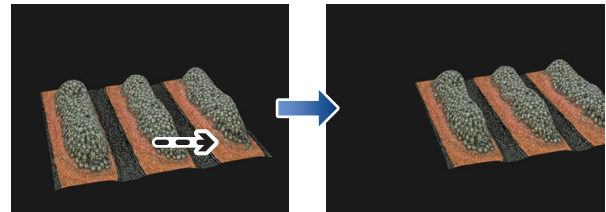
(To stop continuous zooming out, click the left mouse button.)



### Move

To move the image, hold the right mouse button down and drag it in the desired direction: up, right, left, right, or diagonally.

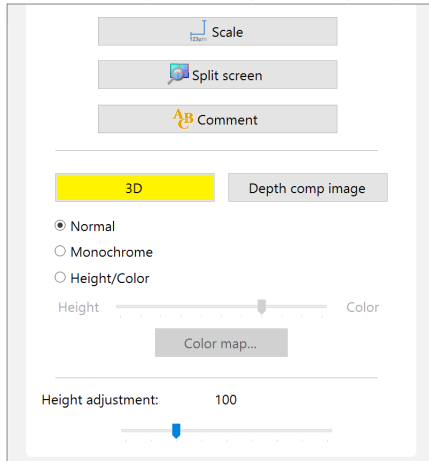
To move in the Z axis, turn the mouse wheel.





## View Settings of 3D Display/Height Adjustment

Performs the view settings of 3D images and height adjustment.

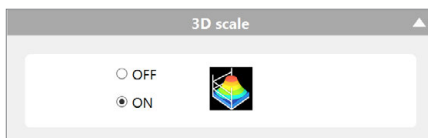


### Scale

Displays a scale on the 3D image.

1 Click [Scale].

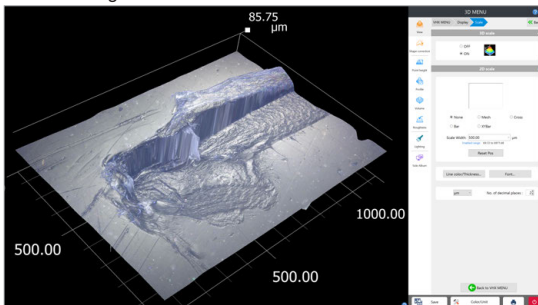
2 Select [ON].



The [3D scale] appears on the screen.

The height anywhere on the cross-section can be measured by pinching the upper and lower planes on the area to be measured by dragging the "●" and "■" on the Y-axis of the scale.

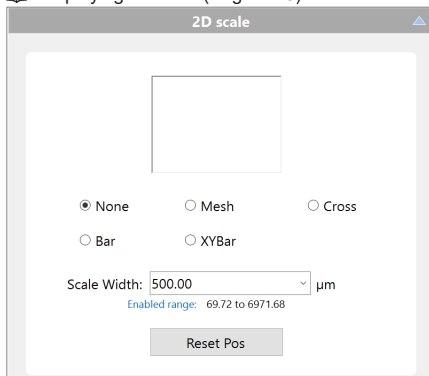
Turn the image for a better view.



Reference

[2D scale] is displayed when displaying the depth composition image on the 3D MENU.

☐ "Displaying a Scale" (Page 7-25)

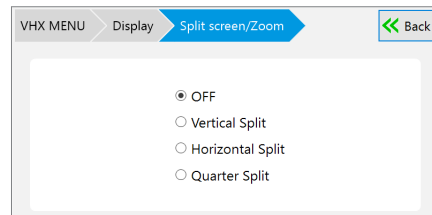


### Split screen

Displays the 3D image observation window as split screens.

1 Click [Split screen].

2 Select the split method.



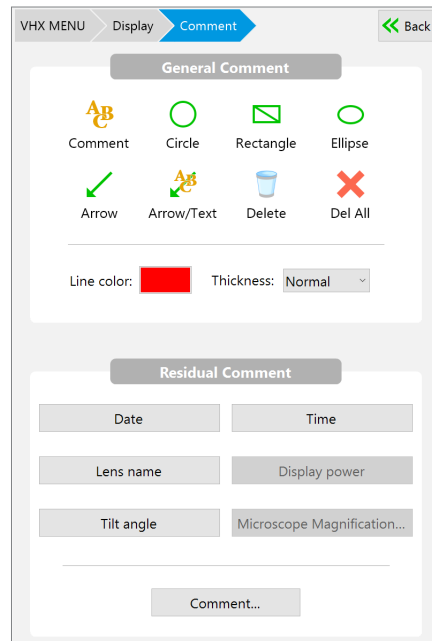
☐ "Split Screen /Zoom" (Page 6-2)

### Comments

Add a comment to the 3D image.

1 Click [Comment].

2 Select a tool to add a comment.



☐ "Displaying Text and Markers (Comment)" (Page 6-4)

### Switch display (3D/Depth composition image)

Switch the image displayed on the 3D MENU observation window.



## Display settings

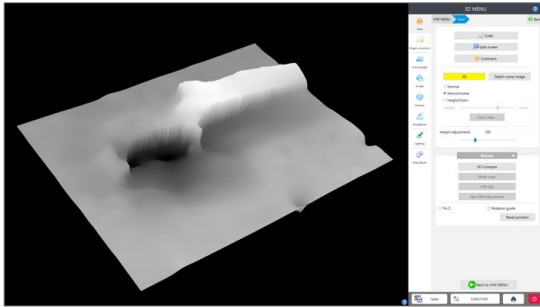
The 3D image can be displayed in monochrome or height/color.

### Monochrome display

#### 1 Select [Monochrome].

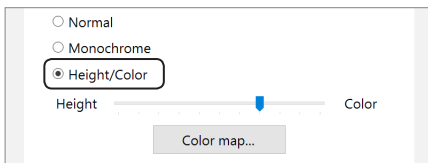


This option removes the surface texture to make height differences easy to understand. Combining it with the light simulation provides clearer height differences.



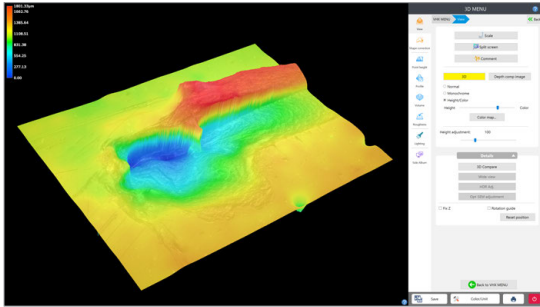
### Height/Color display

#### 1 Select [Height/Color].



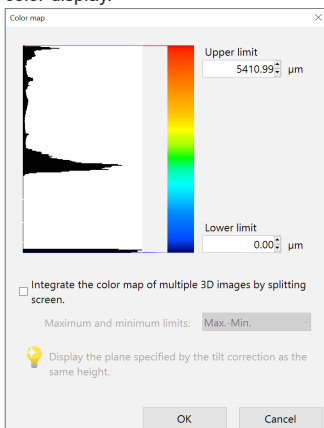
This enables the slide bar for [Height] - [Color].

- When moving the slide bar toward the [Height], color coding is done according to the 3D image height.
- Moving it toward [Color] displays the color of the object.



#### Color map

Click [Color map] to adjust [Upper limit] and [Lower limit] of the color display.

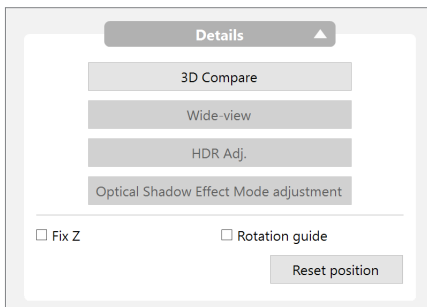


## Height

This option changes the display scale in the height direction of the 3D image.

To view by extending the height from a reference value of 100, drag the slider to the right.

## Details (3D Compare/Wide-View/Display Adjustment/Fix Z/Rotation Guide)



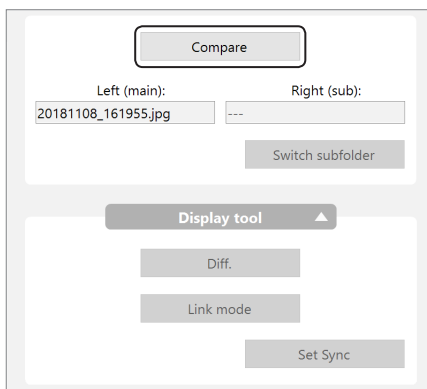
## 3D File Comparison

This feature allows you to tile two 3D images, turn them simultaneously, and display their differences. You can compare two recorded images or use the current image on one side.

### 1 Click [3D Compare].

[Compare] menu displays.

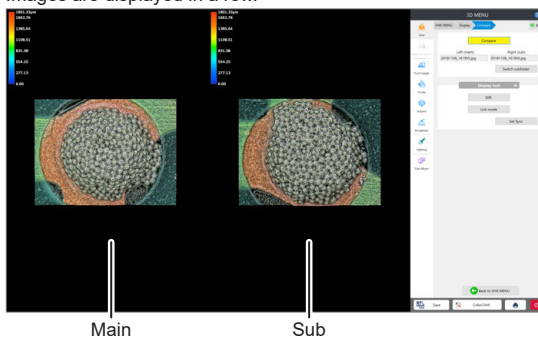
### 2 Click [Compare].



The [Select a file for 3D comparison] screen appears.

### 3 Playback the 3D image for comparison.

Images are displayed in a row.



## Switching subfolder

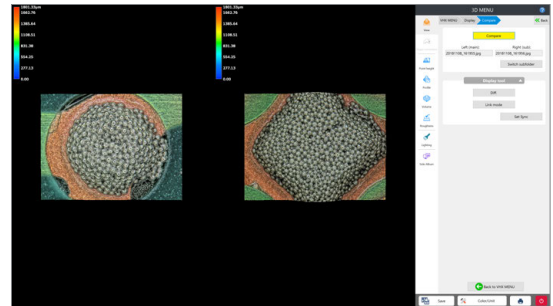
Switching the sub image.

### 1 Click [Switch subfolder].

The [Select a file for 3D comparison] screen appears.

### 2 Playback the 3D image to be displayed.

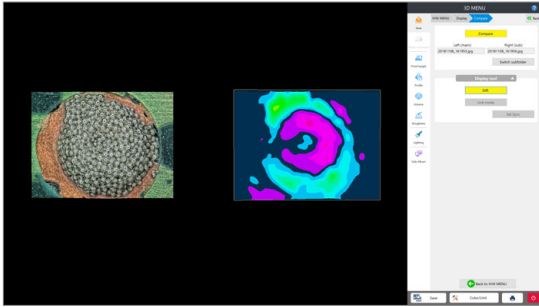
### 3 The screen returns to the 3D comparison mode and displays the selected image as the sub image.



To select another image for the main image, go back to selecting a file for 3D comparison. Click [Exit], then select the image to display from the album and play it back as a 3D image.

### Differential View

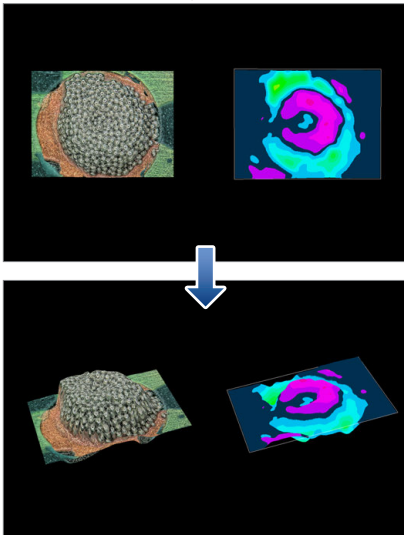
When [Diff.] is clicked, the differential view overlays the main and sub image and highlights the height differences in color. The left screen shows the sub image overlapped on the main image, and the right screen shows the height differences highlighted in graduated colors. When releasing the difference view, click [Diff.] again.



**Point** Images intended for comparison should be recorded under the same conditions, i.e., recording size, angle, lens, etc.

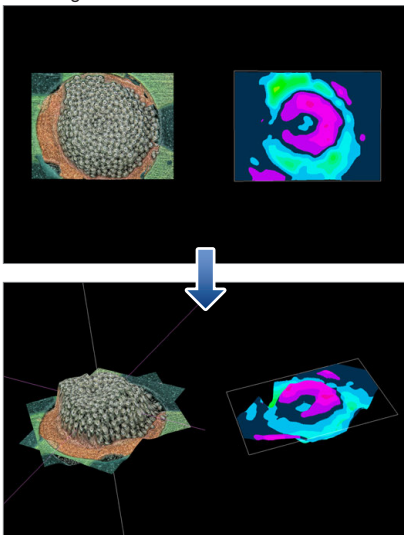
### Manipulating the main image and sub image in link mode

Manipulate the images by operating the mouse on the [Sub image] shown on the right. The main and sub images will both turn and move together.



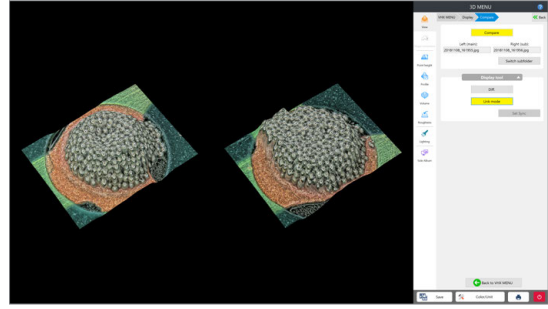
### Manipulating only the main image

Operate the mouse on [Main image] shown on the left. The sub image on the right screen cannot be turned or moved.



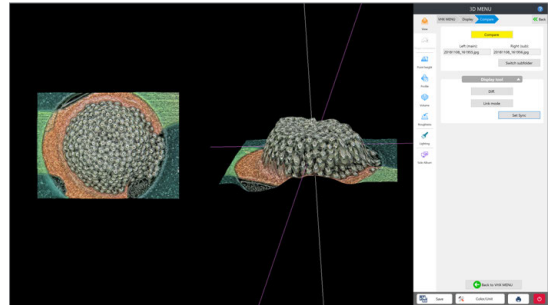
### Link mode

When [Link mode] is clicked, linking the main and sub image allows you to turn and zoom in and out of both images together. This automatically matches the angle and magnification of the sub image to the main image. When releasing linked mode, click [Link mode] again.



### Set Sync

Before linking the main and sub images for comparing, you can correct recording differences, such as angle and position differences, and then synchronize the two images. Adjust the main image and sub image angles respectively to be compared easily, and click [Set Sync].



This sets the current angle and position as the reference point for link mode.

**Point** Set Sync cannot be used if [Link mode] is ON. Release [Link mode] first, then perform [Set Sync].

## Wide-view

This can be selected when displaying the depth composition image on the 3D MENU.

The depth composition image is displayed in wide-view.

☞ "Wide-View" (Page 6-10)

## Fix Z

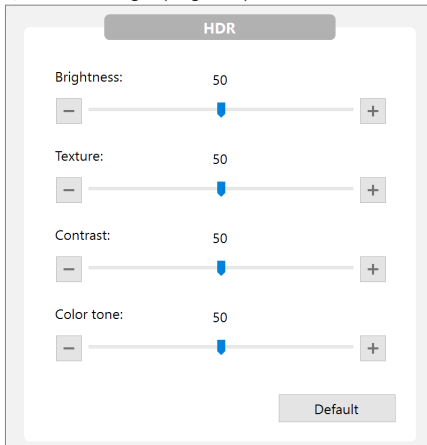
Checking this option turns and moves the image with the Z-axis fixed. Hold the left mouse button down and drag to turn while keeping the Z axis fixed. Hold the right mouse button down and drag to move the object.

## HDR Adj.

This can be selected when displaying the 3D HDR image.

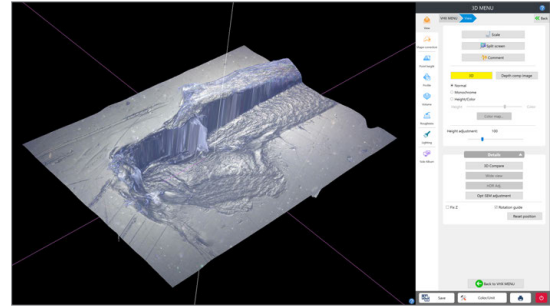
The HDR image is displayed, and the HDR parameter can be adjusted.

☞ "HDR Settings" (Page 8-8)



## Rotation guide

When this option is checked, the X, Y, and Z axes are shown when the 3D image is dragged.

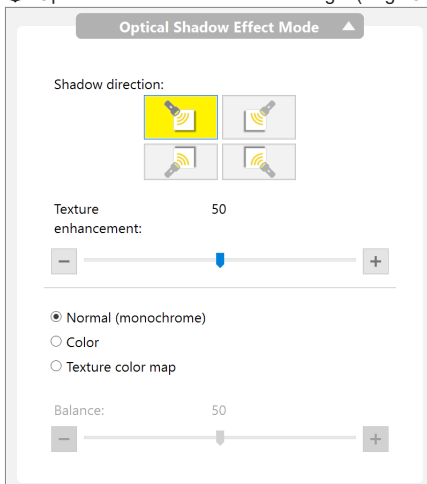


## Optical Shadow Effect Mode adjustment

This can be selected when displaying the 3D Optical Shadow Effect Mode image.

The Optical Shadow Effect Mode image is displayed, and the display method can be adjusted.

☞ "Optical Shadow Effect Mode Settings" (Page 8-2)



# Shape correction

This function corrects the 3D shape to be the image that can be easily observed.

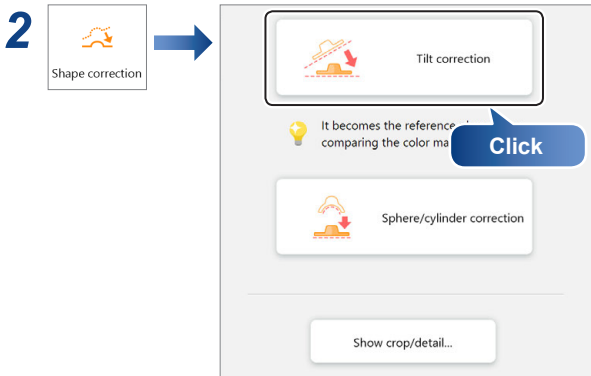
## Tilt Correction

This function corrects the tilt of a 3D image for display. This function is useful when observing or measuring height differences on the surface of an object that lies at an angle.

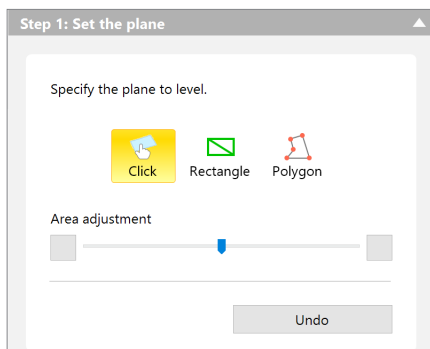
**Point** If performing the tilt correction, HDR data is discarded.

### 1 Playback the 3D image.

☐ "Playing Back 3D Images" (Page 9-15)



### 3 Selects how to specify the plane.



#### ● Click

Click and specify the plane to level. The area width to be painted with each click can be adjusted with the [Area adjustment] slider.

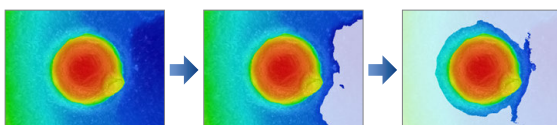
#### ● Rectangle

Specify the plane to level as a rectangle.

#### ● Polygon

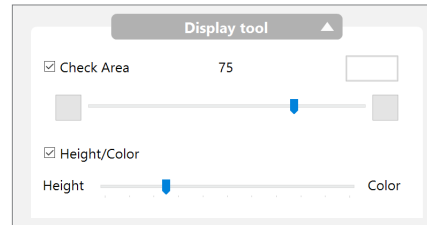
Specify the plane to level as a polygon. The specification can stop by double-click.

### 4 Specify the plane to level.



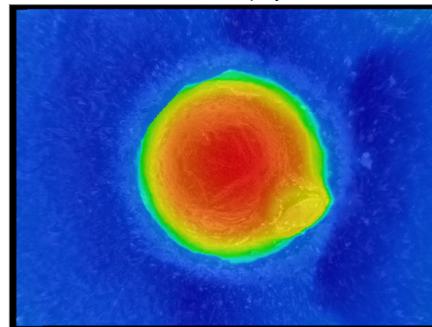
The specified place is going to be painted according to the [Display Tool] settings.

### 5 If necessary, adjust the [Check Area] display and [Height/Color] display.



### 6 Click [Correct].

The correction results are displayed in the observation window.



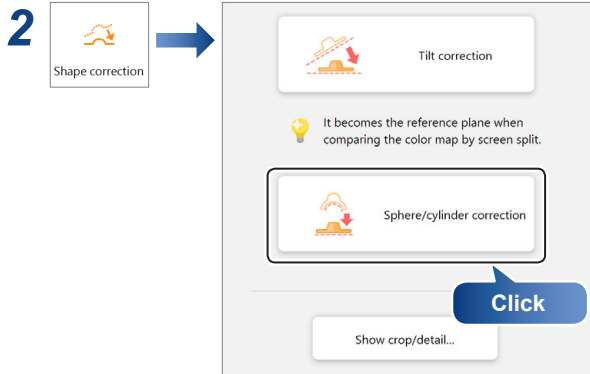
### 7 Click [Complete].

## Sphere/Cylinder Correction

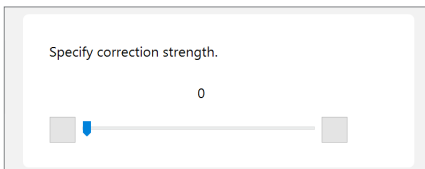
Use this function to check height differences on the surface of a sphere or a cylinder.

### 1 Playback the 3D image.

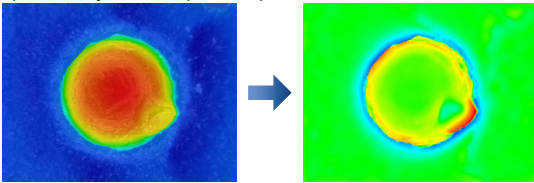
☐ "Playing Back 3D Images" (Page 9-15)



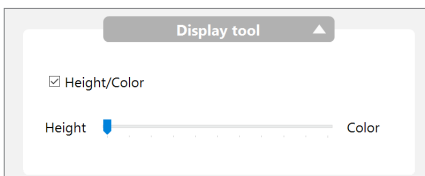
### 3 Specify the correction strength with the slider.



The greater the correction, the greater the effect to correct the sphere or cylinder shape to be plane.



### 4 If necessary, adjust the [Height/Color] display.



### 5 Click [Complete].

This makes it easy to evaluate height differences on the surface of a sphere.

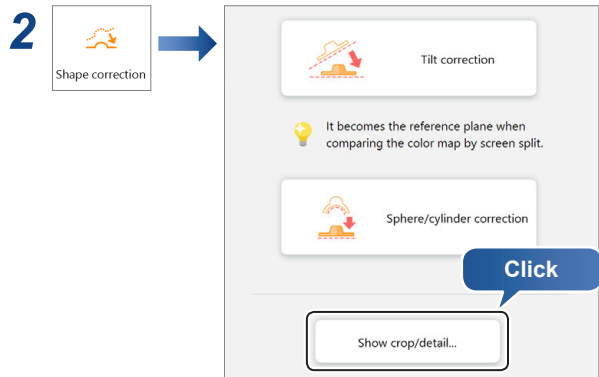
## Showing crop/detail

This tool allows you to crop a portion of the 3D image and observe or save it.

This is useful for observing portions of a 3D stitched image.

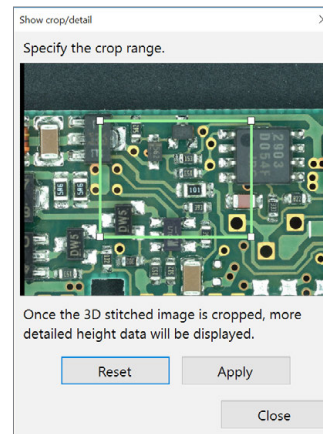
### 1 Playback the 3D image.

☐ "Playing Back 3D Images" (Page 9-15)



The [Show crop/detail] dialog box appears.

### 3 On the image in [Show crop/detail], specify the framing box size to encompass the area to be enlarged, and click [Apply].



An enlarged view of the specified area appears in the observation window.

To return to the entire view, click [Reset].

### 4 Click [Close].

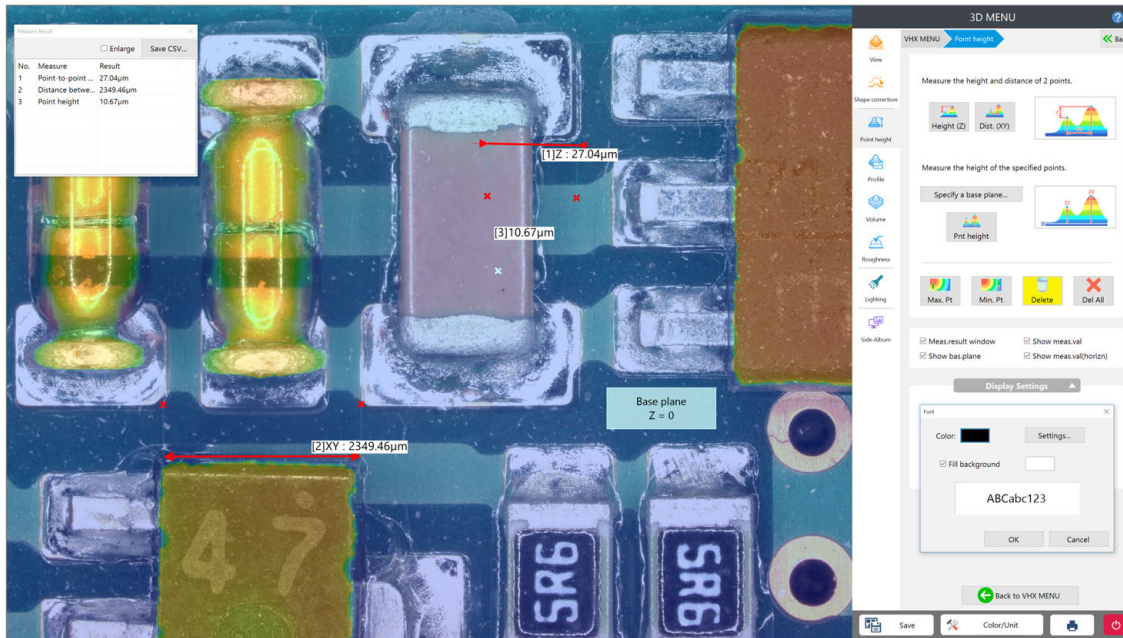
The enlarged image can be turned and moved using the mouse.

- ☐ Reference
  - To observe a different location, click [Show crop/detail] again.
  - To save the cropped 3D image, click [Save] from the on-screen menu options.
  - ☐ "Saving 3D Images" (Page 9-15)

# Point Height (Optional)

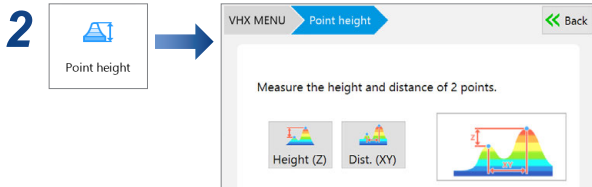
This function can measure a height of 3D images by simple operations.

**Point** The separately sold “3D Profile Measurement Application” (model VHX-H5M) is required to perform the point height. Perform the activation of this application beforehand.  
The “3D profile measurement software” (Model VHX-H5M) requires one license per product.



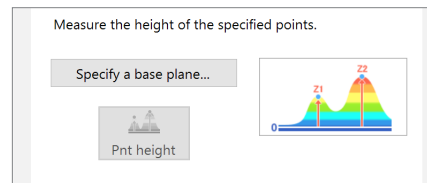
## Starting the point height measurement

**1** Playback the 3D image.  
☐ “Playing Back 3D Images” (Page 9-15)



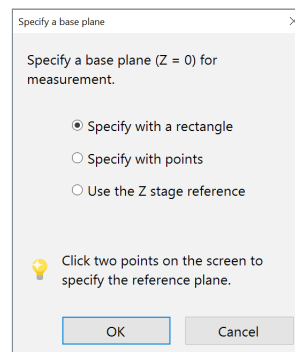
## Measuring heights of specified points

**1** Click [Specify a base plane...].



The [Specify a base plane...] dialog box appears.

**2** If [Specify with a rectangle] and [Specify with points] are selected, specify the area to be a base on the screen.



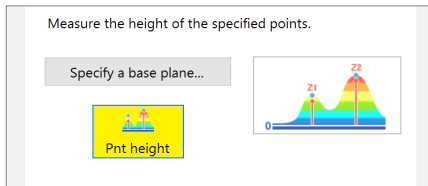
**Point** If [Use the Z stage reference] is selected, the lowest Z position in the 3D composition will be set as the base.  
[Use the Z stage reference] cannot be selected when the shape correction and replay from the album are performed, because there is no effective information on the Z stage.

## Measuring height and distance easily

	Height (Z)	Height between two points are measured.
	Dist. (XY)	Distance between two points are measured.



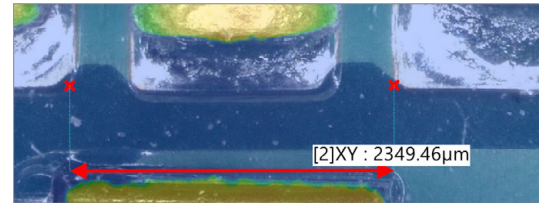
### 3 Click [Point height] and a point you want to measure the height.



The height measured from the base is displayed.

### Display the measurement value

Measurement values are displayed on the screen.

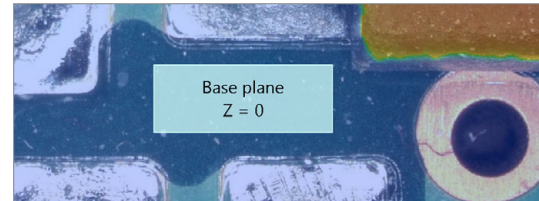


### Other measurement tools

	Displays the highest point in the selected area.
	Displays the lowest point in the selected area.
	Deletes the selected measurement results.
	Deletes all measurement results.

### Display a base plane

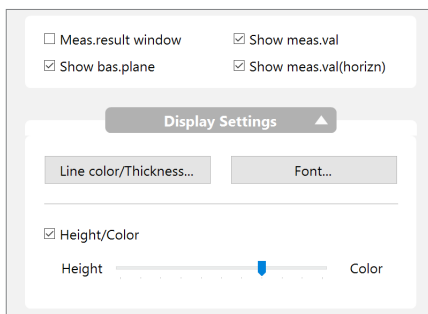
Displays [Base plane Z = 0] in the observation window when specifying a base plane.



### Display measurement value horizontally

When clearing the check box, the measurement value is displayed on the direction according to the measurement result.

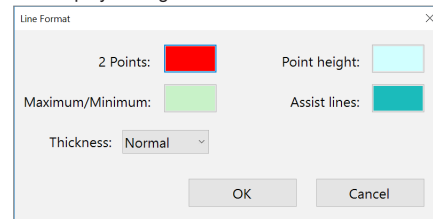
### Display settings



### Display settings

#### Line color/Thickness

The display settings such as dimension lines can be changed.



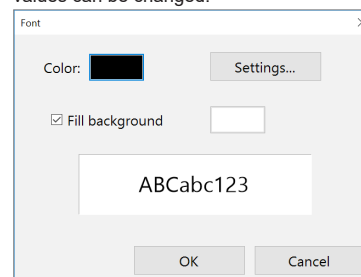
### Measure Result Window

No.	Measure	Result
1	Point-to-point ...	27.04µm
2	Distance betwe...	2349.46µm
3	Point height	10.67µm

Item	Function
No.	Corresponds to the label (subscript) displayed next to the measurement line.
Measurement	Displays the measurement item.
Result	Displays the measurement result.
Enlarge	When checked, enlarges the text size.
Save CSV	Measurement results can be saved as CSV files.

#### Font

The text colors and background colors and others such as measurement values can be changed.



#### Height/Color

Adjusts the observation window display by the slide bar.

- Height : The 3D image is color coded depending on its height.
- Color : The 3D image is displayed with the color of the target.

# 3D Profile Measurements (Optional)

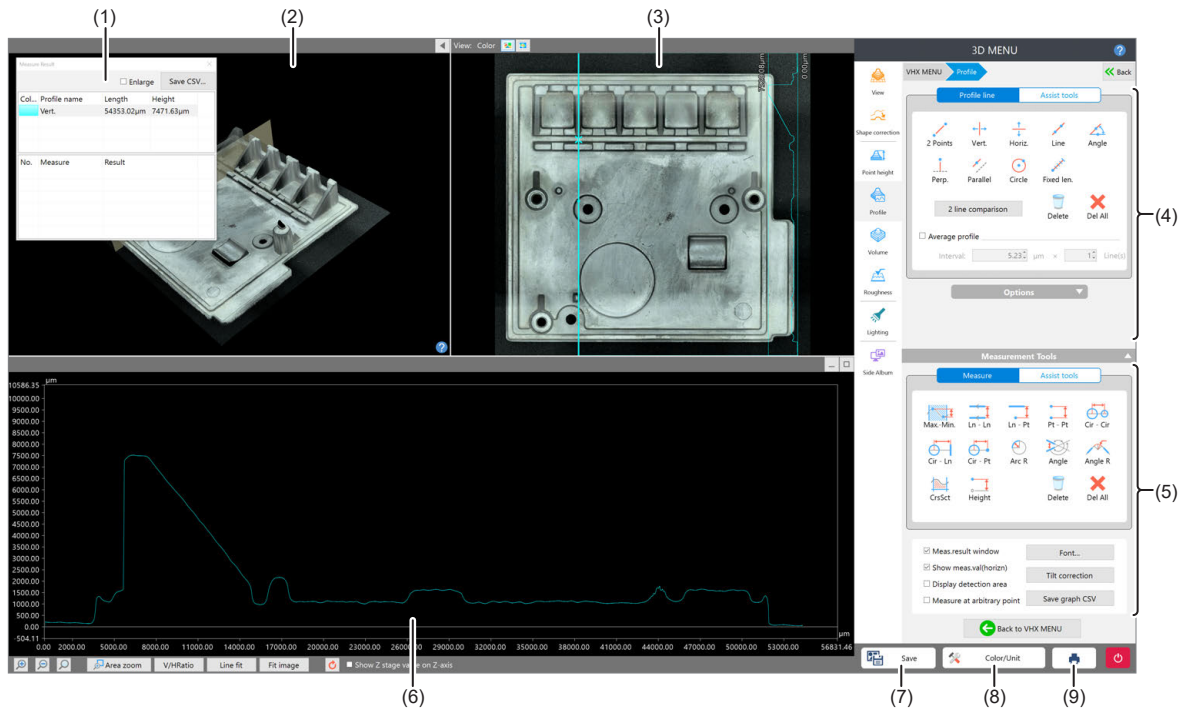
3D measurements allow you to measure cross-sections of 3D images.

**Point** The separately sold “3D Profile Measurement Application” (model VHX-H5M) is required to perform 3D profile measurements. Perform the activation of this application beforehand. The “3D profile measurement software” (Model VHX-H5M) requires one license per product.

## Names and Functions in the Window

This section explains the names and functions of each part of the window used to measure 3D profiles.

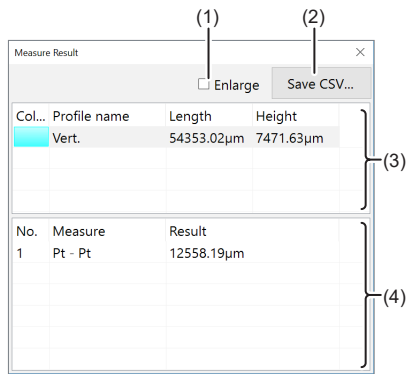
**Point** The content of the display will vary based on the function being used.



No.	Item	Function
(1)	Measure result	Lists profiles and elements placed on the image and measurement results. ☐ “Profile/Measurement Result List” (Page 9-27)
(2)	3D display area	Displays a stereoscopic shape of the target object and the cross section of the selected profile. You can change and manipulate the 3D image display. ☐ “Manipulating the 3D View” (Page 9-16)
(3)	Image display area	Displays an image of the target object when you see it perpendicular to the reference plane. You can set a profile line on this image. You can also change the display type of the image.
(4)	Profile tool	Contains buttons to draw various profile lines, such as a straight line or a circle.
(5)	Measurement tool	Buttons used to measure the interval specified by the profile are displayed.
(6)	Profile display area	Displays the profile graph for the profile line (or for the selected profile line for the multi-line ) on the image. ☐ “Profile Display Area” (Page 9-27)
(7)	[Save]	Saves the current display as a 2D image.
(8)	[Color/Unit]	Displays the [Color/Unit] dialog box. • Sets the scale line, scale auxiliary line and background color. • Sets the unit (m/mm/μm) and number of decimals.
(9)	Print	Displays the print menu. ☐ “Print Settings” (Page 4-10)

## Profile/Measurement Result List

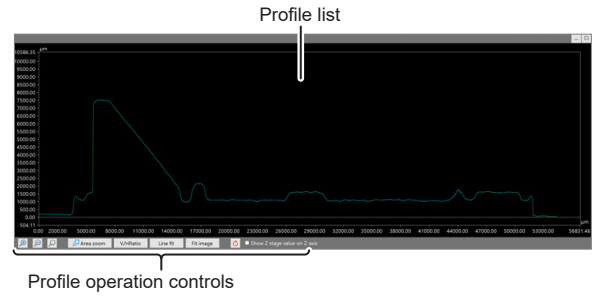
The [Measure Result] dialog box displays the list of profiles and elements placed on the image, and the list of measurement results.



**Reference** When the [Measure result window] check box under Profile tools is unchecked, the [Measure Result] dialog box is hidden. When the check box is checked, the dialog box appears again.

No.	Item	Function																								
(1)	Enlarge	When this check box is checked, the measurement results are displayed in larger fonts.																								
(2)	Save CSV	Measurement results can be saved as CSV files.																								
(3)	Profile list	Displays the list of profile lines. When profile is selected, displays in the 3D display area, image display area and profile display area change.																								
(4)	Measure result list	Displays the measurement values of the selected profile.																								
		<table border="1"> <thead> <tr> <th>Item</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Max. - Min.</td> <td>Difference between max. and min. points in the specified area</td> </tr> <tr> <td>LN - LN</td> <td>Distance between [LN - LN].</td> </tr> <tr> <td>LN - PT</td> <td>Distance between [LN - PT].</td> </tr> <tr> <td>PT - PT</td> <td>Distance between two points.</td> </tr> <tr> <td>CIR - CIR</td> <td>Distance between circles.</td> </tr> <tr> <td>CIR - LN</td> <td>Distance between circle and line.</td> </tr> <tr> <td>CIR - PT</td> <td>Distance between circle and point.</td> </tr> <tr> <td>Arc R</td> <td>Radius value of circle or arc.</td> </tr> <tr> <td>Angle</td> <td>Angle between two lines at their intersection.</td> </tr> <tr> <td>Cross sectional area</td> <td>Area value between line and profile.</td> </tr> <tr> <td>Height</td> <td>The height value when considering the reference plane as 0.</td> </tr> </tbody> </table>	Item	Description	Max. - Min.	Difference between max. and min. points in the specified area	LN - LN	Distance between [LN - LN].	LN - PT	Distance between [LN - PT].	PT - PT	Distance between two points.	CIR - CIR	Distance between circles.	CIR - LN	Distance between circle and line.	CIR - PT	Distance between circle and point.	Arc R	Radius value of circle or arc.	Angle	Angle between two lines at their intersection.	Cross sectional area	Area value between line and profile.	Height	The height value when considering the reference plane as 0.
		Item	Description																							
		Max. - Min.	Difference between max. and min. points in the specified area																							
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		LN - PT	Distance between [LN - PT].																							
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		CIR - CIR	Distance between circles.																							
		CIR - LN	Distance between circle and line.																							
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Angle	Angle between two lines at their intersection.																									
Cross sectional area	Area value between line and profile.																									
Height	The height value when considering the reference plane as 0.																									

## Profile Display Area



### Profile list

Displays the list of profile lines. The display switches according to the element that is selected in the image display area.

### Profile operation controls

Changes the method to view the profile graph.

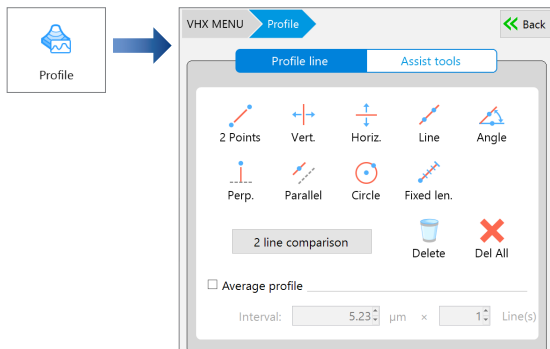
	Enlarges to 1.5 times of the original magnification.
	Reduces to 2/3 times of the original magnification.
	Displays the [Set axis] dialog box. <div> </div> <p>You can set a display area for each of the X-axis and Z-axis with maximum and minimum values. If the [Match Z-axis to X-axis scale] check box is selected, the maximum value of the Z-axis is adjusted to make the aspect ratio 1:1 based on the X-axis.</p>
	Specify a rectangular area on the profile graph by dragging the mouse, then the profile graph is enlarged to fit the specified rectangular area to the entire profile display area.
	Adjust the scaling of the X-axis and Z-axis of the profile to make the aspect ratio 1:1. The X-axis is fixed and the scaling of the Z-axis is adjusted.
	Enlarges or reduces the profile graph to fit it to the entire profile display area.
	Adjusts the maximum or minimum of the Z-axis in the profile display area to the maximum or minimum of the entire height image. Also, adjusts the X-axis to fit the profile graph to the entire profile display area.
	Resets the scaling of the X-axis and Z-axis.
	Displays the height of Z stage on the Z axis scale.

## Starting Profile Measurements

### 1 Playback the 3D image.

☐ "Playing Back 3D Images" (Page 9-15)

### 2



## Setting Profile Line

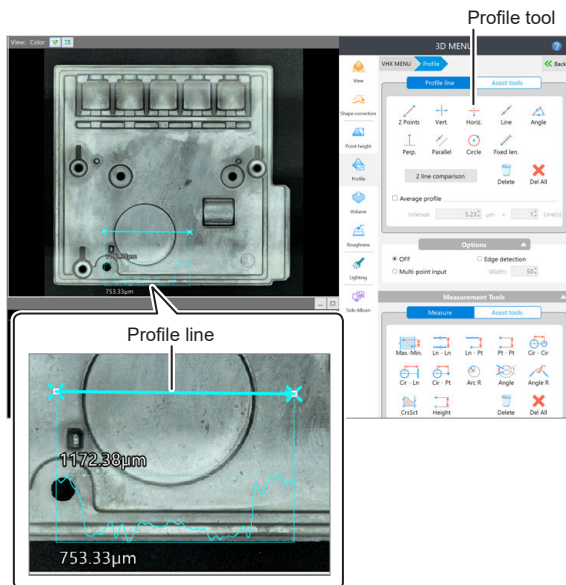
Set a profile line at the measurement position on the image displayed in the image display area. When the profile line is specified on the image, a profile graph at the measurement position is displayed.

### 1 Select the [Assist tool] tab of the profile tool and click the desired button to place an element on the image as needed for the setting of the profile line.

☐ "View" (Page 9-14)

### 2 Click the desired button on the [Profile line] tab and draw a profile line on an image.

☐ "View" (Page 9-14)



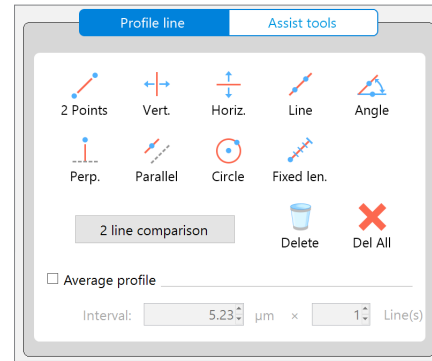
When a profile line is drawn on the image, an actual cross section of the sample where it is intersected by the profile line is displayed in the profile display area.

Because the profile graph is updated in real time during the drawing process of the profile line, you can draw the profile line while confirming the waveform.

The profile list is also displayed in the [Measure Result] dialog box.

## Profile Line Tool

The following describes how to set a measurement line using the profile line tools.



### 2 Points



Measures a line segment that connects two points specified arbitrarily as a measurement line.

### 1 Click [2 Points].

### 2 Click the starting point and move the mouse.

After moving the mouse, the line segment appears.

### 3 Click a desired end point.

The measurement line is determined.

### Vertical



Measures a straight line that is vertical to the display image as a measurement line.

### 1 Click [Vertical].

### 2 Click a point.

The measurement line is determined.

### Horizontal



Measures a straight line that is horizontal to the display image as a measurement line.

### 1 Click [Horiz.].

### 2 Click a point.

The measurement line is determined.

## Line



Measures a straight line that passes through two specified points.

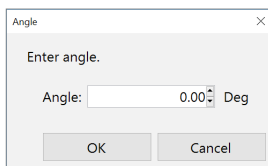
- 1** Click [Line].
- 2** Click the 1st point, and then move the mouse.  
When you move the mouse, a straight line is displayed.
- 3** Move the mouse and click a second point.  
The measurement line is determined.

## Specific angle



Measures a straight line that passes through a point specified by the user and intersects with a reference line at a specified angle as a measurement line.

- 1** Click [Specific angle].  
The [Specific angle] dialog box appears.
- 2** Enter an angle against the reference line and click [OK].



- 3** Put the mouse over a position where you want to locate the reference line, and click the position.
- 4** Move the mouse to rotate the reference line through 360 degrees.
- 5** Select the desired position for the reference line, then click the mouse.  
The reference line is determined and a line that intersects with the reference line at the specified angle is displayed.  
When you move the mouse, the measurement line moves, keeping the angle against the reference line constant.
- 6** Click the position you want to measure.  
The measurement line is determined.

## Perpendicular lines



Measures a straight line that is vertical to a reference line specified as a measurement line.

- 1** Click [Perp.].
- 2** Put the mouse over a position where you want to locate the reference line, and click the position.  
Move the mouse to rotate the reference line through 360 degrees.
- 3** Select the desired position for the reference line, then click the mouse.  
The reference line is created and a line that is perpendicular to the reference line is displayed.
- 4** Place the mouse over a position where you want to make a measurement, and click the position.  
This sets the position of the line perpendicular to the reference line.

## Parallel lines



Measures a straight line that is parallel to a reference line specified as a measurement line.

- 1** Click [Parallel].
- 2** Put the mouse over a position where you want to locate the reference line, and click the position.  
Move the mouse to rotate the reference line through 360 degrees.
- 3** Select the desired position for the reference line, then click the mouse.  
The reference line is created and a line that is parallel to the reference line is displayed.
- 4** Place the mouse over a position where you want to make a measurement, and click the position.  
This sets the position of the line parallel to the reference line.

## Circle



Measures a circle that consists of two points specified as a measurement line.

- 1** Click [Circle].
- 2** Click a circle center and move the mouse.  
When you move the mouse, a circle whose center is the first clicked point and the mouse's last position serves as a radial position of the circle appears.
- 3** Move the mouse and click the mouse at the desired position.  
A circular measurement line, a line connecting the two points, appears showing the radius of the circle.

### Fixed length

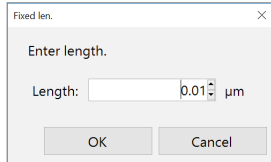


Measures a line segment that has a specified length and direction as a measurement line.

#### 1 Click [Fixed len.].

The [Fixed length] dialog box appears.

#### 2 Enter the length of the measurement line, then click [OK].



#### 3 Click the starting point of the position you want to measure.

A line of the specified length appears.

#### 4 Click a point in the direction you want the line to point.

The measurement line is determined.

### Delete



Deletes individual profile lines displayed in the image display area.

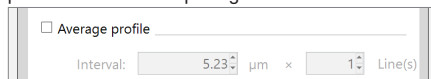
### Delete all



Deletes all the profile lines displayed in the image display area.

### Average profile

Specifying multiple measurement lines parallel to a measurement line allows variations in measurement areas to be eliminated and an average profile to be acquired. Check the box and set the number of profile lines and the spacing between the lines.



#### Interval

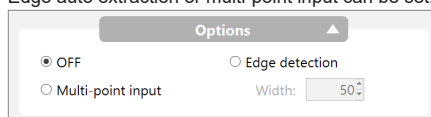
Sets an interval of measurement lines. The greater the value, the larger the interval.

#### Range

In addition to a measurement line that is drawn on an image, enter the number of lines (n) to be drawn on both sides of the line. When drawing the base measurement line, the number of lines that have been specified are automatically drawn on both sides of the base line and total number of measurement lines will be  $2n + 1$ .

### Auxiliary functions

Edge auto extraction or multi-point input can be set.

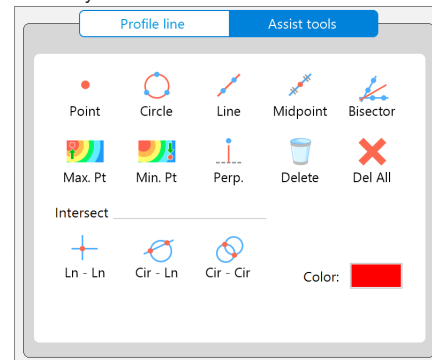


For more details, refer to [☐ "Auxiliary Functions"](#) (Page 7-19).

## Assist Tool (Profile Line)

Elements you create using the assist tool are called assist elements. Assist elements themselves are not measurement lines, instead you can use them as a reference point or reference line when you set a measurement line.

Placing assist elements at the position that will be measurement points enables you to set a measurement line more accurately and efficiently.



### Point



Makes the clicked point an assist point.

#### 1 Click [Point] and click a point in the image display area.

An assist point (X) appears at the clicked point.

### Circle



Creates a circular assist line by clicking 3 points.

#### 1 Click [Circle] and click 3 points in the image display area.

The circular assist line that passes through the clicked 3 points appears.

### Line



The first clicked point becomes a reference and an assist line is created when another point is clicked.

#### 1 Click [Line] and click 2 points.

The assist line that passes through the clicked points appears.

### Midpoint



Click two points to specify their halfway point.

#### 1 Click [Midpoint] and click a starting point and ending point in the image display area.

Assist points (X) appear at the starting point, ending point and middle point.

## Bisector



Specify two assist lines to specify the assist line at their halfway distance.

- 1 Click [Bisector] and click 2 points in the image display area.  
An assist line appears.
- 2 Click 2 points in the image display area.  
Another assist line appears.
- 3 Click a position to set the middle line position.  
An assist line as a bisector appears.

## Max. height and Min. height



Max. Pt



Min. Pt

Highest and lowest points of the heights are set to assist points.

- 1 Click [Max. Pt ] or [Min. Pt], and then drag to specify a target area in the image display area.  
Highest and lowest points are displayed with assist points (X).

## Perpendicular lines



Perp.

Create a line which passes through two points, and a perpendicular line.

- 1 Click [Perp.] and then click two points on the observation screen.  
The assist line that passes through the clicked points appears.
- 2 Click one point in the observation window.  
Perpendicular intersect the created assist line, and the line that connects the clicked point will appear.

## Delete



Delete

Deletes individual assist points/lines displayed in the image display area.

## Delete all



Del All

Deletes all assist points/lines displayed in the image display area.

## Line-Line (intersection)



Ln - Ln

Sets 2 assist lines and makes their intersection point an assist point.

- 1 Click [Ln - Ln] and click 2 points in the image display area.  
An assist line appears.
- 2 Click 2 points in the image display area.  
Another assist line appears and the assist point (X) appears at the intersection point of those lines.

## Circle-Line (intersection)



Cir - Ln

Sets a circular assist line and a linear assist line, and makes their intersection point an assist point.

- 1 Click [Cir - Ln] and click 3 points in the image display area.  
The circular assist line that passes through the clicked 3 points appears.
- 2 Click 2 points in the image display area.  
The line that passes through the clicked points appears and the assist point (X) appears at the intersection point with the circular assist line.

## Circle-Circle (intersection)



Cir - Cir

Sets 2 circular assist lines and makes their intersection point an assist point.

- 1 Click [Cir - Cir] and click 3 points in the image display area.  
The circular assist line that passes through the clicked 3 points appears.
- 2 Click 3 points in the image display area.  
The circular assist line that passes through the clicked 3 points appears and the assist point (X) appears at the intersection point of those 2 circles.

## Color (Assist tool color)

Sets the color of assist tools to be displayed in the image display area.

## Setting Measurement Intervals

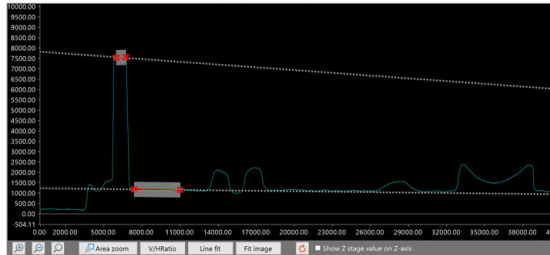
Set measurement intervals on the profile displayed in the profile display area to obtain measurement values for each interval.

- 1 Select the [Assist tool] tab in the measurement tool window and click the icon to place the desired element on the profile as needed.

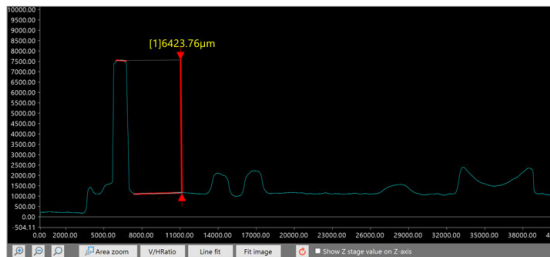
☐ "Assist Tool (Measurement Tool)" (Page 9-35)

- 2 Click the icon on the [Measurement] tab in the measurement tool window and set a measurement interval on a profile.

☐ "Measurement Tools" (Page 9-32)

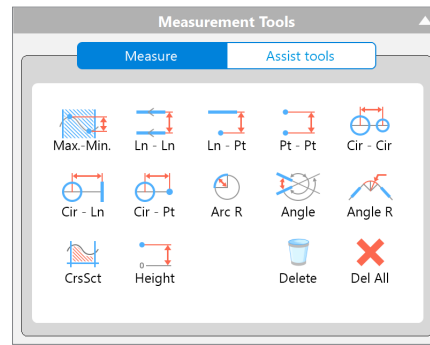


When a measurement interval is set on a profile, the measured value appears in the profile display area and in the profile/measurement list.



## Measurement Tools

The following describes the measurement interval setting using measurement tools.



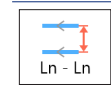
### Max. - Min.



Detects the highest and lowest points in the Z direction in the specified area and calculates difference between the heights.

- 1 Click [Max. - Min.].
- 2 Specify the first point in the measurement area.
- 3 Specify the second point in the measurement area.  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 4 Click the position to display the measured value.  
The position to display the measured value is set.

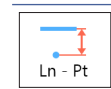
### Ln - Ln



Measures the distance between two lines.

- 1 Click [Ln - Ln].
- 2 Specify Line 1.
- 3 Specify Line 2.  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 4 Click the position to display the measured value.  
The position to display the measured value is set.

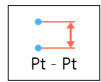
### Ln - Pt



Measures the distance between a line and a point.

- 1 Click [Ln - Pt].
- 2 Specify a line.
- 3 Specify a point.  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 4 Click the position to display the measured value.  
The position to display the measured value is set.



**Pt - Pt**

Measures the distance between two points.

- 1 Click [Pt - Pt].**  
Displays the measurement type menu.
- 2 Select the measurement type.**
- 3 Specify Point 1 and Point 2.**  
Click the desired places to specify two points.  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 4 Click the position to display the measured value.**  
The position to display the measured value is set.

**Cir - Cir**

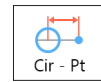
Measures the distance between two circles.

- 1 Click [Cir - Cir].**  
Displays the measurement type menu.
- 2 Select the measurement type.**
- 3 Specify Circle 1 and Circle 2.**  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 4 Click the position to display the measured value.**  
The position to display the measured value is set.

**Cir - Ln**

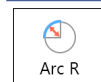
Measures the distance between a circle and a line.

- 1 Click [Cir - Ln].**
- 2 Specify a circle.**
- 3 Specify a line.**  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 4 Click the position to display the measured value.**  
The position to display the measured value is set.

**Cir - Pt**

Measures the distance between a circle and a point.

- 1 Click [Cir - Pt].**  
Displays the measurement type menu.
- 2 Select the measurement type.**
- 3 Specify a circle.**
- 4 Specify a point.**  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 5 Click the position to display the measured value.**  
The position to display the measured value is set.

**Arc R**

Measures the radius of an arc.

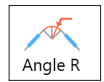
- 1 Click [Arc R].**
- 2 Specify a circle.**  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 3 Click the position to display the measured value.**  
The position to display the measured value is set.

**Angle**

Measures the angle between two lines at their intersection.

- 1 Click [Angle].**
- 2 Specify Line 1.**
- 3 Specify Line 2.**
- 4 Specify which of the angles created with the two lines will be the angle to be measured.**  
When you move the mouse, the position of the angle to be measured is indicated by an arrow with a dotted line. Click when the position to be measured is indicated.  
The measurement value follows the mouse pointer and is displayed in the measurement result.
- 5 Click the position to display the measured value.**  
The position to display the measured value is set.

### Angle R



Measures the radius of an angle.

- 1 Click [Angle R].
- 2 Specify Line 1.
- 3 Specify Line 2.
- 4 Click the position to display the measured value.

The position to display the measured value is set.

### Delete



Deletes the selected measurement.

### Delete all



Deletes all measurement displayed on the profile.

### Cross sectional area

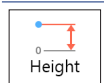


Measures the area between a line and the profile.

- 1 Click [CrsSct].  
Displays the measurement type menu.
- 2 Select the measurement type.
- 3 Specify Line 1.  
Line to become the cross sectional area reference is displayed in red full line.
- 4 Click to specify vertical line 1.
- 5 Click to specify vertical line 2.  
The area to be measured is filled with yellow. The measurement value follows the mouse pointer and is displayed in the measurement result.
- 6 Click the position to display the measured value.

The position to display the measured value is set.

### Height



Measures the height of the specified point when considering the reference plane as 0.

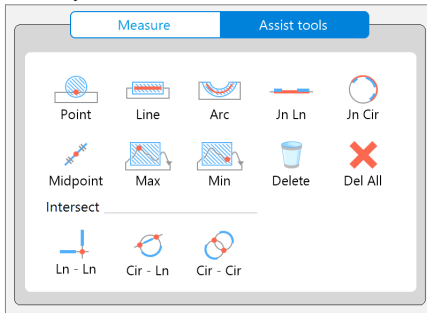
- 1 Click [Height].
- 2 Specify a point.
- 3 Click the position to display the measured value.

The position to display the measured value is set.

## Assist Tool (Measurement Tool)

Elements created by using assist tools are called assist elements. Assist elements do not create any measurements, instead, they are to be used as a reference point or a reference line when you set measurement lines.

Placing assist elements where there will be placing measurement points, enables you to set measurement lines more accurately and efficiently.



### Point



An element that expresses a point.

**1** Click [Point].

**2** Click a point.

A point is placed.

### Line



A line element that expresses a line segment on the profile.

**1** Click [Line].

**2** Click the 1st point, and then move the mouse.

When you move the mouse, the line scan area is displayed.

**3** Click the 2nd point arbitrarily.

A line is placed on the profile.

### Arc



An element that creates an arc on the profile.

**1** Click [Arc].

**2** Click the 1st point on the circle's circumference.

**3** Click the 2nd point on the circle's circumference.

When you move the mouse, the circle area is displayed.

**4** Click the 3rd point on the circle's circumference.

An arc is placed on the profile.

### Join Line



Creates a line that joins more than one line.

**1** Click [Jn Ln].

**2** Select an existing line element or point element.

**3** Repeat step 2.

A new line element is placed based on the selected point elements and the sets of points that created the selected line elements.

**4** Double-click to fix it.

### Join Circle



Creates a circle that connects multiple arcs.

**1** Click [Jn Cir].

**2** Select an existing circle element or point element.

**3** Repeat step 2.

A new circle element is placed based on the selected point elements and the sets of points that created the selected circle elements.

**4** Double-click to fix it.

### Midpoint



Creates a middle point of two points as a point element.

**1** Click [Midpoint].

**2** Click an existing point element.

**3** Click another existing point element.

The middle point of the selected point elements is placed.

### Max



Creates the maximum point in the direction of the Z-axis within the specified area.

**1** Click [Max].

**2** Click the mouse at the start point of the area.

When you move the mouse, a rectangle appears accordingly.

**3** Click the mouse at a diagonal point of the area.

The area is specified and the maximum point is placed.

**Min**



Creates the minimum point in the direction of the Z-axis within the specified area.

- 1** Click [Min].
- 2** Click the mouse at the start point of the area.  
When you move the mouse, a rectangle appears accordingly.
- 3** Click the mouse at a diagonal point of the area.  
The area is specified and the minimum point is placed.

**Delete**



Deletes individual assist points/lines displayed on the profile.

**Delete all**



Deletes all assist points/lines displayed on the profile.

**Line-Line (intersection)**



Creates the intersection of two lines on the profile that have been selected as a point element.

- 1** Click [Ln - Ln].
- 2** Select an existing line element or point element.
- 3** Repeat step 2.  
A new point element is placed at the intersection point of the selected line elements.

**Circle-Line (intersection)**



Creates the intersection of a line and a circle on the profile that have been selected as a point element.

- 1** Click [Cir - Ln].
- 2** Select an existing circle element.
- 3** Select an existing line element.  
A new point element is placed at the intersection point of the selected circle element and line element.

**Circle-Circle (intersection)**



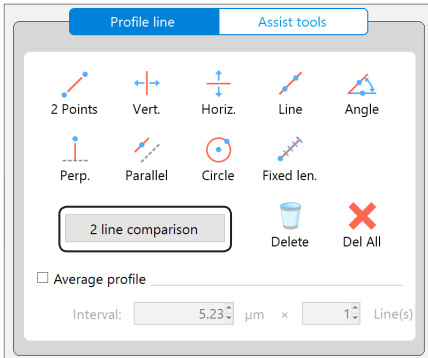
Creates the intersection of two circles on the profile that have been selected as a point element.

- 1** Click [Cir - Cir].
- 2** Select an existing circle element.
- 3** Repeat step 2.  
A new point element is placed at the intersection point of the selected circle elements.

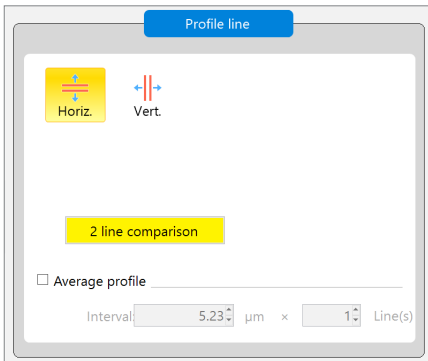
## 2 line comparison

Places 2 parallel profile lines (horizontal or vertical lines). Specifies the measurement intervals and acquire measurement values of the profile's increment/increment at each interval.

### 1 Click [2 line comparison].



### 2 Click [Horiz.] or [Vert.].



### 3 Drag a profile line to the position of the measurement target.

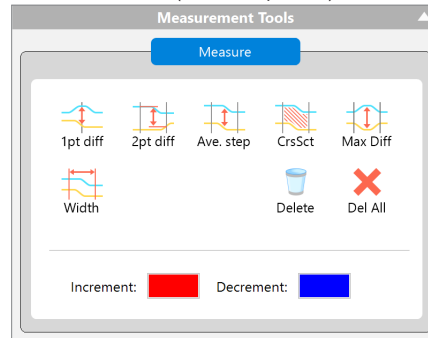
### 4 Click the icon on [Measurement tool] window and set a measurement interval on a profile.

☐ "Measurement Tool (2 Line Comparison)" (Page 9-37)

When a measurement interval is set on a profile, the measured value appears in [Measure Result] dialog box.

## Measurement Tool (2 Line Comparison)

The following describes how to set measurement intervals using measurement tools (2 line comparison).



**Reference** Colors specifying increment/discrement can be changed.

### 1pt diff



Measures the profile's differential distance at the specified point.

### 1 Click a point.

A line is set at the clicked point and the measurement result appears.

### 2pt diff



Measures the profile's differential distance between the specified points.

### 1 Click a point.

A line is set at the clicked position.

### 2 Click a point.

A line is set at the clicked point and the measurement result appears.

### Ave. step



Measures the profile's average differential distance within the specified interval.

### 1 Click a point.

A line is set at the clicked position.

### 2 Click a point.

A line is set at the clicked point and the measurement result appears.

### Cross sectional area



Measures the area of the domain between the specified interval and profile.

### 1 Click a point.

A line is set at the clicked position.

### 2 Click a point.

A line is set at the clicked point and the measurement result appears.

**Max Diff**



Measures the peak profile's differential distance within the specified interval.

**1 Click a point.**

A line is set at the clicked position.

**2 Click a point.**

A line is set at the clicked point and the measurement result appears.

**Width**



Measures the width of the specified interval.

**1 Click a point.**

A line is set at the clicked position.

**2 Click a point.**

A line is set at the clicked point and the measurement result appears.

**Delete**



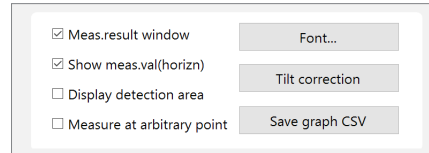
Delete an individual measurement displayed on the profile.

**Delete all**



Deletes all measurement displayed on the profile.

**Display settings**



**Measurement result window**

Sets to show or hide the measurement result window.  
 "Profile/Measurement Result List" (Page 9-27)

**Display measurement value horizontally**

When clearing the check box, the measurement value is displayed on the direction according to the measurement result.

**Display detection area**

When this checkbox is selected, the scan area of a point element or a line element on the profile is displayed.

**Measure at arbitrary point**

When this checkbox is selected, specifying and performing measurement on a measurement interval other than the profile are available.

**Font**

Display colors of measurement results can be changed.

**Tilt correction**

Tilt of a profile line can be corrected.

**Save graph CSV**

Saves the graph shown in the profile graph display area in CSV format.

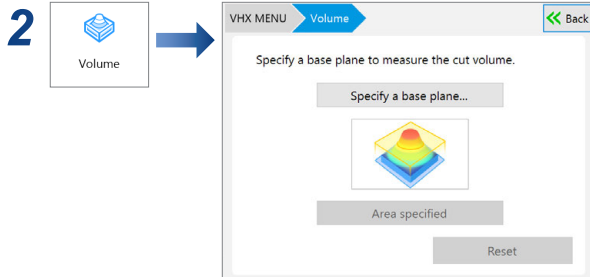
# Volume Measurement (Option)

This function allows you to measure volumes and surface areas of 3D images.

**Point** The separately sold "3D Profile Measurement Application" (model VHX-H5M) is required to perform volume measurements. Perform the activation of this application beforehand. The "3D profile measurement software" (Model VHX-H5M) requires one license per product.

## 1 Playback the 3D image.

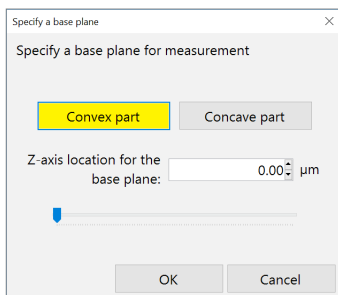
☐ "Playing Back 3D Images" (Page 9-15)



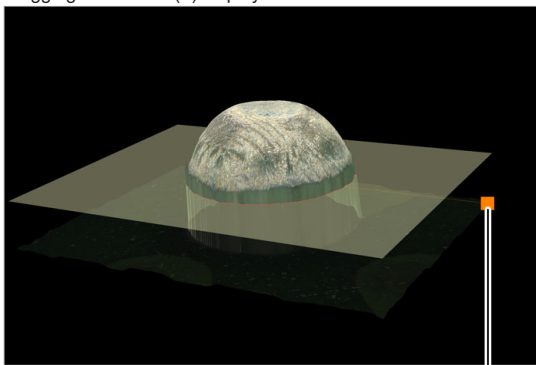
## 3 Click [Specify a base plane...].

The [Specify a base plane...] dialog box appears.

## 4 Specify Z position of the measurement target (convex part/dint part) and base plane.



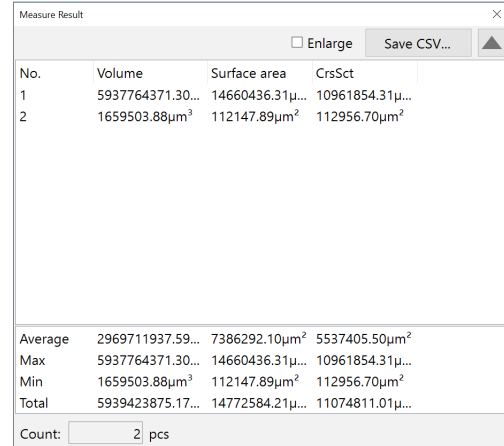
The specified position of the base plane can be specified by dragging the handle (■) displayed on the observation window.



Handle

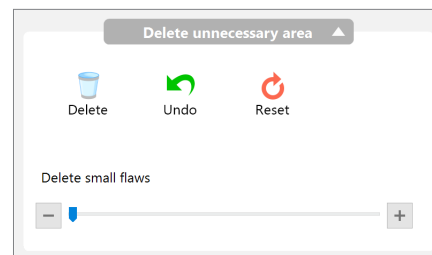
## 5 Click [OK].

Measurement results appear on the [Measure Result] dialog box.



No.	Volume	Surface area	CrsSct
1	5937764371.30...	14660436.31μ...	10961854.31μ...
2	1659503.88μm <sup>3</sup>	112147.89μm <sup>2</sup>	112956.70μm <sup>2</sup>
Average 2969711937.59... 7386292.10μm <sup>2</sup> 5537405.50μm <sup>2</sup>			
Max 5937764371.30... 14660436.31μ... 10961854.31μ...			
Min 1659503.88μm <sup>3</sup> 112147.89μm <sup>2</sup> 112956.70μm <sup>2</sup>			
Total 5939423875.17... 14772584.21μ... 11074811.01μ...			
Count: <input type="text" value="2"/> pcs			

## 6 Deletes unwanted areas as required.



### ● Delete

Deletes the selected rectangle area from the measurement target.

### ● Undo

Deletes the most recent command.

### ● Reset

Returns to the status before deleting unwanted areas.

### ● Delete small flaws

Deletes small flaws of the measurement target by operating the slider.

## 7 To save the measurement results, click [Save].

# Roughness Measurement(optional)

Roughness of 3D images can be measured.

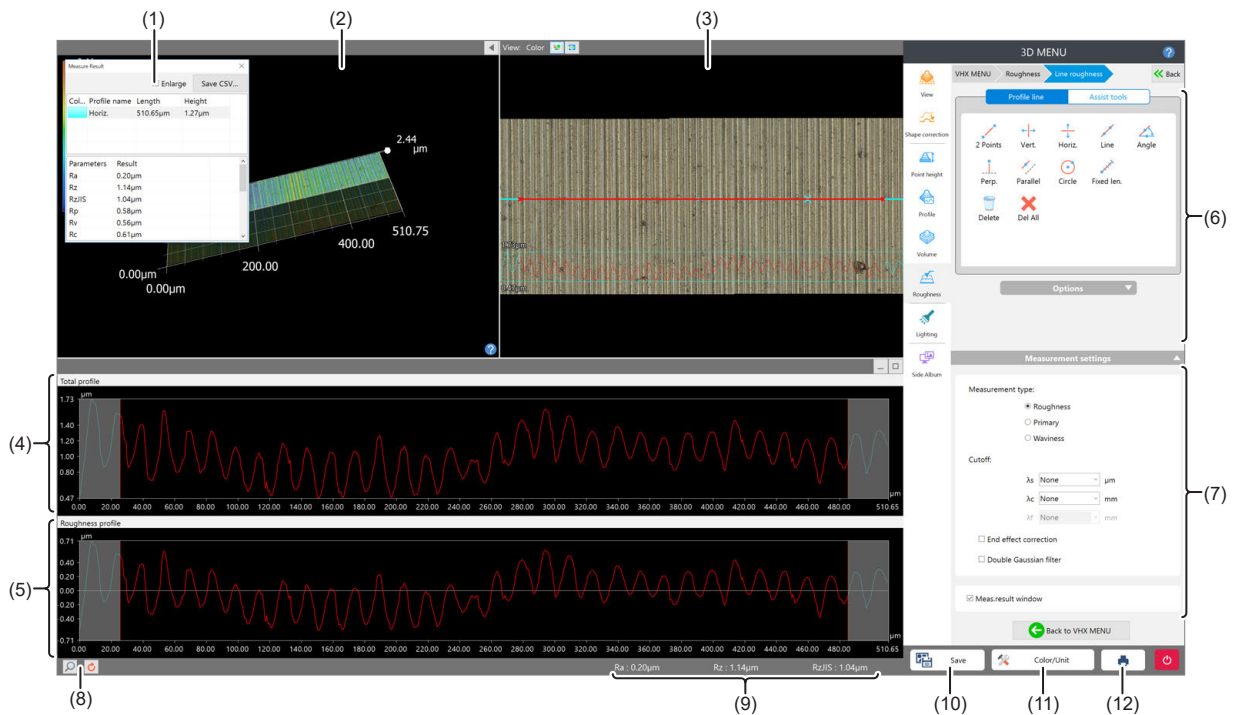
Machined parts have very different surfaces that are shiny, textured, etc. These differences come from differences in surface condition. Parameters that quantify the differences include the one dimensional profile roughness and the two dimensional surface roughness, which can be measured by this function.

**Point** The separately sold “3D Profile Measurement Application” (model VHX-H5M) is required to perform the roughness measurement. Perform the activation of this application beforehand. The “3D profile measurement software” (Model VHX-H5M) requires one license per product.

## Line Roughness Measurement: Names and Functions in the Window

This section explains the names and functions of each part of the window used to measure roughness.

**Point** The content of the display will vary based on the function being used.



No.	Item	Function
(1)	Measurement results	Lists profiles and elements placed on the image and measurement results. ☐ “Measurement Result List” (Page 9-41)
(2)	3D display area	Displays a stereoscopic shape of the target object and the cross section of the selected profile. You can change and manipulate the 3D image display. ☐ “Manipulating the 3D View” (Page 9-16)
(3)	Image display area	Displays an image of the target object when you see it perpendicular to the reference plane. You can set a profile line on this image. You can also change the display type of the image.
(4)	Total profile	Displays the roughness/primary/waviness curve obtained using the profile line settings.
(5)	Roughness/primary/waviness profile	Displays the roughness/primary/waviness curve to which the cutoff value specified in the line roughness measurement settings is applied.
(6)	Profile tool	Contains buttons to draw various profile lines, such as a straight line or a circle.
(7)	Measurement settings	Selects a measurement type and sets the cutoff.
(8)	Profile operation controls	Changes the method to view the roughness/primary/waviness profile and the measurement primary profile in the direction of the Z axis. ☐ “Setting Evaluation Length” (Page 9-42)
(9)	Measure result display area	Roughnesses Ra, Rz, and Rq and parameters corresponding to the roughnesses are displayed by measurement type.
(10)	[Save]	Saves the current display as a 2D image.
(11)	[Color/Unit]	Displays the [Color/Unit] dialog box. • Sets the scale line, scale auxiliary line and background color. • Sets the unit (m/mm/μm) and number of decimals.
(12)	Print	Displays the print menu. ☐ “Print Settings” (Page 4-10)



## Measurement Result List

Displays measured values of the profile being selected in the image display area for the following selected profile parameters.

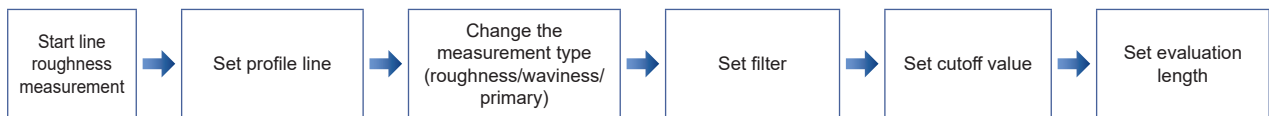
Parameters	Roughness	Primary	Waviness
Evaluation length	Length of the part between vertical cursors in the X axis direction		
Reference length	The cutoff value $\lambda_c$ is displayed for the roughness curve; the cutoff value $\lambda_f$ is displayed for the waviness curve; and the evaluation length is displayed for the primary curve. However, the value is equivalent to the evaluation length when the evaluation length is shorter than the cutoff value.		
No. of reference lengths	The calculated number of sampling length is displayed according to the cutoff value $\lambda_c$ for the roughness curve, and according to the cutoff value $\lambda_f$ for the waviness curve. However, the number of evaluation length is 1 when the evaluation length is shorter than the cutoff value.		
Highest peak	Rp	Pp	Wp
Lowest valley	Rv	Pv	Wv

Parameters	Roughness	Primary	Waviness
Max. height	Rz	Pz	Wz
Average height	Rc	Pc	Wc
Total height of the profile	Rt	Pt	Wt
Arithmetical mean height	Ra	Pa	Wa
Root mean square height	Rq	Pq	Wq
Skewness	Rsk	Psk	Wsk
Kurtosis	Rku	Pku	Wku
Element average length	RSm	PSm	WSm
Root mean square tilt	PΔq	PΔq	WΔq
Ten point height of the profile	RzJIS	-	-

For details of each parameter, refer to ["Roughness Definitions"](#) (Page 9-43).

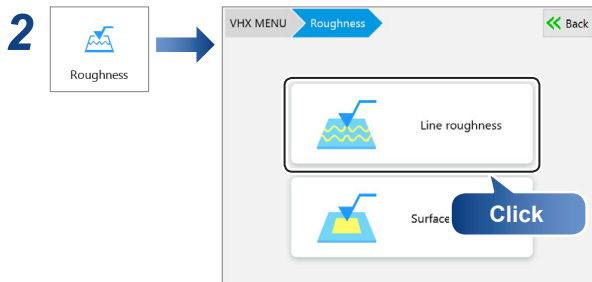
## Line Roughness Measurement

The line roughness measurement can be made by the following procedure:



### Start line roughness measurement

- 1 Playback the 3D image.  
["Playing Back 3D Images"](#) (Page 9-15)



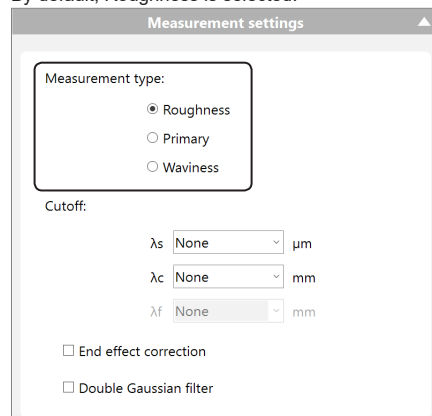
### Set profile line

Set a profile line at the measurement position on the image displayed in the image display area. When the profile line is specified on the image, a profile graph at the measurement position is displayed.  
 For more details, refer to ["Setting Profile Line"](#) (Page 9-28).

### Change the measurement type

- 1 Changes [Measurement type] of [Measurement settings].

By default, Roughness is selected.

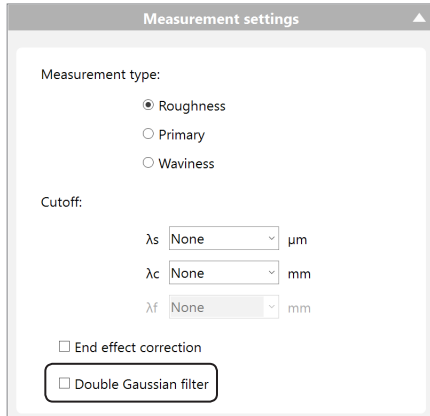


- **Roughness**  
Displays a graph of roughness profile (R: Roughness).
- **Primary**  
Displays a graph of primary profile (P: Primary).
- **Waviness**  
Displays a graph of waviness profile (W: Waviness).

## Set filter

Sets the filter to ON/OFF.

- 1 Click the [Double Gaussian filter] checkbox to select ON/OFF.



### End effect correction

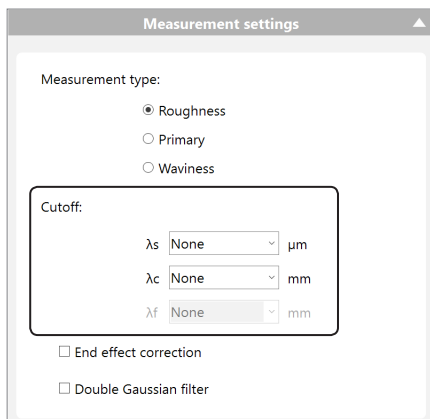
When Double gaussian filter is selected, selecting [End effect correction] checkbox can correct the circumference of the surface so it is not distorted.

## Set cutoff value

The cutoff value is the ISO standard parameter. The wavelength at which the gain of the phase compensation filter equals 50%. The input fields ( ) for the cutoff values that correspond to the roughness, primary, and waviness are as mentioned below.

Measurement type	$\lambda_s$	$\lambda_c$	$\lambda_f$
Roughness profile	<input type="radio"/>	<input type="radio"/>	-
Primary profile	<input type="radio"/>	-	-
Waviness profile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 1 Select the cutoff value.



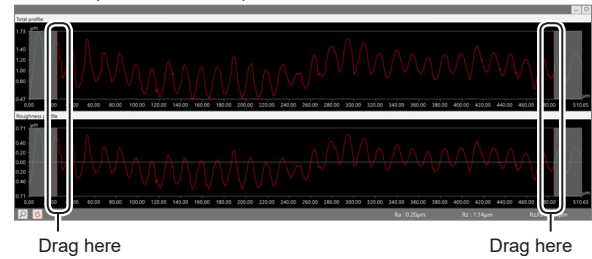
You can set each parameter by selecting a value from the dropdown list or typing a value directly.

	Maximum value	Minimum value
$\lambda_s$	Twice of pixel length	A half of Profile X-axis length
$\lambda_c$	The larger value of five times of pixel length or 0.025 mm	Minimum selection that exceeds profile X-axis length
$\lambda_f$		

## Setting Evaluation Length

As required, specify an evaluation length on the profile graph. You can set an evaluation length by dragging two vertical cursors that are displayed on the profile graph.

The cursor positions are shared between the “roughness/primary/waviness profile” and “total profile”.



**Reference** The evaluation length is set automatically, based on the cutoff value  $\lambda_c$  when the measurement type is roughness and the cutoff value  $\lambda_f$  when the measurement type is waviness.

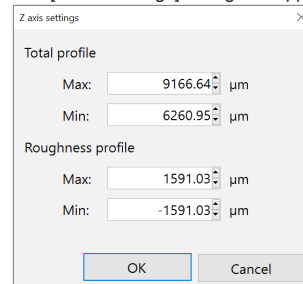
For the horizontal direction of the “roughness/primary/waviness curve profile” and “total profile”, always the whole profiles are displayed fitting to the display area.

By default (right after the profile is updated), both of the roughness/primary/waviness profile and total profile are displayed fitting to the display area, you can configure the axis setting for the Z axis (vertical axis display of the profile graph).

**Point** You can specify the range of the Z axis for each of total profile and the roughness/primary/waviness profile individually. However, you cannot adjust the X axis.

- 1 Click (specify value) in the profile operation controls.

The [Z axis settings] dialog box appears.



- 2 Set the maximum and minimum values on the Z-axis of the desired profile graph, and click [OK].

**Reference** To return the Z-axis scaling to the original state, click (Reset).

## Roughness Definitions

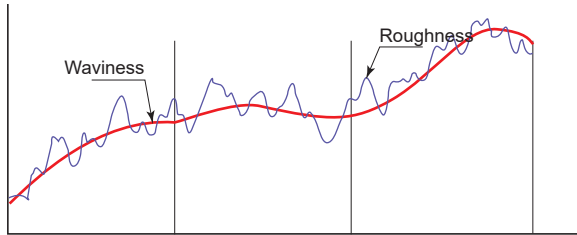
### What is Surface Roughness

#### ● Roughness (surface roughness)

Roughness (surface roughness) has a complicated shape in which there are continuous peaks and valleys whose height, depth and intervals differ. The surface condition wherein uneven surfaces appear in a continuing sequence in relatively short cycles and at relatively shorter intervals than the depth is called the roughness (surface roughness).

#### ● Waviness

Waviness refers to uneven surfaces that appear periodically at longer intervals than the roughness, which can be defined as deviation from an ideal surface that appears repeatedly at relatively longer intervals than the depth.



#### ● Traced profile

"Traced profile" is a surface profile of a sample, which is calculated from measurements with this product.

#### ● Total profile

Total profile means a curve which is sampled (digitalized) at regular intervals as a coordinate (a continuously changing graph) of which measured curve consists of vertical and horizontal axes. In the surface roughness measurement where surface irregularity is measured by tracing the stylus, up and down changes in the continuously moving stylus need to be sampled and digitalized at regular intervals. This product had sampled at a constant interval when measured the surface. The profile graph corresponds to the measured cross section curve.

#### ● Profile

Profile refers to a generic name of curves, such as measured cross section curve, cross section curve, roughness curve and waviness curve.

#### ● Primary profile

Primary profile means a curve in which a low-pass filter of phase compensation type of the cutoff value  $\lambda_s$  is applied to the measured cross section curve.

#### ● Roughness profile

Roughness profile means a curve in which only high frequency component of the cross section curve is recorded through a high-pass filter of phase compensation type (cutoff value  $\lambda_c$ ).

#### ● Waviness profile

Waviness profile means a curve in which the phase compensation filter of cutoff values  $\lambda_f$  and  $\lambda_c$  is applied to the cross section curve.

#### ● Average line

As the average line, there are 3 types of average lines, such as average line for roughness curve, average line for waviness curve and average line for primary curve, all of which are curves.

#### ● Average line for roughness profile

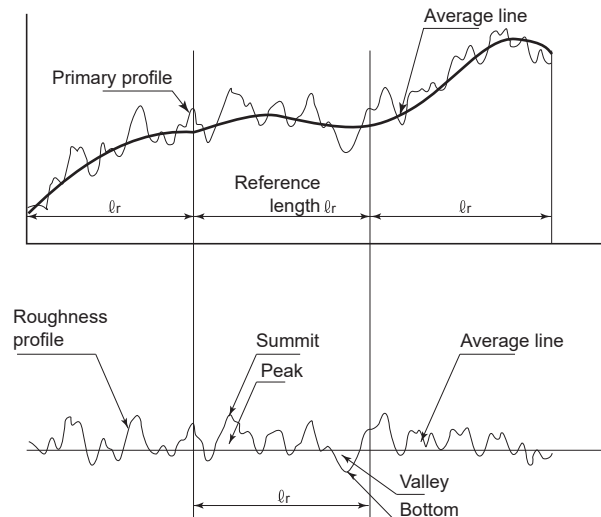
Average line for roughness curve means a curve in which low frequency component cut by a low-pass filter of phase compensation type  $\lambda_c$  (low-pass filter) is recorded.

#### ● Average line for waviness profile

Average line for waviness curve means a curve in which low frequency component cut by a low-pass filter of phase compensation type  $\lambda_f$  (low-pass filter) is recorded.

#### ● Average line for primary profile

Average line for primary curve means a curve which indicates a nominal shape applied to the cross section curve by means of the least squares method.

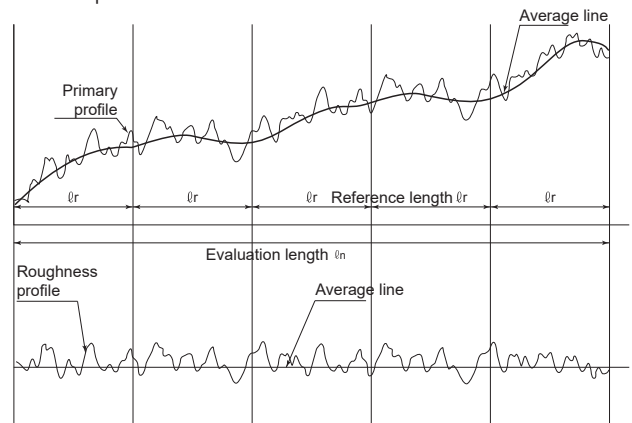


#### ● Sampling length

Arithmetic mean roughness and other roughness parameters are determined based on the extracted part of a given length from the profile. This extracted length is called the "sampling length." The sampling lengths of the roughness profile and waviness profile are equivalent to their respective cutoff values ( $\lambda_c$  for the roughness profile and  $\lambda_f$  for the waviness profile). The sampling length of the primary profile is equivalent to the profile's evaluation length.

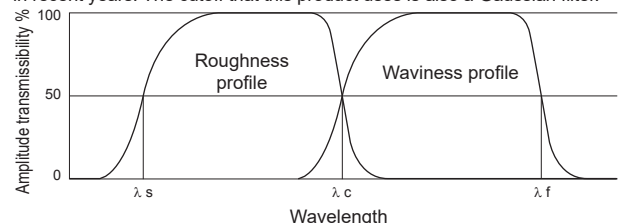
#### ● Evaluation length

"Evaluation length" refers to the part of a given length extracted from the profile in order to determine arithmetic mean roughness and other roughness parameters. An evaluation length must contain at least one sampling length. Generally, an evaluation length is five times the corresponding sampling length. However, there are no specific rules on evaluation lengths used for waviness parameters.



#### ● Cutoff (cutoff value)

The cutoff refers to the predetermined wavelength to be removed from a cross section curve. A roughness curve is created by removing the long-wavelength component from the cross section curve, and a waviness curve is created by removing the short-wavelength component from the same. When the contact-type surface roughness measuring equipment was the analog equipment that performs the measurement using its electric circuit consisting of capacitors and resistors, 2 CR filter was normally used. With trend of times toward digitalization, however, the phase compensation digital filter (Gaussian filter) has been widely used in recent years. The cutoff that this product uses is also a Gaussian filter.



Depth UP

## Surface texture parameter definitions

This product uses equations that comply with "ISO 4287:1997 Surface roughness-Definitions" and "ISO 13565:1996". For more information, refer to the "ISO 4287:1997 " and "ISO 13565:1996" standards issued by standardization organizations (BSI, DIN, JSA, etc.).

**Reference** When discussing parameters, Pp is Highest primary profile peak, Rp is Highest roughness profile peak, and Wp is Highest waviness profile peak. Each refers to the corresponding curve to profile curve. However, some of the parameters for roughness and waviness profiles are referred to as different language for reasons of history or convenience.

### JIS B0601:2001 (ISO4287:1997)

#### Maximum profile peak height

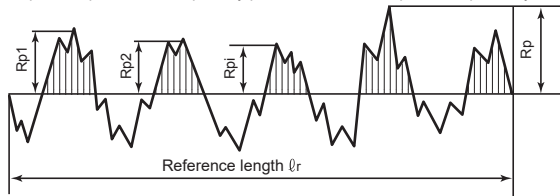
Maximum profile peak height indicates the point along the sampling length at which the curve is highest.

**Reference**

- Peaks are determined for each region that exceed the average line.
- Z(x) for each curve takes the average height of the roughness profile (when P, it is a primary profile, and when W, it is a waviness profile) to be 0 and determines the height of position x along the curve.

$$R_p = \max(Z(x))$$

\* Pp and Wp are used for primary profile and waviness profile respectively.



Maximum profile peak height (for a roughness profile)

#### Maximum profile valley depth

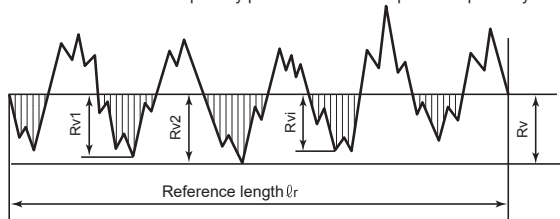
Maximum profile valley depth indicates the point along the sampling length at which the profile curve is lowest.

**Reference**

- Valleys are determined for each region that falls below the average line.
- Z(x) for each curve takes the average height of the roughness profile (when P, it is a primary profile, and when W, it is a waviness profile) to be 0 and determines the height of position x along the curve.

$$R_v = |\min(Z(x))|$$

\* Pv and Wv are used for primary profile and waviness profile respectively.

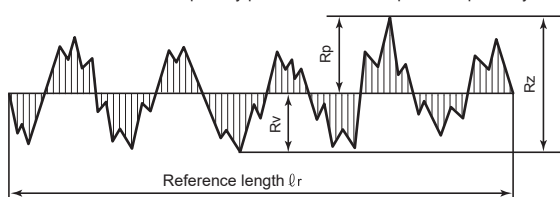


#### Maximum height of profile

Maximum height of the profile indicates the absolute vertical distance between the Maximum profile peak height and the Maximum profile valley depth along the sampling length.

$$R_z = R_p + R_v$$

\* Pz and Wz are used for primary profile and waviness profile respectively.

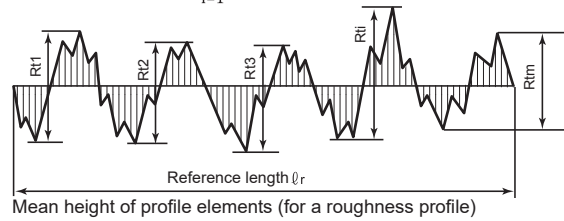


**Reference** When dealing with roughness profile, Rz is referred to as Maximum roughness while Wz is referred to as Maximum waviness when dealing with waviness profile.

#### Mean height of profile elements

Mean height of profile elements indicates the average value of the height of the curve element along the sampling length.

$$R_c, P_c, W_c = \frac{1}{m} \sum_{i=1}^m R_{ti}$$



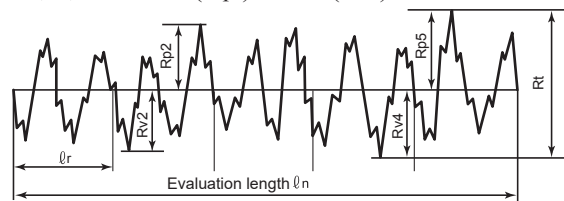
Mean height of profile elements (for a roughness profile)

Profile elements consist of a peak and a neighboring valley. The peaks (or valley) that constitutes element have minimum height and length standards such that they will be treated as noise and considered a part of the preceding valley (or peak) if the height (depth) is less than 10% of the maximum height or the length is less than 1% of the segment length.

#### Total height of profile

Total height of profile is the vertical distance between the Maximum profile peak height and the Maximum profile valley depth along the evaluation length.

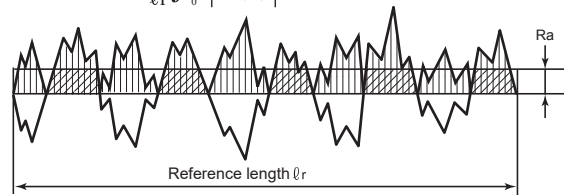
$$R_t, P_t, W_t = \max(R_{pi}) + \max(R_{vi})$$



#### Arithmetical mean height

Arithmetical mean height indicates the average of the absolute value along the sampling length.

$$R_a, P_a, W_a = \frac{1}{l_r} \int_0^{l_r} |Z(x)| dx$$



Arithmetical mean height (for a roughness profile)

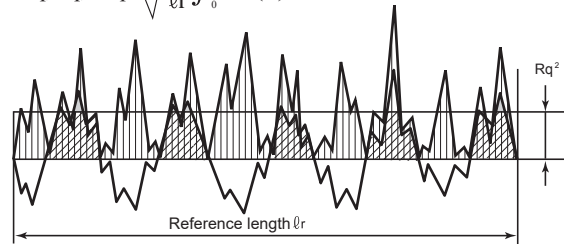
**Reference** When dealing with the roughness profile, Ra is referred to as Arithmetic mean roughness while Wa is referred to as Arithmetic mean waviness for the waviness profile.

#### Root mean square deviation

Root mean square deviation indicates the root mean square along the sampling length.

**Reference** For the roughness profile, Rq is referred to as Root-mean-square roughness while Wq is referred to as Root-mean-square waviness for the waviness profile.

$$R_q, P_q, W_q = \sqrt{\frac{1}{l_r} \int_0^{l_r} Z^2(x) dx}$$



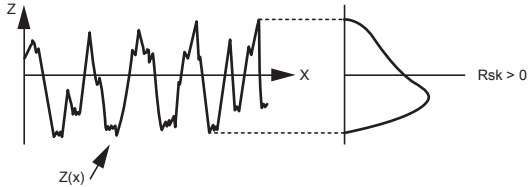
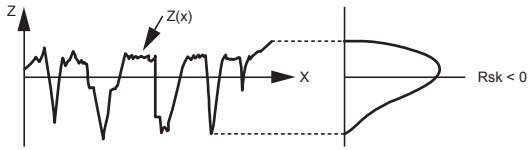
Root means square height (for a roughness profile)

● **Skewness**

Skewness uses the cube of the root mean square deviation to display the dimensionless cube of the sampling length Z (x).

$$R_{sk} = \frac{1}{Rq^3} \left[ \frac{1}{\ell_r} \int_0^{\ell_r} Z^3(x) dx \right]$$

\* Psk and Wsk are used for primary profile and waviness profile respectively.

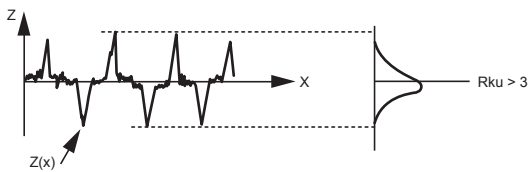
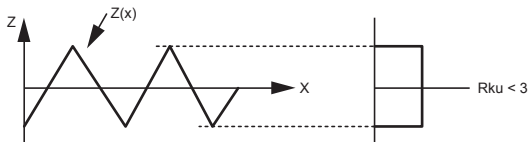


● **Kurtosis**

Kurtosis uses the fourth power of the root mean square deviation to display the dimensionless fourth power of the sampling length Z(x).

$$R_{ku} = \frac{1}{Rq^4} \left[ \frac{1}{\ell_r} \int_0^{\ell_r} Z^4(x) dx \right]$$

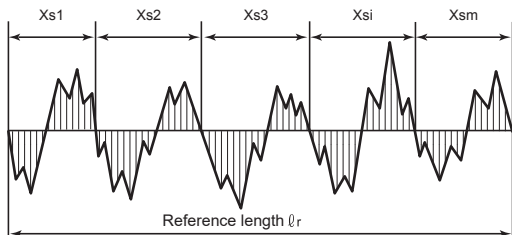
\* Pku and Wku are used for primary profile and waviness profile respectively.



● **Mean width of the profile elements**

Mean width of the profile elements indicates the average value of the length of the profile element along the sampling length.

$$R_{Sm}, P_{Sm}, W_{Sm} = \frac{1}{m} \sum_{i=1}^m X_{si}$$



Mean width of the profile elements (for a roughness profile)

X<sub>si</sub> is the length of a single profile element. The peaks (valley) that constitute element have minimum height and length standards such that they will be treated as noise and considered a part of the preceding valley(peak) if the height (depth) is less than 10% of the maximum height or the length is less than 1% of the segment length.

● **Root mean square slope**

Root mean square slope indicates the root mean square of the local tilt dZ/dX along the sampling length.

$$R\Delta q, P\Delta q, W\Delta q = \sqrt{\frac{1}{\ell_r} \int_0^{\ell_r} \left[ \frac{dZ(x)}{dx} \right]^2 dx}$$

The local tilt refers to the derivative of Z (x). Derivatives generally use the seven-point formula shown below (Because the first three points on either end lack sufficient data, three or five point formulae are used).

$$\frac{dZ_i}{dx_i} = \frac{(Z_{i+3} - 9Z_{i+2} + 45Z_{i+1} - 45Z_{i-1} + 9Z_{i-2} - Z_{i-3})}{60x}$$

● **Cross point average roughness (Rz JIS)**

Cross point average roughness is the value expressed in microns (μm) that is obtained by extracting only the sampling length (ℓ<sub>r</sub>) from the roughness profile in the direction of its average line and finding the sum of the averages of the absolute values of the height (Y<sub>p</sub>) from the highest peak to the 5th peak and those of the height (Y<sub>v</sub>) from the lowest bottom to the 5th bottom.

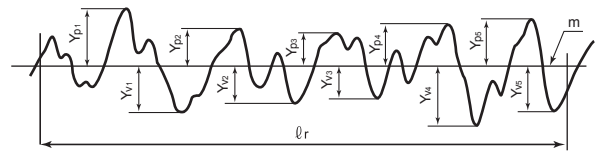
$$R_z = \frac{|Y_{p1} + Y_{p2} + Y_{p3} + Y_{p4} + Y_{p5}| + |Y_{v1} + Y_{v2} + Y_{v3} + Y_{v4} + Y_{v5}|}{5}$$

Y<sub>p1</sub> + Y<sub>p2</sub> + Y<sub>p3</sub> + Y<sub>p4</sub> + Y<sub>p5</sub>

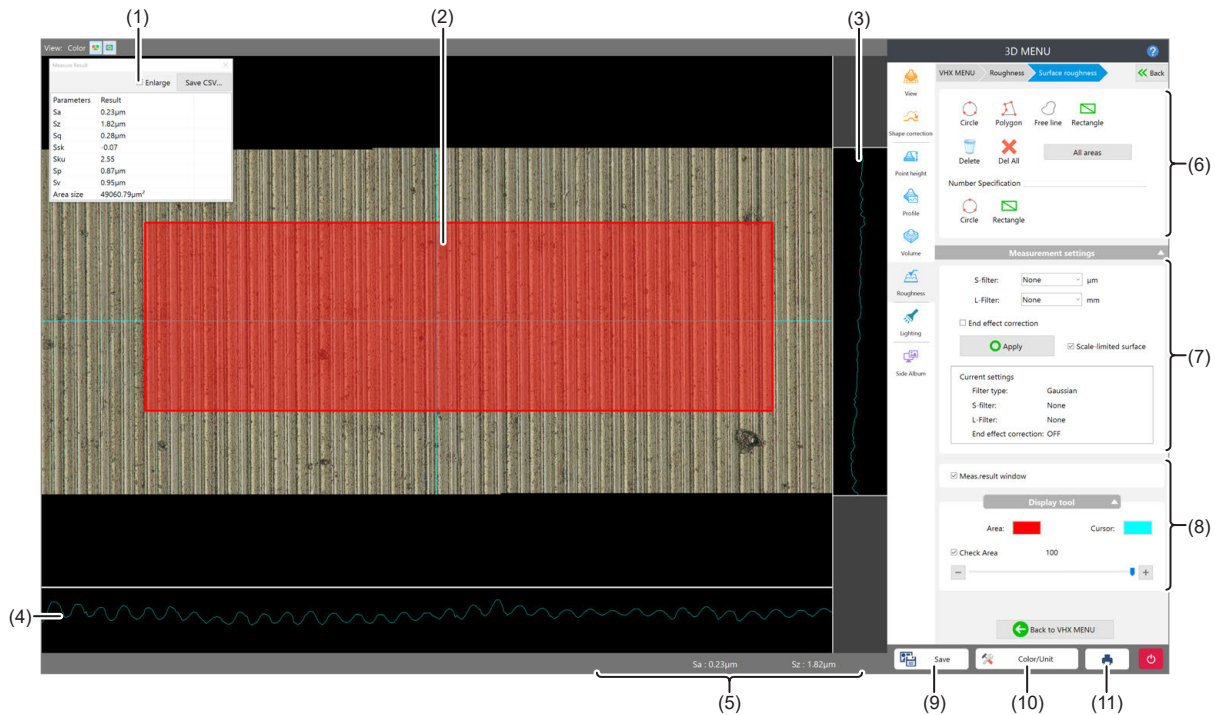
: The Height from the highest peak to the 5th peak of the extracted part for the reference length (ℓ<sub>r</sub>)

Y<sub>v1</sub> + Y<sub>v2</sub> + Y<sub>v3</sub> + Y<sub>v4</sub> + Y<sub>v5</sub>

: The height from the lowest bottom to the 5th bottom of the extracted part for the reference length (ℓ<sub>r</sub>)



# Surface Roughness Measurement: Names and Functions in the Window



No.	Item	Function
(1)	Measurement results	Displays the list of measurement results of the surface roughness. ☐ "Measurement Result List" (Page 9-41)
(2)	Image display area	Displays an image of the sample when you see it from the perpendicular direction to the reference plane. You can also change the display type and magnification of the image.
(3)	Profile display area (Vertical direction)	Displays the cross section profile of the sample which is cut perpendicularly to the reference plane at the cursor position in vertical direction on the image.
(4)	Profile display area (Horizontal direction)	Displays the cross section profile of the sample which is cut perpendicularly to the reference plane at the cursor position in horizontal direction on the image.
(5)	Measure result display area	Displays the surface roughnesses Sa and Sz.
(6)	Area settings tool	Adds, edits, and deletes areas. ☐ "Setting Measurement Area" (Page 9-47)
(7)	Measurement settings	Configure a cutoff value and an end effect correction of a filter, and switch displaying of height image. ☐ "Setting Filter" (Page 9-48)
(8)	Display tool	Changes the color of measurement target areas or the cursor. Also, changes the transparency of the measurement target area display.
(9)	[Save]	Saves the current display as a 2D image.
(10)	[Color/Unit]	Displays the [Color/Unit] dialog box. <ul style="list-style-type: none"> <li>• Sets the scale line, scale auxiliary line and background color.</li> <li>• Sets the unit (m/mm/µm) and number of decimals.</li> </ul>
(11)	Print	Displays the print menu. ☐ "Print Settings" (Page 4-10)

## Measurement Result List

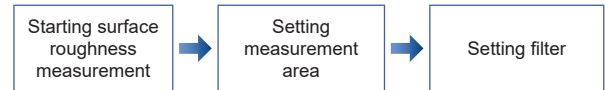
Displays the following measurement values:

Parameters	Description
Sq (Root mean square height)	The root mean square of height at each point in the area. It is equivalent to the standard deviation of height.
Ssk (Skewness)	Indicates the skewness of the height distribution in the area.
Sku (Kurtosis)	Indicates the kurtosis of the height distribution in the area.
Sp (Maximum peak height)	The height of the highest point in the area.
Sv (Maximum pit height)	The absolute value of the height of the lowest point in the area.
Sz (Maximum height)	A sum of the maximum peak height and the maximum pit height in the area.
Sa (Arithmetic mean height)	The average value of the absolute value of height at each point in the area.
Area square measure	The square measure value of the area.

For details of each measurement item, refer to "Surface Roughness Definitions" (Page 9-49).

## Surface Roughness Measurement

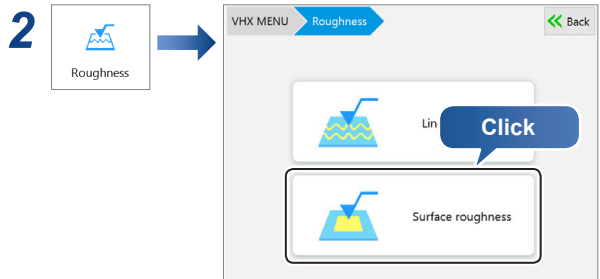
The surface roughness measurement can be made by the following procedure:



## Starting surface roughness measurement

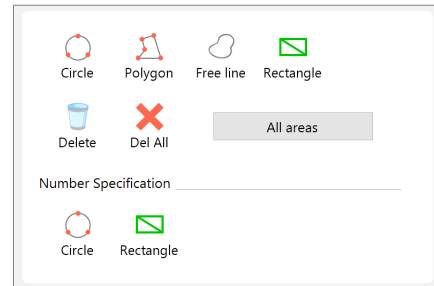
### 1 Playback the 3D image.

"Playing Back 3D Images" (Page 9-15)



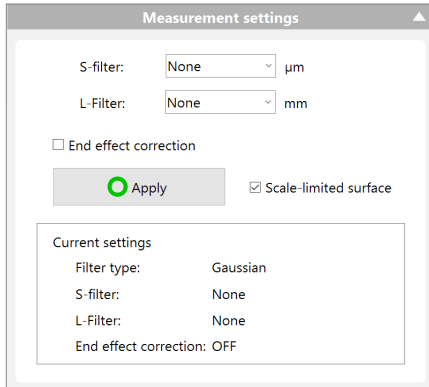
## Setting Measurement Area

Determines the area over which roughness will be measured. Multiple areas can also be set.



Tool	Function
Circle	Click three points on the circumference of the circle that contains the area to be extracted.
Polygon	Enclose the area to be extracted by sequentially clicking each vertex point and double click to indicate the final vertex point.
Free line	Drag the mouse around the perimeter of the area to extract.
Rectangle	Drag the diagonally opposite corners of the rectangular area to extract.
Delete	Click the desired extraction area to delete a single one.
Del All	Deletes all extraction areas.
All areas	All areas are measured.
Circle (Number specification)	Enter the radius or diameter of the extracted circle area to specify.
Rectangle (Number specification)	Enter the width and height of the extracted rectangle area to specify.

## Setting Filter



### 1 Select a cutoff wavelength for a S-filter.

On the profile graph, the components that have smaller scale than the cutoff wavelength specified will be removed from the image.

### 2 Select a cutoff wavelength for a L-filter.

On the profile graph, the components that have bigger scale than the cutoff wavelength specified will be removed from the image.

### 3 Specify the [End effect correction] setting.

- When this checkbox is selected, distortion in the area that has distortion will be suppressed by the primary Gaussian regression filter.
- When this checkbox is cleared, the area is extended with the image end pixel data, and then an ordinary Gaussian filter will be applied.

### 4 Click [Apply].

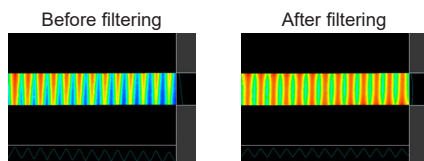
The filtering is executed and measured values in the measurement result list are updated.



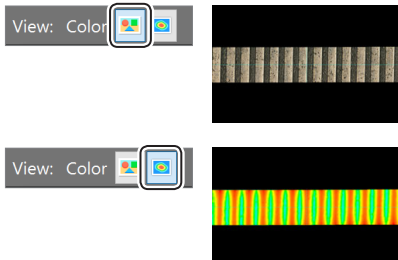
- Until [Apply] is clicked, measurement values in the measured result list are not renewed.
- If the cutoff wavelength is large, processing takes additional time.



- The surface profile before and after filtering can be switched by turning [Measurement surface] on.



- Just after [Measurement surface] is turned on, images are displayed in height view. As required, use the button in upper left of the image display area to switch the screen to the color image.



## Filter operation

In the surface roughness measurement, filtering is executed using a Gaussian filter.

When you execute filtering, filtering is performed in the order of S-filter and L-filter against the entire image. After the filtering is completed, the measurement result list will be updated.



**When the Gaussian filter is applied to an image, the margins (the area half of the cutoff wavelength distance away from the edge) will be distorted, therefore either set the area to avoid the margins, or turn on the [End effect correction] checkbox.**

### S-filter

This filter is the filter to remove roughness components which are small in scale like optical resolution (low-pass filter).

Set S-filter to a value that is more than three times of the measurement resolution in XY-plane. When the effect is not sufficient, make the setting bigger.

The minimum cutoff wavelength of S-filter is double of the pixel length, and the maximum cutoff wavelength is one half of the length of the longer side of the image.

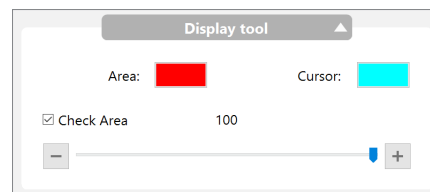
### L-filter

This filter is the filter to remove waviness components which are large in scale (high-pass filter).

Set L-filter to a value that is five times of the cycle length of shapes you want to remove as waviness.

The minimum cutoff wavelength of L-filter is one hundred times of the pixel length, and the maximum cutoff wavelength is the wavelength of the first option that is longer than the longer side length of the image.

## Display tool



### Area

Changes the color of measurement target areas.

### Cursor

Changes the color of profile lines.

### Check Area

Turns on/off the measurement target area display. Adjusts the color by slider.



## Surface Roughness Definitions

### Definitions of Terms

#### Filter operation

This product filters the image entirely first and then sets the area to start the measurement. Frequency filter at this time is different for each category.



**When the Gaussian filter is applied to an image, the margins (the area half of the cutoff wavelength distance away from the edge) will be distorted, therefore, either set the area avoiding the margins, or turn on the [End effect correction] setting.**

#### Gaussian filter

This is the Gaussian filter specified by JISB0632:2001 (ISO 11562:1996) and ISO 16610-21:2011 whose surface area has been extended.

#### Double gaussian filter

This is the filter defined by JIS B0671-1: 2002 (ISO 13565-1: 1996) whose surface area has been extended. This filter reduces undesirable distortion that occurs when evaluating function parameters.

#### Spline filter

This is the Spline filter specified by ISO/TS 16610-22:2006 whose surface area has been extended. Since Spline filter is applied in X direction and Y direction independently and synthesized for calculation, the cutoff wavelength characteristic changes according to the angle of the plane. The cutoff wavelength specified by Spline filter represents the cutoff wavelength parallel to X axis and Y axis directions.

### Height parameters

The height parameters are the parameters concerned only with change in height.

#### Sq Root mean square height

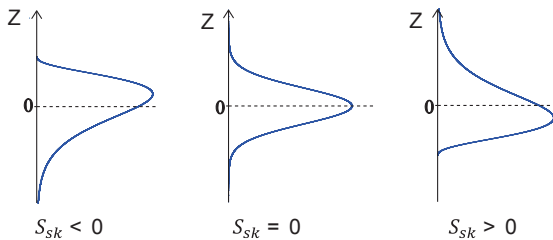
It is the root mean square of height at each point in definition area. It is equivalent to the standard deviation of height.

$$S_q = \sqrt{\frac{1}{A} \iint_A z^2(x, y) dx dy}$$

#### Ssk Skewness

It is the cubic average of height which is rendered dimensionless with the cube of Sq. It indicates the asymmetric property of height distribution which is centered on the reference surface. When Ssk equals 0, it means that the height distribution is symmetric with respect to the reference plane. While Ssk < 0, Ssk > 0, it means that the height distribution is skewed either higher or lower, relative to the reference plane.

$$S_{sk} = \frac{1}{S_q^3} \left[ \frac{1}{A} \iint_A z^3(x, y) dx dy \right]$$



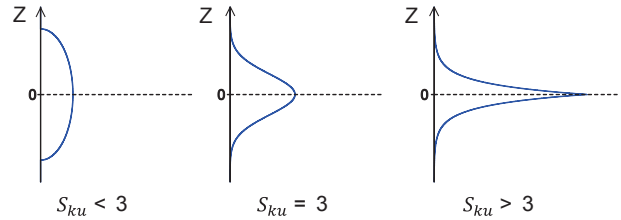
#### Sku Kurtosis

It is the average fourth power of height which is rendered dimensionless with the fourth power of Sq. Indicates the sharpness of the height distribution.

When Sku equals 3, it means that the height distribution of scale-limited surface is a normal distribution.

While Sku < 3, Sku > 3, it means that the height distribution takes either collapsed or sharpened shape.

$$S_{ku} = \frac{1}{S_q^4} \left[ \frac{1}{A} \iint_A z^4(x, y) dx dy \right]$$



#### Sp Maximum peak height

It is the height of the highest point in definition area.

$$S_p = \max_A z(x, y)$$

#### Sv Maximum valley depth

It is the absolute value of height of the lowest point in definition area.

$$S_v = |\min_A z(x, y)|$$

#### Sz Maximum height

It is a sum of the maximum peak height and the maximum valley depth in definition area.

$$S_z = S_p + S_v$$

#### Sa Arithmetical mean height

It is the average value of the absolute value of height at each point in definition area.

$$S_a = \frac{1}{A} \iint_A |z(x, y)| dx dy$$

#### End effect correction

In the Gaussian filter, this option prevents a distortion from occurring in any shape of the surface periphery of image (the area half of the cutoff wavelength distance away from the edge). The larger the cutoff frequency, the longer the processing time.

#### Original surface

This surface refers to the surface consisting of height data at the start-up time of ISO 25178 surface roughness function.

#### Scale-limited surface

This represents a surface obtained by applying the S-filter and L-filter to the original surface.

#### S-filter

This is the filter (low-pass filter) to remove components which are small in scale.

This filter is equivalent to the cutoff value λs of JIS B0601-2001. It refers to a low-pass filter for a frequency filter such as a Gaussian filter.

#### L-filter

This is the filter (high-pass filter) to remove components which are large in scale.

This filter removes components such as waviness and extracts only roughness components. This is equivalent to the cutoff value λc of JIS B0633-2001. It refers to a highpass filter for a frequency filter such as a Gaussian filter.

#### Height

It refers to a distance from the reference surface at each point in a scale-limited surface. Points lower than the reference surface will have negative values. In the definitional equation, the height in coordinates (x, y) is expressed by z (x, y).

# Lighting Simulations

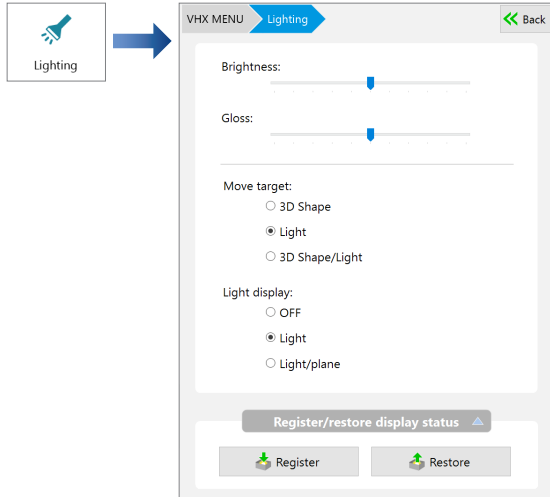
This features allows you to observe the surface of the object in greater detail by applying virtual lighting from various directions and brightness levels on the 3D image.

## 3D lighting display

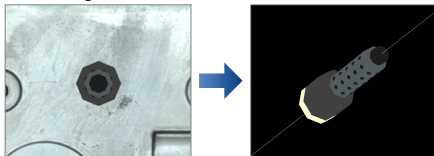
### 1 Playback the 3D image.

☐ "Playing Back 3D Images" (Page 9-15)

### 2



The [3D Lighting] symbol appears in the center of the image. You can change the orientation of the light by dragging the light over the image.



## 3D lighting settings

### Brightness

Adjust the brightness of the light by dragging the slider.

### Gloss

Adjust the glossiness of the object by dragging the slider.

### Move target

Specify movements of the object or the light by mouse operation.

3D Shape	Only the object moves. The lighting direction does not move.
Light	Only the lighting direction of the light moves. The object does not move.
3D Shape/Light	Both object and light move together.

### Light display

Specify whether to show/hide the light beam.

Hide	Hides the light beam. The light will still emit light.
Light	Displays the light beam.
Light/plane	Shows the light beam and the coordinates of the beam.

### Register/restore display status

This command registers the lighting direction and the position and rotated angle of the object.

- Reg.Settings: Registers the current settings.
- Apply : Reads and applies the registered settings.

**Reference** Saves the settings active when [Reg. Settings] is clicked. Use [Apply] to restore the display status.

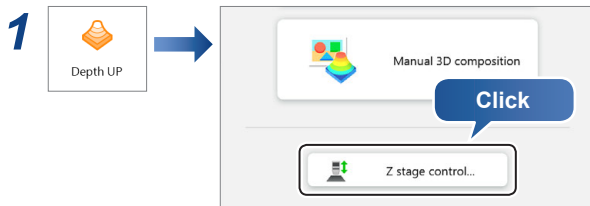
# Z Stage Control

Using the VHX-S770E/S750E, or others, this product can control the lens height to adjust the focus, measure height, and perform the depth composition and the 3D display.

## Adjusting Focus from the VHX MENU

### Adjusting manually

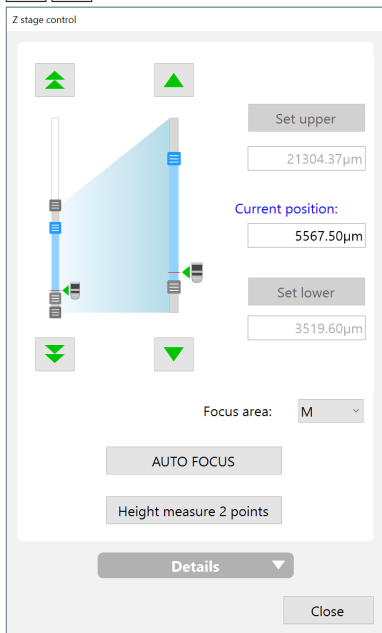
**Reference** The Z stage can also be controlled using the FOCUS dial on the console.



The [Z-stage control] dialog box appears.

### 2 Click the to adjust focus.

moves in fine (small) increments.  
 moves in coarse (large) increments.



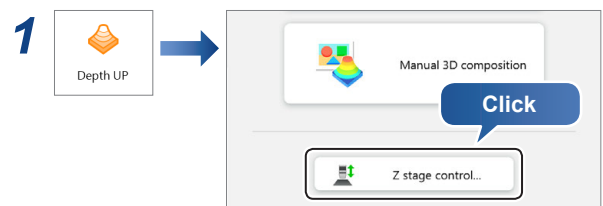
To exit, click [Close].

## Using Auto Focus

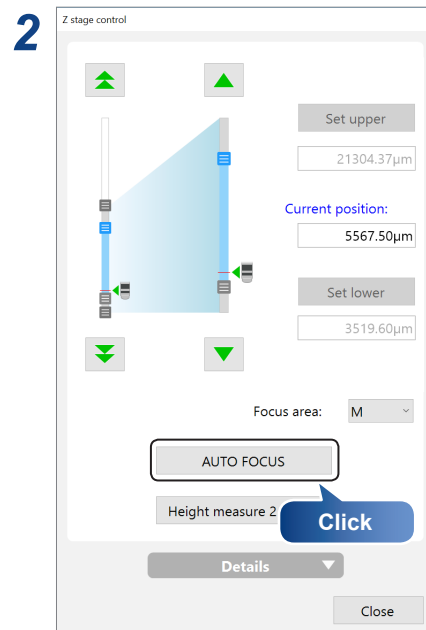
**NOTICE**

To prevent interference with the observation object, auto focusing is done by moving the Z-axis stage upwards. To avoid interference while using auto focus, be sure there is at least 3 mm or more (except at using VHX-E2500) between the lens and object.

**Reference** Auto focus can also be executed by pressing the [AUTO FOCUS] button on the console. Auto focus begins immediately when performing the auto focus on the console.



The [Z-stage control] dialog box appears.



The Z stage starts moving up and down and stops at the height where the image is in focus.

### 3 Drag the focus area to the location to focus on, as required, and click [Auto focus] again.

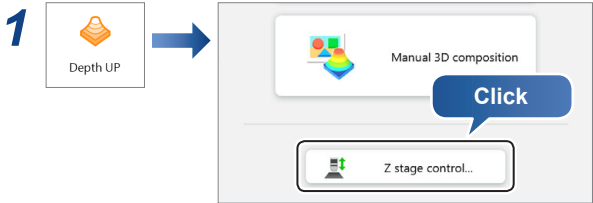
The size of the focus area can be changed with [Focus area] in the focus adjustment dialog box.

Depth UP

## Measuring the Height between 2 Points

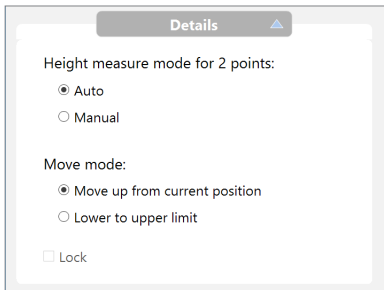
Auto focus can be used to measure the difference in height of two specified areas.

<b>NOTICE</b>	<p>To prevent interference with the observation object, the height measurement between two points is done by moving the Z stage upwards.</p> <p>To avoid interference while using this measurement, be sure there is at least 3 mm between the lens and object.</p>
---------------	---



The [Z-stage control] dialog box appears.

### 2 Open the Details menu.



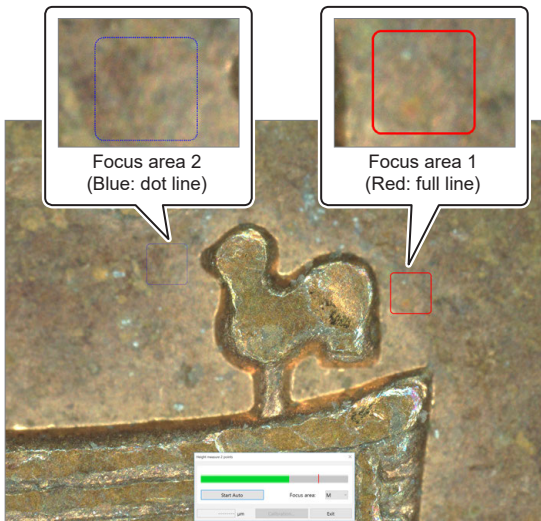
### 3 Specify [Height measure 2 points].

- Auto : Specify the areas to measure the height difference. The measurement is performed automatically.
- Manual : Manually adjust using the fine and coarse buttons.

### 4 Select [Move up from current position] at [Move mode].

### 5 Click [Z Measure 2pt].

The [Height measure 2 points] dialog box appears, and [Focus area 1] appears in a red frame, and [Focus area 2] appears in a blue frame in the observation window.



## Height measure 2 points (auto)

### 6 Drag focus areas 1 and 2 to the positions to measure.

The focus area size can be selected from "S/M/L/XL".

- |         |   |
|---------|---|
| \ Point | <ul style="list-style-type: none"> <li>• It outputs a positive measurement value if focus area 1 (red frame) is higher than focus area 2 (blue frame).</li> <li>• It outputs a negative measurement value if focus area 1 (red frame) is lower than focus area 2 (blue frame).</li> </ul> |
|---------|---|

### 7 Adjust the focus on the lowest focal plane and click [Start Auto].

The Z stage moves up and the height between the two points appears in the text box.

Click [Calibration] enables  "Calibration" (Page 9-53).

To stop measuring the height of two points, click [Exit].

## Height measure 2 points (manual)

### 6 Click to focus on the lowest focal plane.

### 7 When the position is in focus, click a point near the measurement position.

An X appears at the clicked point.

- |         |   |
|---------|---|
| \ Point | <p>Accidental clicks that cause the X to move will not affect the measurement value. The X represents the measurement location.</p> |
|---------|---|

### 8 Click to focus on the highest focal plane.

### 9 When the position is in focus, click a point near the measurement position.

The height between the two points appears in the text box.

Click [Calibration] enables  "Calibration" (Page 9-53).

To stop measuring the height of two points, click [Exit].

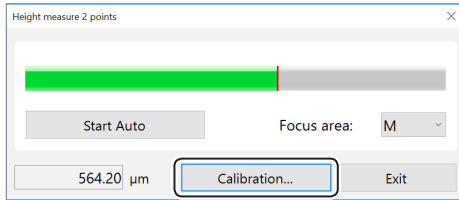
- |           |   |
|-----------|---|
| Reference | <ul style="list-style-type: none"> <li>• The focus adjustment can be done using the focus dial on the console or the mouse wheel.</li> <li>• [Lock] in the detailed menu is active only when VHX-S90F is used. Uncheck [Lock] before adjusting the Z stage manually. The [Lock] is always unchecked if the lens power is less than x350.</li> </ul> |
|-----------|---|

## Calibration

### 1 Use [Z Measure 2 pt] to measure a known height.

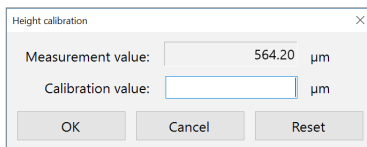
☐ "Measuring the Height between 2 Points" (Page 9-52)

### 2 Click [Calibration].



The [Height calibration] dialog box appears.

### 3 Enter the exact height measured in step 1 in the [Calibration value] box, and click [OK].



The calibrated value is reflected in the measurement.

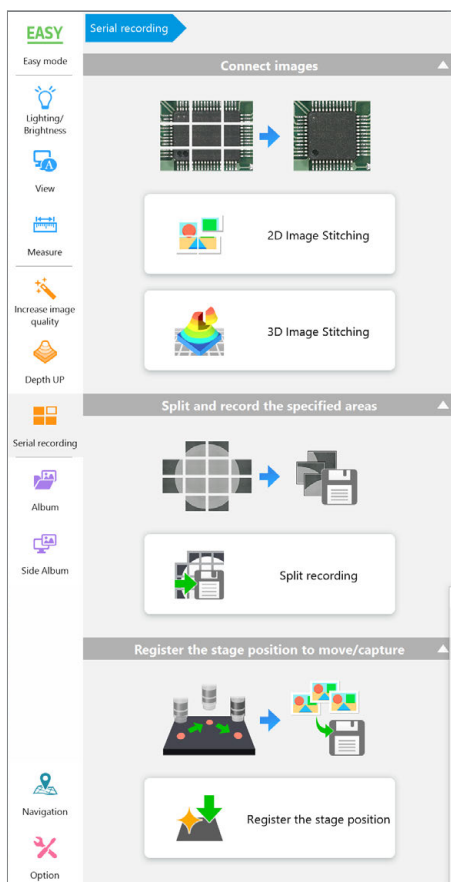
To initialize calibration, click [Reset].

## MEMO

# 10

## Serial Recording

### How to combine multiple images to obtain a wide-view



<b>Automatic Image Stitching</b> . . . . .	<b>10-2</b>
Stitching 2D Images Automatically . . . . .	10-2
Stitching 3D Images Automatically . . . . .	10-5
<b>Manual Image Stitching</b> . . . . .	<b>10-7</b>
Stitching 2D Images . . . . .	10-7
Stitching 3D Images . . . . .	10-8
<b>Split Recording</b> . . . . .	<b>10-9</b>
<b>Registering the Stage Position</b> . . . . .	<b>10-11</b>

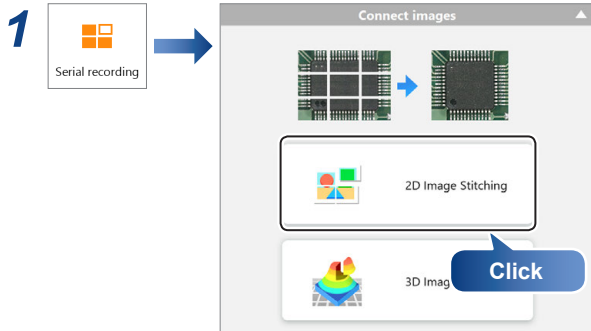
# Automatic Image Stitching

With these functions, the XYθ stage is moved automatically, multiple images are captured and assembled and wide-view images are obtained. The stitched image combines high resolution and a wide viewing angle. Image stitching can be done in both "2D Image Stitching" and "3D Image Stitching". The automatic XYθ stage is required to use the automatic image stitching function. Refer to ["Manual Image Stitching"](#) (Page 10-7) when using the manual XYθ stage.

## Stitching 2D Images Automatically

### Point

- The maximum size of the stitched image is 50000 x 50000 pixels.
- The maximum is 20000 x 20000 pixels when selecting [HDR] or [Optical Shadow Effect Mode] for the image format.
- Image stitching cannot be made at [Split screen].

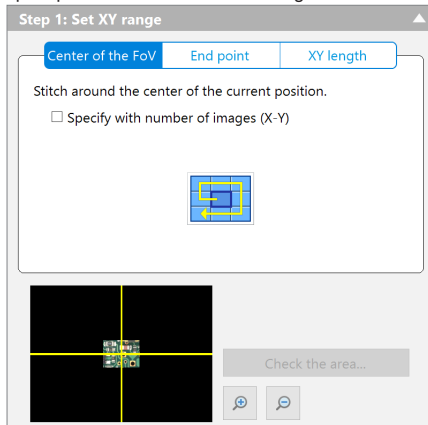


The [2D image stitching] menu appears.

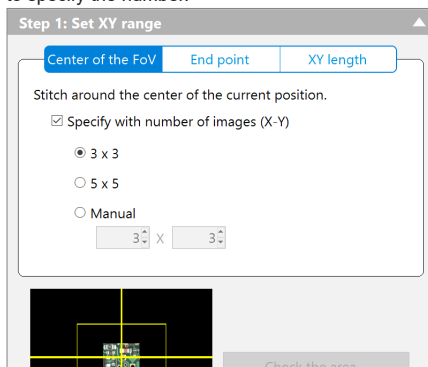
## 2 Select the method for image stitching (XY range).

### Center of the FoV

- Centered on the current position, the XYθ stage is moved in a spiral pattern and the obtained images are assembled.



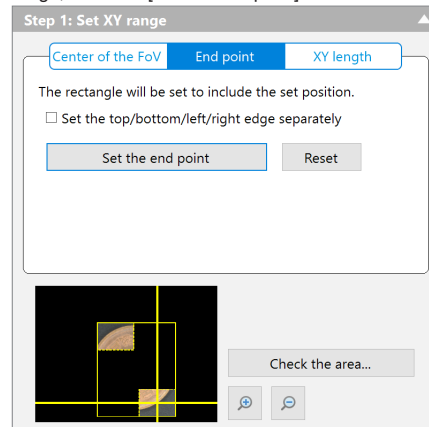
- To stitch the specified number of images centering around the current position, put a check on [Specify with number of images] to specify the number.



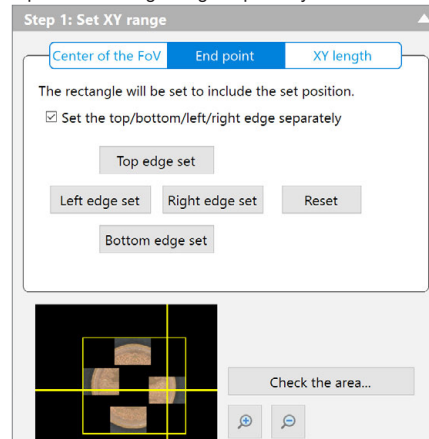
### End point

Select the [End point] tab, and stitch the rectangular region including the specified position.

- Move the stage to a position you want to include in the stitching range, and click [Set the end point].



- Checking [Set the top/bottom/left/right separately] can set the top/bottom/left/right edge separately.

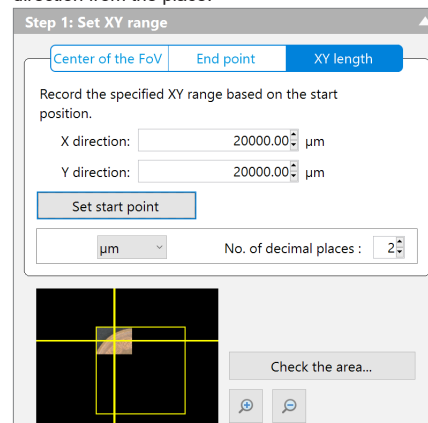


- Click [Reset] to perform again the end point settings when specifying the end point again.

### XY length

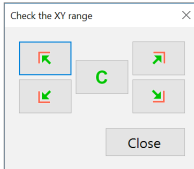
Stitches an area specified by length.

The upper-left place of the specified vision is set to the start point when clicking [Set start point]. Specify the X direction and Y direction from the place.



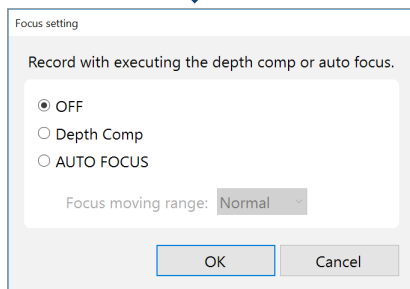


### 3 Click [Check the area], as required, and check the stitching range.



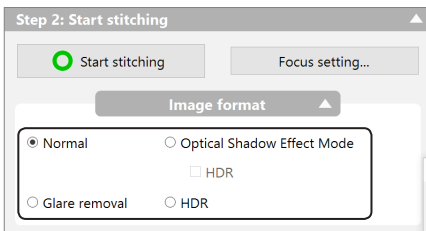
Clicking the arrow moves the stage to the four corners of the specified range.  
Clicking [C] moves the stage to the center of the stitching range.

### 4 Click [Focus setting] to perform settings when composing the high object.



Select [Depth Comp] or [Auto focus], then select [Focus moving range].

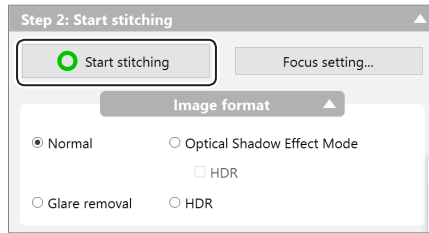
### 5 Set [Image format] as necessary.



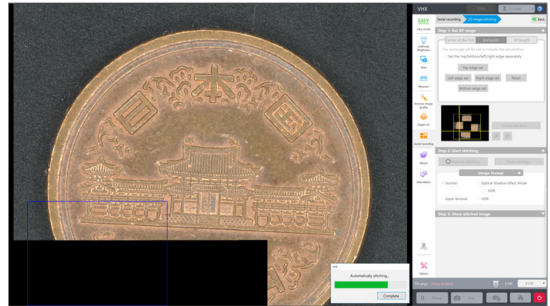
When [Glare removal], [HDR], or [Optical Shadow Effect Mode] is selected, stitched images recorded by respective effects can be acquired.

- "Removing Glare (Reflected light Removal)" (Page 8-6)
- "Increase Resolution (HDR)" (Page 8-8)
- "Optical Shadow Effect Mode" (Page 8-2)

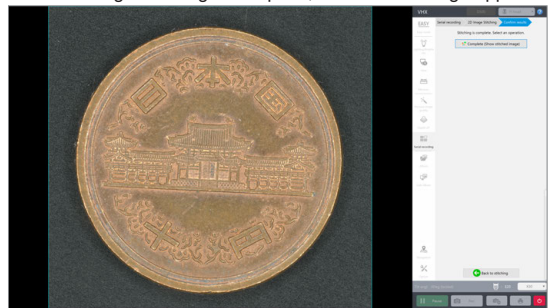
### 6 Click [Start stitching].



The auto stitching dialog box is displayed, and the stitching image is displayed on the observation window.



After the image stitching is complete, the stitched image appears.



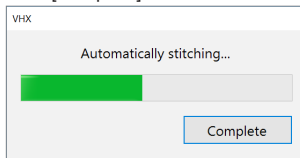
### 7 Click [Complete (Show stitched image)].

The stitched image appears and the [Wide-view] dialog box appears.

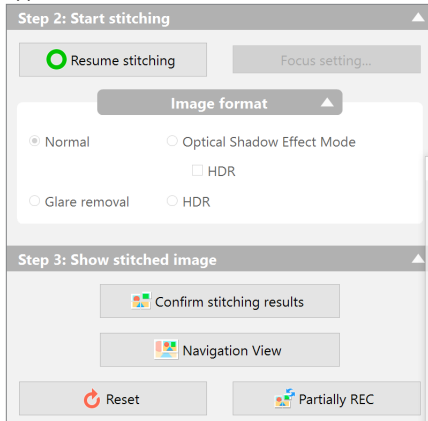
- "Wide-View" (Page 6-10)

## To exit while image stitching is in progress

Click [Complete] on the auto stitching dialog box.




[Start stitching] of [Step 2] changes to [Resume stitching] and [Step 3] appears.




### ● Resume stitching

Image stitching is resumed at the position where you had stopped.

### ● Confirm stitching results

Image stitching is finished at the position where stitching was stopped, and the stitched image is displayed in  "Wide-View" (Page 6-10).

### ● Navigation View

To use the stitched result for the navigation image, click [Navigation display].  
 "Navigation" (Page 3-11)

### ● Reset

Image stitching starts from the beginning.

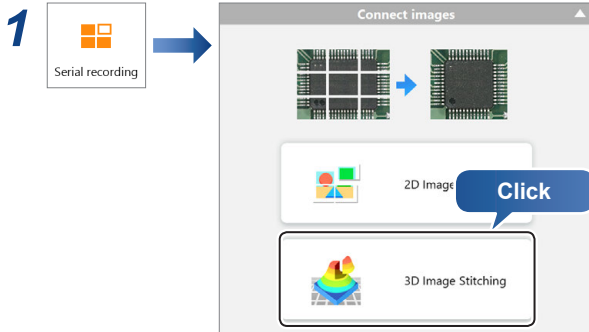
### ● Partially REC

A blue frame appears when clicking the position to be recaptured on the observation window. Only the parts are recaptured to update the stitched image.

## Stitching 3D Images Automatically

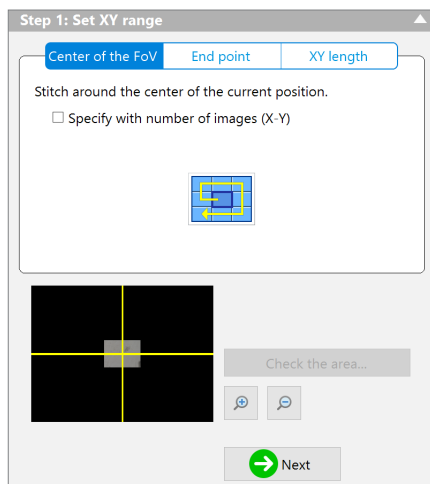
Stitching an image captured in 3D allows you to observe a 3D image over a larger area.

- The maximum size of the stitched image is 50,000 x 50,000 pixels.
- The maximum is 20000 x 20000 pixels when selecting [HDR] or [Optical Shadow Effect Mode] for the image format.
- Image stitching cannot be made at [Split screen].
- The Z-axis motorized stage, such as VHX-S770E/S750E, is required to use this function.



The [3D image stitching] menu appears.

### 2 Select the method for image stitching.

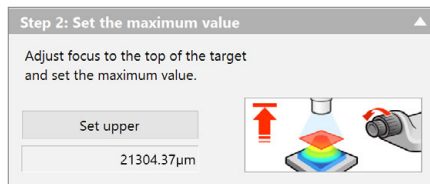


The same image stitching setup procedures as those for 2D image stitching apply to this setting.

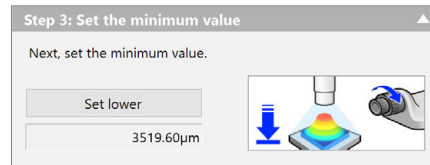
- "Stitching 2D Images Automatically" (Page 10-2)

### 3 Click [Next].

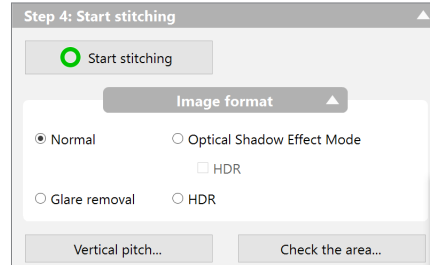
### 4 Move the Z stage to the upper limit of the object, and click [Set upper].



### 5 Move the Z stage to the lower limit of the object, and click [Set lower].



### 6 Perform [Image type] and [Vertical pitch] settings and range confirmation, as required.



#### • Image format

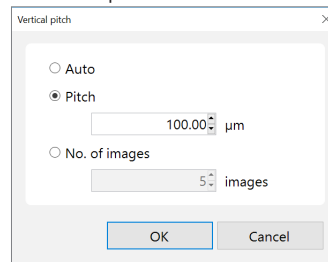
When [Glare removal], [HDR], or [Optical Shadow Effect Mode] is selected, stitched images recorded by respective effects can be acquired.

- "Removing Glare (Reflected light Removal)" (Page 8-6)
- "Increase Resolution (HDR)" (Page 8-8)
- "Optical Shadow Effect Mode" (Page 8-2)

#### • Vertical pitch

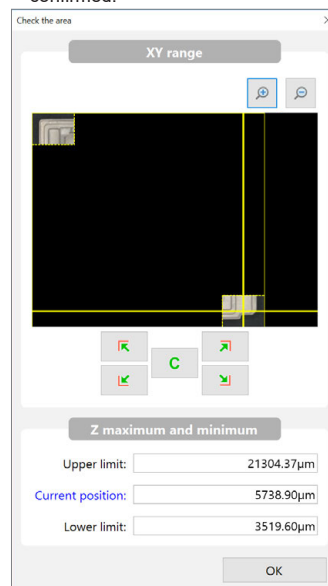
Vertical pitch can be specified by distance (pitch) or number of sheets.

In the case of [Auto], this automatically sets the best-suited pitch for the lens power.

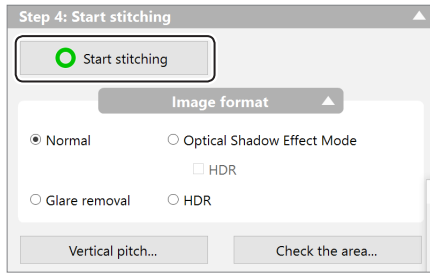


#### • Check the area

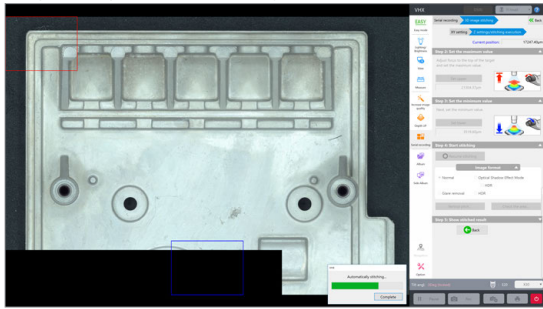
- Clicking the arrow moves the stage to the four corners at the upper and lower in the left and right. Clicking [C] moves the stage to the center of the stitching range.
- The upper limit/lower limit/current position of the Z stage can be confirmed.



## 7 Click [Start stitching].



The auto stitching dialog box is displayed, and the Z-axis stage moves upward to start the capture of the depth composition image. Images being stitched are displayed in the observation window.



After the image stitching is complete, the stitched image appears.



## 8 Click [3D Display] or [2D display (depth composition image)].

The 3D display or depth composition image is displayed.

☐ "Fine Depth Composition" (Page 9-9)

☐ "View (3D display)" (Page 9-15)

**Reference** If a depth composition image was shown, the [Wide view] dialog box will be displayed.

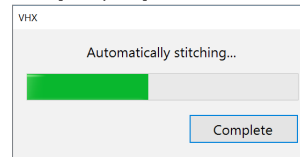
☐ "Wide-View" (Page 6-10)

## To exit while image stitching is in progress

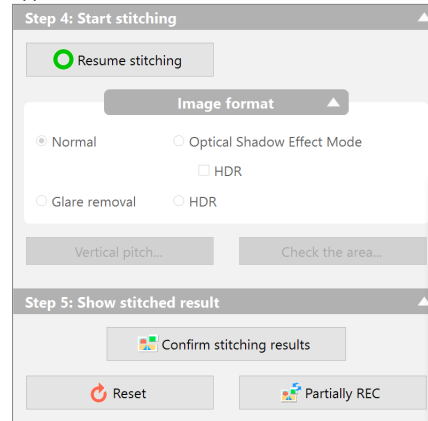
Click [Complete] on the auto stitching dialog box.

[Start stitching] changes to [Resume stitching] and what is shown in Step 3 and 4 also changes.

Click [Complete] on the auto stitching dialog box.



[Start stitching] of [Step 4] changes to [Resume stitching] and [Step 5] appears.



### ● Resume stitching

Image stitching is resumed at the position where you had stopped.

### ● Confirm stitching results

Image stitching is finished at the position where stitching was stopped, and the result confirmation screen appears.

### ● Reset

Image stitching starts from the beginning.

### ● Partially REC

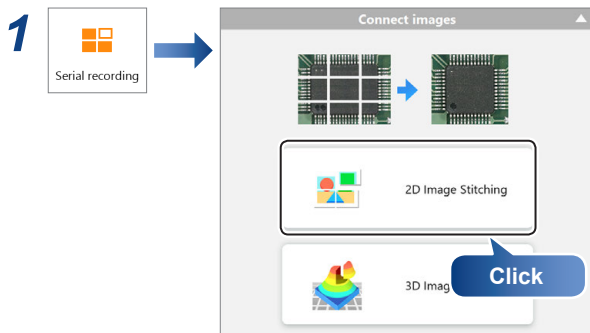
A blue frame appears when clicking the position to be recaptured on the observation window. Only the parts are recaptured to update the stitched image.

# Manual Image Stitching

This function stitches images that are recorded while moving the object horizontally to produce wide-view images. The stitched image combines high resolution and a wide viewing angle. Image stitching can be done in both 2D and 3D.

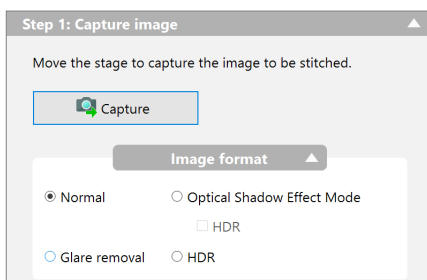
## Stitching 2D Images

- Point**
- The maximum size of the stitched image is 50,000 x 50,000 pixels.
  - The maximum is 20000 x 20000 pixels when selecting [HDR] or [Optical Shadow Effect Mode] for the image format.
  - Image stitching cannot be made at [Split screen].



The [2D image stitching] menu appears.

## 2 Set [Image format] as necessary.

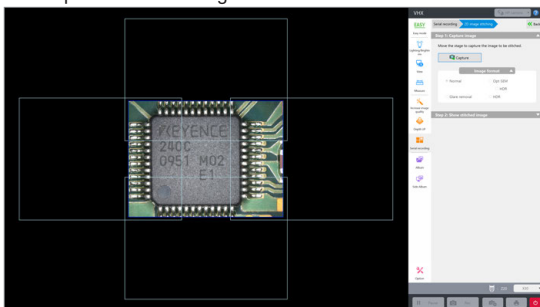


When [Glare removal], [HDR], or [Optical Shadow Effect Mode] is selected, stitched images recorded by respective effects can be acquired.

- "Removing Glare (Reflected light Removal)" (Page 8-6)
- "Increase Resolution (HDR)" (Page 8-8)
- "Optical Shadow Effect Mode" (Page 8-2)

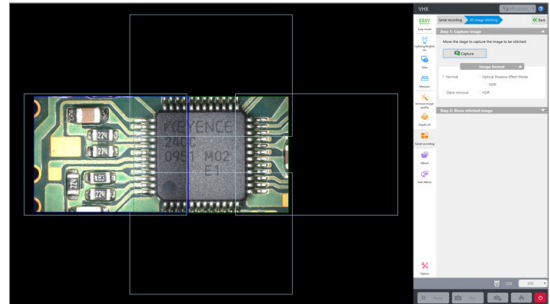
## 3 Click [Capture].

This captures the first image.



## 4 Move the object horizontally and click [Capture] again.

The next image is captured and stitched to the first image.



- Point**
- If the frame color turns "yellow", it indicates the status that stitching failed. Move the object back to the original position and capture the image again.

## 5 Repeat step 5 until the desired area is stitched.

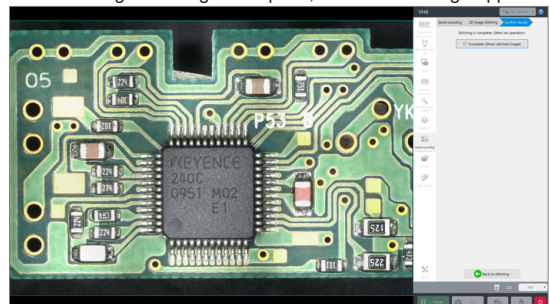
- Point**
- If the stitched image exceeds 50000 pixels, an error message will appear.

## 6 Click [Confirm stitching results].



**Reference** To start over from the beginning, click [Reset].

After the image stitching is complete, the stitched image appears.



## 7 Click [Complete (Show stitched image)].

The stitched image appears and the [Wide-view] dialog box appears.

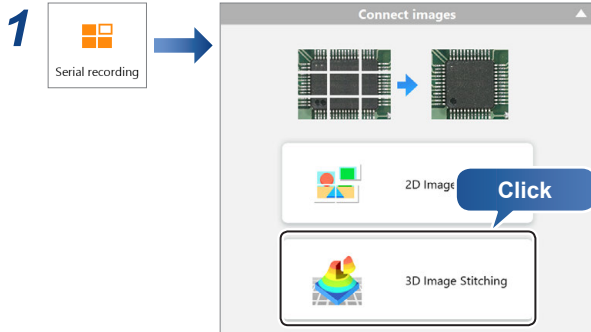
- "Wide-View" (Page 6-10)

## Stitching 3D Images

Stitching an image captured in 3D allows you to observe a 3D image over a larger area.

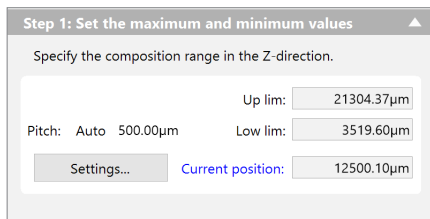
**Point**

- The maximum size of the stitched image is 50,000 x 50,000 pixels.
- The maximum is 20000 x 20000 pixels when selecting [HDR] or [Optical Shadow Effect Mode] for the image format.
- Image stitching cannot be made at [Split screen].
- The Z-axis motorized stage is required to use this function.



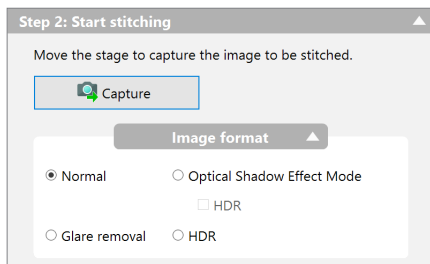
The [3D image stitching] menu appears.

### 2 Click [Settings] and set the composition range and vertical pitch of the Z stage.



Settings of the height range and the pitch are the same as those of the auto image stitching.  
 "Stitching 3D Images Automatically" (Page 10-5)

### 3 Set [Image format] as necessary.

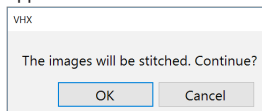


When [Glare removal], [HDR], or [Optical Shadow Effect Mode] is selected, stitched images recorded by respective effects can be acquired.

- "Removing Glare (Reflected light Removal)" (Page 8-6)
- "Increase Resolution (HDR)" (Page 8-8)
- "Optical Shadow Effect Mode" (Page 8-2)

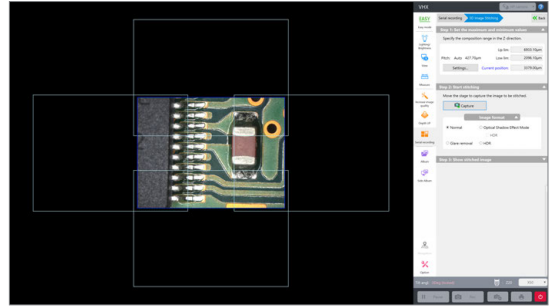
### 4 Click [Capture].

The microscope starts capturing depth composed images. When the images have been captured, a confirmation dialog will appear.

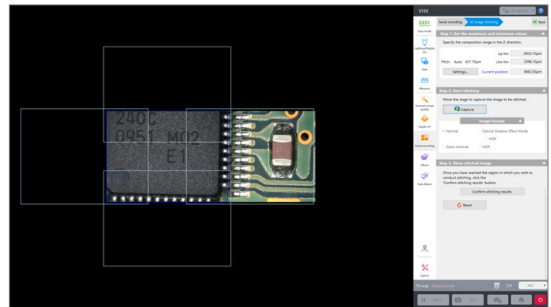


### 5 Click [OK].

The stitched image appears.



### 6 Move the object horizontally and click [Capture].



**Point**

If the frame color turns "yellow", it indicates the status that stitching failed. Move the object back to the original position and capture the image again.

### 7 Repeat steps 5 to 6 until the desired area is stitched.

**Point**

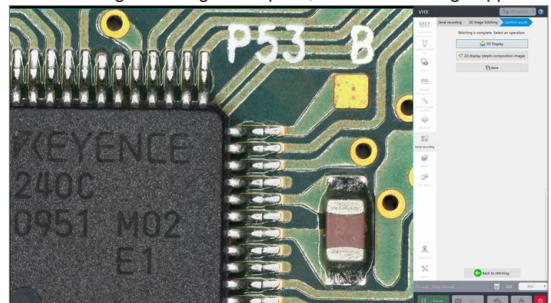
If the stitched image exceeds 50000 pixels, an error message will appear.

### 8 Click [Confirm stitching results].



**Reference** To start over from the beginning, click [Reset].

After the image stitching is complete, the stitched image appears.



### 9 Click [3D Display] or [2D display (depth composition image)].

The 3D display or depth composition image is displayed.

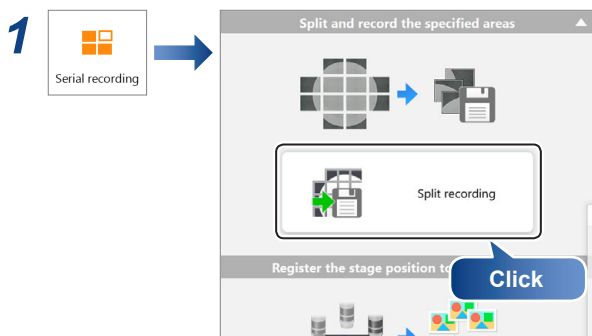
- "Fine Depth Composition" (Page 9-9)
- "View (3D display)" (Page 9-15)

**Reference**

If a depth composition image was shown, the [Wide view] dialog box will be displayed.  
 "Wide-View" (Page 6-10)

# Split Recording

This function saves image data in each field of view in batch before stitching. The recorded results can also be used as images for contamination analysis.

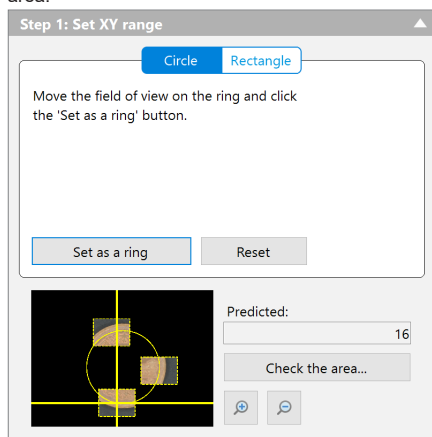


The split recording menu appears.

## 2 Select the method for image stitching (XY range).

### ● Circle

This is selected when recording a circular object. Move to points on the circle and click [Set as a ring]. A circular area including the three or more points is the recording area.

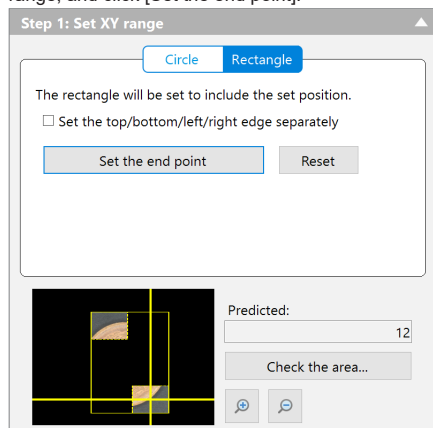


Click [Reset] to set again the circumference settings when specifying the circumference again.

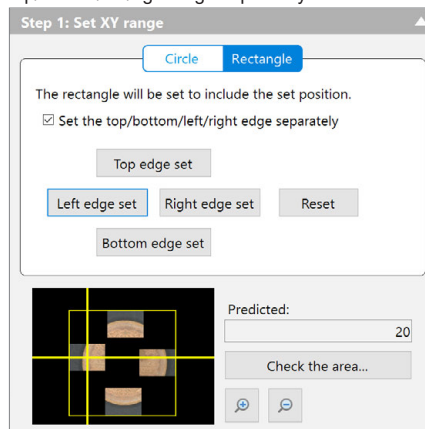
### ● Rectangle

Select the [Rectangle] tab, and stitch the rectangular region including the specified position.

- Move the stage to a position you want to include in the stitching range, and click [Set the end point].

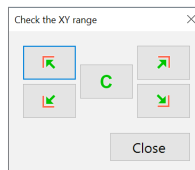


- Checking [Set the top/bottom/left/right separately] can set the top/bottom/left/right edge separately.



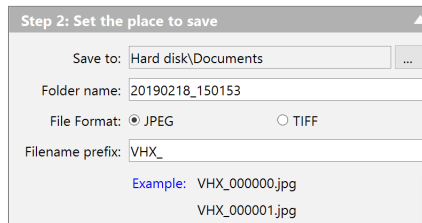
Click [Reset] to perform again the end point settings when specifying the end point again.

## 3 Click [Check the area], as required, and check the stitching range.



Clicking the arrow moves the stage to the four corners at the upper and lower in the left and right. Clicking [C] moves the stage to the center of the stitching range.

## 4 Specify the destination folder.

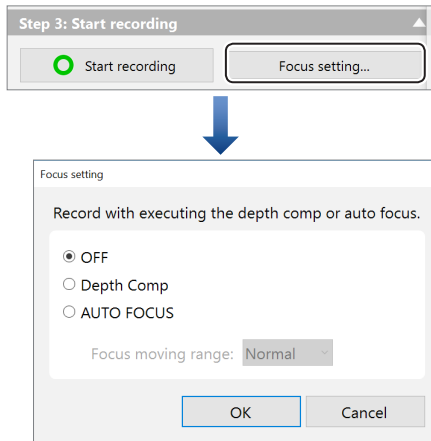


Item	Function
Save to	Enter the saving destination folder.
Folder name	Enter the saving destination folder name.
File format	Select the file format (JPEG/TIFF).
Filename prefix	The entered texts will be added for saved file names in common.

The file names of resulting images are the same as those of the auto recording.

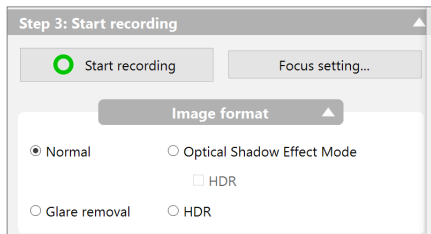
☐ "Automatic Save Mode" (Page 4-5)

**5 Click [Focus setting] to perform settings when composing the high object.**



Select [Depth Comp] or [Auto focus], then select [Focus moving range].

**6 Set [Image format] as necessary.**



When [Glare removal], [HDR], or [Optical Shadow Effect Mode] is selected, stitched images recorded by respective effects can be acquired.

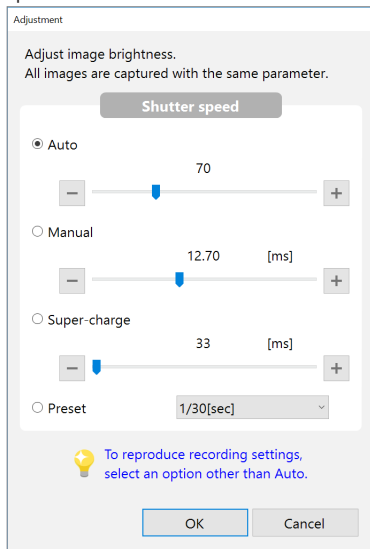
- "Removing Glare (Reflected light Removal)" (Page 8-6)
- "Increase Resolution (HDR)" (Page 8-8)
- "Optical Shadow Effect Mode" (Page 8-2)

**7 Click [Start recording].**

The [Adjust image] dialog box appears.

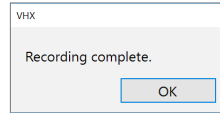
**8 Adjust the image brightness.**

During the split recording, it is fixed to the brightness value specified here.



**9 Click [OK].**

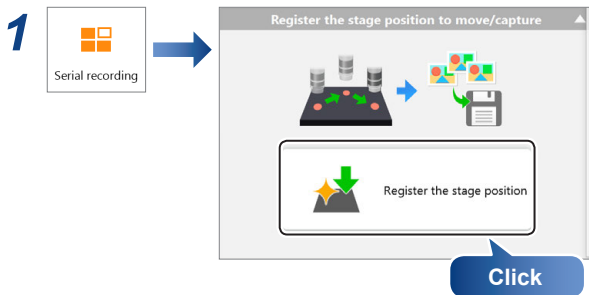
The split recording starts. After completion, the confirmation message will appear.





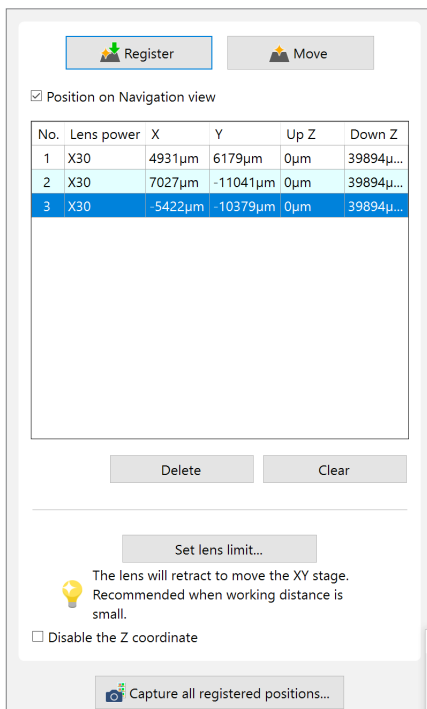
# Registering the Stage Position

By registering the position of the stage, you can immediately move to a registered position on the XYθ stage. Up to 999 positions on the XYθ stage can be registered.



Registering the stage position menu appears.

## 2 Move the stage to the registered position, and click [Register].



### ● Register

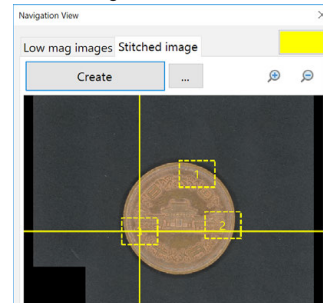
Register the stage position coordinate to the list. Multiple positions (max. 999) can be registered.

### ● Move

Move the stage to the position selected in the list.

### ● Position on Navigation view

When selected on, the stage position registered in the list is displayed on the navigation.



### ● Delete

Delete the selected stage position from the list.

### ● Clear

Delete all the registered stage positions.

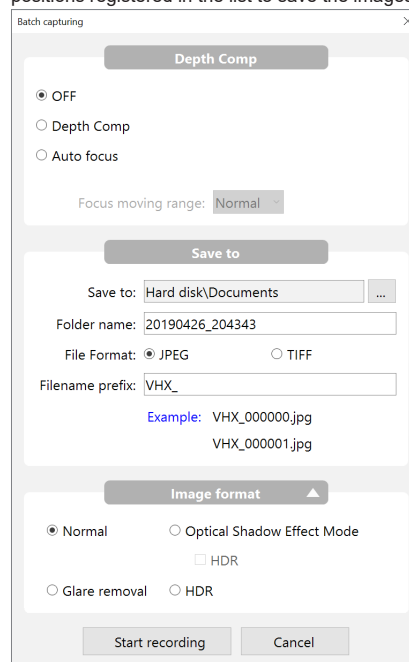
### ● Set lens limit

"Set lens limit" (Page 7-58)

### ● Capture all registered positions

The [Batch capturing] dialog box appears.

Clicking [Start recording] can perform the recording at all stage positions registered in the list to save the images.



### ○ Depth composition

Select [Depth Comp] or [Auto focus] when composing the high object.

### ○ Save to

"Automatic Save Mode" (Page 4-5)

### ○ Image format

Set [Image format] as necessary.

"Removing Glare (Reflected light Removal)" (Page 8-6)

"Increase Resolution (HDR)" (Page 8-8)

"Optical Shadow Effect Mode" (Page 8-2)

## MEMO

# 11

## Album/Side Album

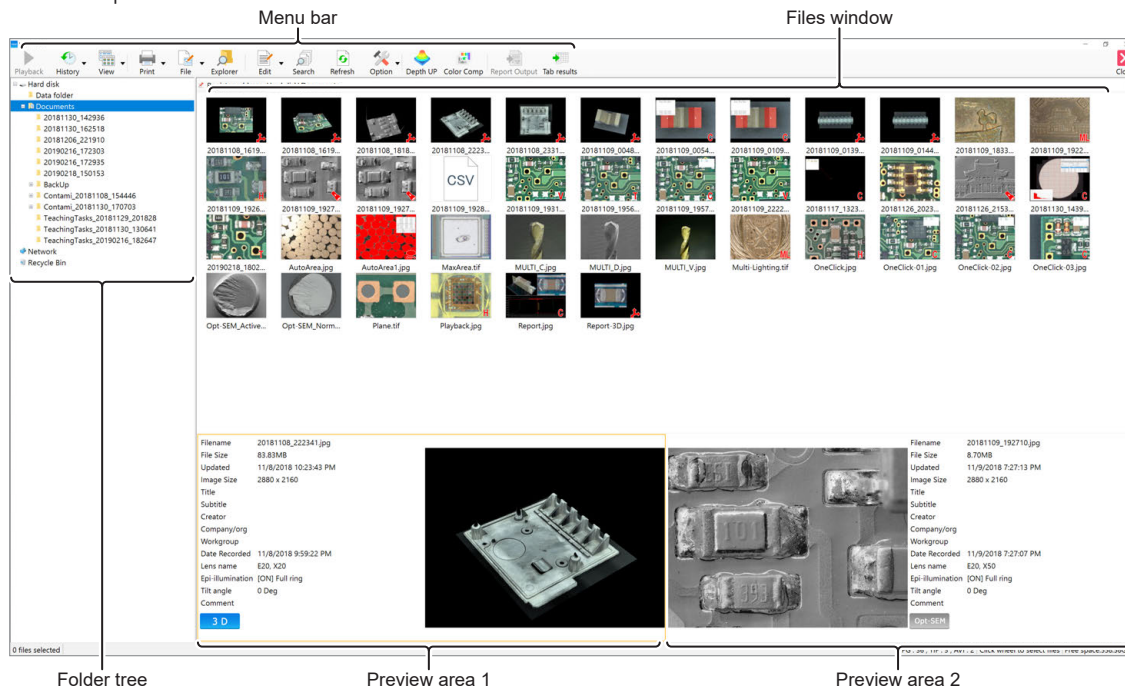
### How to work with saved files

<b>Album</b> .....	<b>11-2</b>
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# Album

## Part Names and Functions

This section explains the names and functions used in the Album window.



### Menu bar

#### Playback



This button plays back an image file selected from the files window. Clicking the [Playback] button displays the file in the entire observation window.

#### Reference

- You can also playback a file by double-clicking it in "Files window".
- Or, you can right-click the file in [Files] and click Playback on the pop-up menu.
- Playing a multiple selection of CSV files displays up to four measure results side by side.

#### History



This command displays a history of the files that have been previously played. These files can be played by selecting them from the list.

#### View



Set the "Files window" display. Also, this button shows/hides the preview area.   
 □ "Changing the View of [Files window]" (Page 11-11)

#### Reference

Or, you can change the view format from the pop-up menu presented by right-clicking in "Files window".

#### Print



This button prints (Page 4-10) the currently selected image with the printer. To install the printer driver, temporarily deactivate the system protection function (Page 12-3).

### File



Controls files.

#### New Folder

Creates a new folder on the hard disk in the microscope. Select the folder, at the folder view, where a new folder is to be created before clicking.

#### Reference

You can create a new folder from the menu which is displayed by right-clicking a folder or files window.

#### Rename

Changes the name of the selected folder or file.

#### Reference

You can change a name of a file or folder by right-clicking a folder or file.

#### Delete

Move the selected file to the Recycle Bin.

#### Reference

You can delete a file or folder from the menu by right-clicking a folder or file.

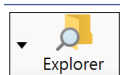
#### Properties

You can display/set file properties (such as title and creator) and display file information (such as file type and size).

#### Reference

- When a folder is selected, the folder information is displayed.
- You can also display the file or folder properties by right-clicking a folder or file.

## Explorer



Launch Explorer.

## Edit



The operation lastly made for a folder or file is undone. Also, this button drops down to show the Cut, Copy, Paste, and Select all commands.

### Reference

- [Undo] is allowed for only one command. Some operations cannot be undone.
- You can also use these commands from the pop-up menu presented by right-clicking the folder or file.

## Search



This command searches within the hard disk. You can specify search criteria.  
 "Searching Files" (Page 11-10)

### Reference

You can also search by right-clicking a folder and clicking Search on the pop-up menu.

## Refresh



This command refreshes the album view.

## Option



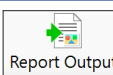
This button allows you to set the options of various functions.  
 "Options" (Page 11-12)

## Depth UP



This command combines image files recorded at different focal points. The files can be displayed combined or in 3D. This is useful for viewing objects that are difficult to view completely in focus due to large height differences.  
 "Depth UP" (Page 11-9)

## Report Output



This command prints the image and file information on a single sheet (Excel) using a predefined format.  
 "Report Output" (Page 11-13)

## Measurement results tabulation



This button combines multiple one-click automatic measurement results in Excel.  
 "Measurement Results Tabulation" (Page 11-14)

## Close



This button closes the album function and returns to the observation window.

## Folder tree

This is a tree view of the folders on the hard disk or other storage devices.

### ● Hard disk

This shows the hard disk in the microscope. Users can store images in the data folder and create new folders.



**The VHX-7000 Communication Software can browse the Documents folder and the Data folder.**

### ● Removable disk (F:)

Any USB memory device connected to the USB port will be recognized as a drive and added to the tree view.

### ● Network

This shows any shared drives on the network.  
 Refer to  "LAN Connection" (Page 13-2) to perform settings.

### ● Recycle Bin

Deleted files are saved here.

## Files window

This window shows the files currently saved in the selected folder. The view can be set to show thumbnails, details, or other views. The display method change is made by  "Changing the View of [Files window]" (Page 11-11) in the [View] menu.

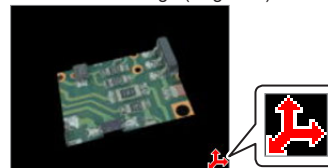


In thumbnail view, the contents of the file is indicated by a symbol displayed in the lower right of the thumbnail.

### ● 3D File

appears in the lower right of the thumbnail.

This is the 3D image (Page 9-2). The image can be played back in 3D.



### ● Multi-lighting file

appears in the lower right of the thumbnail.

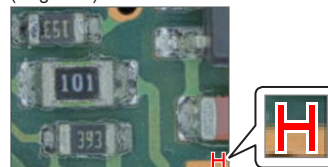
This image is recorded with the multi-lighting function (Page 8-10).




### ● HDR file

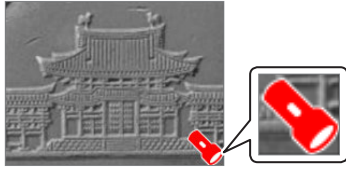
appears in the lower right of the thumbnail.

This image is recorded with the High Dynamic Range (HDR) function (Page 8-8).




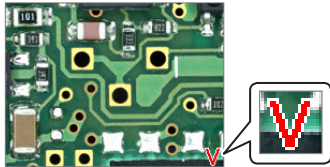
● **Optical Shadow Effect Mode file**

 appears in the lower right of the thumbnail.  
This image is recorded with the Optical Shadow Effect Mode function (Page 8-2).




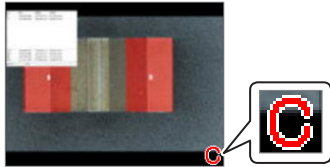
● **Video files**

 appears in the lower right of the thumbnail.  
This file is a video recording (Page 4-6).



● **File with CSV data**

 appears in the lower right of the thumbnail.  
This image file has measurement data in CSV format.




The CSV data can be extracted using the VHX-7000 Communication Software and imported into Excel, or other applications to complete further analysis.  
☞ “Extracting CSV Data” (Page 13-14)

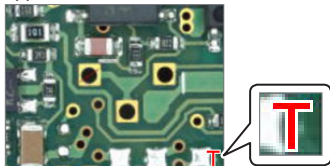
● **CSV data file**

This file contains measurement data such as length and area in CSV format (Page 7-16).  
The data can be exported into Excel or other application for comparison.




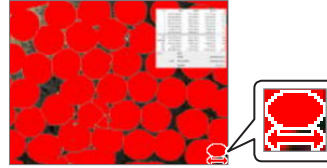
● **Template file**

 appears in the lower right of the thumbnail.  
It is a template file that has been created with one-click automatic measurement (Page 7-52) or teaching auto measurement (Page 7-56).  
One-click automatic measurement can be conducted with a template applied to it.




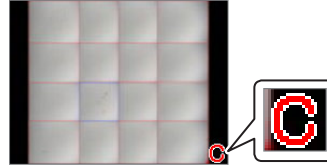
● **Auto area data file**

 appears in the lower right of the thumbnail.  
It is a data file that contains measurement results and settings using the automatic area measurement (Page 7-26).  
Measurement results can be confirmed and output or another automatic area measurement can be completed with the same settings.



● **Contamination analysis results file**

 appears in the lower right of the thumbnail.  
This image file includes analysis results using the contamination analysis function (Page 7-42).



## Preview Area

The file preview area displays properties and a preview of the image.












### ● Preview image

The file preview area displays the selected image.

### ● File properties display

Symbols are used to indicate basic information about the selected file and its content, as well as information set in the file properties (Page 11-8).

**Reference** Symbols that indicate the contents of the file are displayed under the properties display.

3D File	
Multi-lighting file	
HDR files	
Optical Shadow Effect Mode file	
3D HDR file	
3D Optical Shadow Effect Mode file	
Video file	
Measurement image file	
Template file	
Auto area data file	
Contamination analysis results file	

### ● Using the preview area

Clicking a preview area (1 or 2) makes it the active preview. The preview area shows the file selected from “Files window”.

#### 1 Click either the left or right preview area

The clicked preview area becomes active and an orange frame appears.


#### 2 Click the desired file in the files window to display it in the preview area.

The preview image and file properties appear in the preview area.

**Point** If a CSV file is selected, only the basic file information is displayed.

## Playing Files


The following methods can be used to playback selected files in “Files window” of the album.

- Click 
- Double-click in the files window.
- Click [Playback] from the mouse right-click menu.
- Double-click the preview window.

## Playing still images

### 1 Select the file to play in “Files window”.

### 2 Click [Playback].

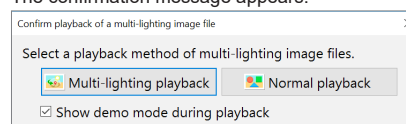
The image appears in the entire observation window. To play and confirm high-resolution images, use  “Wide-View” (Page 6-10).


## Playing multi-lighting files

### 1 Select a multi-lighting file to play from “Files window”.

### 2 Click [Playback].

The confirmation message appears.



**Point** In [Show confirmation message for the playback method] of  “Options” (Page 11-12), turning [Multi-lighting image file] off playbacks the multi-lighting file without displaying the confirmation message.

### 3 Click [Multi-lighting playback].

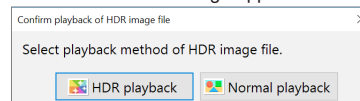
The Multi-lighting screen (Page 8-10) appears.


## Playing HDR images

### 1 Select the HDR file to play in “Files window”.

### 2 Click [Playback].

The confirmation message appears.



**Point** In [Show confirmation message for the playback method] of  “Options” (Page 11-12), turning [HDR image file] off playbacks the HDR file without displaying the confirmation message.

### 3 Click [HDR Playback].

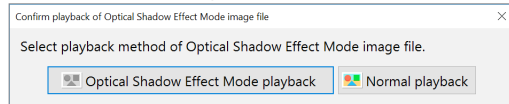
The HDR screen (Page 8-8) appears.

## Playing Optical Shadow Effect Mode images

- 1 Select the Optical Shadow Effect Mode file to play in “Files window”.

- 2 Click [Playback].

The confirmation message appears.



In [Show confirmation message for the playback method] of “Options” (Page 11-12), turning [Optical Shadow Effect Mode image file] off playbacks the Optical Shadow Effect Mode image file without displaying the confirmation message.

- 3 Click [Optical Shadow Effect Mode playback].

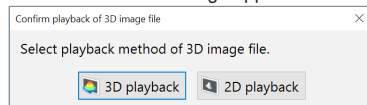
The Optical Shadow Effect Mode screen (Page 8-2) appears.

## Playing back 3D images

- 1 Select the 3D file to play in “Files window”.

- 2 Click [Playback].

The confirmation message appears.



In [Show confirmation message for the playback method] of “Options” (Page 11-12), turning [3D image file] off playbacks the 3D image file without displaying the confirmation message.

- 3 Click [3D playback].

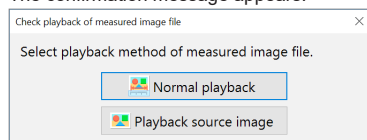
The 3D view (Page 9-15) appears.

## Playing measured image files

- 1 Select the measurement image file to play in “Files window”.

- 2 Click [Playback].

The confirmation message appears.



In [Show confirmation message for the playback method] of “Options” (Page 11-12), turning [Measurement image file] off playbacks the measured file without displaying the confirmation message.

- 3 Click [Normal playback].

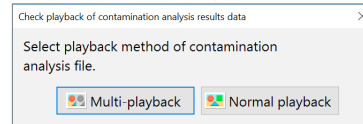
The measurement image file is displayed.

## Playing contamination analysis results files

- 1 Select the analysis result file to play in “Files window”.

- 2 Click [Playback].

The confirmation message appears.



In [Show confirmation message for the playback method] of “Options” (Page 11-12), turning [Contamination analysis results file] off performs the multi-playback without displaying the confirmation message.

- 3 Click [Multi-playback].

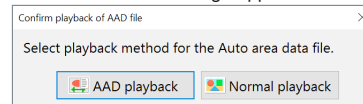
The multi-playback for the contamination analysis results file starts.

## Playing back automatic area measurement data file

- 1 Select the auto area data file to play in “Files window”.

- 2 Click [Playback].

The confirmation message appears.



In [Show confirmation message for the playback method] of “Options” (Page 11-12), turning [Auto area data file] off playbacks the measurement result screen of the auto area measurement without displaying the confirmation message.

- 3 Click [AAD playback].

The measurement result screen of automatic area measurement (Page 7-26) appears.

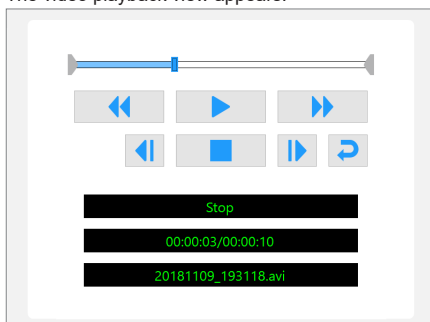









## Playing video

**1** Select the video file to play in “Files window”.

**2** Click [Playback].

The video playback view appears.



Button	Function
	Rewinds the video.
	Click [Playback] to start playing the video. The button changes to the [Pause] button while playing.
	Fast forwards the video.
	Each click reverses the video one frame.
	Stops playback and pauses the video.
	Each click advances the video one frame.
	Click this button to turn repeat ON. A video will play repeatedly when the [Playback] button is clicked. Click again to turn repeat OFF.

**Reference** Clicking the slide bar displays the video at that point.

## Editing videos

### Cropping & Saving video

Specify start and end points to save a segment of the video.

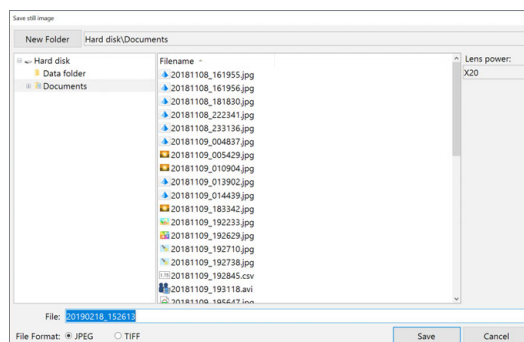
**1** Drag the start point cursor and end point cursor to specify the start and end of the segment to crop.



**2** Click [Crop & Save].

The [Crop & Save] dialog box appears.

**3** Enter the folder where the file is to be saved and the file name, and click [Save].



**4** This will save the video between the start and end points.

**Reference** You can also create a new folder to save the file. You can also enter file properties before saving.

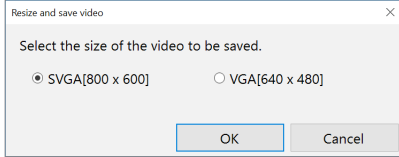
## Resizing and save video

The resolution of the video file can be reduced before saving it. This reduces the file size.

### 1 Click [Resize].

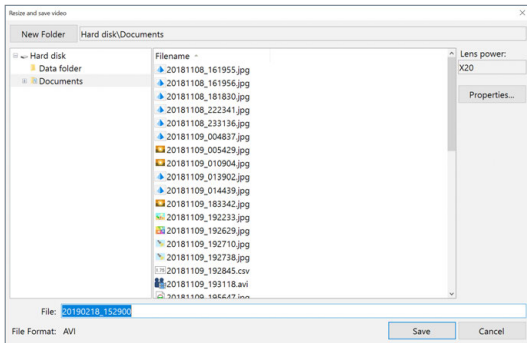
The [Resize] dialog box appears.

### 2 Select the size to save and click [OK].



The [Resize] dialog box appears.

### 3 Enter the folder where the file is to be saved and the file name, and click [Save].



The video is saved.

**Reference** You can also create a new folder to save the file. You can also enter file properties before saving.

## Saving still images

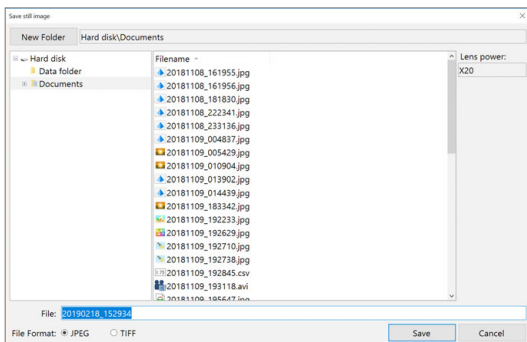
Specified frames can be saved as still images.

### 1 Play the video and pause at the frame to save.

### 2 Click [Captr Still...]

The [Rec] dialog box appears.

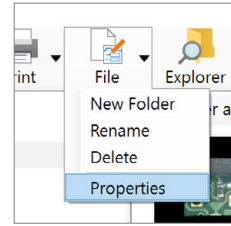
### 3 Enter the folder, image format, file name to save the image, and click [Save].



This saves the still image.

## Displaying and Entering Properties

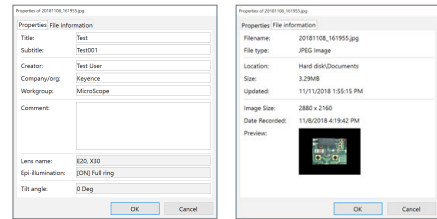
### 1 Click [File] and select [Properties].



The [File Properties] appears.

**Point** CSV files do not have the [Properties] tab.

**Reference** Clicking the [File information] tab displays basic information about the file.



### 2 Enter information into the [Properties] tab as necessary.

**Point** The [Lens Name], [Epi-illumination] and [Tilt angle] field cannot be changed.

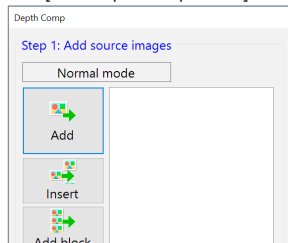
### 3 Click [OK].

## Depth UP

Perform "Fine Depth Composition" (Page 9-9) from multiple images available for depth composition.

**1** Click Depth UP.

The [Fine depth composition] dialog box appears.



**2** Select image files from "Files window" on which you wish to perform depth composition.

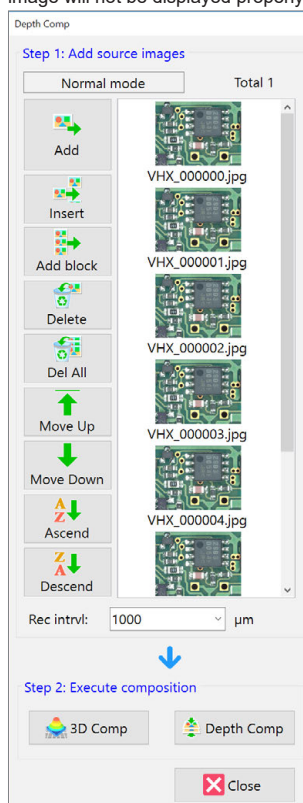
The USB memory image data can be selected. Depth composition cannot be done on files stored on network drives.

**3** Click [Add].

**4** The image files are added to the [Depth Comp] dialog box.

**5** Repeat steps 2 and 3 until all image files to be used in [Depth UP] are included.

The images should be added to the list so that they are in order from the topmost layer of the object to the lowermost. The resulting image will not be displayed properly if the images are not in order.



Button	Function
Insert	Images can be inserted at specific positions by specifying the position and clicking [Insert].
Add block	A block of images in the currently open folder can be added.
Delete Delete all	These commands remove files (or all files) added to the [Depth Comp] dialog box. This will not delete the original image.
Move Up Move Down	This command moves the selected file up or down in the list.
Ascend Descend	This command sorts the selected filenames on their names.
Rec interval	Enter the amount of travel represented by the recorded images.

**6** Click [3D Comp] or [Depth Comp].

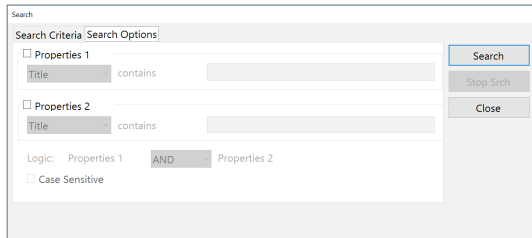
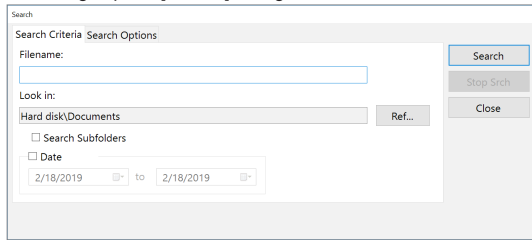
This displays the image with depth UP in the full area of the window.

For more details about the depth composition, refer to "Types and Features of Depth Composition" (Page 9-2).

# Searching Files



This brings up the [Search] dialog box.



## 2 Specify search criteria.

### ● [Search criteria] tab

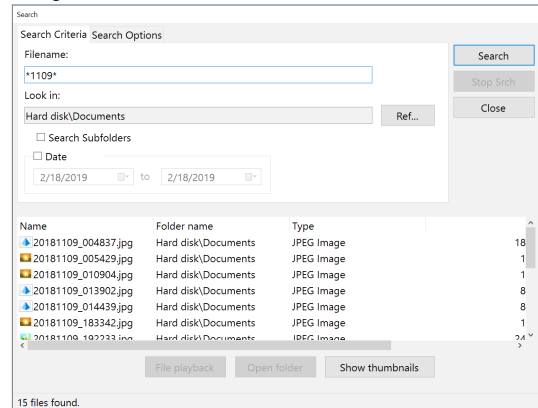
Item	Function
Filename	Enter the file name to search for. <b>Point</b> <ul style="list-style-type: none"> <li>To search for all files that contain the specified characters, type an asterisk (*) before and after the characters. (Example) *observe*</li> <li>Manually entered file names must include the extension.</li> </ul>
Look in:	This displays the folder to search in. To change the location, click [Ref...] and select the desired folder.
Search Subfolders	Check this option to include the folders below the specified folder in the search.
Date	Check this option to narrow the search range to the recording date. Specify the start date and end date.

### ● [Search Options] tab

Item	Function
Properties	Check this option and select a property item, then enter the characters to search for. If you specify [Properties 1] and [Properties 2], select logics ([AND (both)]/[OR (either)]).
Case Sensitive	Check this option to distinguish between upper and lower case.

## 3 Click [Search].

The search results will appear in the lower portion of the [Search] dialog box.



The following operations are available by selecting any of the files found.

### ● File playback

Select any one of the files found and click [File playback]. The selected file will begin playing.  
 □ "Playing Files" (Page 11-5)

### ● Open folder

To open the folder that contains a file in the search results, select the desired file and click [Open folder]. The contents of the folder will appear in "Files window".

### ● Show Thumbnails

This button will show the thumbnails of all files in the search results in "Files window".











**Point** The locations that can be searched are the [Data folder] and [Document folder].

## Changing the View of [Files window]

1 Click  to select the display method.

### List





This view shows the filenames.

Register address Hard disk\Documents	
 20181108_161955.jpg	 20181108_161956.jpg
 20181109_005429.jpg	 20181109_010904.jpg
 20181109_192629.jpg	 20181109_192710.jpg
 20181109_195709.jpg	 20181109_222215+.avi
 20190218_180254.jpg	 AutoArea.jpg

### Details





This view shows the file names with details.

The view shows the file name along with its type, size, and when it was last updated.

Register address Hard disk\Documents			
Name	Type	Size	Updated
 20190218_180254.jpg	JPEG Image	10,658 KB	2/16/2019
 MULTI_V.jpg	JPEG Image	338 KB	12/7/2018
 MULTI_D.jpg	JPEG Image	279 KB	12/7/2018
 MULTI_C.jpg	JPEG Image	272 KB	12/7/2018

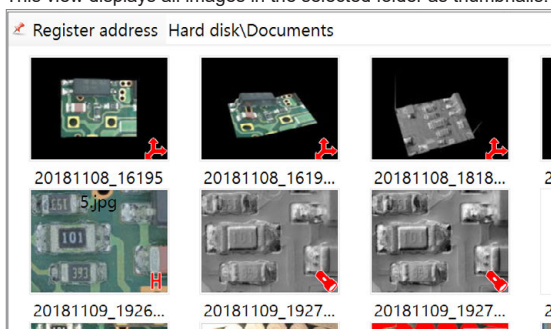
### Show properties

This view shows the properties of the selected image files. The following items, if entered, are displayed: name, title, subtitle, creator, company/org., workgroup, lens name (lens type and power), epi-illumination, and tilt angle.

Register address Hard disk\Documents		
Name	Title	Subtitle
 20190200_161955.jpg	Test	Test001
 20190200_161956.jpg	Test	Test001
 20190200_181830.jpg	Test	Test001
 20190200_222341.jpg		

### Show thumbnails

This view displays all images in the selected folder as thumbnails.



### Sort by

Select the item to sort by. A menu will appear with a choice of items you can sort by.

### Ascending

The files are displayed in ascending order based on the selected "sort by" item.

### Descending

The files are displayed in descending order based on the selected sort by item.

# Options

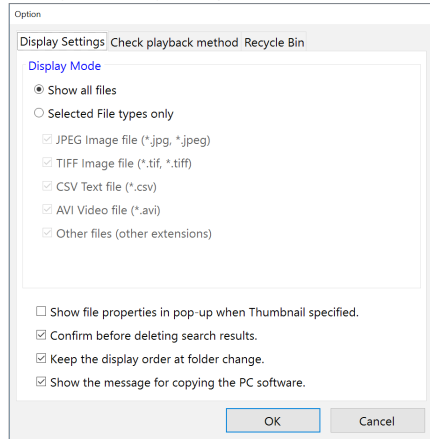
## Option settings

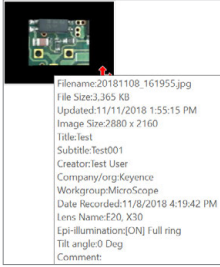
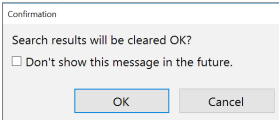
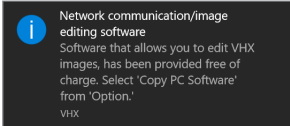
1 Click  to select [Options].

The [Options] dialog box appears.

### Display settings

Specify the display settings.

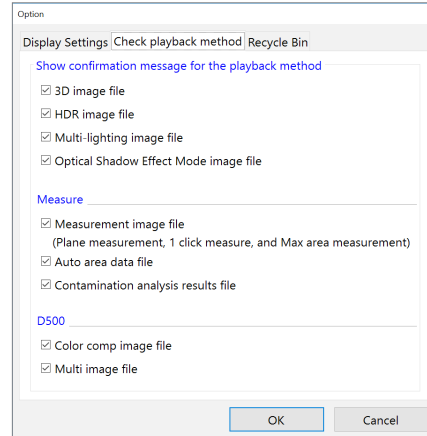



Item	Function
Display Mode	<ul style="list-style-type: none"> <li>• <b>Show all files</b> All files are displayed in "Files window".</li> <li>• <b>Selected File types only</b> Select the file type (extension) to be displayed in "Files window".</li> </ul>
Show file properties in pop-up when the thumbnail specified.	<p>Placing the mouse cursor over a thumbnail displays the properties for that file.</p> 
Confirm before deleting search results.	<p>After viewing thumbnails of the search results, navigating to another folder clears the search results. A confirmation message appears.</p> 
Keep the display order when navigating folders	<p>Turn this option ON to apply the same display order to all folders.</p>
Show the message for copying the PC software	<p>This [Copy PC Software...] message appears when you insert a memory device in the USB port.</p> 

### Confirmation of playback method

When playing back a selected file, set whether to display the [Confirm file playback] message.

The target file is played automatically if checking off.



For details of each file confirmation message, refer to  "Playing Files" (Page 11-5).

### Recycle Bin

Click on [Empty Recycle Bin] to delete the files in the recycle bin.

 **Point Deleted files cannot be recovered.**

## Copy PC Software

This allows you to copy the software for viewing and basic measuring so that it can be installed on a remote PC.


1 Click  to select [Copy PC Software].

[Browse For Folder] appears.

2 Select the destination folder and click [OK].

## Explorer

This launches Explorer, included with Windows 10.

 **Important** The album function on this microscope treats and displays "D:\CommonData" as the "Data folder", and "D:\Personal\ (Compute name) \VHX\_Admin\ Documents " as the "Documents" folder. If these folders are changed, the applications for the VHX-7000 may not function properly.

# Report Output

This function generates images and file information using pre-formatted templates for Excel. It allows you to easily create formatted reports.

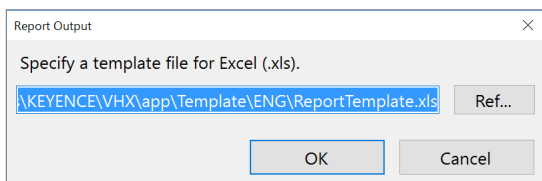
**Point** Excel must be installed in order to use the Report Output function. For the application installation, refer to [ ] “Temporarily Disabling System Protection” (Page 12-3).

## 1 Select an image for which you wish to generate a report.

## 2 Click Report Output

The [Report Output] dialog box appears.

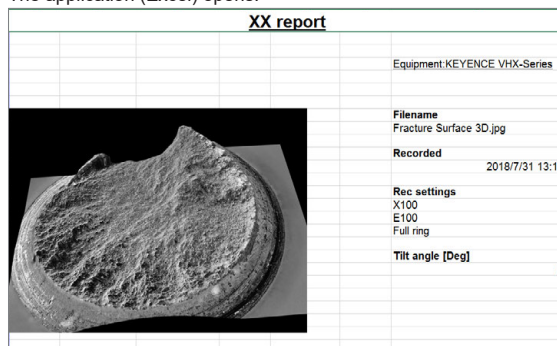
## 3 Select a template to use.



**Reference** Standard templates are stored in this folder. C:\Program Files\KEYENCE\VHX\app\Template\ENG You can also create and save your own templates using Excel.

**Point** Output of multiple images is supported. With this output format, multiple reports are included in one book. The format of the title pages of the images cannot be changed.

The application (Excel) opens.



## Quick placeholders for templates

The quick placeholders allow you to import the properties displayed for an image file in your template.

Keyword	Content displayed	VHX Image file	Non-VHX Image file	Image file with CSV data	Measure results CSV file
[image]	Image	✓	✓	✓	×
[lensname]	Lens name like "VH-Z20" etc.	✓	×	✓	×
[lenspower]	Lens power	✓	×	✓	×
[lighting]	Lighting	✓	×	✓	×
[title]	Title file property	✓	×	✓	×
[subtitle]	Subtitle file property	✓	×	✓	×
[creator]	Creator file property	✓	×	✓	×
[company]	Company/org:file property	✓	×	✓	×
[workgroup]	Workgroup file property	✓	×	✓	×
[comment]	File property comment	✓	×	✓	×
[measurement]	Measurement result	×	×	✓	✓
[datecreated]	Date recorded (date created)	✓	✓	✓	✓
[filename]	Filename	✓	✓	✓	✓
[tiltangle]	Tilt angle	✓	×	✓	×

✓ : this file type supports this quick placeholder.  
 × : this file type does not support this quick placeholder.

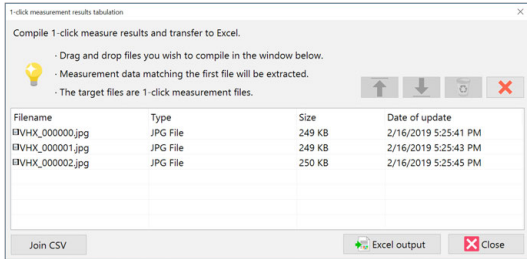
# Measurement Results Tabulation

This function combines one-click automatic measurement results in Excel.

**1 Click**  .

The [1-click auto measurement results tabulation] dialog box appears.

**2 Drag & drop files that were captured with the one-click automatic measurement to add them.**



**3 Click [Excel output].**

The summary results appear in Excel.

No.	1	2	3	4		
Measure	Lines	Diameter	Angle	Radius	Count	
Unit	$\mu\text{m}$	$\mu\text{m}$	Deg	$\mu\text{m}$	pcs	
20190221	1522.26	1073.21	89.24	155.91	0	
20190221	1550.63	1065.64	89.07	178.07	0	
20190221	1577.91	1074.14	89.36	173.82	0	

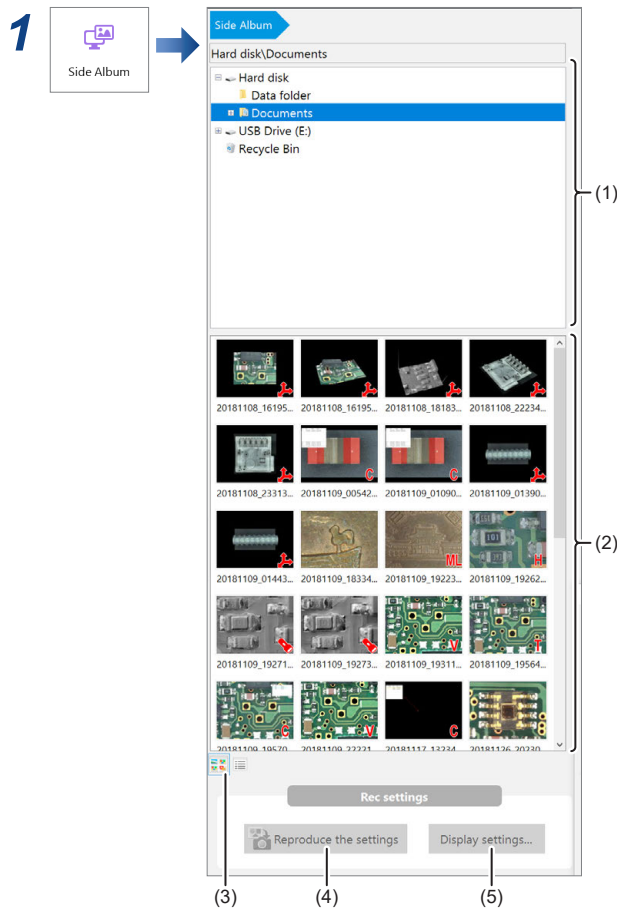
**Reference** By clicking [Join CSV], measurement results of individual files added to the [1-click auto measurement results tabulation] dialog box can be saved together as a CSV file.

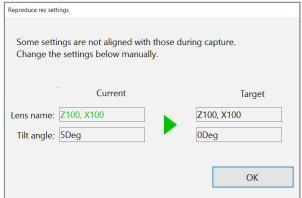
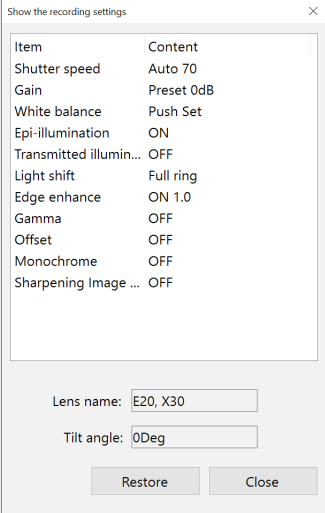



# Side Album

The side album displays thumbnails next to the observation window. This allows you to rearrange images seamlessly without launching the album function.

## Names and Functions of the Side Album



(4) Reproduce rec settings	<p>The settings used during recording can be applied to the observed image. Only the conditions shown in the [Display settings] can be applied.</p> <p>If the lens, magnification, or tilt angle is different, a dialog box to ask to adjust the settings will appear.</p> 
(5) Display settings	<p>This shows the settings used when the image was recorded. Click [Restore] to load the recording settings.</p> 

(1)	Select Folder	This is a tree view of the folders on the hard disk or other storage devices.
(2)	Filename	<p>The files in the selected folder are displayed.</p> <p>Right-click over the preview image to display a menu.</p> <ul style="list-style-type: none"> <li>• <b>Playback</b> The image is played in the observation window as a 2D image. Files to be displayed are "JPEG" and "TIF".</li> </ul> <p> <b>Point</b> <u>The side album does not support 3D playback, video playback, or CSV files. These files must be played from the [Album].</u></p> <ul style="list-style-type: none"> <li>• <b>Cut</b> Cuts the selected file.</li> <li>• <b>Copy</b> Copies the selected file.</li> <li>• <b>Paste</b> Pastes the cut/copied file.</li> <li>• <b>Rename</b> This changes the filename.</li> <li>• <b>Delete</b> This command moves the selected folder or file to the recycle bin.</li> </ul>
(3)	Switching display	Switch the files display method (thumbnail display/detail display).

## Playing Images

- The following methods can be used to playback selected files.
- Click [Playback] from the mouse right-click menu.
  - Double-click over the preview image.
  - Drag & drop the image to observe onto the observation window.

## MEMO

# 12

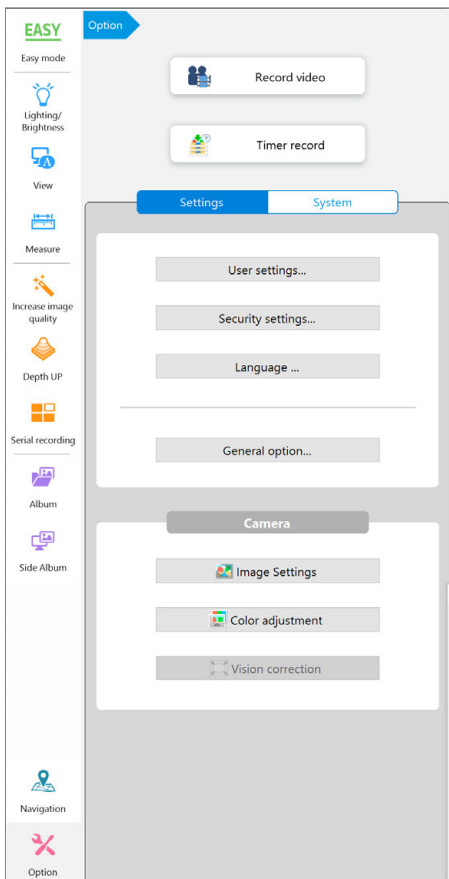
## Options

### How to configure the operating environment and network communication settings.

Refer to the following for the video recording and timer recording.

📖 "Video Recording" (Page 4-6)

📖 "Timer Record" (Page 4-9)



### Settings . . . . . 12-2

Displaying the [Settings] Menu . . . . . 12-2

User Settings. . . . . 12-2

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Camera Direction Setting . . . . . 12-19

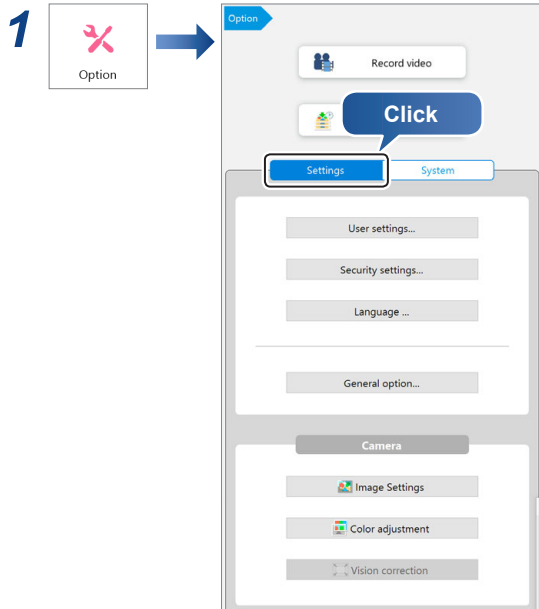
Electric Revolver Settings . . . . . 12-19

Z Stage Power . . . . . 12-20

# Settings

Configuring the microscope's operating environment.

## Displaying the [Settings] Menu



### 2 Click the button for the setting item.

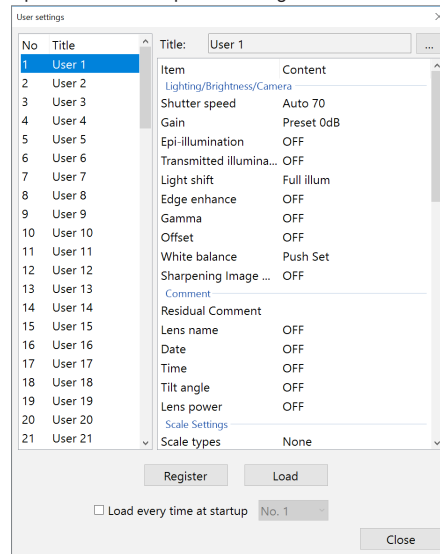
- ☐ "User Settings" (Page 12-2)
- ☐ "Security Settings" (Page 12-3)
- ☐ "Language" (Page 12-7)
- ☐ "General Option" (Page 12-8)
- ☐ "Image Settings" (Page 12-9)
- ☐ "Color Adjustment (White Balance)" (Page 12-11)
- ☐ "Vision Correction" (Page 12-12)

**Point** The item which can be set varies according to the connecting camera unit.

## User Settings

This microscope can store the setup (camera, recording, and options) for each user.

Up to 100 user setups can be registered and recalled.



## Registering a user setup

**Point** The user setup function registers the current settings of the microscope. Adjust each function on the microscope beforehand, then register the settings.

### 1 Click [User Settings] on the [Settings] menu.

- ☐ "Displaying the [Settings] Menu" (Page 12-2)

### 2 Select the [User Settings] to register under.

### 3 Specify [Title], such as the observation name or observer's name for later reference.

### 4 Click [Reg.Settings].

This registers the current settings. The following items will be registered.

Item	Contents
Lighting, Brightness/ Camera	Shutter speed
	Gain
	Epi-illumination
	Transmitted illumination
	Light shift
	Edge enhance
	Gamma
	Offset
	White balance
	Vivid & sharp image mode

Item	Contents
Comment	Residual Comment
	Lens name
	Date
	Time
	Tilt angle
	Magnification
Scale Settings	Scale types
	Scale Width
General option settings	Sound function
	JPEG Compress
	Power button
Lens settings	Lens power
Rec settings	Automatically save mode
	Folder
	File format
	Filename prefix
Timer record	Folder
	File format
	Filename prefix

## Recalling a user setup

### 1 Click [User Settings] on the [Settings] menu.

☐ "Displaying the [Settings] Menu" (Page 12-2)

### 2 Select [User Settings] and click [Load].

The loaded settings are reflected on the observation window.

**Reference** If [Load every time at startup] is ON, the user setup loaded at this unit launching can be specified.

## Security Settings

The microscope has been set with protection enabled to prevent changes from being made to the internal system. This protection must be disabled to configure the system for connecting external devices, network settings, etc.

## Temporarily Disabling System Protection

**Point** The following items can be configured or installed by temporarily disabling the system's protection. Operation of the microscope is not guaranteed if any other settings or installations are made.

- FTP and share folder settings
- Network settings (IP address settings)
- Printer driver installation
- Language, country and region settings

### 1 Click [Security settings] on the [Settings] menu.

☐ "Displaying the [Settings] Menu" (Page 12-2)

The security administration password input dialog appears.

### 2 Enter the password and click [OK].

The password is preset to "VHX" (half-width characters all caps) at the time of shipping.

A dialog box titled "VHX" with a text input field for "Security admin password:" and "OK" and "Cancel" buttons.

The Network/Security settings dialog appears.

A dialog box titled "Network/Security settings" with the following sections:
 

- System protection settings:** "System protection: Enabled".
  - Install a new program or a driver
    - Install a driver or adjust network settings (Cancel the system protection temporarily.)
    - Install a new program (Permanently disable system protection.)
- Set the calibration password:**
  - Use password
  - Calibration password: [input field]
  - Password confirmation: [input field]
- Change security admin password:**
  - Security password: [input field]
  - Password confirmation: [input field]

 "OK" and "Cancel" buttons are at the bottom.

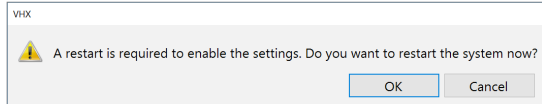
### 3 Check the [Install a new program or a driver] option, and select [Install a driver or adjust network settings], and click [OK].

The confirmation window appears.

A dialog box titled "VHX" with a warning icon and the text: "The system protection will be canceled temporarily. To prevent computer viruses, disconnect the LAN cable (if any)." and a "Confirmation" button.

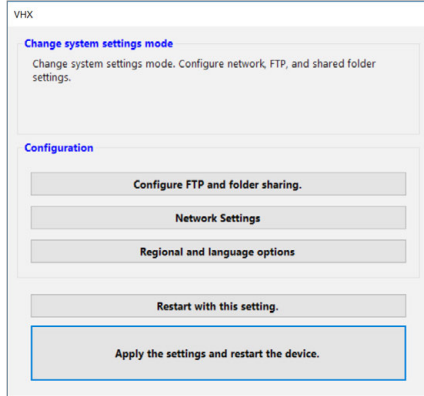
**4 Confirm that the LAN cable is removed, and click [Confirm].**

You will be prompted to restart the system.



**5 Click [OK].**

The system will start up with the system protection temporarily disabled and the following dialog will appear: "This mode cancels the system protection temporarily".



**Installing drivers**

**1 Temporarily disable system protection.**

☐ "Temporarily Disabling System Protection" (Page 12-3)

**2 Install the driver as documented in the manual for the external device you wish to install.**

<b>NOTICE</b>	If the installation process prompts you to restart the OS, select [Cancel] and let the installer finish. Then select [Restart with this setting] from the VHX MENU .
---------------	--

**3 When the installation completes, click [Protect the system and return to normal operation.] .**

The microscope will restart.

**Configuring FTP and File-Sharing**

**Point** Password entry is required to use the FTP and file-sharing features.

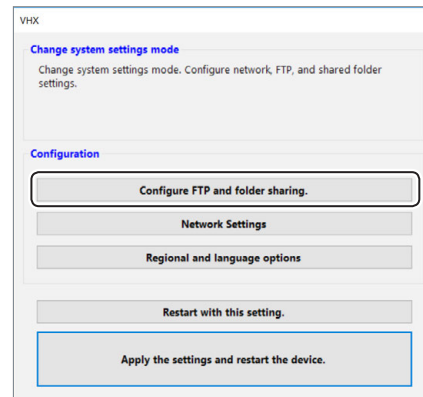
**Reference** The following folders are used by the FTP server and for network sharing.

- FTP server function:  
D:\CommonData will be made public.
- File sharing:  
D:\CommonData will be shared as [DataFolder].

**1 Temporarily disable system protection.**

☐ "Temporarily Disabling System Protection" (Page 12-3)

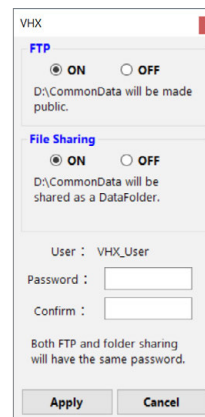
**2 Click [Configure FTP and folder sharing].**



The [FTP] and [File Sharing] settings dialog appears.

**Point** The user name cannot be changed.

**3 Select the [ON(do)]/[OFF(do not)] options for FTP and file sharing.**



**4 Specify a password for FTP and file sharing, as necessary.**

Passwords are case-sensitive. This password is necessary to connect to the microscope. Be sure to record it and store it in a safe place.

**Point** The network settings (Page 12-5) must be configured in order to use the FTP server.

**5 Click [Reflect settings to reboot.] .**

The system restarts.

**6 Access the microscope from a PC using the FTP server and/or file sharing.**

## Configuring the Network

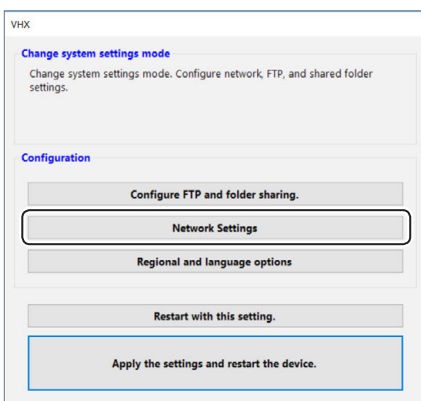
### Point

- Before connecting the microscope to an internal LAN, ask your system administrator to assign an IP address to the microscope. Also find out the subnet mask and default gateway address. Using incorrect or illegal settings will prevent communications and may interfere with the internal LAN.
- To connect peer-to-peer between a PC and this unit, use a crossed cable. Please set any values for the IP address by IPv4 within the range from 192.168.0.1 to 192.168.0.254. (Ex)
  - This unit IP address: 192.168.0.1
  - PC IP address: 192.168.0.2, subnet mask: 255.255.255.0
- Use a category 5 or higher LAN cable if using a 10BASE-T/100BASE-TX connection, or category 5e or higher LAN cable for a 1000BASE-T connection.

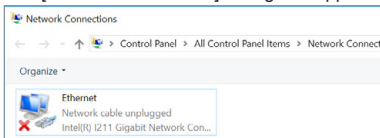
### 1 Temporarily disable system protection.

☐ "Temporarily Disabling System Protection" (Page 12-3)

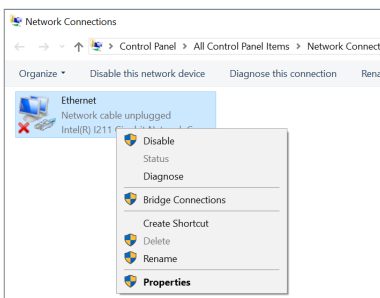
### 2 Click [Network Settings] .



The [Network Connection] dialog box appears.

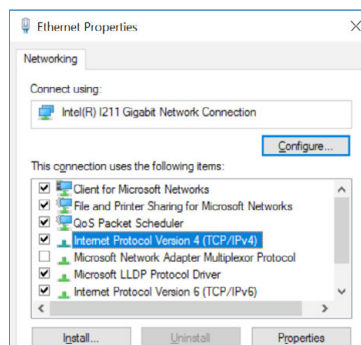


### 3 Right-click [Local Area Connection] and select [Properties].



The [Local Area Connection Properties] dialog box appears.

### 4 Select [Internet Protocol Version 4 (TCP/IPv4)], and click [Properties].



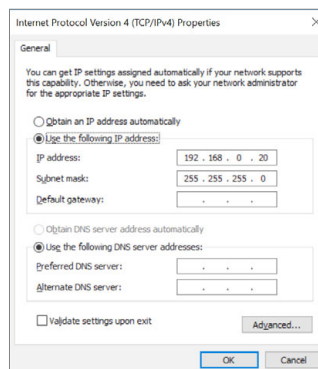
This displays [Internet protocol version 4 (TCP/IPv4) properties].

### Reference

TCP/IPv4 is explained below as example.

- For a peer-to-peer connection, select [Internet protocol version 4 (TCP/IPv4)].
- If TCP/IPv6 has been specified when the microscope is connected to an internal LAN, select [Internet protocol version 6 (TCP/IPv6)].

### 5 Specify the IP address, subnet mask, and default gateway, and click [OK].

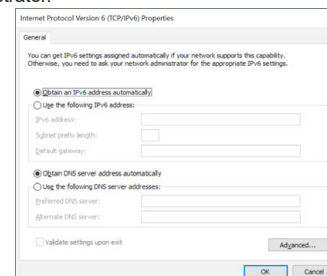


	LAN connection	Peer-to-peer connection example
IP address		192.168.0.1
Subnet mask	Specify the value provided by your system administrator.	255.255.255.0
Default gateway		Not required

For a peer-to-peer connection, set the PC's IP address to 192.168.0.2, and the subnet mask to 255.255.255.0.

### Reference

When using TCP/IPv6, the following window appears. For the details of setting contents, ask your system administrator.



### 6 Close the [Network Connection] dialog.

### 7 Click [Reflect settings to reboot.] .

The microscope will restart.

## Completely disabling system protection

To install applications that run on Windows 10, it is necessary to disable system protection completely.

<b>NOTICE</b>	<p>Once system protection is disabled, the system cannot be returned to a protected state. This means that system files will no longer be writeprotected. Be sure to install commercially available virus protection software. Connecting to a network or inserting an external memory device without virus protection software installed increases the risk of infection.</p> <p>Some applications may affect the VHX software and cause malfunctions. Users are responsible for verifying the operation of such applications, and shall use them at their own risk.</p>
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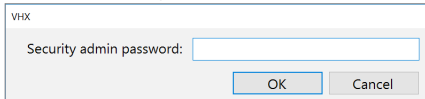
### 1 Click [Security settings] on the [Settings] menu.

☞ "Displaying the [Settings] Menu" (Page 12-2)

The security administration password input dialog appears.

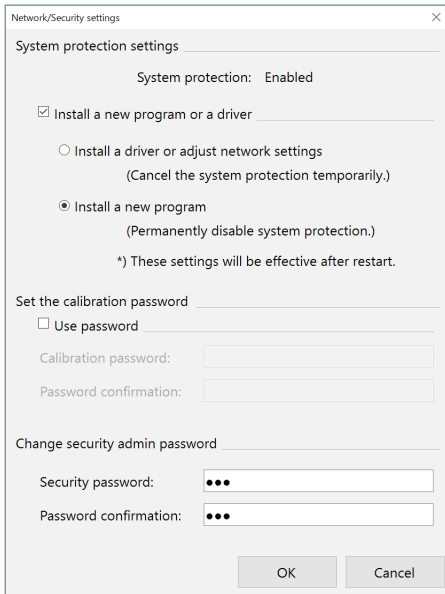
### 2 Enter the password and click [OK].

The password is preset to "VHX" (half-width characters all caps) at the time of shipping.

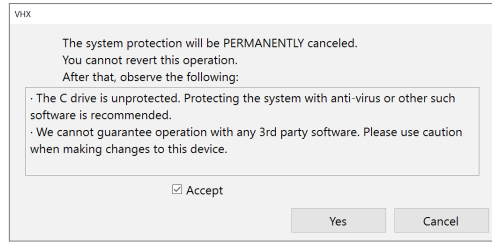


The Network/Security settings dialog appears.

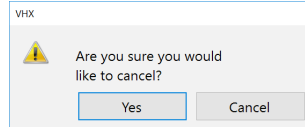
### 3 Check the [Install a new program or driver] option, and select [Install a new program], and click [OK].



### 4 Read the warning on the dialog carefully. If you accept the risks, check the checkbox and click [Yes].

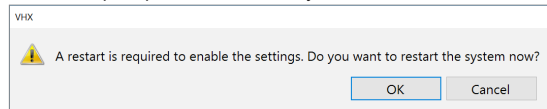


The following dialog appears.



### 5 Click [Confirmation].

You will be prompted to restart the system.



### 6 Click [Yes].

The system will restart with the system protection disabled.

<b>NOTICE</b>	The system will restart several times. Do not turn the main power off during this time.
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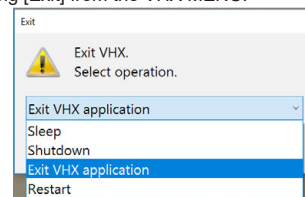
### 7 Install the application as necessary.

**Point** If the system protection is disabled completely, the system may prompt you for the ID and password when the VHX-7000 starts up. If prompted, enter the ID and password shown below.

- ID : VHX\_Admin
- Pass : VHXADMIN

**Reference** The following menus will change when system protection is completely disabled.

- You can now choose to [Exit VHX application] by clicking [Exit] from the VHX MENU.



- The IP address, FTP, and share folder settings should be configured using the functions provided with Windows 10. These functions are accessed by clicking [Exit] from the VHX MENU and selecting [Exit application].



## Setting the calibration password

A password can be set in order to set or change the calibration.

Click [OK] and restart the microscope to make this setting take effect.

### Point

- **Once you set the calibration password, you will need to enter it in order to change the calibration settings.**
- **Record and store the calibration password in a safe place.**

## Changing the security administration password

Specify a password to allow installation of a driver or to configure network settings and communication software settings. Click [OK] and restart the microscope to make this setting take effect.

### Point

- **Once you set the security administration password, you will need to enter it in order to change the Network/Security Settings.**
- **Record and store the security administration password in a safe place.**

## Language

You can change the display language of the microscope. The following procedure is an example to switch the display language to Japanese.

### 1 Click [Language] on the [Settings] menu.

☐ "Displaying the [Settings] Menu" (Page 12-2)  
The language selection dialog appears.

### 2 Select the language to display (in this case [Japanese]) and click [OK].

The confirmation window appears.

### 3 Click [OK].

After restarting, the display language of this unit changes.

# General Option

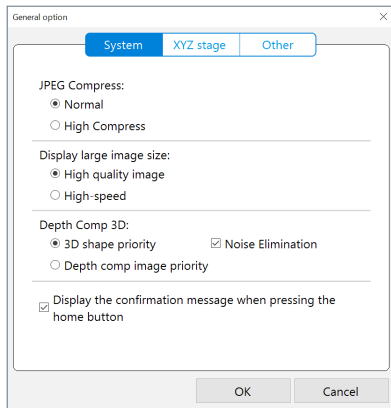
These settings configure the common operating settings for the microscope.

## 1 Click [Option...] on the [Settings] menu.

☞ "Displaying the [Settings] Menu" (Page 12-2)

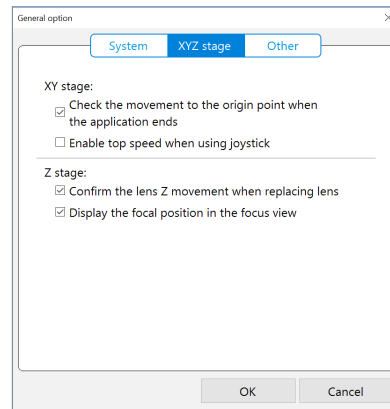
The [Option...] dialog box appears.

### ● [System] tab



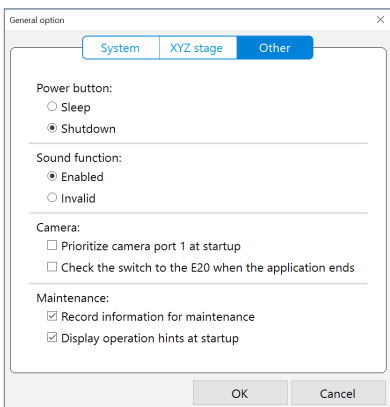
Item	Function
JPEG Compress	Specify the compression ratio to use when recording (saving) JPEG formats. (Default: Normal mode) <ul style="list-style-type: none"> <li>Typically, file compression should be set to [Normal] mode.</li> <li>While [High compression] reduces the size of the data file, it results in lower picture quality.</li> </ul>
Display large image size	Select the mode for when displaying images with large size. (Default: High-quality image) <ul style="list-style-type: none"> <li>For better picture quality, select [High quality image].</li> <li>For faster display speed, select [High-speed].</li> </ul>
Depth Comp 3D	When creating depth composition images, select whether to give priority to 3D form or depth composition image. (Default: 3D shape priority) <ul style="list-style-type: none"> <li>Noise Elimination This option is active only when the 3D shape priority is active. Noises that will occur during the 3D composition are suppressed.</li> </ul>
Display the confirmation message when pressing the home button	This is to set whether to display the confirmation message when pressing the [Home] button on the console.

### ● [XYZ stage] tab



Item	Function
XY stage	<ul style="list-style-type: none"> <li>Check the movement to the origin point when the application ends (Default: ON)</li> <li>Enable top speed when using joystick (Default: OFF)</li> </ul>
Z stage	<ul style="list-style-type: none"> <li>Confirm the lens Z movement when replacing lens (Default: ON)</li> <li>Display the focal position in the focus view (Default: ON)</li> </ul>

● Others



Item	Function
Power button	<ul style="list-style-type: none"> <li>• Sleep The sleep stores the system status in the internal memory and terminates the system. The next startup will require a shorter time because the status is loaded not from the hard drive but from the internal memory. In the sleep status, the system continue to supply power to the internal memory to store the status. If the main switch on the left side of the product is turned OFF or the power cable is pulled out, the system will follow the usual startup procedure. When you do not use this product for long period of time, turn off the power switch and pull out the power cable.</li> <li>• Shutdown (Default) This option shuts down the power to the system completely.</li> </ul>
Sound function	The sound function is not used when selecting [Invalid]. (Default: Enabled)
Camera	<ul style="list-style-type: none"> <li>• Prioritize camera port 1 at startup (Default: OFF)</li> <li>• Check the switch to the E20 when the application ends (Default: OFF)</li> </ul>
Maintenance	<ul style="list-style-type: none"> <li>• Record information for maintenance (Default: ON)</li> <li>• Display operation hints at startup (Default: ON)</li> </ul>

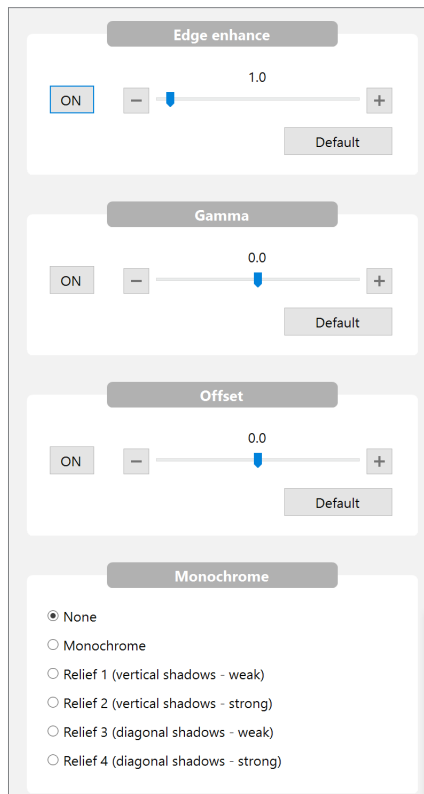
## Image Settings

### 1 Click [Image settings] on the [Settings] menu.

☞ "Displaying the [Settings] Menu" (Page 12-2)

The setting menu of the image settings appears.

### 2 Sets the image correction method.

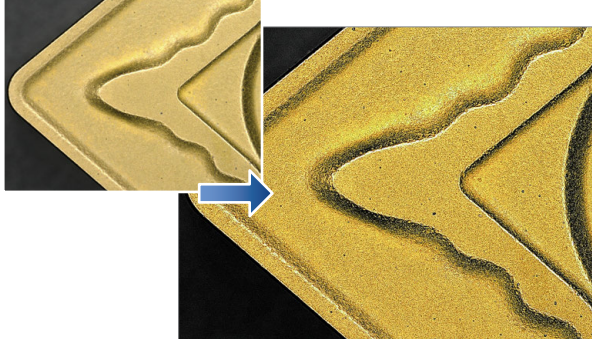


## Edge enhance

This section explains the edge enhancement effect. Edge enhance makes scratches and minute features more noticeable by emphasizing the edges in the image.

**Point** [Edge enhance] cannot be used together with the relief function of [Monochrome].

The following occurs when the edge enhancement is ON.

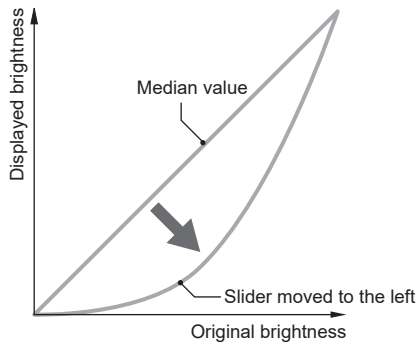


## Gamma

This section explains how [Gamma correction] corrects the contrast of the light or dark areas of an image.

Gamma correction works as follows:

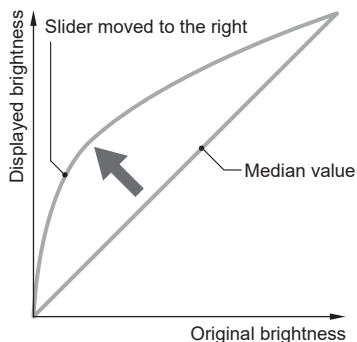
### ● Emphasizing the bright areas



Dragging the slider to the left emphasizes the contrast and gradation of the bright areas.

**Point** This is useful for increasing the contrast of images that appear saturated white or lack gray-scale definition because they are too light.

### ● Emphasizing the dark areas



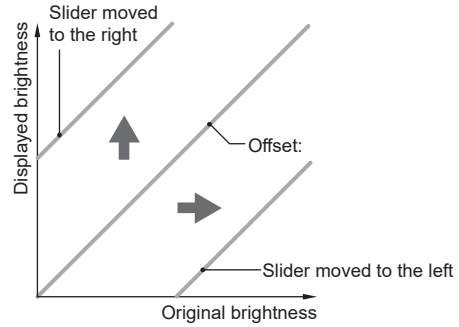
Dragging the slider to the right emphasizes the contrast and gradation of the dark areas.

**Point** This is useful for increasing the contrast of images that lack gray-scale definition because they are too dark.

## Offset

This section explains [Offset adjustment] which adjusts the brightness and darkness of the overall image.

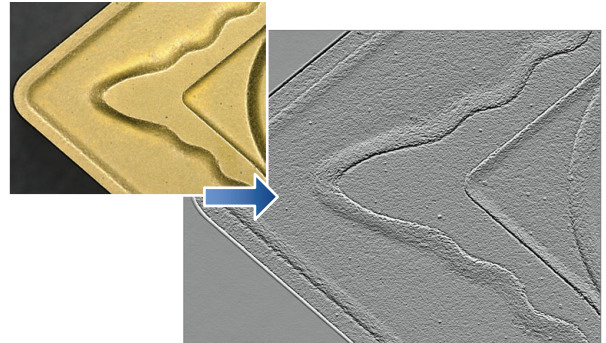
In the offset adjustment, dragging the slider to the right makes the overall image brighter (whiter). Dragging it to the left makes the overall image darker (black).



## Monochrome

This section explains the special effect images (monochrome and relief).

### [Relief 2]



### Monochrome

This effect allows observation without the influences of color.

**Point** The [Monochrome] effect is only applied to the image observed by the camera. Image files saved in color can be processed with the monochrome effect, but not displayed in monochrome.

### Relief

The relief effect highlights areas of the image where the brightness changes, making it easy to observe scratches and minute features.

Relief 1	Displays the shadow from above and below (weak)
Relief 2	Displays the shadow from above and below (strong)
Relief 3	Displays the shadow from an angle (weak)
Relief 4	Displays the shadow from an angle (strong)

## Color Adjustment (White Balance)

This section explains how to adjust the white balance of the screen.

The white balance is adjusted by the [WHITE BALANCE] button on the console, or [WHITE BALANCE] on the VHX MENU.

Normally, this adjustment is made using the [WHITE BALANCE] button on the console. To make detailed adjustments, use [WHITE BALANCE] from the VHX MENU.

### Adjusting on the Console

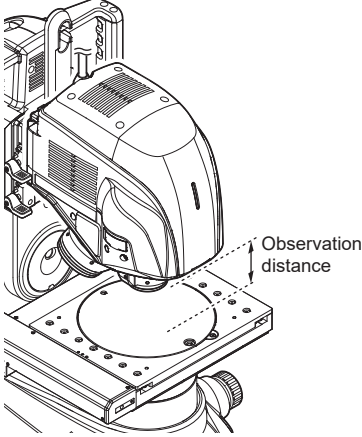
#### 1 Make the lens to a magnification that is appropriate for the observation.

Turn the zoom ring on the lens, or adjust the magnification with "information view" of the VHX MENU.

#### 2 Place a white object on the stage and focus on the object.

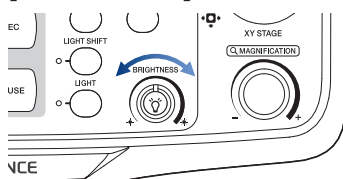
The observation distance is set according to the lens used.

Lens model	Observation distance
VH-Z00R/T	95 mm
VH-Z20R/T	25.5 mm
VH-Z20UR/T	20.8 mm
VH-Z100R/T	25 mm
VH-Z100UR/UT	25 mm
VH-Z250R/T	6.5 mm
VH-Z500R/T	4.4 mm
VH-Z50L/T	85 mm
VH-ZST	15 mm
VHX-E20	30 mm
VHX-E100	24 mm
VHX-E500	6.3 mm
VHX-E2500	1 mm



**Reference** Use an object with a matte white surface (such as copy paper) for best results.

#### 3 Adjust the image brightness by turning the [BRIGHTNESS] dial on the console.

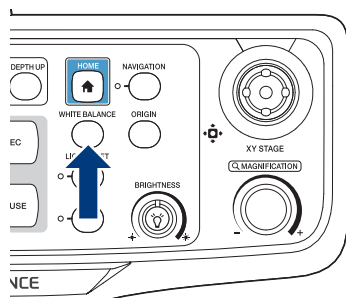


Adjust the image to the appropriate brightness.

☐ "Adjusting the Brightness and Focus" (Page 3-4)

**Point** Adjust to prevent the image from becoming so bright that the image is saturated.

#### 4 Press the [WHITE BALANCE] button on the console.



This will adjust the white balance.

### Adjusting with VHX MENU

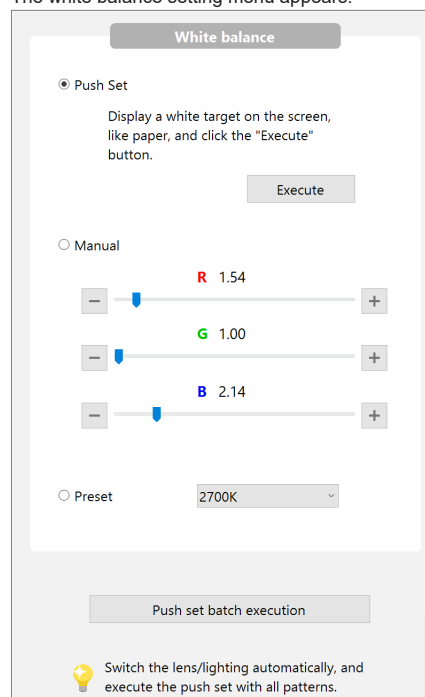
To adjust the white balance in greater detail, use [Options] - [Color adjustment] from the VHX MENU.

**Point** [Push Set] performs the same operation as the [WHITE BALANCE] button on the console.

#### 1 Click [Color adjustment] on the [Settings] menu.

☐ "Displaying the [Settings] Menu" (Page 12-2)

The white balance setting menu appears.



Push Set	This mode adjusts the white balance when the user clicks the [Execute] button while observing a white object.
Auto	This mode automatically adjusts the white balance to the image being displayed. Auto mode reduces color variation caused by changes in the lighting environment which can occur, for instance, when the timer is used to capture images for extended period of time.
Manual	Adjust the white balance as desired by dragging each slider of R/G/B while viewing the target.
Preset	Select the color temperature according to the lighting and environment. <ul style="list-style-type: none"> <li>2700 K: For imaging under an incandescent lamp.</li> <li>3200 K: For imaging under a halogen lamp.</li> <li>5600 K: For imaging under sunlight during the day.</li> <li>9000 K: For imaging in shaded light on a clear day.</li> </ul>

#### 2 Adjust the white balance by selecting either of [Push set], [Auto], [Manual], [Preset].

##### ● Push set batch execution

This can be executed when using the Fully-Integrated (FI) Head (VHX-7100) and High-Performance Camera (VHX-7020). Switch the lightning automatically, and execute the push set with all patterns to adjust the white balance.

## Vision Correction

Correction is made to the field-of-view of the image receiving element with 1/2 inches.

This is used when matching the magnification and field-of-view with the previous model.

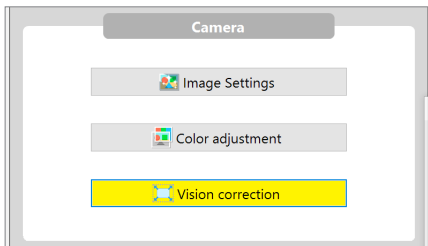


**This can only be set when the High-Performance Camera (VHX-7020) is connected.  
The view is corrected automatically in the case of the Fully-Integrated (FI) Head (VHX-7100).**

### 1 Click [Vision correction] on the [Settings] menu.

☐ "Displaying the [Settings] Menu" (Page 12-2)

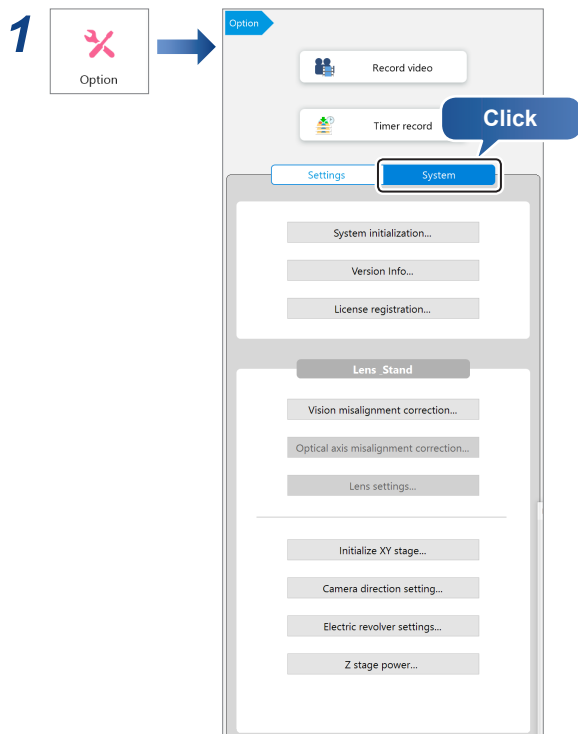
The button turns yellow and the corrected image appears in the observation window.



Click [Vision correction] again when releasing [Vision correction].

# System

## [System] Menu Display



### 2 Click the button for the setting item.

- "System Initialization" (Page 12-13)
- "Version Info" (Page 12-13)
- "License Activation" (Page 12-13)
- "Vision Misalignment Correction" (Page 12-14)
- "Optical Axis Misalignment Correction" (Page 12-16)
- "Lens Settings" (Page 12-18)
- "Initializing Automatic XY Stage" (Page 12-18)
- "Camera Direction Setting" (Page 12-19)
- "Electric Revolver Settings" (Page 12-19)
- "Z Stage Power" (Page 12-20)

**Point** The item which can be set varies according to the connecting camera unit.

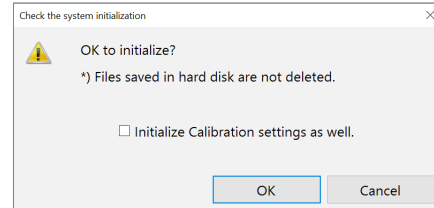
## System Initialization

Initialization resets the settings for each function from the VHX MENU to the factory defaults. It will also initialize all user setups at  "User Settings" (Page 12-2).

### 1 Click [System initialization] on the [System] menu.

"[System] Menu Display" (Page 12-13)

The [Confirm Initialization] dialog appears.



To reset the calibration values to the factory settings, select [Initialize Calibration settings as well.].

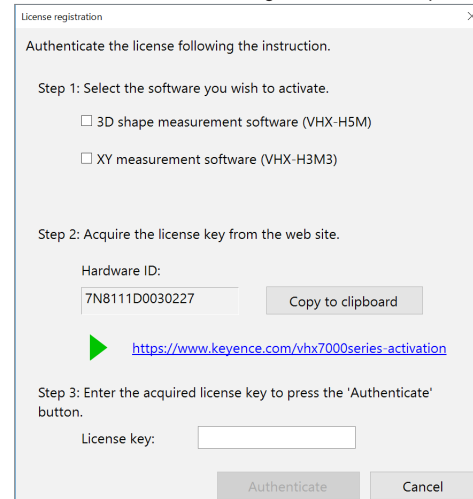
### 2 Click [OK].

## Version Info

This command allows you to confirm the version of the system. Use it to confirm the version when contacting KEYENCE, or to check for update availability.

## License Activation

Perform the license activation for the optional software. Refer to "Software License Registration" of each optional software.



## Vision Misalignment Correction

**Point** This can only be set when connecting the Fully-Integrated (FI) Head (VHX-7100) or high resolution zoom lens VH-ZST.

The stage position is corrected so that the field-of-view and focus do not change even if the objective lens is switched. This correction can be readjusted.

There is an automatic correction using a correction scale (chart) and a manual correction that can use arbitrary samples.

A correction value is calculated so as to provide the same field-of-view and focus for the multiple objective lenses by performing settings.

This section explains the settings when connecting the Fully-Integrated (FI) Head (VHX-7100).

Perform settings according to the [Vision misalignment correction] dialog box as well when connecting the high resolution zoom lens VH-ZST.

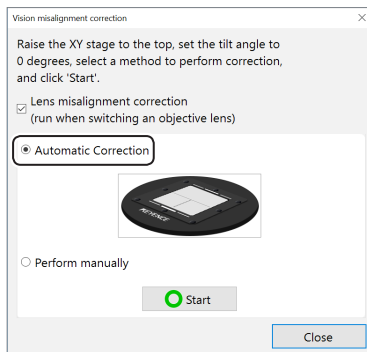
### Auto correction

#### 1 Click [Vision misalignment correction] on the [System] menu.

☐ "[System] Menu Display" (Page 12-13)

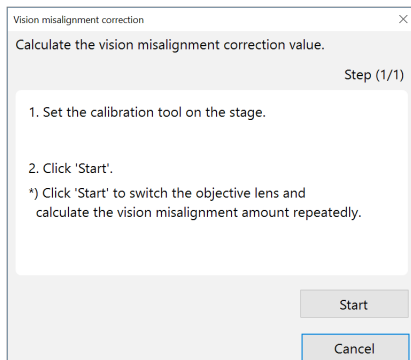
The [Vision misalignment correction] dialog box appears.

#### 2 Select [Automatic Correction (with transmitted illumination.)] and click [Start].

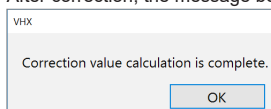


**Point** Uncheck [Vision misalignment correction (run when switching an objective lens)] if you do not want to activate the vision misalignment correction in switching the objective lens.

#### 3 Set the calibration tool on the stage, and click [Start].



After correction, the message below will appear.



#### 4 Click [OK].

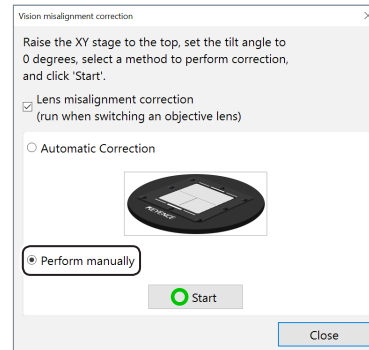
### Manual correction

#### 1 Click [Vision misalignment correction] on the [System] menu.

☐ "[System] Menu Display" (Page 12-13)

The [Vision misalignment correction] dialog box appears.

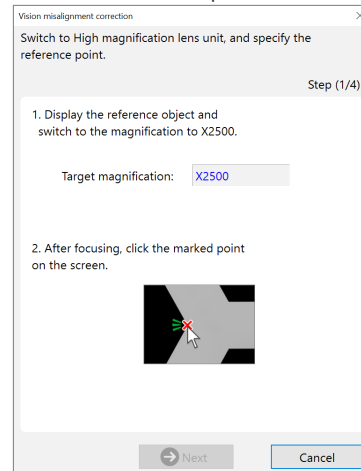
#### 2 Select [Perform manually] and click [Start].



**Point** Uncheck [Vision misalignment correction (run when switching an objective lens)] if you do not want to activate the vision misalignment correction in switching the objective lens.

#### 3 Perform settings of the highest magnification lens unit.

Switch to the magnification with 2500x. Align with the focus, then click on a characteristic part with the mouse.

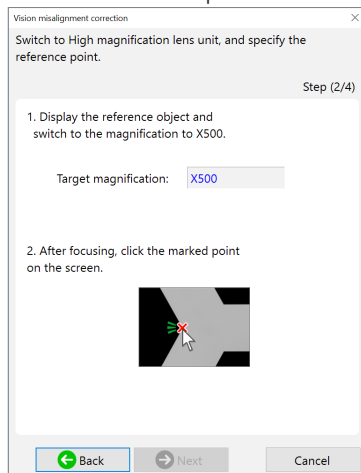


#### 4 Click [Next].



## 5 Perform settings of the high magnification lens unit.

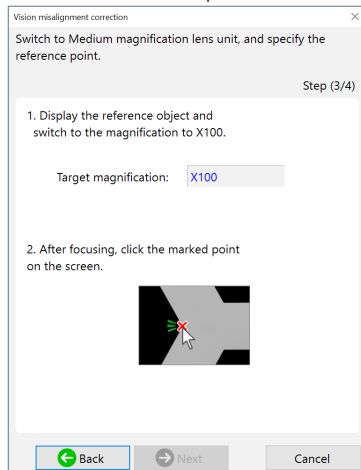
Switch to the magnification with 500x. Align with the focus, then click on a characteristic part with the mouse.



## 6 Click [Next].

## 7 Perform settings of the middle magnification lens unit.

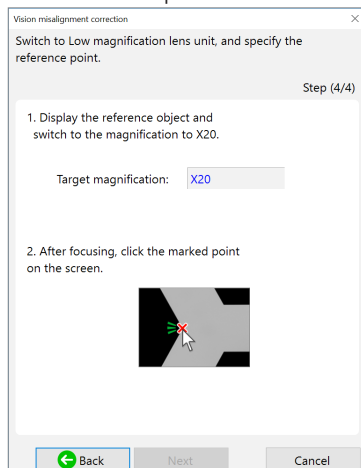
Switch to the magnification with 100x. Align with the focus, then click on a characteristic part with the mouse.



## 8 Click [Next].

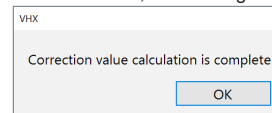
## 9 Perform settings of the low magnification lens unit.

Switch to the magnification with 20x. Align with the focus, then click on a characteristic part with the mouse.



## 10 Click [Next].

After correction, the message below will appear.



## 11 Click [OK].

## Optical Axis Misalignment Correction

**Point** This can only be set when the High-Performance Camera (VHX-7020) is connected.

The stage position is corrected so that the field-of-view and focus do not change if the lens power is changed with the zoom ring. This correction can be readjusted.

There is an automatic adjustment using a correction scale and a manual adjustment that can use arbitrary samples. A correction value is calculated so as to provide the same field-of-view and focus for the high- and low-power by multiple settings.

### Auto correction

Uncheck [Optical axis misalignment correction] if you do not want to activate the optical axis misalignment correction in switching the magnification with the zoom ring.

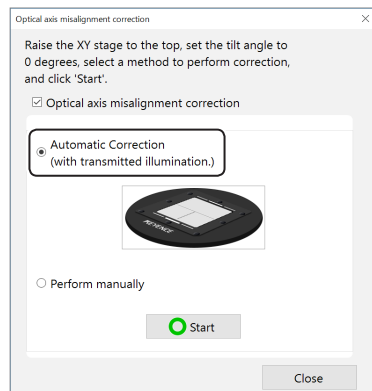
**Reference** Repeat the correction of high- and low-power twice to calculate the correction value.

#### 1 Click [Optical axis misalignment correction] on the [System] menu.

☐ "[System] Menu Display" (Page 12-13)

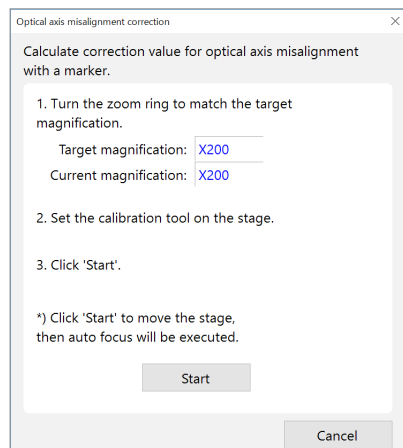
The [Optical axis misalignment correction] dialog box appears.

#### 2 Select [Automatic Correction (with transmitted illumination.)] and click [Start].



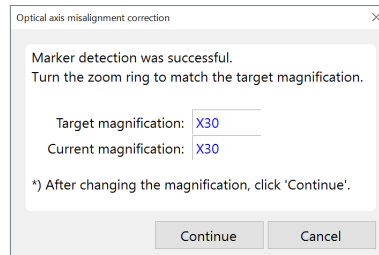
**Point** Uncheck [Optical axis misalignment correction] if you do not want to activate the vision misalignment correction in switching the magnification with the zoom ring.

#### 3 Set the lens magnification to [Target magnification] (high magnification). Set the calibration tool on the stage, and click [Start].



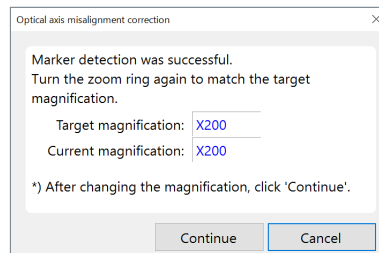
A message appears after detecting the marker.

#### 4 Set the lens magnification to [Target magnification] (low magnification), and click [Continue].



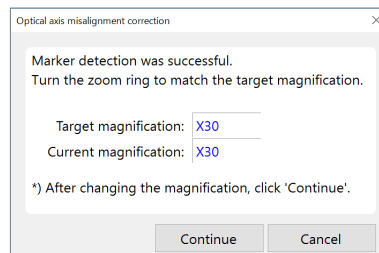
A message appears after detecting the marker.

#### 5 Set the lens magnification to [Target magnification] (high magnification) again, and click [Continue].

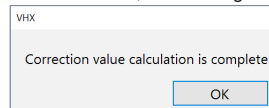


A message appears after detecting the marker.

#### 6 Set the lens magnification to [Target magnification] (low magnification) again, and click [Continue].



After correction, the message below will appear.



#### 7 Click [OK].

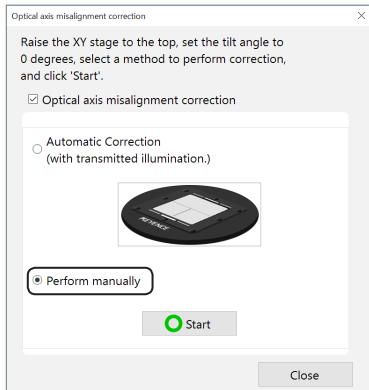
## Manual correction

### 1 Click [Optical axis misalignment correction] on the [System] menu.

☐ "[System] Menu Display" (Page 12-13)

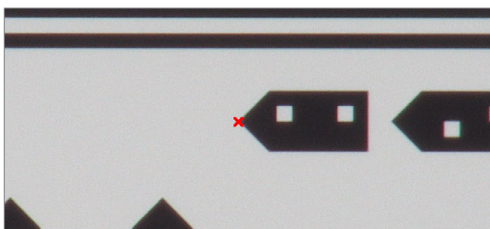
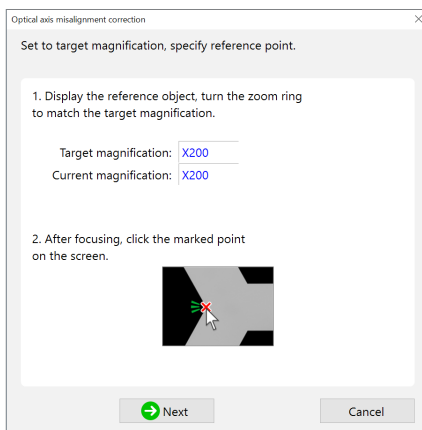
The [Optical axis misalignment correction] dialog box appears.

### 2 Select [Perform manually] and click [Start].

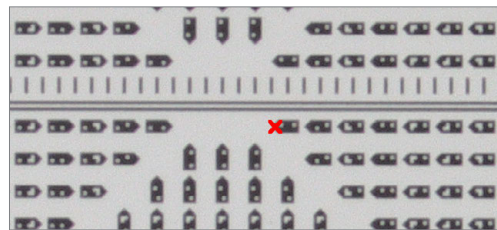
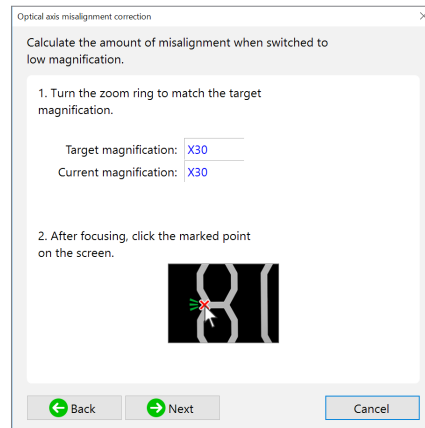


### 3 Place an arbitrary sample on the stage.

### 4 Set the lens magnification to [Target magnification] (high magnification), and click on a characteristic part with the mouse.

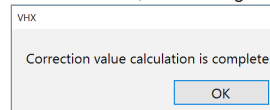


### 5 Set the lens magnification to [Target magnification] (low magnification), and click the same place as clicked for the high-power lens.



### 6 Setup the high- and low-power lenses again following the dialog.

After correction, the message below will appear.



## Lens Settings

**Point** This can only be set when the High-Performance Camera (VHX-7020) is connected.

Specify the type of lens to attach to the microscope. The microscope stores the calibration value, and push set value for white balance for each lens.

☞ “Calibration” (Page 7-5)

☞ “Color Adjustment (White Balance)” (Page 12-11)

The settings are reflected automatically if only selecting the objective lens in the lens settings at lens replacement.

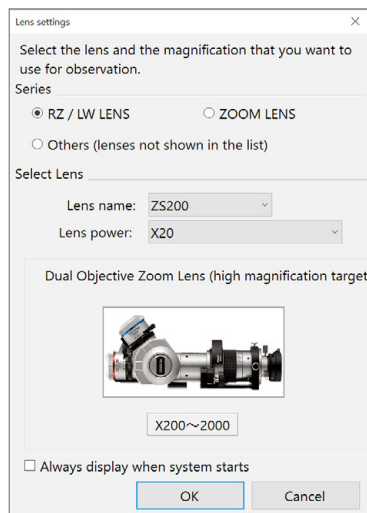
**Reference** The lens type and power is automatically recognized when a lens that supports the automatic lens/zoom recognition function is attached. [Lens Settings] are not required.

### 1 Click [Lens Settings] on the [System] menu.

☞ “[System] Menu Display” (Page 12-13)

The [Lens Settings] dialog box appears.

### 2 Select the lens to use and click [OK].



If the list does not include the model number for your lens, select [Optional Lens 1] or [Optional Lens 2].

#### ● Always display when system starts

The [Lens selection] screen appears when the application starts up.  
(Default: ON)

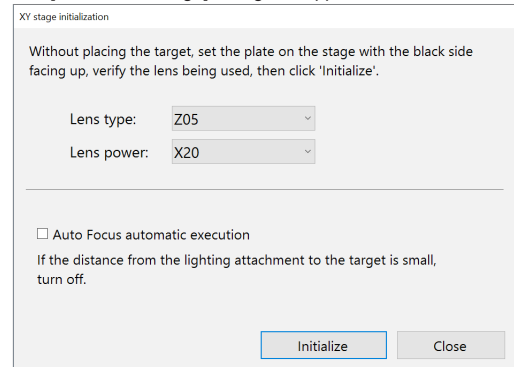
## Initializing Automatic XY Stage

Performs the  $\theta$  initialization of the stage.

### 1 Click [Lens Settings] on the [System] menu.

☞ “[System] Menu Display” (Page 12-13)

The [Initialize XY stage] dialog box appears.



### 2 With the black area of circular monochrome plate facing upward, place the plate on the stage.

### 3 Raise the XY $\theta$ stage as far as it can move up.

### 4 In the [Lens Settings], specify the type and power of the lens in use.

**Reference**

- The [Lens type] is recognized automatically when using the Fully-Integrated (FI) Head (VHX-7100).
- This procedure is not required for lenses that have the automatic lens/zoom recognition function, because [Lens type] and [Lens power] are detected automatically.

### 5 As needed, turn on the “Auto Focus automatic execution”.

### 6 Click [Initialize].

Then, the  $\theta$  initialization starts.

## Camera Direction Setting

For the Fully-Integrated (FI) Head (VHX-7100), image directions will be set. For the High-Performance Camera (VHX-7020), the mounting direction of the camera will be set.

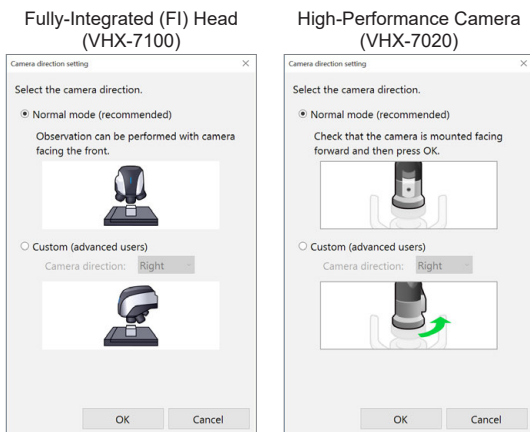
If, for example, the stage is to be tilted to the right, the mounting direction [Right] will provide more natural camera image.

### 1 Click [Lens Settings] on the [System] menu.

□ "System Menu Display" (Page 12-13)

The [Camera direction setting] dialog box appears.

### 2 Set the mounting direction of the camera.



#### ● Normal mode (recommended)

Check that the camera is mounted facing forward and then click [OK].

#### ● Custom (advanced users):

Select [Right]/[Left]/[Auto (Fully-Integrated (FI) Head only)] in harmony with the stand tilt direction, and click [OK].  
In the case of the High-Performance Camera, mount the camera to the set direction, then click [OK].

## Electric Revolver Settings

**Point** This can only be set when connecting the Fully-Integrated (FI) Head (VHX-7100).

Perform settings relating to the electric revolver of the Fully-Integrated (FI) Head (VHX-7100).

### Mounting the target lens

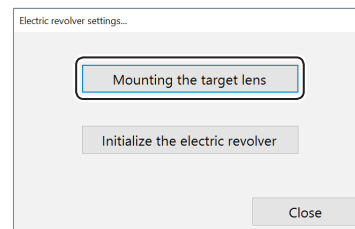
Rotate the electric revolver to remove and mount the objective lens.

### 1 Click [Electric revolver settings] on the [System] menu.

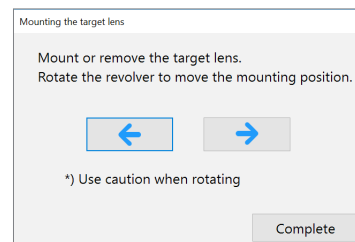
□ "System Menu Display" (Page 12-13)

The [Electric revolver settings] dialog box appears.

### 2 Click [Mount the objective lens].



### 3 Click [←]/[→] to mount and remove the objective lens.



**NOTICE**

Click [←]/[→] to rotate the revolver. Be careful that the objective lens does not touch the object.

## Initializing the Electric Revolver

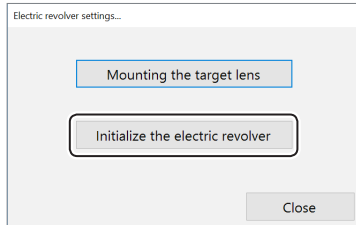
Initialize the electric revolver.

### 1 Click [Electric revolver settings] on the [System] menu.

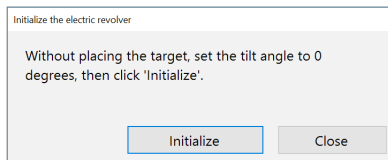
☐ "[System] Menu Display" (Page 12-13)

The [Electric revolver settings] dialog box appears.

### 2 Click [Initialize the electric revolver].



### 3 Check that there is no object on the stage, and set the stand tilt angle to 0, then click [Initialize].



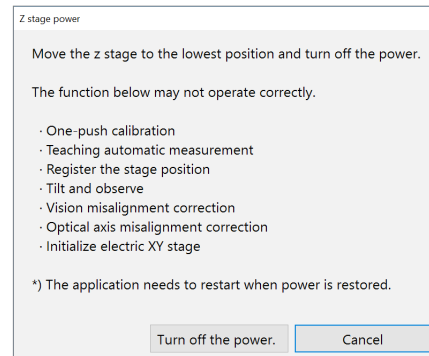
## Z Stage Power

Clear the excitation of the down Z stage of the stand (VHX-S770E/S750E).

### 1 Click [Z stage power] on the [System] menu.

☐ "[System] Menu Display" (Page 12-13)

The [Z stage power] dialog box appears.



### 2 Click [Turn off the power].

The power to the z stage is turned off and the stage moves down.

# 13

## Connecting to an External PC

### Methods to Connect the Microscope to a PC.

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# LAN Connection

Connecting the microscope to a PC via a LAN connection allows you to view and edit images recorded and stored on the microscope from the PC.

## Overview of LAN Connection

### ● VHX-7000 Communication Software

This software allows remote control operation of the microscope from a Windows-based PC, and provides file edit functions such as copy and delete.

### ● FTP server function

This function allows you to copy files between the microscope and a PC.

### ● File sharing function

File sharing provides Windows-based PCs with access to a shared folder on the microscope, allowing files to be copied to and from the microscope.

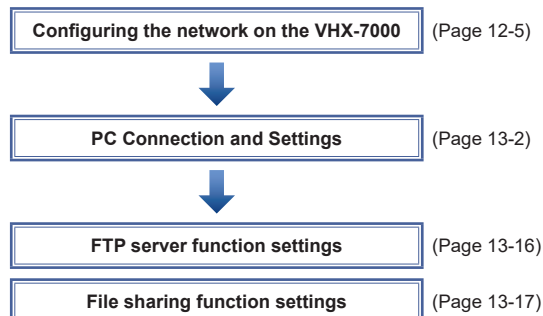
## Operating Environment of the PC

Supported operating systems	Windows 7 SP1 Windows 8.1 Update Windows 10
Processor	Intel Core™2 Duo E8400 or above
Memory	2 GB or more
Connection interface	PC must be equipped with one of these LAN ports: LAN (RJ-45 1000BASE-T/100BASE-TX/ 10BASE-T)
Display resolution	1280 x 1024 or higher
Hard disk drive	3GB or more
Graphics memory	256MB or more
Display colors	32 bits or more
Graphics chip	Support for Direct X11
Direct X	Version 11 or later
Others	CD-ROM drive or USB port

## Flow of Preparations

This section explains the flow of work to complete before acquiring image data via the LAN connection.

**Point** Before connecting the microscope to an internal LAN, ask your system administrator to assign an IP address to the microscope. Also find out the subnet mask and default gateway address.



## PC Connection and Settings

### Point

- Before connecting the microscope to an internal LAN, ask your system administrator to assign an IP address to the microscope. Also find out the subnet mask and default gateway address. Using incorrect or illegal settings will prevent communications and may interfere with the internal LAN.
- To connect peer-to-peer between a PC and this unit, use a crossed cable.  
Please set any values for the IP address by IPv4 within the range from 192.168.0.1 to 192.168.0.254.  
(Ex)
  - This unit IP address: 192.168.0.1
  - PC IP address: 192.168.0.2,  
subnet mask: 255.255.255.0
- Use a category 5 or higher LAN cable if using a 10BASE-T/100BASE-TX connection, or category 5e or higher LAN cable for a 1000BASE-T connection.

### 1 Configuring the network on the microscope.

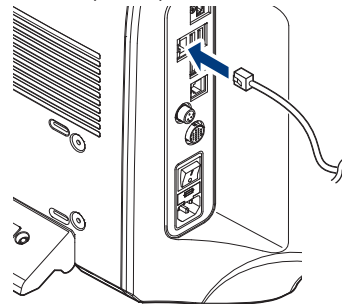
☐ "Configuring the Network" (Page 12-5)

### 2 Confirming the network settings on the PC.

### 3 LAN cable connection

Connect the LAN cable to the LAN port on the left side panel and the LAN port on the hub.

To connect the microscope to a LAN within a group, use a straight cable. To connect peer-to-peer with a PC, use a crossed cable.





# VHX-7000 Communication Software

VHX-7000 communication software enables remote control operation of the microscope, and can capture images to a PC.

## Overview of Functions

### ● File editing functions

- Browse files on the microscope and PC on the same screen, and effortlessly copy, move, and delete files.
- Export CSV formatted files to Excel files.

### ● Measurement data tabulation function

- The image files with measurement data and the CSV file measurement data that is compiled inside a folder are tabulated, and can be output into Excel files.

## Installing the Software

This section explains the procedures for installing the VHX-7000 Communication Software to the PC.

**Point** To perform the installation, users must log in with an account that has Administrator privileges. To use the software, log in with an account that has normal or higher privileges for Windows 7/10.

**1** Turn the PC power on and start up Windows.

**2** Double-click the installer that you downloaded from the download site.

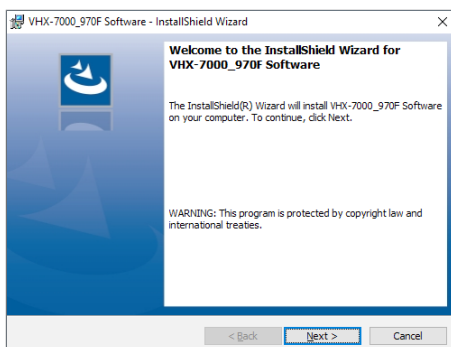
**Reference** You can also copy the installer from [Album] in the VHX MENU.  
 "Copy PC Software" (Page 11-12)

The [VHX-7000\_970F Software] window appears.

**Point**

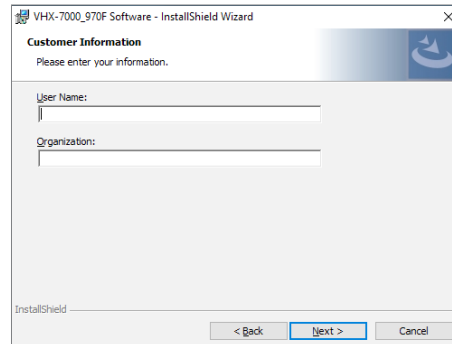
- If [User Account Control] appears, click [Yes].
- The installation wizard will display a message indicating it will install some or all of the following components according to your PC's environment. Click [OK] and confirm acceptance of the usage agreement to proceed with the installation.
  - .NET Framework 4.5.2 Full
  - Visual C++ 2010 SP1 redistributable package (x86)
  - Visual C++ 2013 redistributable package (x86)
  - Visual C++ 2015 redistributable package (x86)
  - Direct X End-User Runtimes (June 2010)

**3** Click [Next].



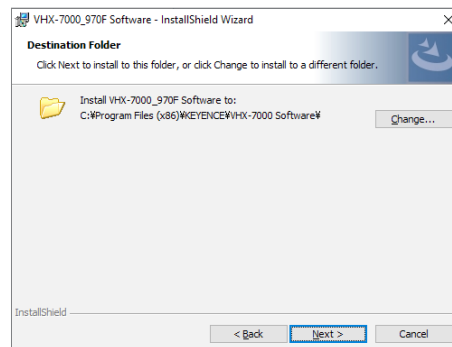
The window for entering the user information appears.

**4** As required, enter [User Name] and [Organization], and click [Next].



The window for selecting the folder to be installation destination appears.

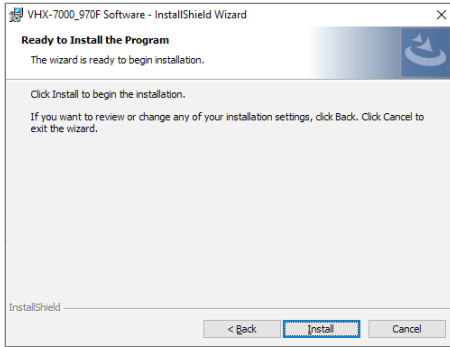
**5** Click [Next].



**Reference** To change the folder to be installation destination, click [Change] and specify a different folder.

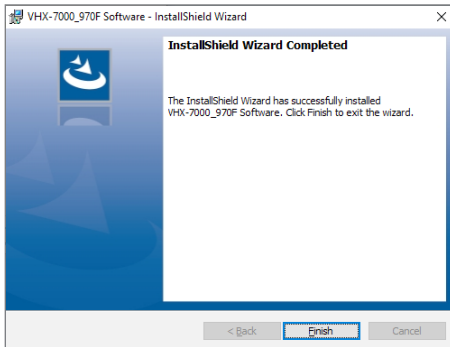
The [Ready to Install the program] dialog appears.

## 6 Click [Install].



The installation begins. When the installation finishes, the [InstallShield Wizard Completed] dialog box appears.

## 7 Click [Finish].



## Uninstalling the Software

- 1 Turn the PC power on and start up Windows.
- 2 From the [Start] menu, select [Windows System] - [Control Panel] - [Programs and Features].
- 3 Select the VHX-7000 Communication Software and click [Uninstall].
- 4 When the confirmation dialog box appears, click [Yes].

Point If [User Account Control] appears, click [Yes].

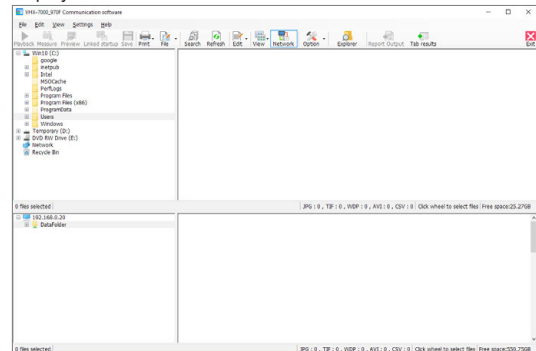
## Startup of VHX-7000 Communication Software

- 1 Double-click the [VHX-7000\_970F communication software] icon on the desktop. The first time the program is started, the [VHX-7000\_970F Communication software] window appears.
- 2 If the network is connected, click [Network].



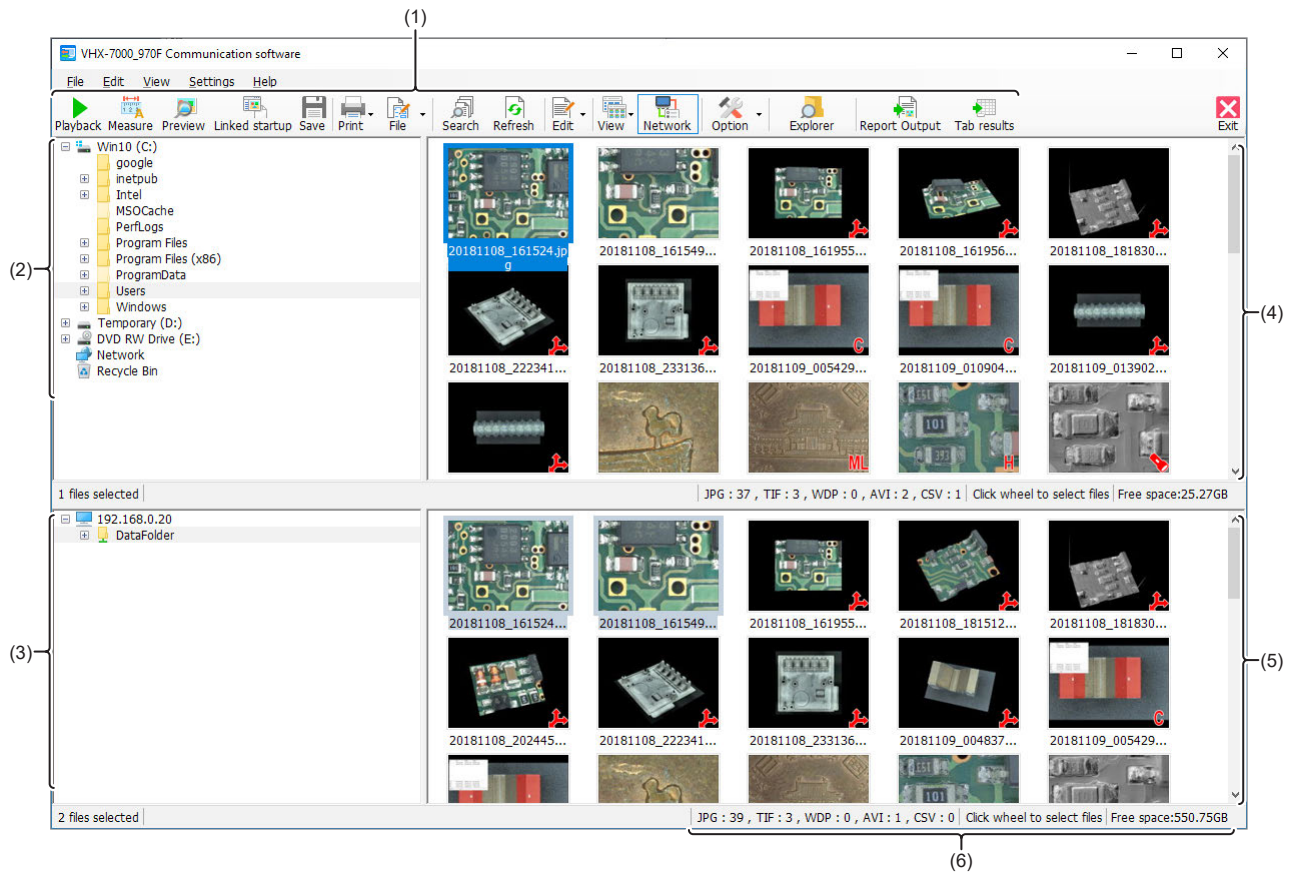
"Network Settings" (Page 13-13)

The contents of the hard disks of computer and microscope are displayed.



## Names and Functions on the Window

The upper area of the window shows the contents inside the PC's hard disk and other storage devices.  
The lower area of the window shows the contents of the microscope's hard disk.



No.	Item	Function
(1)	Toolbar	The toolbar presents the commonly used commands. ☐ "Toolbar" (Page 13-6)
(2)	PC folder view area	This area shows the folders on the PC's hard disk, and on the drives connected to the PC. In this section, these folders are referred to as [PC folders].  <div style="border: 1px solid gray; padding: 2px; display: inline-block;">Reference</div> These four file types can be displayed as thumbnails. <ul style="list-style-type: none"> <li>• JPEG file (.jpg)/TIFF file (.tif)/HDPhoto (.wdp)/AVI file (.avi)</li> </ul>
(3)	VHX folder view area	This area shows the folder structure on the hard disk in the microscope. In this section, these folders are referred to as [VHX data folders].  <div style="border: 1px solid gray; padding: 2px; display: inline-block;">Point</div> <b>The VHX-7000 Communication Software can only access the "Data folder" (D:\CommonData).</b> <b>The VHX-7000 Communication Software cannot access the Documents folder.</b>
(4)	PC files list area	This area shows a list of files in the local folder. In this section, these files are referred to as [PC files].
(5)	VHX files list area	This area shows a list of files in the VHX folder. In this section, these files are referred to as [VHX files].
(6)	Status bar	The right end of the status bar displays the following information: <ul style="list-style-type: none"> <li>• HD free space : Remaining space available on the microscope's hard disk.</li> <li>• Files : Indicates the number of each file type in the current folder (JPEG, TIFF, WDP, AVI, and CSV).</li> <li>• Selected files : Indicates the number of selected files.</li> </ul> <div style="border: 1px solid gray; padding: 2px; display: inline-block;">Reference</div> The toolbar and status bar can be hidden by selecting the settings on the [View] menu.

## Toolbar

The names and functions of the toolbar icons are explained below.

### Playback



Plays back the selected file.  
The display method varies according to the type of selected file.  
☐ "Playing Images" (Page 13-7)

### Measure



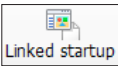
On 2D images, this command measures length and area, and allows additional comments.  
☐ "Measuring 2D Images" (Page 13-11)

### Preview



Displays the selected file in a [Preview] window.  
AVI files and images recorded in high definition (4000 x 3000) or higher resolution cannot be previewed.  
☐ "Preview" (Page 13-12)

### Linked startup



Automatically opens the selected file in the associated application based on the file extension in the PC's settings.  
For example, the image file can be opened in a commercially available image editor application.  
The following file types are supported: JPEG, TIFF, AVI, and CSV.

### Save



Saves the captured images under automatically assigned names.  
☐ "Saving" (Page 13-12)

### Print



Print the selected images from the printer connected to the computer.  
☐ "Printer" (Page 4-10)

### File



Controls files.  
Items that can be controlled are the same as those of [File] in Album.  
☐ "File" (Page 11-2)

### Search



Searches files within the computer's hard disk.  
☐ "Searching Files" (Page 11-10)

### Refresh



Refreshes the display to reflect the latest information.

### Edit



This command is used to edit files or folders.  
☐ "Editing" (Page 13-12)

### View



Toggles display between thumbnail and properties.  
☐ "View" (Page 13-13)

### Network



Shows/hides VHX folder display area and VHX file list area.

### Option



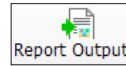
You can set the network settings and options of various functions.  
☐ "Network Settings" (Page 13-13)  
☐ "Options" (Page 13-13)

### Explorer



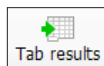
Launches Explorer.

### Report Output



Output the information of the selected CSV file to an Excel file.

### Tab Result



This function combines one-click automatic measurement results in Excel.  
☐ "Measurement Data Tabulation" (Page 13-15)

## Playing Images

Double-clicking a thumbnail image displays it using the method best suited for that image. Right-clicking on any selected image and clicking [Measure] changes the display to the measurement view.

**Point** 3D images opened by clicking [Measure] will be played as 2D images.

### 2D image

The image is displayed in a [Wide-view] window, allowing zooming by rotating the mouse wheel, and area resizing by dragging the mouse. After zooming to the desired display size, the observation area can be changed by dragging on the image.

### 3D image

The image appears in the 3D view. 3D images can be rotated and observed in the XYZ directions.  
 □ "Displaying in 3D" (Page 13-8)

### Multi-lighting image

The images recorded with this function can be observed later with the lighting direction changed.

### HDR image

HDR images can be displayed after adjusting the HDR effect.

### Optical Shadow Effect Mode image

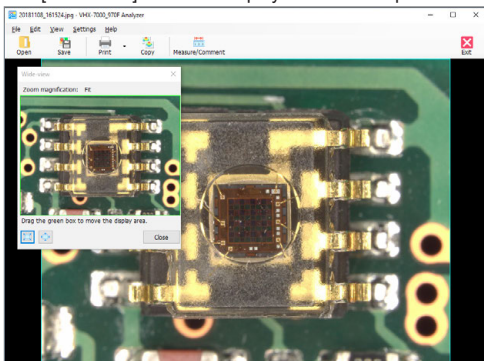
Optical Shadow Effect Mode images can be displayed after adjusting the Optical Shadow Effect Mode effect.

## Playing 2D images

When playing 2D images, they are shown in the wide-view window.

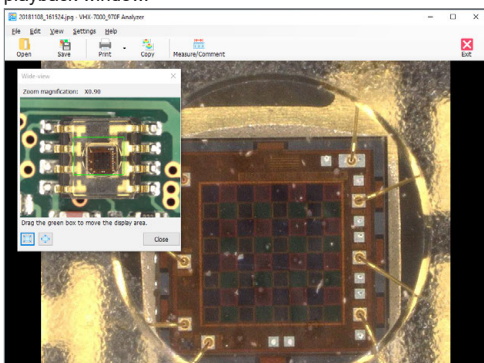
### 1 Double-click the file to play.

The [Wide-view] window and play window will open.


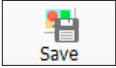
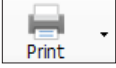
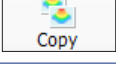
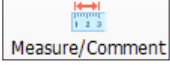
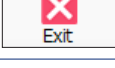


### 2 Rotating the mouse wheel changes the zoom ratio in the playback window.

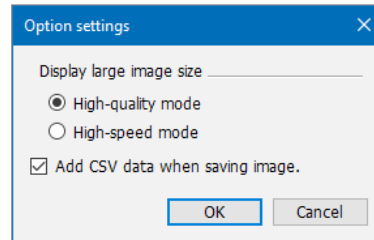
When the playback window is zoomed in on a portion of the entire image, the wide-view window will indicate the displayed area inside a green frame. Drag this frame to change the area displayed in the playback window.



### Toolbar

	Select the image to display in a new window.
	Saves the displayed image under a userspecified name. The size of the image can be set in the [Option Settings].
	Print the displayed images from the printer connected to the computer. □ "Printer" (Page 4-10)
	Copy the displayed image to the clipboard.
	This command is used to measure the image or add comments.
	Stops playback.

### Menu [Settings]



#### ○ Display large image size

If the response time is slow when the display is [Highquality mode], select [High-speed mode]. This will make operations faster.

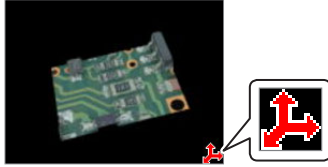
#### ○ Add CSV data when saving image

This option exports saved CSV data to Excel for viewing the measurement data on the image.

## Displaying in 3D

Displaying 3D image files in 3D.

**Reference** Thumbnails of 3D image files will have a red 3D symbol in the lower right.



### 1 Select the 3D image file and click [Playback].

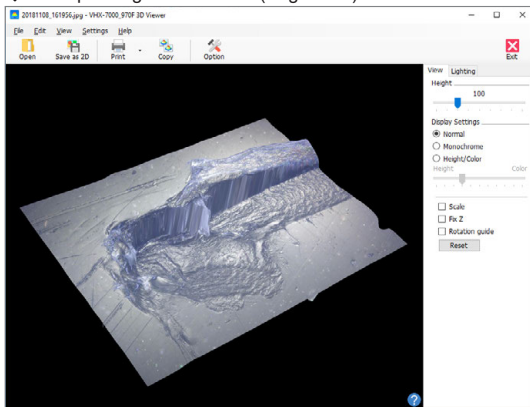
The confirmation message appears.

### 2 Click [3D playback].

### 3 The displayed 3D image can be edited.

The displayed 3D image can be manipulated by turning it, zooming in and out, and moving it.

☐ "Manipulating the 3D View" (Page 9-16)



### Toolbar

	Select the image to display in a new 3D view.
	Saves the displayed image as a 2D image.
	Print the displayed images from the printer connected to the computer. ☐ "Printer" (Page 4-10)
	Stores the displayed image on the PC's clipboard. The copied image can be pasted into commercially available software.
	Opens the [Option settings] dialog box. Setting of the following items is available. <ul style="list-style-type: none"> <li>• Color (scale line, scale assistance line, background)</li> <li>• Unit (m/mm/μm)</li> <li>• Number of decimal</li> </ul>
	Exits the 3D view.

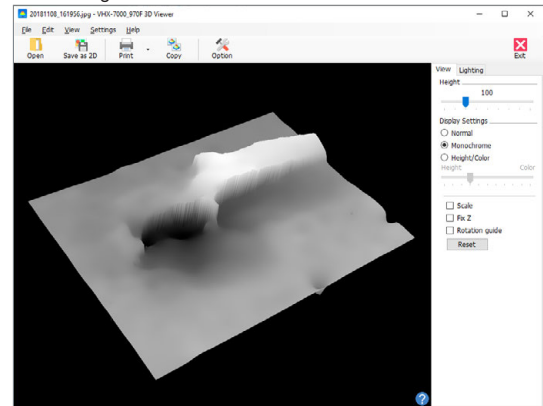
## [Display] tab

### ○Height

Dragging the slider right or left adjusts the scale factor used to display the image height.

### ○Monochrome

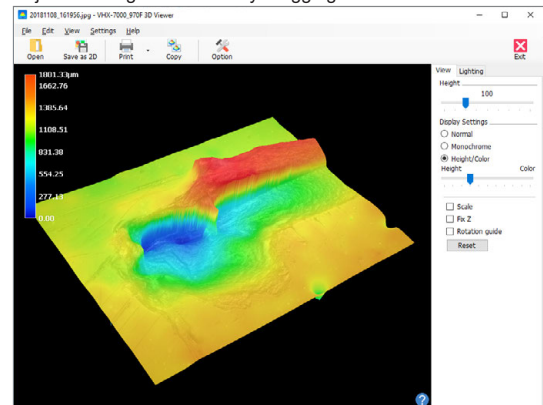
This option removes the surface texture to make height differences easy to understand. Combining it with the light simulation provides clearer height differences.



### ○Height/Color

Selecting the [Height/Color] option displays the image with emphasis on height. The highest areas of the 3D image are shown in red, and the lowest areas are shown in dark blue.

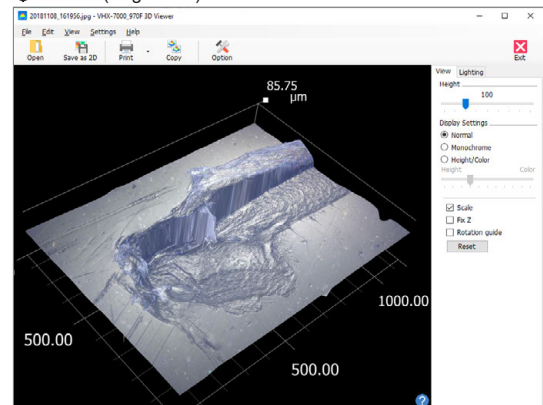
Adjust the height and color by dragging the slide bar.



### ○Scale

If the [Scale] option is checked, a simple scale will appear. Change the height of the (squares) or (dots) to measure the rough height.

☐ "Scale" (Page 9-17)

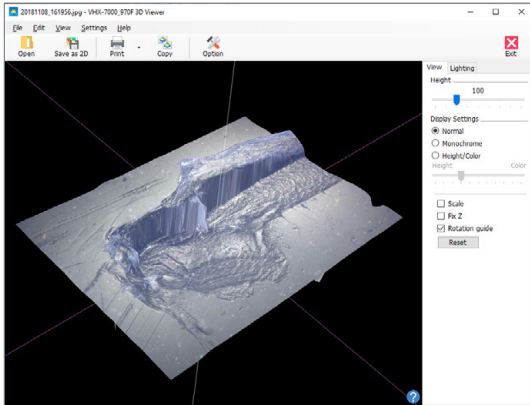


### ○Fix Z

Checking the [Fix Z] check box turns and moves the image with the Z-axis fixed. Hold the left mouse button down and drag to turn while keeping the Z-axis fixed. Hold the right mouse button down and drag to move the object.

○ **Rotation guide**

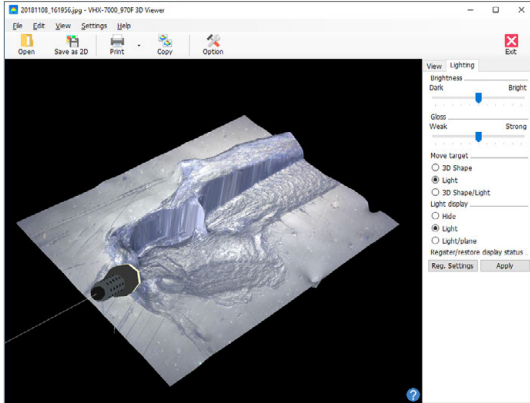
Checking the [Rotation guide] check box displays the X, Y, and Z-axis during mouse drag movements. Click again to turn the [Rotation guide] display OFF.



● **[Lighting] tab**

Selecting the [Lighting] tab enables the lighting simulator which can be used to apply lighting from any direction. Drag the mouse to change the lighting direction. This allows you to observe height differences on the image in greater clarity.

□ "Lighting Simulations" (Page 9-50)



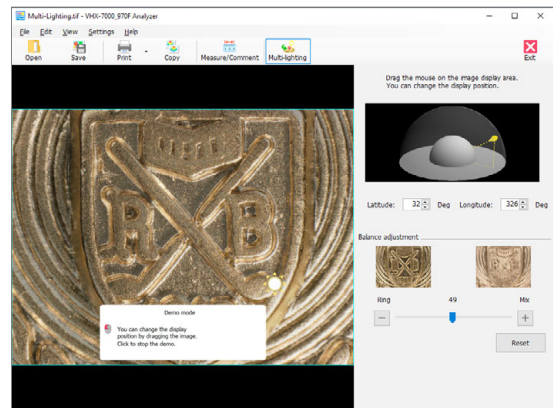
**Multi-lighting playback**

Plays back a Multi-lighting image.

**Reference** Thumbnails of Multi-lighting files will have a [ML] symbol in the lower right.

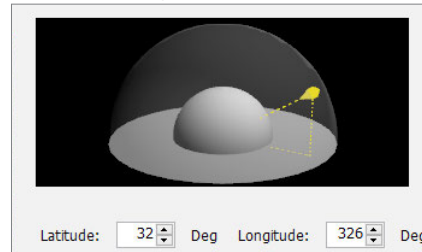


- 1** Select a Multi-lighting file and click [Playback]. The confirmation message appears.
- 2** Click [Multi-lighting playback].
- 3** You can change the lighting direction of the Multilighting image to check.



● **Light direction**

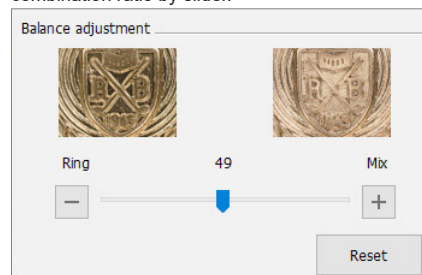
You can change the lighting direction by clicking the image display area. The following indicator shows the direction of illumination.



You can also set the lighting direction by entering a latitude and a longitude.

● **Balance adjustment**

An image illuminated from straight above can be put in the state under the ring + coaxial combined illumination. Adjusts the combination ratio by slider.

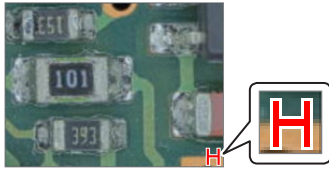


Clicking [Reset] resets the illumination angle and the combination ratio to the default values.

## Playing HDR images

Plays back the HDR file.

**Reference** Thumbnails of HDR files will have [H] symbol in the lower right.



### 1 Select the HDR image file and click [Playback].

The confirmation message appears.

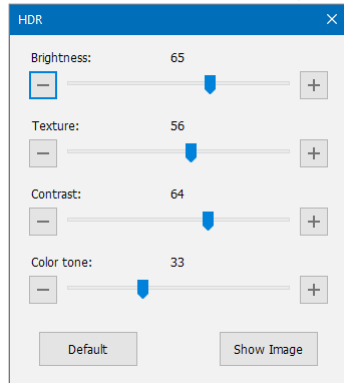
### 2 Click [HDR Playback].

This brings up the playback window and the [High dynamic range] dialog box.

### 3 Adjust each setting while viewing the image.

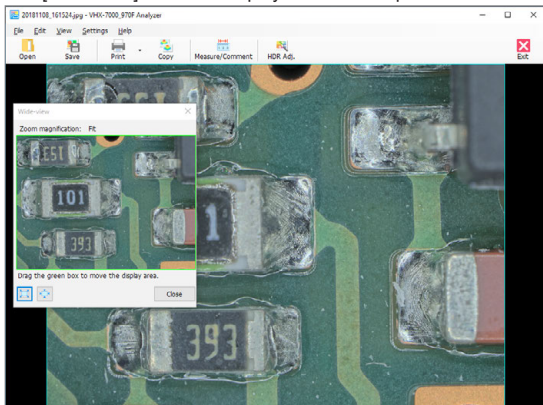
The following can be adjusted: brightness, texture, contrast, and color.

Click [Default] to return each setting to their optimum values.

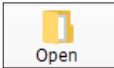
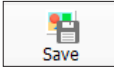

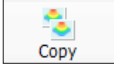
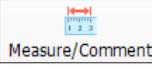

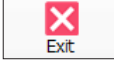


### 4 Click [Show Image].

The [Wide-view] window and play window will open.



## ● Toolbar

	Select the image to display in a new window.
	Saves the displayed image.
	Print the displayed images from the printer connected to the computer. ☐ "Printer" (Page 4-10)
	Copy the displayed image to the clipboard.
	This command is used to measure the image or add comments.
	Allows each item to be readjusted.
	Stops HDR playback.



## Measuring 2D Images

With 2D images, you can measure length and area, enter comments, and save.

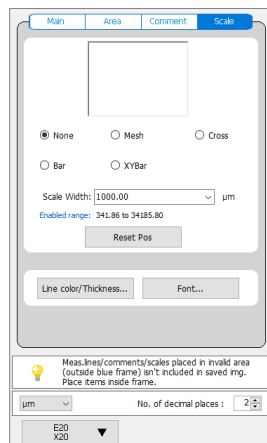
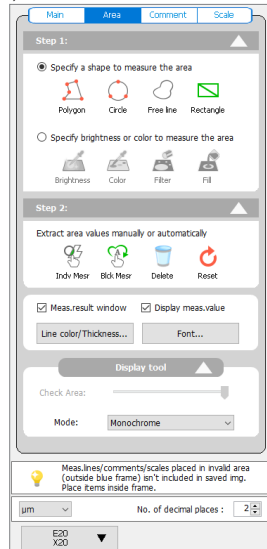
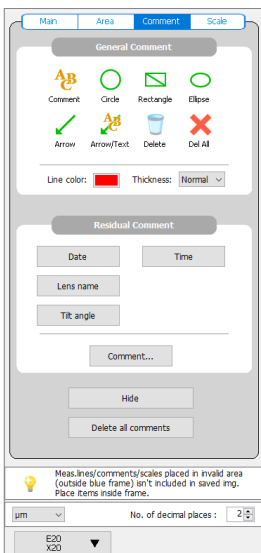
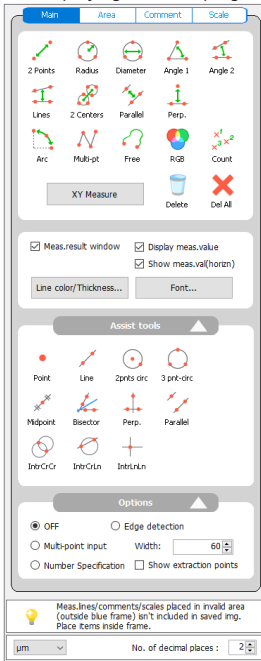
### 1 Select the file to measure and click [Measure].

The [Specify measurement size] dialog box appears.

### 2 Select the size of the image to measure and click [OK].

The [Wide view] window and play window opens. There are four tabs for tools of [Measure/Comment].

- "Main Measurements" (Page 7-10)
- "Area Measurements" (Page 7-20)
- "Displaying Text and Markers (Comment)" (Page 6-4)
- "Displaying a Scale" (Page 7-25)

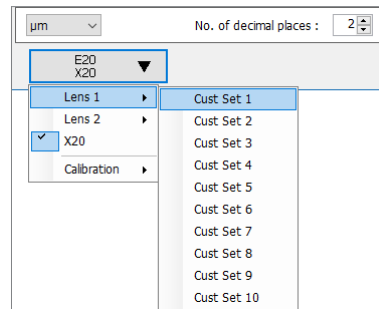


## Changing calibration

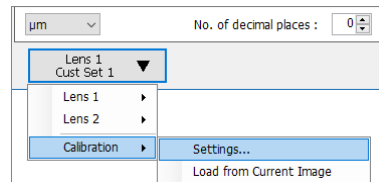
Normally, the calibration set when the image was recorded is loaded automatically.

The procedure below allows you to redo the calibration.

### 1 Click the lens power view and select [Lens 1] or [Lens 2].

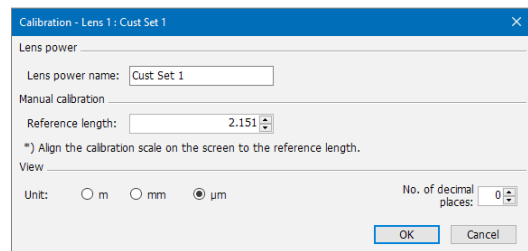


### 2 Click [Lens 1] or [Lens 2] - [Calibration] - [Settings...]



The [Calibration] dialog box appears.

### 3 Enter the a known length on the screen as the reference length.



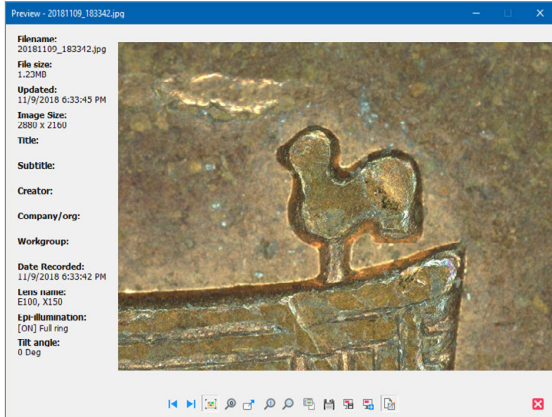
### 4 Click the start and end points of the length specified as the reference in step 3.

The start and end points can be moved by dragging either point.

### 5 Specify the display units and number of decimals to display, and click [OK].

The calibrated value is saved.

## Preview

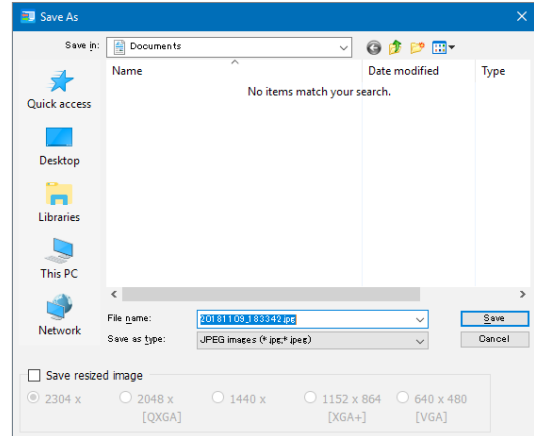


Preview shows the observed image and file properties. Various operations can be performed by using the icons below the image.

	<b>Previous image</b> Displays one file before the currently displayed file in the same folder.
	<b>Next image</b> Displays one file after the currently displayed file in the same folder.
	<b>Fit to window size</b> Adjusts and displays the image to the size of the window.
	<b>Actual size</b> Displays the image in actual scale.
	<b>Full screen image</b> Displays the image over the entire screen.
	<b>Enlarge</b> Enlarges the image display size. Zooming is also possible by rotating the mouse wheel button.
	<b>Reduced-size</b> Reduces the image display size. Zooming is also possible by rotating the mouse wheel button.
	<b>Linked application startup</b> Starts up the associated application with the image file opened in a new window.
	<b>Save As</b> Saves the captured image under a user-specified name. The image can also be resized.
	<b>Specify area and save</b> Cuts and saves the selected area of the image.
	<b>Specify area and copy</b> Cuts and copies the selected area of the image.
	<b>Show properties ON/OFF</b> Toggles the properties information display ON/OFF.

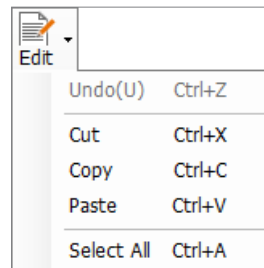
## Saving

- Select the file to save.**  
VHX files and PC files can be selected.
- Click [Save].**  
The [Save As] dialog box appears.
- Select a folder and enter a filename to save the image as, then click [Save].**



The selected file is saved. To resize the image before saving it, check the [Resize to] option and select the size.

## Editing



- **Cut**  
Cuts the selected file or folder and copies it to the clipboard.
- **Copy**  
Copies the selected file or folder and copies it to the clipboard.
- **Paste**  
Pastes the file or folder copied to the clipboard, using Cut or Copy, to the selected folder.
- **Select All**  
Selects all files in the currently open folder.

## View

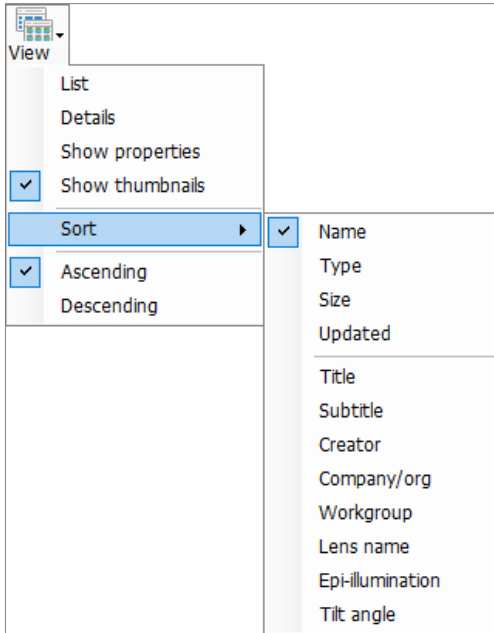


Image files can be viewed by selecting one of the following methods.

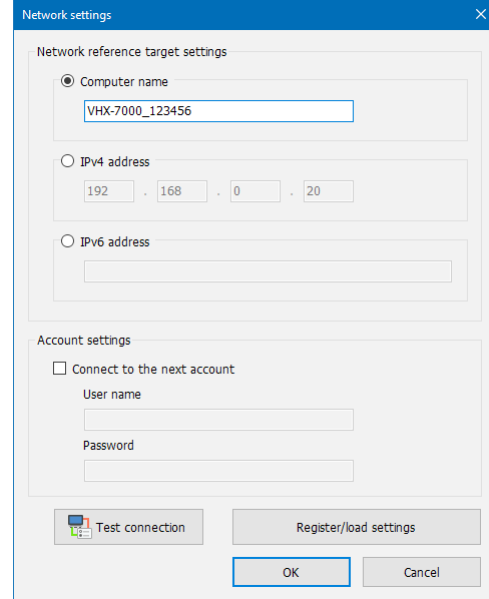
- **List**  
Shows the filenames as a list.
- **Details**  
Shows the filename, size, timestamp of last update, and other details as a list.
- **Show properties**  
Shows the filename and properties information.
- **Show thumbnails**  
Shows the files as thumbnails.
- **Sort by**  
The following options are available.
 

Name	Title	Workgroup
Type	Subtitle	Lens name
Size	Creator	Epi-illumination
Updated	Company/org	Tilt angle
- **Ascending**  
Displays files in ascending order (from smaller or newer) based on the selected sort by item.
- **Descending**  
Displays files in descending order (from larger or older) based on the selected sort by item.

## Options

### Network Settings

Configure settings for connecting the microscope to a network.



- **Network reference target settings**  
Enter either [Computer name]/[IPv4 address]/[IPv6 address] of the microscope.
- **Account settings**  
Check the option and input the [User name] and [Password] for connecting to the microscope. Choose the user name (VHX\_User) specified in the filesharing settings. ["Configuring FTP and File-Sharing"](#) (Page 12-4)
- **Test connection**  
This command tests the connection with the microscope based on the "Network interface target settings" and "Account settings". If the connection succeeds, [Connection was successful.] message appears.
- **Register/load settings**  
This command registers the current network settings. Registered settings can also be read.

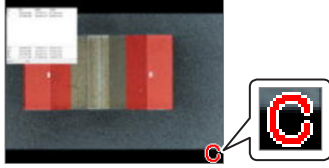
### Option settings

The [Option...] dialog box appears.  
["General Option"](#) (Page 12-8)

## Extracting CSV Data

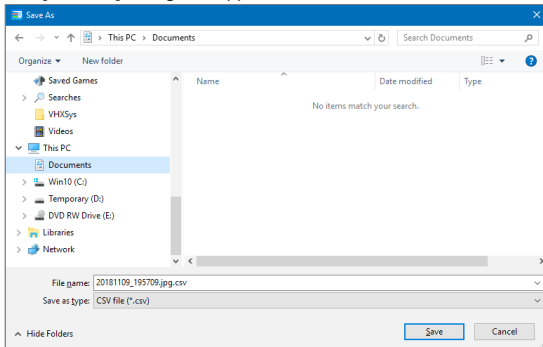
The measurement results embedded in an image as CSV data can be saved as a CSV formatted file.

**Reference** Thumbnails of images with CSV data will have [C] symbol in the lower right.



- 1** Select the image with CSV data.
- 2** On the [File] menu, select [Extract CSV data].

The [Save As] dialog box appears.



- 3** Enter a filename and click [Save].

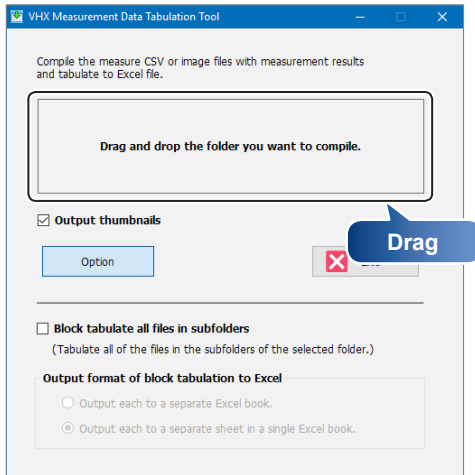
The CSV file is saved.

## Measurement Data Tabulation

When the VHX-7000 Communication Software has been installed, the [VHX-7000\_970F Measurement Data Tabulation Tool] icon is created automatically.

The [VHX-7000\_970F Measurement Data Tabulation Tool] tabulates the image files with measurement data or the CSV file measurement data that is compiled inside a folder, and outputs it into Excel files.

- 1 Double-click the [VHX-7000\_970F Measurement Data Tabulation Tool] icon.
- 2 Drag the folder with the tabulated files (Measurement result images and CSV files) from explorer, etc. into the square frame.



- 3 Automatically export the tabulated results to the Excel files.

Enter a filename and save the file.

File Name	Date	1. Diameter [µm]	2. Diameter [µm]	Count
OneClick-05.jpg	2018/11/15 15:00	1074.54	1069.88	0
OneClick-06.jpg	2018/11/15 15:00	1074.54	1069.88	0
OneClick-07.jpg	2018/11/15 15:00	1074.54	1069.88	0
OneClick-04.jpg	2018/11/15 15:00	1074.54	1069.88	0
OneClick-01.jpg	2018/11/15 15:00	1074.54	1069.88	0
OneClick-02.jpg	2018/11/15 15:00	1074.54	1069.88	0
OneClick-03.jpg	2018/11/15 15:00	1074.54	1069.88	0

### Thumbnail image output mode

When [Output thumbnails] is selected, the thumbnail images are exported to the first column.

Image	File Name	Date	1. Diameter [µm]	2. Diameter [µm]	Count
	OneClick-05.jpg	2018/11/15 15:00	1074.54	1069.88	0
	OneClick-06.jpg	2018/11/15 15:00	1074.54	1069.88	0
	OneClick-07.jpg	2018/11/15 15:00	1074.54	1069.88	0

- Since the thumbnail images are fixed in the cells, they are also linked in the measurement data sorting.
- Click a thumbnail image to display its original image file. This works for JPEG files (\*.jpeg, \*.jpg) and TIF files (\*.tif, \*.tiff).

### Option

#### Sub folder batch mode

When [Block tabulate all files in subfolders] is selected, all the files inside the subfolders of the specified folders are exported as a batch.

#### Excel output at sub folder batch mode

When the [Output each to a separate Excel book.] is selected, the files inside the subfolders are output to separate Excel books.

When the [Output each to a separate sheet in a single Excel book.] is selected, the files inside the subfolders are output to separate sheets in an Excel book.

#### Point

- The supported models for [VHX-7000\_970F Measurement Data Tabulation Tool] are shown as below.

The CSV files and image files with measurement data output via VHX-500/500F/600/700F/900/900F/950F/970F/1000/2000/5000/6000/7000 series

- The supported Excel versions are shown below. Excel 2010/2013/2016
  - [Main measurements] and [1 click measure] are the types of measurements that can be output. [Area Measure], [Auto area measurement] and [3D Profile Measurements] are not supported.
  - All of the measurement result items and sequence numbers inside the folders need to match each other.
- If the CSV files and the image files with measurement data are mixed inside the folders, the old files will be tabulated by the update dates.

# FTP Server Function

Using FTP client software, a PC can read image files saved on the hard disk in the microscope, and write image files on the PC to the hard disk in the microscope.

**Point** Turn the FTP function on the microscope on.  
 "Configuring FTP and File-Sharing" (Page 12-4)

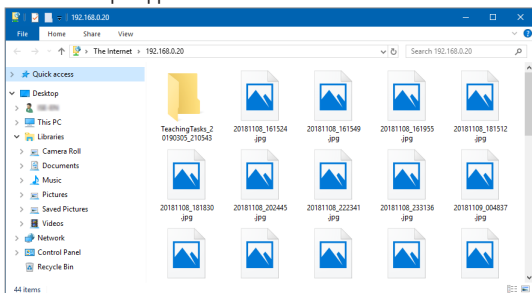
## Using Internet Explorer to Connect

This procedure will explain how to use the FTP function using Explorer as the FTP client.

- 1 Launch Explorer.
- 2 In the address bar, type [ftp://IP address of the microscope/], and press the Enter key.  
 The first time you connect to the microscope, the [Logon method] dialog box appears.
- 3 Enter the user and password and click [Logon].
- 4 Enter [User] as "VHX\_User", and [Password] as the password specified in the microscope's settings.

For more details about the password, refer to "Configuring FTP and File-Sharing" (Page 12-4).

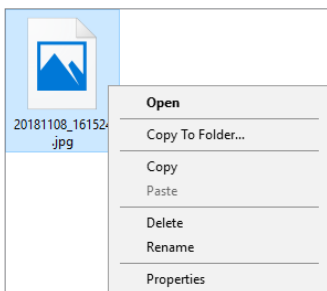
The contents of the "D:\CommonData" (data folder for [Album]) on the microscope appears.



**Reference** The FTP server allows access to the files and folders saved under "D:\CommonData".

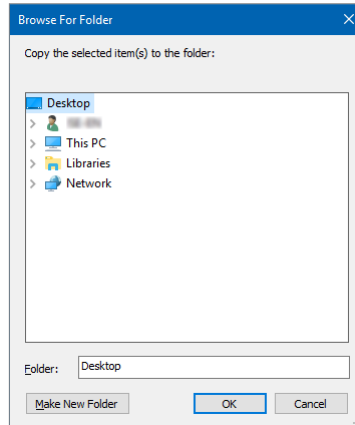
## Copying images files on the microscope to the PC

- 1 Right-click the folder or file to copy.



- 2 Select [Copy To folder].  
 The [Browse For Folder] dialog box appears.

- 3 Select the destination folder and click [OK].

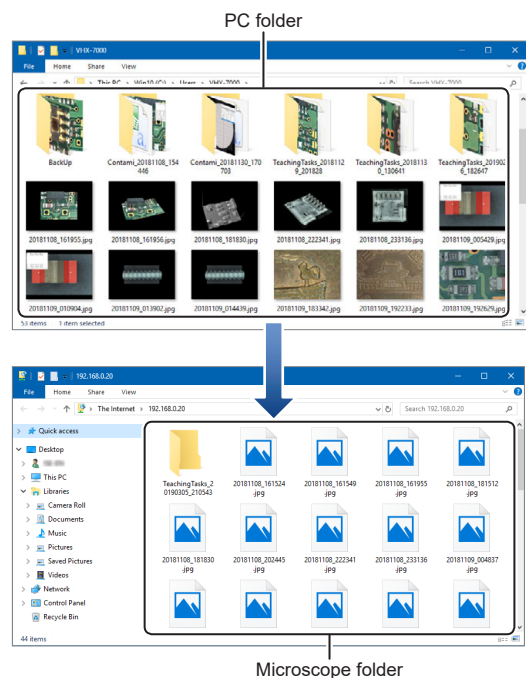


The files on the microscope are copied to the PC.

## Copying image files or folders on the PC to the microscope

- 1 Drag the files to copy to the folder on the microscope.

The files or folders on the PC are copied to the microscope. Instead of dragging, you can also use copy and paste.



# File Sharing Function

The file sharing function allows you to copy files between the microscope and the PC.

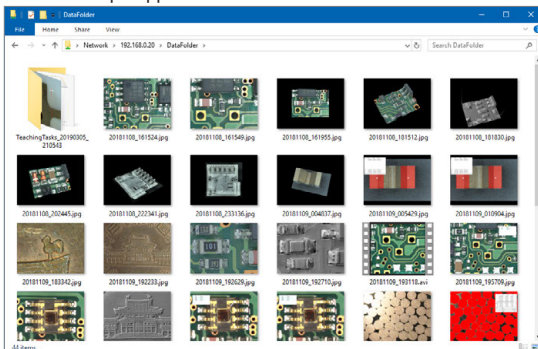
- Point** Turn the file sharing function on the microscope on.  
 “Configuring FTP and File-Sharing” (Page 12-4)

## Using Internet Explorer to Connect

- 1** Launch Explorer.
- 2** In the address bar, type [\\IP address of the microscope].
- 3** Click [Go].
- 4** Enter the user and password and click [OK].
- 5** Enter [User] as “VHX\_User”, and [Password] as the password specified in the microscope’s settings.

For more details about the password, refer to  “Configuring FTP and File-Sharing” (Page 12-4).

The contents of the “D:\CommonData” (data folder for [Album]) on the microscope appears.



The files can be manipulated using Explorer.

## MEMO



# Appendix

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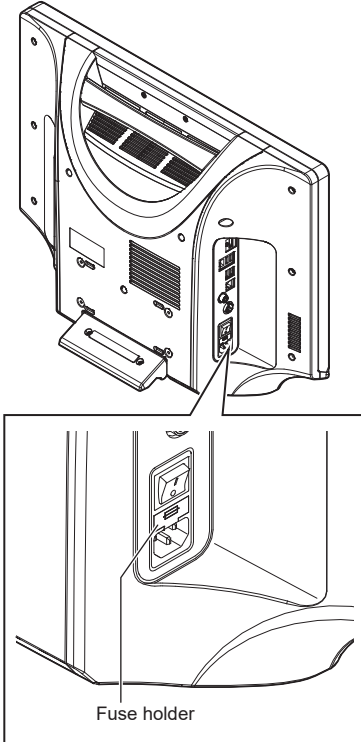
# List of Necessary Authentication Information and Default Settings

Item	User name	Password	Related page
Calibration	-	Set by client	<a href="#">☐ "Setting the calibration password" (Page 12-7)</a>
Network/Security Settings	-	VHX	<a href="#">☐ "Security Settings" (Page 12-3)</a>
FTP/File Sharing	VHX_User	Set by client	<a href="#">☐ "Configuring FTP and File-Sharing" (Page 12-4)</a>
Windows log-on after Completely disabling system protection	VHX_Admin	VHXADMIN	<a href="#">☐ "Completely disabling system protection" (Page 12-6)</a>
Communication Software setting	-	Set by client	<a href="#">☐ "Options" (Page 13-13)</a>

# Replacing the Fuse

When replacing the fuse, be sure to use FIT series fuse from Nippon Seisen Corporation that meets the following rating:

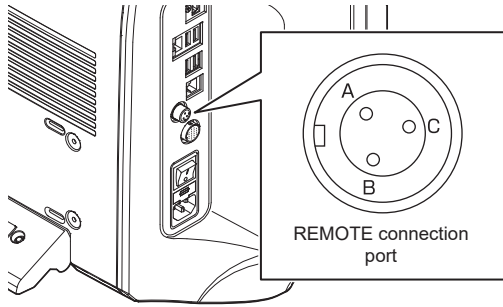
- Rated voltage : 250 V
- Rated current : 4.0 A
- Prearcing time-current characteristic : Time lag



- 1** Turn off the power switch.
- 2** Remove the AC power cord set.
- 3** Pull out the fuse holder from the AC power supply connection port.
- 4** Mount a new fuse in the fuse holder.
- 5** Return the fuse holder to the AC power supply connection port.

# REMOTE Connector (Capture/Pause)

A switch (such as a foot-activated switch) can be connected to the capture/pause REMOTE connector to capture and pause images.



Pin number	Pin name
A	Pause remote
B	Capture remote
C	COM

## Using the REMOTE Connector to Capture

- 1 Using a foot switch or other device, short pins B and C on the REMOTE connector.

The LED over the [PAUSE] button on the console will light up and a [Capture] dialog box will appear.

- 2 Specify the save conditions.

Specify the image format and other properties.

- 3 Click [Save].

The LED over the [PAUSE] button on the console will go out indicating the image has been captured. Refer to ["Capturing \(Saving\) Images"](#) (Page 3-7) for saving images.

**Point** It depends on the power setting contents.

**Reference** If performing ["Automatic Save Mode"](#) (Page 4-5), recording can be made one after another.

## Using the REMOTE Connector to Pause and Release Images

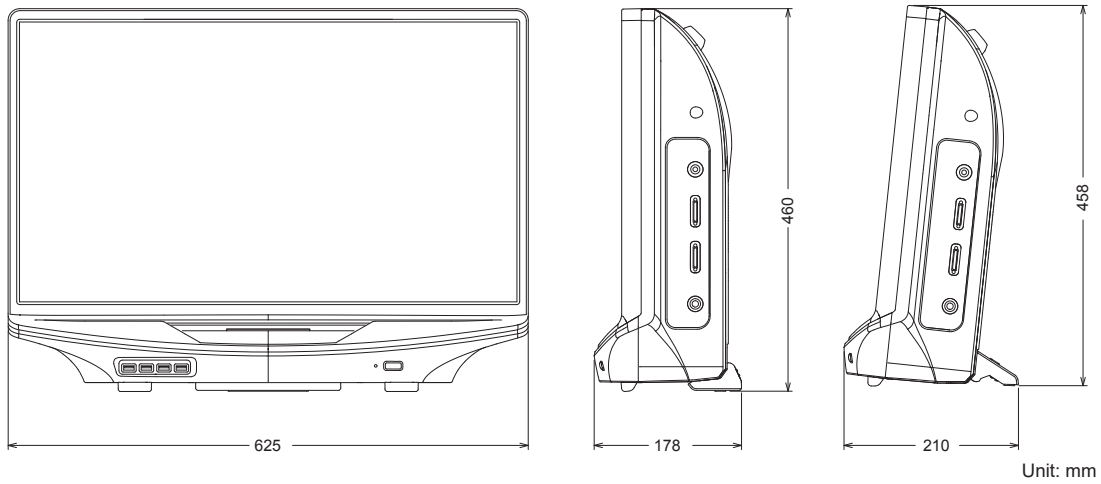
- 1 Using a foot switch or other device, short pins A and C on the REMOTE connector.

This will pause the image as indicated by the lit LED over the [PAUSE] button on the console.

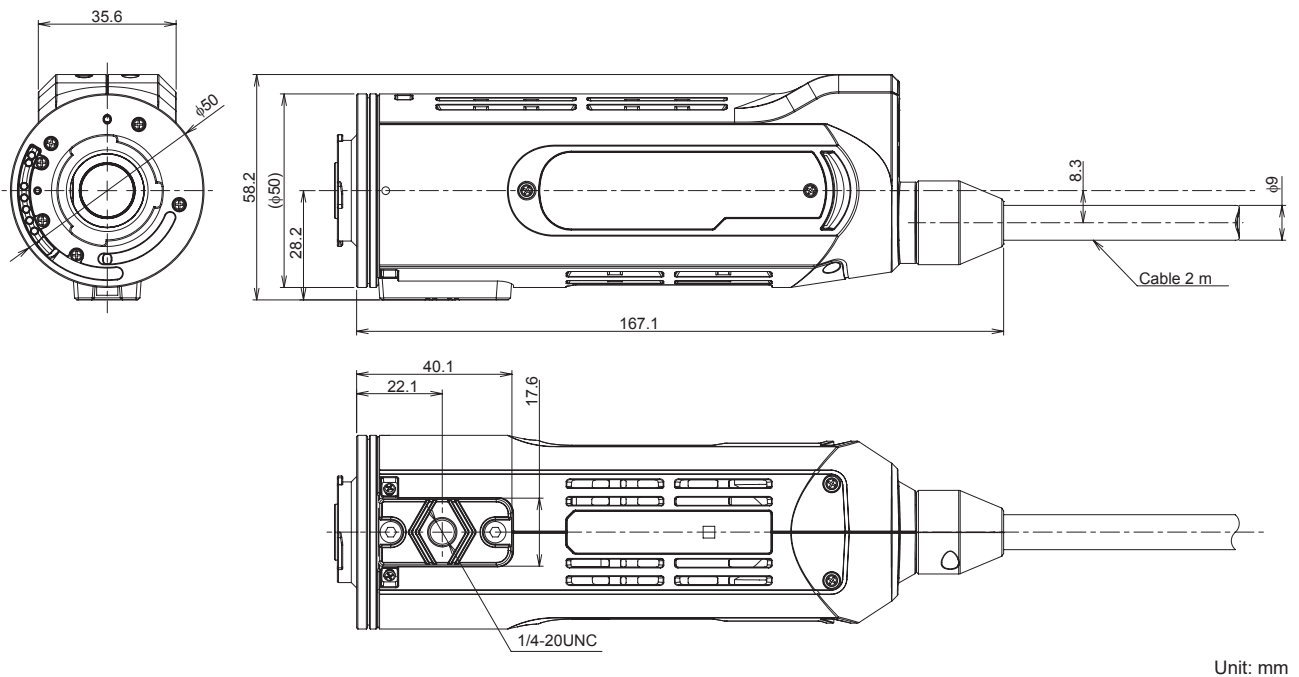
Short pins A and C on the REMOTE connector again to release the pause. The LED over the [PAUSE] button on the console will go out. Using the REMOTE Connector to I go out.

# Dimensions

## VHX-7000 Controller



## High-Performance Camera (VHX-7020)



# Specifications

## VHX-7000/7020

Item		Specifications	
High-Performance Camera	Image receiving element	1/1.8 type 3.19 million pixels CMOS image sensor Total pixels 2064 (H) x 1554 (V) Executable pixels 2048 (H) x 1536 (V)	
	Scanning method	Progressive	
	Frame rate	50 F/S (max.)	
	Resolution	Normal	2048 (H) x 1536 (V)
		Stage shift	6144 (H) x 4608 (V) <sup>*1</sup>
	High dynamic range	Each RGB pixel in 16-bit resolution	
	Gain	Manual, Preset	
	Electronic shutter	Auto, Manual, 1/60, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/5000, 1/9000, 1/19000	
	Supercharge shutter	The setting is available from 0.02s to 16s by 0.01s	
	White balance	Push set, Manual, Preset (2700 K, 3200 K, 5600 K, 9000 K)	
	Back-focus	Adjustment not required	
Built-in light source	Type	Super luminosity LED	
	Longevity	40000 hours (referent value)	
LCD monitor	Size	Color LCD (IPS) 27"	
	Panel size	596.736 (H) x 335.664 (V) mm	
	Pixel pitch	0.1554 mm (H) x 0.1554 mm (V)	
	Number of pixels	3840 (H) x 2160 (V)	
	Display colors	Approx. 1.07 billion colors <sup>*2</sup>	
	Brightness	350 cd/m <sup>2</sup> (Center 1 Point, typ)	
	Contrast ratio	1300:1 (typ)	
	Viewing angle	±89° (typical, horizontal), ±89° (typical, vertical)	
Hard disk drive unit	Storage capacity	1TB (including 350GB reserved area) Approx. 2160000 images (when a 3 million-pixel image is compressed) to approx. 71100 images (when a 3 million-pixel image is not compressed)	
Image format		When compressed: JPEG When not compressed: TIFF	
Maximum image size		50000 pixels (H) x 50000 pixels (V) (using image stitching function)	
Video output	Output format	Display Port 3840 pixels x 2160 pixels	
	Scanning frequency	Special LCD monitor	132 kHz (H), 60 Hz (V)
		External monitor	132 kHz (H), 60 Hz (V)
Input	Mouse input	USB mouse support	
	Keyboard input	USB keyboard support	
	External remote input	Pause/Capture, Non-voltage input (Contact/non-contact)	
Interface	LAN	RJ-45 (10BASE-T/100BASE-TX/1000BASE-T)	
	USB2.0 series A	6 ports	
	USB3.0 series A	2 ports	
Power supply	Power supply voltage	AC 100 – 240 V ±10% 50/60 Hz	
	Power consumption	430 VA	
Environmental resistance	Operating ambient temperature	+5 to 40°C <sup>*3</sup>	
	Operating ambient humidity	35 to 80% RH, No condensation <sup>*4</sup>	

Item		Specifications
Weight	Controller	Approx. 12.0 Kg
	Camera Units	Approx. 0.6 Kg (High-Performance Camera) Approx. 5.0 Kg (Fully-Integrated (FI) Head)
	Console	Approx. 0.45 Kg
Dimensions (excluding protrusions)		Width 625 mm x Height 460 mm x Length 180 mm (at storage)

\*1 At high resolution function usage by the motorized stage shift

\*2 Display by 8bit + 2FRC

\*3 At hand-held observation for the High-Performance Camera: 5°C to 35°C

\*4 If the ambient temperature is 40°C, use it under the condition where the absolute humidity is 70% RH or less.

# Specifications (Various Functions)

	Function	Contents	Console supported
Observation function	Auto focus function	Provided	✓
	Focus view function	Provided	
	Lighting shift function (height difference enhancement)	Provided (Full, Partial, Flanking, dark field, bright field, mix illumination modes)	✓
	Multi-lighting function	Provided	✓
	Camera-shake correcting function	Provided	✓
	Optical Shadow Effect Mode function	Provided	✓
Display function	Full screen display function	Provided	
	Split function	Horizontal split, vertical split, 4-part split, 9-part split, Linkage display function	✓
	Real-time digital zoom	1.0 to 10.0x	
	Comment display function	Provided	
Image optimization function	Glare eliminating function	Provided	✓
	Ring eliminating function	Provided	
	HDR function	Provided	✓
	Fine shot function	Provided	
Stitching function	2D image stitching	Provided	✓
	3D image stitching	Provided	✓
	Navigation function	Provided	
3D function	Live depth composition function	Provided	✓
	Quick Composition and 3D function	Provided	✓
	Fine depth composition	Provided	
	Manual 3D composition	Provided	
	3D display function	Provided	
	3D shape correction function	Provided (Slope/Sphere/Cylinder)	
	3D 2-screen simultaneous comparison function	Provided (Combination/Comparison/Difference display mode)	
Recording function	Report output (Excel)	Provided	
	Recording settings reproduction function	Provided	
	Timer capture function	Provided	
	Video recording/playback function	<ul style="list-style-type: none"> <li>• Maximum 50 frames/sec.</li> <li>• Video size: 640 x 480, 800 x 600, 2048 x 1536, 2880 x 2160</li> </ul>	



	Function	Contents	Console supported
Measurement function	Distance, angle, radius, area, etc.	Various functions provided	
	Automatic edge detection	Provided	
	Scale display	Various functions provided	✓
	Automatic count, area measurement functions	Provided (enables distance/area measurement through brightness/color extraction)	
	Automatic area measurements	Provided	
	Grain size analysis	Provided	
	Contamination analysis	Provided	
	One-click measurement	Provided	
	Auto measurement	Provided	
	Teaching auto measurement	Provided	
	Lens/zoom automatic recognition function (TRIPLE'R)	Provided	
	Auto calibration	Provided (numerical input not required)	
	One push calibration function	Provided (scale position adjustment not required)	
	CSV storage	Provided	
3D measurement function *1 (VHX-H5M option function)	3D profile measurement	Provided	
	Point-to-point height measurement function	Provided	
	3D volume measurement	Provided	
	Roughness measurement	Provided	
Manual XY measurement system *2 (VHX-H3M3 option function)	XY stage measurement	Provided	
	Wide image display function	Provided	
Utility	Easy mode	Provided	✓
	Space saving uni	Provided	
	Foot switch compatibility	Provided	
	User settings	Provided	
	System protection settings	Provided	
	PC mode	Provided	
	Network connection settings	Provided (communication software, file-sharing, FTP)	
	Function guide	Provided	
Software for PC (Available free of charge)	Communication software	Allows easy image data transfer between the VHX and PC. (LAN)	
	3D playback software	Plays back 3D images saved in the VHX on a PC.	
	Optical Shadow Effect Mode playback software	Adjusts the parameter of Optical Shadow Effect Mode images saved in the VHX.	
	Multi-lighting playback software	Existing multi-lighting images can be played back with the VHX after their illumination orientations are changed.	
	3D HDR playback/measurement/stitched image playback software	HDR parameter adjustment, stitched image display and measurement can be performed.	
	One-click measurement compilation software	Summarizes and transfer one-click measurement results to Excel.	

\*1 The 3D measurement function (VHX-H5M) requires one license per product.

\*2 The Manual XY measurement system (VHX-H3M3) requires one license per product.

# Specifications (Detailed Modules)

Software Package	Video recording module	Records and plays back video.
	Area measurement module	Measures area of 2D images.
	Timer capture module	Provides functions for capturing images automatically at specified time intervals.
	Split-screen module	Provides functions for tiling screens horizontally, vertically, into quarters or ninths.
	Comment input module	Provides functions for entering and displaying comments such as text and markings on the observed image.
	Image improvement module	Provides image processing functions for correcting images to make observation easier.
	High-quality depth composition module	Composes a single image from multiple images captured in focus at different heights.

# Software Usage Agreement

The use of "VHX-7000 main software" and "VHX-7000 communication software" (hereinafter referred to as [this software]) is subject to the terms outlined in this software license agreement (hereinafter referred to as [this agreement]) and to the customers consent to this agreement. The customer's use or duplication of this software, in whole or in part, constitutes the customer's consent to enter into this agreement.

## Article 1 (Usage Rights)

- 1 Contingent of the customer's compliance with the terms of this agreement, KEYENCE Corporation (hereinafter referred to as KEYENCE) extends to the customer non-exclusive usage rights.
- 2 The customer may install this software without the limit of the number of the licenses, provided that this software is used only in the same corporation in order to use our product you have purchased.

## Article 2 (Limitations on Duplication)

The customer may make no more than 1 copy of this software for backup purposes only.

## Article 3 (Prohibitions)

The customer is prohibited from doing the following with this software.

- a. Additions or changes to any or all of the functions of this software.  
However, installation of updates or new features provided by KEYENCE is expressly allowed.
- b. Reverse compiling or reverse assembling of this software for the purposes of reverse engineering.
- c. Sale, transfer, redistribution, license, rental or lease to the third party.  
This does not include instances where permission has been obtained from KEYENCE in advance.

## Article 4 (Copyright)

The copyrights of this software and all associated documentation are the property of KEYENCE.

## Article 5 (Exemption of Liability)

KEYENCE shall not be held liable by the user or third party for any damages arising from the use of the software.

## Article 6 (Support)

Based on this agreement, KEYENCE agrees to provide the customer with technical support in response to customer questions regarding this software. However, KEYENCE makes no guarantee that the technical support offered will meet the customer's needs.

## Article 7 (Termination of Agreement)

- 1 Should the customer destroy this software and any backup copies, this agreement will automatically expire with the customer's cessation of use of this software.
- 2 KEYENCE reserves the right to unilaterally terminate this agreement should the customer violate any of the terms of this agreement. In this instance, this software and all copies should be immediately returned to KEYENCE for destruction.
- 3 Should KEYENCE be caused damages by the customer's violation of this agreement, the customer will compensate KEYENCE for those damages.

## Article 8 (Basis in Law)

This agreement is to be adjudicated according to Japanese law.

# Usage Agreement for Operation Software

## MICROSOFT SOFTWARE LICENSE TERMS

### WINDOWS 10 IOT ENTERPRISE & MOBILE (ALL EDITIONS)

**IF YOU LIVE IN (OR IF YOUR PRINCIPAL PLACE OF BUSINESS IS IN) THE UNITED STATES, PLEASE READ THE BINDING ARBITRATION CLAUSE AND CLASS ACTION WAIVER IN SECTION 9. IT AFFECTS HOW DISPUTES ARE RESOLVED.**

Thank you for choosing Microsoft!

Depending on how you obtained the Windows software, this is a license agreement between (i) you and the device manufacturer or software installer that distributes the software with your device; or (ii) you and Microsoft Corporation (or, based on where you live or if a business where your principal place of business is located, one of its affiliates) if you acquired the software from a retailer. Microsoft is the device manufacturer for devices produced by Microsoft or one of its affiliates, and Microsoft is the retailer if you acquired the software directly from Microsoft.

This agreement describes your rights and the conditions upon which you may use the Windows software. You should review the entire agreement, including any supplemental license terms that accompany the software and any linked terms, because all of the terms are important and together create this agreement that applies to you. You can review linked terms by pasting the (aka.ms/) link into a browser window.

**By accepting this agreement or using the software, you agree to all of these terms, and consent to the transmission of certain information during activation and during your use of the software as per the privacy statement described in Section 3. If you do not accept and comply with these terms, you may not use the software or its features.** You may contact the device manufacturer or installer, or your retailer if you purchased the software directly, to determine its return policy and return the software or device for a refund or credit under that policy. You must comply with that policy, which might require you to return the software with the entire device on which the software is installed for a refund or credit, if any.

#### 1. Overview.

- a. **Applicability.** This agreement applies to the Windows software that is preinstalled on your device, or acquired from a retailer and installed by you, the media on which you received the software (if any), any fonts, icons, images or sound files included with the software, and also any Microsoft updates, upgrades, supplements or services for the software, unless other terms come with them. It also applies to Windows apps developed by Microsoft that provide functionality such as mail, calendar, contacts, music and news that are included with and are a part of Windows. If this agreement contains terms regarding a feature or service not available on your device, then those terms do not apply.
- b. **Additional terms.** Depending on your device's capabilities, how it is configured, and how you use it, additional Microsoft and third party terms may apply to your use of certain features, services and apps.
  - (i) Some Windows apps provide an access point to, or rely on, online services, and the use of those services is sometimes governed by separate terms and privacy policies, such as the Microsoft Services Agreement at (aka.ms/msa). You can view these terms and policies by looking at the service terms of use or the app's settings, as applicable; please read them. The services may not be available in all regions.
  - (ii) The manufacturer or installer may also preinstall apps, which will be subject to separate license terms.
  - (iii) The software may include third party software such as Adobe Flash Player that is licensed under its own terms. You agree that your use of Adobe Flash Player is governed by the license terms for Adobe Systems Incorporated at (aka.ms/adobe/flash). Adobe and Flash are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.
  - (iv) The software may include third party programs that are licensed to you under this agreement, or under their own terms. License terms, notices and acknowledgements, if any, for the third party program can be view at (aka.ms/thirdpartynotices).

#### 2. Installation and Use Rights.

- a. **License.** The software license is permanently assigned to the device with which you acquired the software. You may only use the software on that device.
- b. **Device.** In this agreement, "device" means a physical hardware system) with an internal storage device capable of running the software. A hardware partition or blade is considered to be a device.
- c. **Restrictions.** The manufacturer or installer and Microsoft reserve all rights (such as rights under intellectual property laws) not expressly granted in this agreement. For example, this license does not give you any right to, and you may not:
  - (i) use or virtualize features of the software separately;
  - (ii) publish, copy (other than the permitted backup copy), rent, lease, or lend the software;
  - (iii) transfer the software (except as permitted by this agreement);
  - (iv) work around any technical restrictions or limitations in the software;
  - (v) use the software as server software, for commercial hosting, make the software available for simultaneous use by multiple users over a network, install the software on a server and allow users to access it remotely, or install the software on a device for use only by remote users;
  - (vi) reverse engineer, decompile, or disassemble the software, or attempt to do so, except and only to the extent that the foregoing restriction is (a) permitted by applicable law; (b) permitted by licensing terms governing the use of open source components that may be included with the software; or (c) required to debug changes to any libraries licensed under the GNU Lesser General Public License which are included with and linked to by the software; and
  - (vii) when using Internet-based features you may not use those features in any way that could interfere with anyone else's use of them, or to try to gain access to or use any service, data, account, or network, in an unauthorized manner.
- d. **Multi use scenarios.**
  - (i) **Multiple versions.** If when acquiring the software, you were provided with multiple versions (such as 32-bit and 64-bit versions), you may install and activate only one of those versions at a time.
  - (ii) **Multiple or pooled connections.** Hardware or software you use to multiplex or pool connections, or reduce the number of devices or users that access or use the software, does not reduce the number of licenses you need. You may only use such hardware or software if you have a license for each instance of the software you are using.
  - (iii) **Device connections.** You may allow up to 20 other devices to access the software installed on the licensed device for the purpose of using the following software features: file services, print services, Internet information services, and Internet connection sharing and telephony services on the licensed device. The 20 connection limit applies to devices that access the software indirectly through "multiplexing" or other software or hardware that pools connections. You may allow any number of devices to access the software on the licensed device to synchronize data between devices. This section does not mean, however, that you have the right to install the software, or use the primary function of the software (other than the features listed in this section), on any of these other devices.
  - (iv) **Remote access.** Users may access the licensed device from another device using remote access technologies, but only on devices separately licensed to run the same or higher edition of this software.
  - (v) **Remote assistance.** You may use remote assistance technologies to share an active session without obtaining any additional licenses for the software. Remote assistance allows one user to connect directly to another user's computer, usually to correct problems.
  - (vi) **POS application.** If the software is installed on a retail point of service device, you may use the software with a point of service application

("POS Application"). A POS Application is a software application which provides only the following functions: (i) process sales and service transactions, scan and track inventory, record and/or transmit customer information, and perform related management functions, and/or (ii) provide information directly and indirectly to customers about available products and services. You may use other programs with the software as long as the other programs: (i) directly support the manufacturer's specific use for the device, or (ii) provide system utilities, resource management, or anti-virus or similar protection. For clarification purposes, an automated teller machine ("ATM") is not a retail point of service device.

(vii) **Cloud Computing Devices.** If your device uses Internet browsing functionality to connect to and access cloud hosted applications: (i) no desktop functions may run locally on the device, and (ii) any files that result from the use of the desktop functions may not be permanently stored on the system. "Desktop functions," as used in this agreement, means a consumer or business task or process performed by a computer or computing device. This includes but is not limited to email, word processing, spreadsheets, database, scheduling, network or internet browsing and personal finance.

(viii) **Desktop Functions.** If your system performs desktop functions, then you must ensure that they: (i) are only used to support the application, and (ii) operate only when used with the application.

e. **Specific Use.** The manufacturer designed the licensed device for a specific use. You may only use the software for that use.

f. **Backup copy.** You may make a single copy of the software for backup purposes, and may also use that backup copy to transfer the software if it was acquired as stand-alone software, as described below.

3. **Privacy; Consent to Use of Data.** Your privacy is important to us. Some of the software features send or receive information when using those features. Many of these features can be switched off in the user interface, or you can choose not to use them. By accepting this agreement and using the software you agree that Microsoft may collect, use, and disclose the information as described in the Microsoft Privacy Statement available at ([aka.ms/privacy](https://aka.ms/privacy)), and as may be described in the user interface associated with the software features.

#### 4. Transfer

a. **Software preinstalled on device.** If you acquired the software preinstalled on a device, you may transfer the license to use the software directly to another user, only with the licensed device. The transfer must include the software and, if provided with the device, an authentic Windows label including the product key. Before any permitted transfer, the other party must agree that this agreement applies to the transfer and use of the software.

b. **Stand-alone software.** If you acquired the software as stand-alone software, you may transfer the software to another device that belongs to you. You may also transfer the software to a device owned by someone else if (i) you are the first licensed user of the software and (ii) the new user agrees to the terms of this agreement. You may use the backup copy we allow you to make or the media that the software came on to transfer the software. Every time you transfer the software to a new device, you must remove the software from the prior device. You may not transfer the software to share licenses between devices.

5. **Authorized Software and Activation.** You are authorized to use this software only if you are properly licensed and the software has been properly activated with a genuine product key or by other authorized method. When you connect to the Internet while using the software, the software will automatically contact Microsoft or its affiliate to confirm the software is genuine and the license is associated with the licensed device. You can also activate the software manually by Internet or telephone. In either case, transmission of certain information will occur, and Internet, telephone and SMS service charges may apply. During activation (or reactivation that may be triggered by changes to your device's components), the software may determine that the installed instance of the software is counterfeit, improperly licensed or includes unauthorized changes. If activation fails the software will attempt to repair itself by replacing any tampered Microsoft software with genuine Microsoft software. You may also receive reminders to obtain a proper license for the software. Successful activation does not confirm that the software is genuine or properly licensed. You may not bypass or circumvent activation. To help determine if your software is genuine and whether you are properly licensed, see ([aka.ms/genuine](https://aka.ms/genuine)). Certain updates, support, and other services might only be offered to users of genuine Microsoft software.

6. **Updates.** You may obtain updates only from Microsoft or authorized sources, and Microsoft may need to update your system to provide you with those updates. The software periodically checks for system and app updates, and may download and install them for you. To the extent automatic updates are enabled on your device, by accepting this agreement, you agree to receive these types of automatic updates without any additional notice.

7. **Geographic and Export Restrictions.** If your software is restricted for use in a particular geographic region, then you may activate the software only in that region. You must also comply with all domestic and international export laws and regulations that apply to the software, which include restrictions on destinations, end users, and end use. For further information on geographic and export restrictions, visit ([aka.ms/georestrict](https://aka.ms/georestrict)) and ([aka.ms/exporting](https://aka.ms/exporting)).

8. **Support and Refund Procedures.** For the software generally, contact the device manufacturer or installer for support options. Refer to the support number provided with the software. For updates and supplements obtained directly from Microsoft, Microsoft may provide limited support services for properly licensed software as described at ([aka.ms/mssupport](https://aka.ms/mssupport)). If you are seeking a refund, contact the manufacturer or installer to determine its refund policies. You must comply with those policies, which might require you to return the software with the entire device on which the software is installed for a refund.

#### 9. Binding Arbitration and Class Action Waiver if You Live in (or if a Business Your Principal Place of Business is in) the United States.

We hope we never have a dispute, but if we do, you and we agree to try for 60 days to resolve it informally. If we can't, you and we agree to **binding individual arbitration before the American Arbitration Association ("AAA") under the Federal Arbitration Act ("FAA"), and not to sue in court in front of a judge or jury.** Instead, a neutral arbitrator will decide and the arbitrator's decision will be final except for a limited right of appeal under the FAA. **Class action lawsuits, class-wide arbitrations, private attorney-general actions, and any other proceeding where someone acts in a representative capacity aren't allowed. Nor is combining individual proceedings without the consent of all parties.** "We," "our," and "us" includes Microsoft, the device manufacturer, and software installer.

a. **Disputes covered—everything except IP.** The term "dispute" is as broad as it can be. It includes any claim or controversy between you and the manufacturer or installer, or you and Microsoft, concerning the software, its price, or this agreement, under any legal theory including contract, warranty, tort, statute, or regulation, **except disputes relating to the enforcement or validity of your, your licensors', our, or our licensors' intellectual property rights.**

b. **Mail a Notice of Dispute first.** If you have a dispute and our customer service representatives can't resolve it, send a Notice of Dispute by U.S. Mail to the manufacturer or installer, ATTN: LEGAL DEPARTMENT. If your dispute is with Microsoft, mail it to Microsoft Corporation, ATTN: LCA ARBITRATION, One Microsoft Way, Redmond, WA 98052-6399. Tell us your name, address, how to contact you, what the problem is, and what you want. A form is available at ([aka.ms/disputeform](https://aka.ms/disputeform)). We'll do the same if we have a dispute with you. After 60 days, you or we may start an arbitration if the dispute is unresolved.

c. **Small claims court option.** Instead of mailing a Notice of Dispute, and if you meet the court's requirements, you may sue us in small claims court in your county of residence (or if a business your principal place of business) or our principal place of business—King County, Washington USA if your dispute is with Microsoft. We hope you'll mail a Notice of Dispute and give us 60 days to try to work it out, but you don't have to before going to small claims court.

d. **Arbitration procedure.** The AAA will conduct any arbitration under its Commercial Arbitration Rules (or if you are an individual and use the software for personal or household use, or if the value of the dispute is \$75,000 USD or less whether or not you are an individual or how you use the software, its Consumer Arbitration Rules). For more information, see ([aka.ms/adr](https://aka.ms/adr)) or call 1-800-778-7879. To start an arbitration, submit the form available at ([aka.ms/arbitration](https://aka.ms/arbitration)) to the AAA; mail a copy to the manufacturer or installer (or to Microsoft if your dispute is with Microsoft). In a dispute involving \$25,000 USD or less, any hearing will be telephonic unless the arbitrator finds good cause to hold an in-person hearing instead. Any in-person hearing will take place in your county of residence (of if a business your principal place of business) or our principal place of

business—King County, Washington if your dispute is with Microsoft. You choose. The arbitrator may award the same damages to you individually as a court could. The arbitrator may award declaratory or injunctive relief only to you individually to satisfy your individual claim.

- e. Arbitration fees and payments.**
- (i) **Disputes involving \$75,000 USD or less.** The manufacturer or installer (or Microsoft if your dispute is with Microsoft) will promptly reimburse your filing fees and pay the AAA's and arbitrator's fees and expenses. If you reject our last written settlement offer made before the arbitrator was appointed, your dispute goes all the way to an arbitrator's decision (called an "award"), and the arbitrator awards you more than this last written offer, the manufacturer or installer (or Microsoft if your dispute is with Microsoft) will: (1) pay the greater of the award or \$1,000 USD; (2) pay your reasonable attorney's fees, if any; and (3) reimburse any expenses (including expert witness fees and costs) that your attorney reasonably accrues for investigating, preparing, and pursuing your claim in arbitration. The arbitrator will determine the amounts unless you and we agree on them.
  - (ii) **Disputes involving more than \$75,000 USD.** The AAA rules will govern payment of filing fees and the AAA's and arbitrator's fees and expenses.
  - (iii) **Disputes involving any amount.** If you start an arbitration we won't seek our AAA or arbitrator's fees and expenses, or your filing fees we reimbursed, unless the arbitrator finds the arbitration frivolous or brought for an improper purpose. If we start an arbitration we will pay all filing, AAA, and arbitrator's fees and expenses. We won't seek our attorney's fees or expenses from you in any arbitration. Fees and expenses are not counted in determining how much a dispute involves.
- f. Must file within one year.** You and we must file in small claims court or arbitration any claim or dispute (except intellectual property disputes — see Section 9.a.) within one year from when it first could be filed. Otherwise, it's permanently barred.
- g. Severability.** If the class action waiver is found to be illegal or unenforceable as to all or some parts of a dispute, those parts won't be arbitrated but will proceed in court, with the rest proceeding in arbitration. If any other provision of Section 9 is found to be illegal or unenforceable, that provision will be severed but the rest of Section 9 still applies.
- h. Conflict with AAA rules.** This agreement governs if it conflicts with the AAA's Commercial Arbitration Rules or Consumer Arbitration Rules.
- i. Microsoft as party or third-party beneficiary.** If Microsoft is the device manufacturer or if you acquired the software from a retailer, Microsoft is a party to this agreement. Otherwise, Microsoft is not a party but is a third-party beneficiary of your agreement with the manufacturer or installer to resolve disputes through informal negotiation and arbitration.
- 10. Governing Law.** The laws of the state or country where you live (or if a business where your principal place of business is located) govern all claims and disputes concerning the software, its price, or this agreement, including breach of contract claims and claims under state consumer protection laws, unfair competition laws, implied warranty laws, for unjust enrichment, and in tort, regardless of conflict of law principles. In the United States, the FAA governs all provisions relating to arbitration.
- 11. Consumer Rights, Regional Variations.** This agreement describes certain legal rights. You may have other rights, including consumer rights, under the laws of your state or country. You may also have rights with respect to the party from which you acquired the software. This agreement does not change those other rights if the laws of your state or country do not permit it to do so. For example, if you acquired the software in one of the below regions, or mandatory country law applies, then the following provisions apply to you:
- a. Australia.** References to "Limited Warranty" are references to the express warranty provided by Microsoft or the manufacturer or installer. This warranty is given in addition to other rights and remedies you may have under law, including your rights and remedies in accordance with the statutory guarantees under the Australian Consumer Law.
- In this section, "goods" refers to the software for which Microsoft or the manufacturer or installer provides the express warranty. Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure.
- b. Canada.** You may stop receiving updates on your device by turning off Internet access. If and when you re-connect to the Internet, the software will resume checking for and installing updates.
- c. European Union.** The academic use restriction in Section 12.d(i) below does not apply in the jurisdictions listed on this site: (aka.ms/academicuse).
- d. Germany and Austria.**
- (i) **Warranty.** The properly licensed software will perform substantially as described in any Microsoft materials that accompany the software. However, the manufacturer or installer, and Microsoft, give no contractual guarantee in relation to the licensed software.
  - (ii) **Limitation of Liability.** In case of intentional conduct, gross negligence, claims based on the Product Liability Act, as well as, in case of death or personal or physical injury, the manufacturer or installer, or Microsoft is liable according to the statutory law.
- Subject to the preceding sentence, the manufacturer or installer, or Microsoft will only be liable for slight negligence if the manufacturer or installer or Microsoft is in breach of such material contractual obligations, the fulfillment of which facilitate the due performance of this agreement, the breach of which would endanger the purpose of this agreement and the compliance with which a party may constantly trust in (so-called "cardinal obligations"). In other cases of slight negligence, the manufacturer or installer or Microsoft will not be liable for slight negligence.
- e. Other regions.** See (aka.ms/variations) for a current list of regional variations
- 12. Additional Notices.**
- a. Networks, data and Internet usage.** Some features of the software and services accessed through the software may require your device to access the Internet. Your access and usage (including charges) may be subject to the terms of your cellular or internet provider agreement. Certain features of the software may help you access the Internet more efficiently, but the software's usage calculations may be different from your service provider's measurements. You are always responsible for (i) understanding and complying with the terms of your own plans and agreements, and (ii) any issues arising from using or accessing networks, including public/open networks. You may use the software to connect to networks, and to share access information about those networks, only if you have permission to do so.
- b. H.264/AVC and MPEG-4 visual standards and VC-1 video standards.** The software may include H.264/MPEG-4 AVC and/or VC-1 decoding technology. MPEG LA, L.L.C. requires this notice:  
THIS PRODUCT IS LICENSED UNDER THE AVC, THE VC-1, AND THE MPEG-4 PART 2 VISUAL PATENT PORTFOLIO LICENSES FOR THE PERSONAL AND NON-COMMERCIAL USE OF A CONSUMER TO (i) ENCODE VIDEO IN COMPLIANCE WITH THE ABOVE STANDARDS ("VIDEO STANDARDS") AND/OR (ii) DECODE AVC, VC-1, AND MPEG-4 PART 2 VIDEO THAT WAS ENCODED BY A CONSUMER ENGAGED IN A PERSONAL AND NON-COMMERCIAL ACTIVITY AND/OR WAS OBTAINED FROM A VIDEO PROVIDER LICENSED TO PROVIDE SUCH VIDEO. NO LICENSE IS GRANTED OR SHALL BE IMPLIED FOR ANY OTHER USE. ADDITIONAL INFORMATION MAY BE OBTAINED FROM MPEG LA, L.L.C. SEE WWW.MPEGLA.COM
- c. Malware protection.** Microsoft cares about protecting your device from malware. The software will turn on malware protection if other protection is not installed or has expired. To do so, other antimalware software will be disabled or may have to be removed.
- d. Limited rights versions.** If the software version you acquired is marked or otherwise intended for a specific or limited use, then you may only use it as specified. You may use other programs with the software as long as the other programs directly support the manufacturer's specific use for the device, or provide system utilities, resource management, or anti-virus or similar protection.
- (i) **Academic.** For academic use, you must be a student, faculty or staff of an educational institution at the time of purchase.
  - (ii) **Evaluation.** For evaluation (or test or demonstration) use, you may not sell the software, use it in a live operating environment, or use it after the evaluation period. Notwithstanding anything to the contrary in this Agreement, evaluation software is provided "AS IS".
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13. Entire Agreement. This agreement (together with the printed paper license terms or other terms accompanying any software supplements, updates, and services that are provided by the manufacturer or installer, or Microsoft, and that you use), and the terms contained in web links listed in this agreement, are the entire agreement for the software and any such supplements, updates, and services (unless the manufacturer or installer, or Microsoft, provides other terms with such supplements, updates, or services). You can review this agreement after your software is running by going to ([aka.ms/useterms](https://aka.ms/useterms)) or going to Settings - System - About within the software. You can also review the terms at any of the links in this agreement by typing the URLs into a browser address bar, and you agree to do so. You agree that you will read the terms before using the software or services, including any linked terms. You understand that by using the software and services, you ratify this agreement and the linked terms. There are also informational links in this agreement. The links containing notices and binding terms are:
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IF YOUR LOCAL LAWS IMPOSE A WARRANTY, GUARANTEE, OR CONDITION EVEN THOUGH THIS AGREEMENT DOES NOT, ITS TERM IS LIMITED TO 90 DAYS FROM WHEN THE FIRST USER ACQUIRES THE SOFTWARE. IF THE MANUFACTURER OR MICROSOFT BREACHES SUCH A WARRANTY, GUARANTEE, OR CONDITION, YOUR SOLE REMEDY, AT THE MANUFACTURER'S OR MICROSOFT'S ELECTION, IS (I) REPAIR OR REPLACEMENT OF THE SOFTWARE AT NO CHARGE, OR (II) RETURN OF THE SOFTWARE (OR AT ITS ELECTION THE DEVICE ON WHICH THE SOFTWARE WAS INSTALLED) FOR A REFUND OF THE AMOUNT PAID, IF ANY. THESE ARE YOUR ONLY REMEDIES FOR BREACH OF A WARRANTY, GUARANTEE, OR CONDITION YOUR LOCAL LAWS IMPOSE.

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Check with your device manufacturer to determine if your device is covered by a warranty.



# Before asking repair and inspection

**This product is mounting a hard disk.**

**Before giving your product to Keyence for repair and inspection, be sure to back up data in the hard disk.**

In case that data remains in the hard disk, it may disappear or cannot be retrieved because of repairs or during transportation. Please back up data in the hard disk.

**When some defects are discovered in the hard disk during repair or inspection, we will replace it.**

**The data stored in the defective hard disk is transferred into a new hard disk.**

If the data stored in the defective hard disk can be taken from it, the data will be transferred into a new hard disk as part of the replacement work. When, however, the data cannot be taken from it, only replacement of the hard disk is carried out.

**Return of the replaced hard disk**

In case that a hard disk is replaced, basically we discard the replaced hard disk. When such hard disk needs to be returned, please inform our sales office about that in advance, or when you request repairs.

**Nondisclosure of the data when repair or inspection is taken place**

In case that data remains in the hard disk, we may open the data file in the hard disk to confirm or analyze the phenomenon, and to move such data. Please delete all the data that must not be disclosed to us before requesting repairs. We will properly manage any data in the hard disk as our customer's confidential information. We will never disclose or leak it to any third parties, or make it available to the public.

## ● Request for data backup

Please backup data in the hard disk regularly.

If you have any questions or concerns, please feel free to contact the nearest sales office.

# Revision history

Revision history	Edition number	Revision details
June 2019	Revised 1st edition	
December 2019	2nd revision 1st edition	
December 2019	2nd revision 2nd edition	
November 2020	3rd revision 1st edition	

# WARRANTIES AND DISCLAIMERS

- (1) KEYENCE warrants the Products to be free of defects in materials and workmanship for a period of one (1) year from the date of shipment. If any models or samples were shown to Buyer, such models or samples were used merely to illustrate the general type and quality of the Products and not to represent that the Products would necessarily conform to said models or samples. Any Products found to be defective must be shipped to KEYENCE with all shipping costs paid by Buyer or offered to KEYENCE for inspection and examination. Upon examination by KEYENCE, KEYENCE, at its sole option, will refund the purchase price of, or repair or replace at no charge any Products found to be defective. This warranty does not apply to any defects resulting from any action of Buyer, including but not limited to improper installation, improper interfacing, improper repair, unauthorized modification, misapplication and mishandling, such as exposure to excessive current, heat, coldness, moisture, vibration or outdoors air. Components which wear are not warranted.
- (2) KEYENCE is pleased to offer suggestions on the use of its various Products. They are only suggestions, and it is Buyer's responsibility to ascertain the fitness of the Products for Buyer's intended use. KEYENCE will not be responsible for any damages that may result from the use of the Products.
- (3) The Products and any samples ("Products/Samples") supplied to Buyer are not to be used internally in humans, for human transportation, as safety devices or fail-safe systems, unless their written specifications state otherwise. Should any Products/Samples be used in such a manner or misused in any way, KEYENCE assumes no responsibility, and additionally Buyer will indemnify KEYENCE and hold KEYENCE harmless from any liability or damage whatsoever arising out of any misuse of the Products/Samples.
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Specifications are subject to change without notice.

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