KEYENCE

96M16456

3D Surface Profiler

VK-X3000 Series

User's Manual

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

Introduction

This manual describes the handling, operating procedures and precautions for the 3D Surface Profiler VK-X3000 Series.

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

This manual uses the following symbols to show important information at a glance.

Be sure to read these messages carefully.

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

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

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

Reference Indicates tips for better understanding or useful information.

Indicates reference pages in this manual or other manual.

Precautions

- Reprinting any part or all of this manual without permission is prohibited.
- Please note that the content of this manual is subject to change without notice for the purpose of improvement.
- Should you find any problem with the content of this manual, such as an unclear point, mistake, or erroneous omission, contact your nearest KEYENCE office.
- If there are missing or misplaced pages, we will provide a new copy of this manual.

Safety Information for the VK-X3000 Series

To prevent damage and to correctly use the 3D Surface Profiler VK-X3000 Series (hereafter referred to as VK-X3000 Series), follow the precautions below.

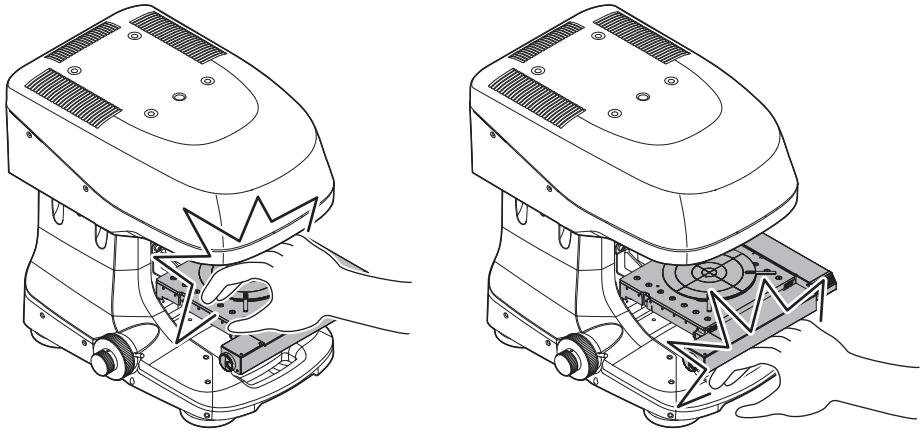
■ General Precautions

DANGER	• **Do not use this product for the purpose to protect a human body or a part of a human body.** • **Do not use this product in a hazardous location and/or potentially explosive atmosphere.** • **Do not use this product in an application that may cause death, serious injury or serious property damage due to a failure with this product should occur, such as nuclear power plants, on aircraft, trains, ships, or vehicles, used within medical equipment, playground equipment, roller coasters and other rides, etc.** • **Unplug the AC power cord first before replacing the fuse. Failure to do so may cause damage or electric shock.**

WARNING	• **If you do not use this product as prescribed by KEYENCE, the product protections may not function correctly.** • **You must perform a sufficient risk assessment for the machine where this product is to be installed prior to installing this product. Provide appropriate protective fail-safe measures on the machine independent from this product in case a failure with this product should occur.**

■ Precautions for use

WARNING	• **Confirm that the components of our product are working normally before use.** • **Considering the possibility of our product failing, use the product after implementing sufficient safety measures to prevent any damage.** • **Do not allow any foreign material to enter inside. It may result in fire, electric shock, malfunction or accident.** • **Never remove the plastic housing of the VK-X3000 Series. Touching the inside may result in an electric shock.** • **The VK-X3000 Series is grounded to the case. Make sure that the device is properly insulated if installed in a high-noise environment or a positive ground situation. Failure to do so may cause damage or electric shock.**

CAUTION	• **Do not stare at the LED light or specularly reflected beam.** • **Do not touch the lens revolver while it is moving. Doing so risks catching hands or fingers in the mechanism.** • **Insertion precautions** **Do not place your hand between the stage and the unit. Doing so may result in your hand getting caught and subsequent injury.** 

NOTICE	• Regularly back up all data saved on the control PC. This mitigates the risk of data loss. Additionally, if the control PC needs to be repaired, make sure to back up data before sending it in for repairs. • Please note we cannot guarantee the function and performance of products that are modified or used outside of the ratings shown in the specifications. • When our product is used in conjunction with equipment from other companies, the normal function and sufficient performance may not be attained depending on the condition of use and the environment. Be sure to make sufficient assessment before such use. • Since the VK-X3000 Series uses precision optics, avoid any vibration or shocks. Doing so may cause damage. • Make sure that the power of the VK-X3000 Series is turned off before removing/inserting the power cable, controller cable, or camera cable. Doing so may cause failure. • Make sure that the lens does not come in contact with the sample. Doing so may cause damage. • Do not place objects that weigh more than 5.0 kg on the standard XY stage or more than 3.0 kg on the motorized XY stage. Doing so may cause damage. • Do not turn the power off during measurement. Otherwise, some or all of the settings may be lost. • Except for when replacing the lens, do not touch the motorized revolver. Doing so may cause failure. • Do not rotate the motorized revolver with your hands when it is turned on. Doing so may cause failure.
Important	• Make sure that the ambient temperature is stable during measurements. • Wait one hour or more for preheating after turning on the power before taking measurements. • When the objective lens is dirty, clean it with compressed air. If the dirt persists, use a cotton swab dipped in alcohol. • Make sure that the device is not subject to vibration during measurement. It is recommended that an anti-vibration stand be used.

■ Precautions for abnormalities

WARNING	Turn off the power immediately in the following cases. Using the unit in an irregular state could cause fire, electric shock, or an accident. Contact your nearest KEYENCE office for repair. • If water or foreign material enters inside the VK-X3000 Series. • If the unit is dropped or the case is damaged. • If the VK-X3000 Series emits smoke or odors.

NOTICE	Back up all data saved on the control PC before sending it in for repairs. The repair procedure carries a risk of data loss. Additionally, regular periodic backups are recommended.

■ Precautions for installation

CAUTION	**Set the VK-X3000 Series on a level surface to avoid damage or injury.**

NOTICE	• **Do not block the controller ventilation slots. Internal temperature increases may result in damage.** **Avoid installation in the following locations. Doing so may cause failure.** • **Locations where the device will be subject to direct vibrations** • **Locations where the ambient temperature drops below 15°C or exceeds 28°C** • **Locations where the ambient humidity drops below 20% RH or exceeds 80% RH (no condensation)** • **Locations where the temperature changes rapidly** • **Locations where the device will be exposed to a direct breeze from an air conditioner** • **Locations where there are corrosive gases or volatile inflammable materials** • **Locations with large amounts of airborne dust, salt, iron or greasy fumes** • **Locations with a risk of exposure to water, oil or chemical droplets** • **Locations where a strong magnetic or electric field is generated** • **Locations where the device may be exposed to direct sunlight, wind, or rain** • **Locations where the voltage varies greatly**

Important	**It is recommended that the VK-X3000 Series be installed on a commercially available anti-vibration stand.**

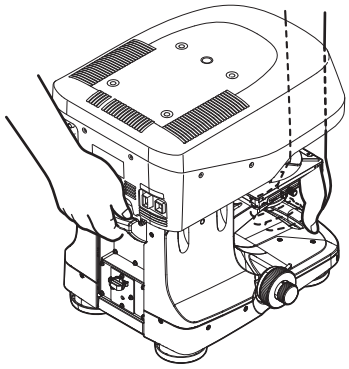
■ Precautions for the power supply

WARNING	• **The VK-X3000 Series is Class I appliance. When installing this device, connect the protective grounding terminal of the power supply cord set to the protective grounding conductor of the installation location. Otherwise, it may cause electric shock or product damage.** • **Do not bend forcefully or put any heavy objects on the power cable. Doing so may lead to a cable break, resulting in fire or electric shock. Do not use a damaged cable.** • **Make sure to use the VK-X3000 Series under proper power supply voltage; otherwise, an electric shock, fire or product malfunctions may occur.** • **The power supply cord set is not provided with the VK-X3000 Series. Use a power cable that complies with the regulations and standards in the country or the region in which the VK-X3000 Series are used.**

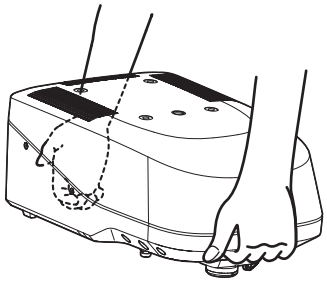
■ Precautions for transportation

CAUTION

- **When transporting the VK-X3000 Series, carry it by holding the base handle. Carrying the device by the measurement portion may damage it. There is also a chance of injury or damage if the device falls.**

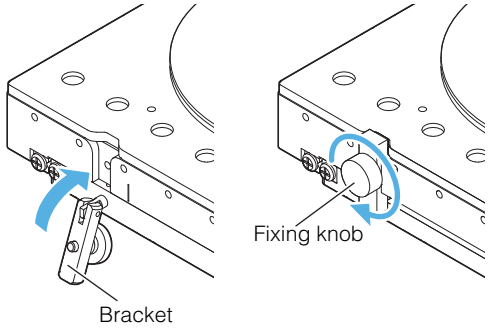


- **Carry the measurement portion of the device by the recessed portions on the front and back of the unit.**

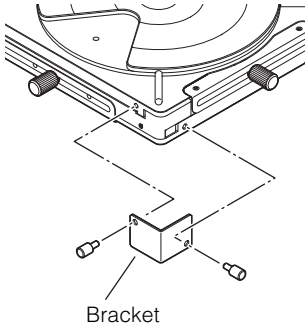


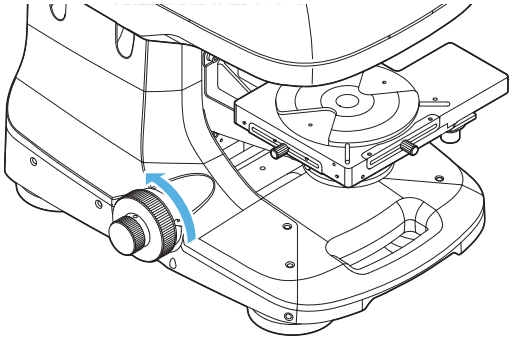
- **Be sure to secure the motorized revolver and XY stage with a locking bracket before transportation. Be sure to also secure the Z stage using the focusing handle.**

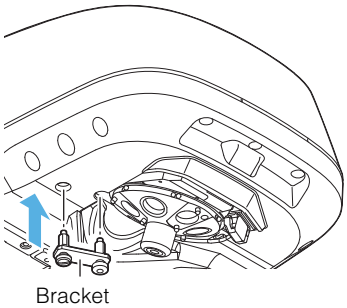
Motorized XY stage



Standard XY stage







NOTICE	• Since the VK-X3000 Series uses precision optical parts, avoid any vibration or shocks. Doing so may cause damage. • Be sure to remove the objective lenses and ring illuminations from the revolver when transporting. Doing so may cause damage. • Be sure to use packaging materials specified by KEYENCE for transportation. Doing so may cause damage. • The VK-X3000 Series is a high precision optical instrument. Sudden changes in temperature may result in damage, including condensation and misalignment of the optical axis. Leave the device at room temperature (between 15°C and 28°C) for 24 hours after unpacking it.

Important	The removed brackets and the lens cases are required when the VK-X3000 Series is transported. Do not discard, be sure to store these pieces in a secure location.

■ Precautions for storage

NOTICE	• Store the device in its packaging if it will not be used for a long period of time. Doing so may cause failure. Avoid storing in the following locations. Doing so may cause failure. • Locations where the device will be subject to direct vibrations • Locations where the ambient temperature drops below 0°C or exceeds 40°C • Locations where the ambient humidity drops below 20% RH or exceeds 80% RH (no condensation) • Locations where the temperature changes rapidly • Locations where there are corrosive gases or volatile inflammable materials • Locations with large amounts of airborne dust, salt, iron or greasy fumes • Locations with a risk of exposure to water, oil or chemical droplets • Locations where a strong magnetic or electric field is generated • Locations where the device may be exposed to direct sunlight, wind, or rain • Locations that are unstable or where the device may fall

■ Other precautions

NOTICE	If the VK-X3000 Series gets dirty, clean it with a dry cloth.

Safety Precautions on Laser Products

The VK-X3000 Series employs a semiconductor laser as the light source.

Model	VK-X3050	VK-X3100
Wavelength	661 nm (Red laser)	404 nm (Violet laser)
Output	0.9 mW	0.9 mW
Laser class	Class 2 Laser Product (IEC60825-1, JIS C6802)	

■ VK-X3050

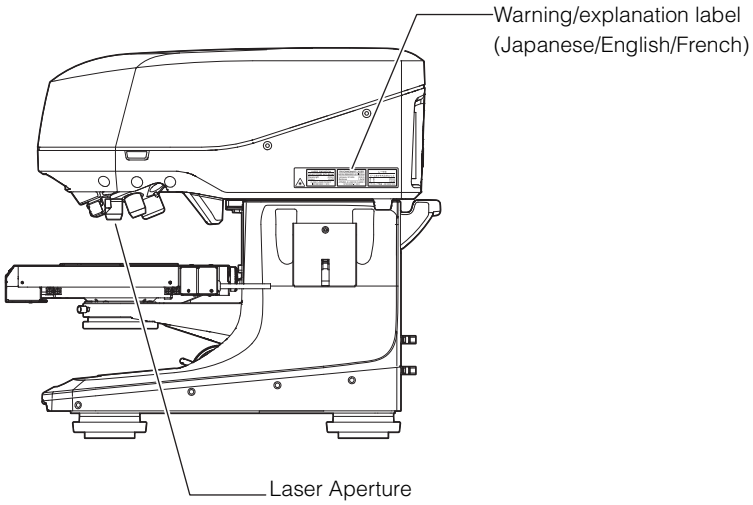
■ VK-X3100

* This product complies with EN 60825-1:2014+A11:2021.

Make sure to comply with the items below. Not doing so may result in eye, skin, or other injuries.

WARNING	**Precautions for Class 2 Laser Products** • **Use of controls, adjustments or procedures other than those specified herein may result in hazardous laser radiation exposure.** • **The VK-X3000 Series is not equipped with a mechanism to stop laser light emissions during disassembly. Never disassemble this product.** • **Do not stare at the laser or specularly reflected beam.** • **Do not intentionally point the laser beam at people.** • **Make sure to stop laser beam emissions before cleaning the laser beam window.** • **Be careful of the path of the laser beam.** **If there is the possibility that the operator may be exposed to the specular or diffuse reflections, block the beam by installing a protective enclosure. Install the VK-X3000 Series so that the path of the laser beam is not at eye level.** • **It is recommended that you erect a protective barrier around the VK-X3000 Series to prevent people from coming close to it while in use.** • **It is recommended that protective eyewear is worn when using the VK-X3000 Series.** • **Do not operate this product using any methods that are not described in this manual.**

Label Location



Use the warning/explanation label provided in this product package that is applicable to the country or region that this product is to be used.

You can paste the warning/explanation label attached onto this product.

Laser Safety Measures

The VK-X3000 Series is equipped with the following items.

1 Laser radiation emission warning light

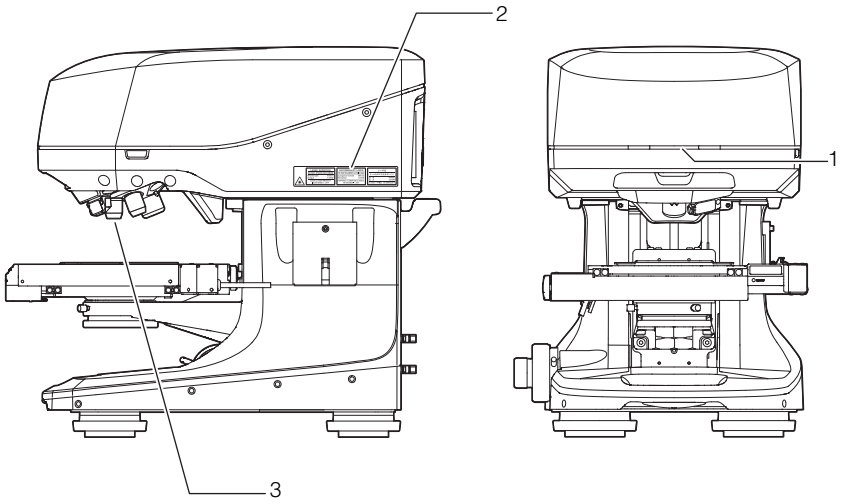
Turning on the main power turns on the laser radiation emission warning light, indicating that the laser is being emitted.

2 Laser warning/explanation label

A laser warning/explanation label is attached to the VK-X3000 Series.

3 Laser Aperture

The laser is emitted from the end of the lens.



Safety precautions on LED product

The degrees of risk for this product are as follows.

Light source	Risk group*
Coaxial illumination	Risk group 1
Ring illumination	Risk group 1

* LED product is 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 ver 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, based on the following specifications. Be sure to consider the following specifications when using this product in the Member State of European Union.

■ EMC directive

- Applicable standard: EN61326-1, Class A
- Be sure to use all the input and output cable of 30 m or less.
- This product is intended to be used in an industrial electromagnetic environment.

These specifications do not give any guarantee that the end-product with this product incorporated complies with this 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
  EN60825-1 Class 2 laser product
  EN62471 Risk Group 1
- Overvoltage Category II
- Use this product under pollution degree 2.
- Use this product at an elevation of 2,000 meters or below.
- 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 AC power inlet falls under a disconnecting device.
  Install this product to be able to remove the AC cord set from the AC power inlet in abnormal situations immediately.

CSA Certification

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.
- Install this product at an altitude of 2000 m 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 AC power inlet falls under a disconnecting device.
  Install this product to be able to remove the AC cord set from the AC power inlet in abnormal situations immediately.

Organization of This Manual

Chapter 1	Getting Started	This chapter describes the principles of the VK-X3000 Series, the contents of the packaging, and the names of each part.
Chapter 2	Set-Up	This chapter describes how to assemble the measurement unit and base, and how to connect each device.
Chapter 3	Before Measuring	This chapter describes the preparation and basic adjustments to be made before taking measurements.
Chapter 4	Accessory Installation	This chapter describes the optional devices and how to install them.
Chapter 5	Maintenance	This chapter describes how to clean the objective lenses and adjustment mirrors, as well as how to replace the fuses.
Appendix	Dimensions/Specifications	This chapter describes the specifications and dimensions of the VK-X3000 Series.

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Appendix

Chapter 1

Getting Started

This chapter describes the principles of the VK-X3000 Series, the contents of the packaging, and the names of each part.

Overview of the VK-X3000 Series

This manual gives a summary of the VK-X3000 Series, which offers both magnified observation and shape measurements.

The White Light Interferometer 3D Laser Scanning Microscope VK-X3000 Series is a magnified observation and measurement system that measures roughness on the surface of samples that are passed through a lens in the same manner as a microscope to be observed and magnified. It also possesses a measuring microscope that can analyze samples to quantify shape and roughness.

Measurement Methods

The VK-X3000 Series employs three methods for measuring surface shapes of the object, which are described herein.

Focus variation

This measurement method captures multiple optical images while the objective lens moves up and down, and obtains the object height information (shape) by calculating the lens focus position from the changes to the contrast of the captured image.

Focus variation is mainly used with an objective lens at a magnification of 20x or lower and it is an effective measurement method for objects that are sharply shaped or curved like tools or molded parts.

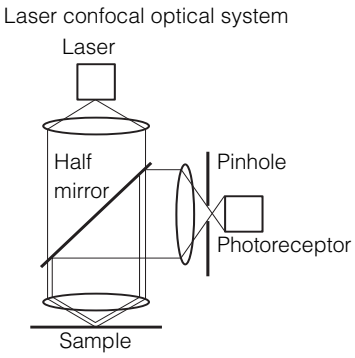
Laser confocal

Light emitted from a laser light source is concentrated onto the object surface via the confocal optical system.

The concentrated light reflects off the object surface and returns to the photoreceptor through the same light path. Placing a pinhole beforehand in front of the photoreceptor that receives the light ensures that no light other than that which passes through the focal point of the objective lens reaches the photoreceptor.

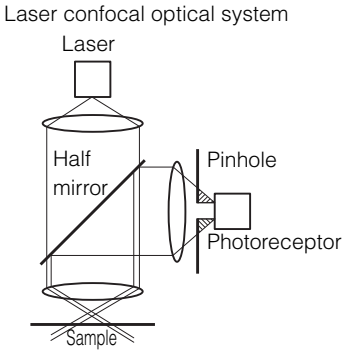
■ Position of the lens when in focus

All of the reflected light enters the photoreceptor.



■ Position of the lens when not in focus

The laser confocal optical system allows only a fraction of the light.



The height information (shape) of the object is captured by detecting the lens position in the Z axis when the reflected light intensity is at its peak.

Since a laser is used to acquire the data, the material of the object doesn't matter.

When using laser confocal mode, there are some disadvantages including reduced data quality at low magnification as well as limited angular resolution.

White light interference

This measurement method uses the principle of constructive and destructive interference to quantify height data.

One of the two light beams that is emitted from a light source (white light LED or the like) is reflected onto a reference surface by a half mirror and the other light beam is transmitted and guided onto the surface of the object. The reflected light is reflected off the reference surface and an image forms on a camera. The other beam of the transmitted light is reflected off the object surface and transmitted by the half mirror to the same camera. Where an image forms. By designing the optical distance from the camera to the reference surface at the same distance as from the camera to the sample surface, the interference stripe that occurs in the optical path difference due to the unevenness of the sample surface is projected onto the image that forms on the camera. Counting the number of interference stripes enables the unevenness (height) of the sample surface to be scanned.

White light interference enables nanometer-level height measurements to be taken, regardless of lens magnification. This method is ideal for small step heights and curved film and glass over a wide field of view.

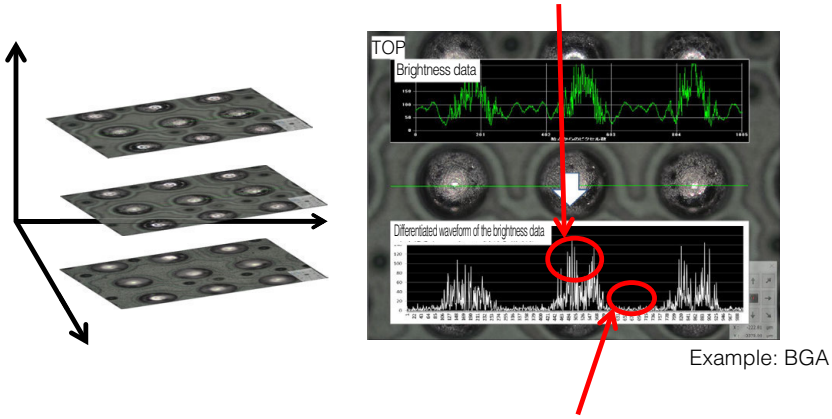
Measurement Principles

This section describes three measurement principles used for measuring the shape of an object's surface.

Focus variation

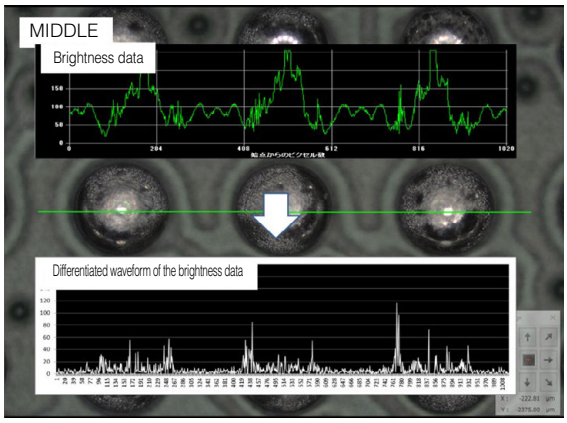
Focus variation detects the brightness difference between adjacent pixels while the objective lens moves up and down. The difference between the focused and unfocused places of the objective lens on the VK-X Series is clear because the depth of field is shallow and the position information when the lens is focused is well tracked.

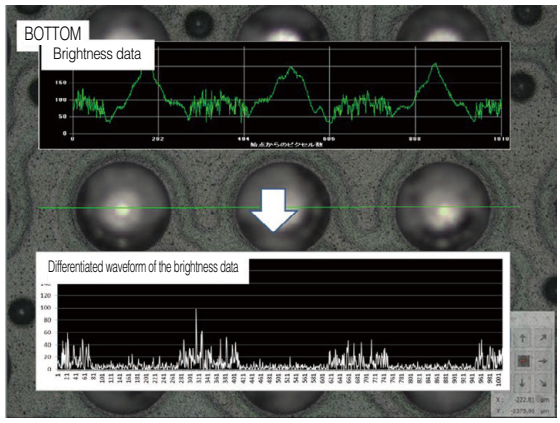
If the lens is focused, minute shapes on the surface can be captured, so the amount of fluctuation in the brightness is significant.



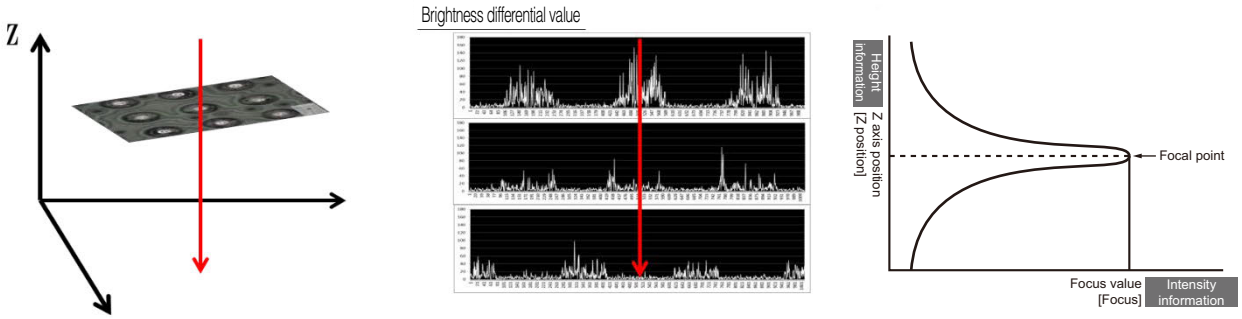
Example: BGA

If the lens is not focused, the focal point on the image will be blurred, so there is almost no difference in the amount of brightness fluctuation.





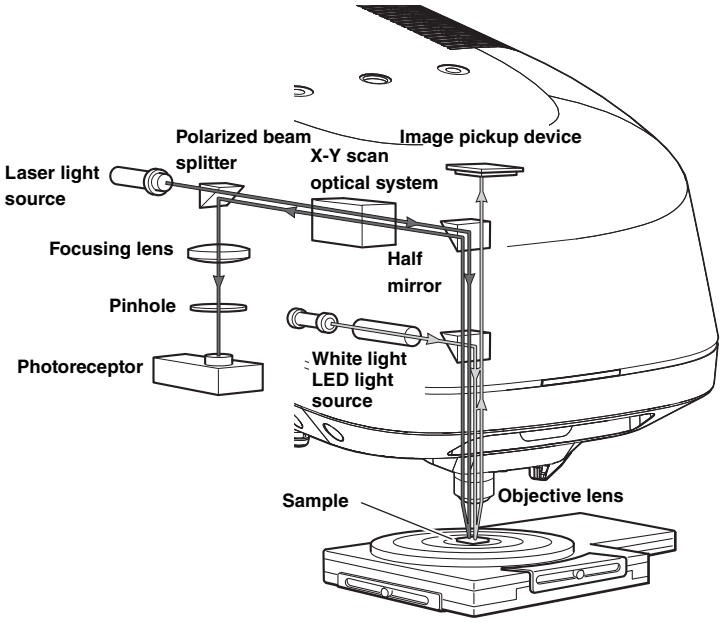
Focus variation focuses on the camera's high-contrast pixels and the pixels around those pixels. The brightness difference between adjacent pixels is recorded while the objective lens moves up and down.



By converting the image luminance difference (amount of image blurring) caused by the objective lens moving to a focus value and making a graphical representation of the vertical movement (positional data of the linear scale) of the objective lens, you can obtain the focus data for each Z position like shown in the above figure.

You can obtain a clear image with a deep focal depth that has been composed by overlapping the height data of the observed object from the highest Z position (that is, focal point) data of the focus value on the graph onto the image.

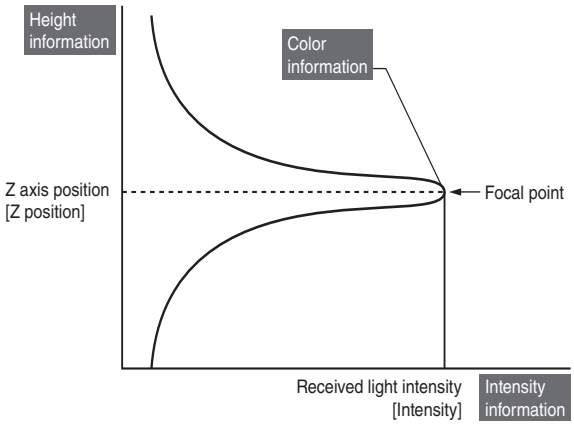
Laser confocal

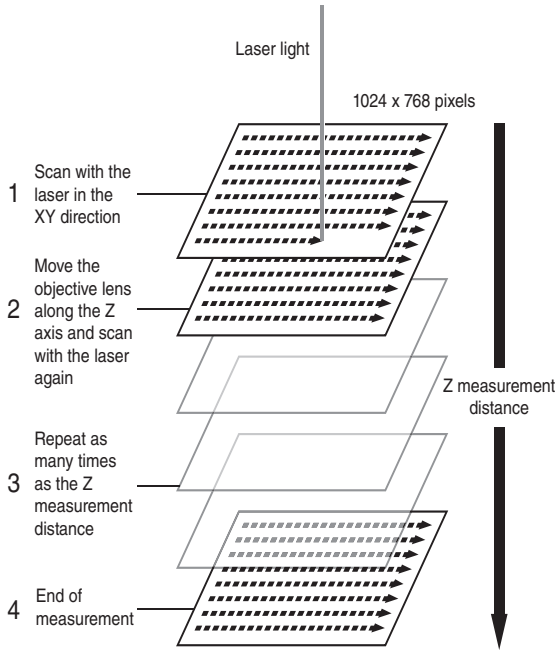


The light emitted from the laser light source is focused onto the surface of the sample via XY scan optics and objective lens. The focused spot light scans the image area within the field of view using the XY scan optical system.

By dividing the field of view into 1024×768 pixels[*1] to scan the image, the reflected light at each pixel is detected by the photoreceptor. By driving the objective lens in the Z axis to repeat the scan of the image, the intensity of each pixel at every position on the Z axis is obtained. With the Z axis position of the highest intensity being the focal point, the height information and the laser intensity are detected. This allows for in focus laser intensity and height images to be obtained.

The device reads the intensity of each Z position for each of the pixels on the 1024×768 pixel screen and determines the Z axis position (the focal point) of the maximum intensity, and records the intensity and color information for that position.

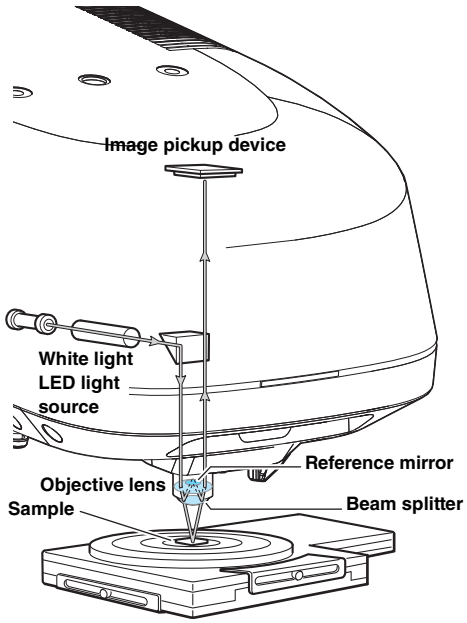




White light interference

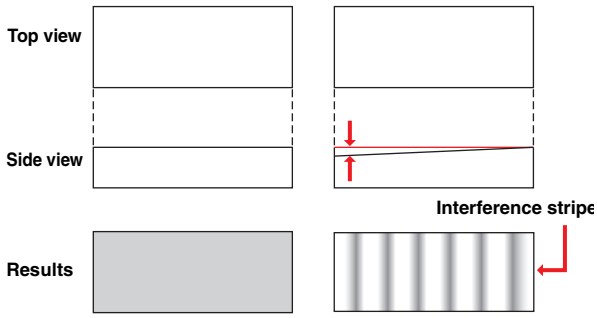
Light interference is the phenomenon of multiple light waves colliding, causing constructive interference or destructive interference.
Optical interferometry is the technique that uses this phenomenon to measure the unevenness of object surfaces.

One of the light beams that is emitted from a light source (white light LED or the like) is reflected onto a reference surface by a half mirror and the other light beam is transmitted and guided onto the surface of sample. The reflected light is reflected off the reference surface and an image forms on the camera.

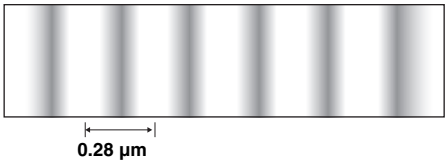


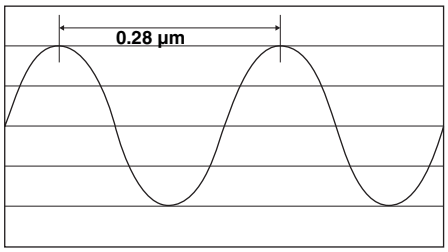
The other beam of the transmitted light is reflected off the object surface and transmitted by the half mirror to the same camera, where an image forms. By designing the optical distance (light path) from the camera to the reference surface at the same distance as from the image pickup device to the sample surface, the interference stripe that occurs in the optical path difference due to the unevenness of the sample surface is projected onto the image that forms on the camera. Counting the number of interference stripes enables the unevenness (height) of the sample surface to be scanned.

As shown in the figure below, when there is an object with a flat surface (left) and an object with an angled surface (right), the interference stripes that occur on the respective surfaces of the objects greatly differ. If the camera is placed at a certain distance from the surface of the object and the interference stripes on the respective objects are observed, interference stripes do not occur as the surface of the object in the image on the left is flat and there is no difference in the light path. (At this time, the interference stripes are shown in the same color such as in gray.) However, interference stripes will occur for an object that is angled like the image on the right because there is a difference in the light path.



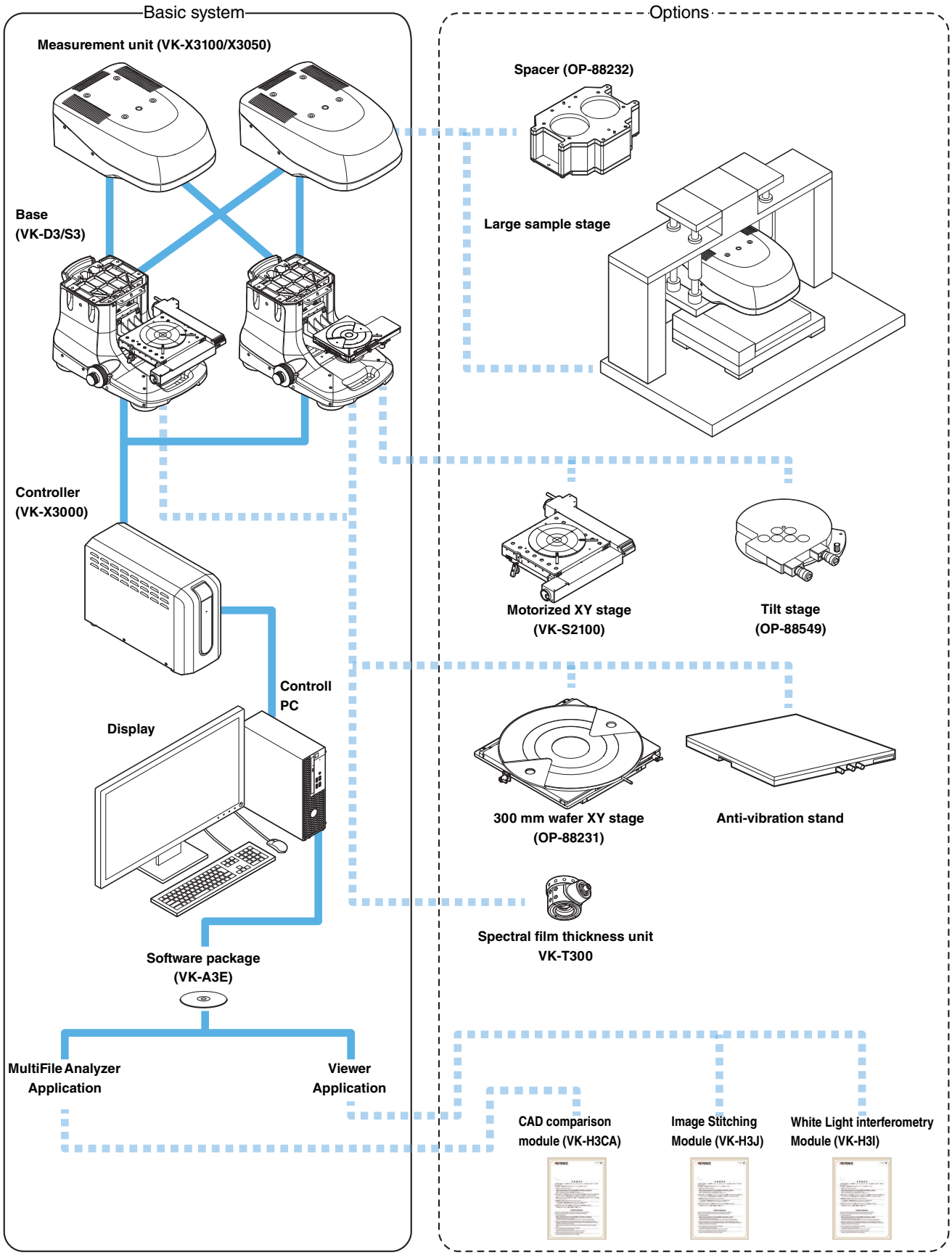
The interference stripes that occur appear in the same interval as half of the light source wavelength (1/2*). Therefore, counting the number of patterns enables you to learn about the changes to the object. Furthermore, the physicist Christiaan Huygens demonstrated that light interference stripes becomes a graph (waveform) at a constant frequency when displayed as a graph waveform as shown in the figure below. An interferometer uses this physical phenomenon (theory) to measure high resolution, even at low magnification.
Now, when 560 nm of light is used as a light source, the interval (wavelength) of these interference stripes is 0.28 µm. This value becomes the height difference of the measured surface. From the fact that the height difference from the peaks on a waveform graph is 0.28 µm, a high resolution of 0.1 nm can be achieved by dividing by 2,000 and scanning the interval of the peaks. An interferometer thus calculates the values by substituting the changes in contrast of the regular interference stripes with the height changes.





System Configuration

The VK-X3000 Series offers the basic system as well as optional devices and applications.



- Measurement unit (VK-X3100/X3050)
  A measurement unit with a semiconductor laser, color C-MOS camera, and an optical scan system built-in. This is used as a microscope mounted onto the specialized base.
- Base (VK-D3/S3)
  This is a base unit to place the measurement on and use as a microscope.
  There are two types of bases: a motorized XY stage model (VK-D3) and a standard manual XY stage model (VK-S3).
- Controller (VK-X3000)
  A control unit with various control and power boards built-in.
- Software package (VK-A3E)
  This package contains software and manuals, including this manual, to use the VK-X3000 Series.
  - Viewer Application
    This operation software controls the VK-X3000 Series to create laser intensity and height images. It adjusts the camera shutter speed, the gain on the photoreceptor, and the scanning format.
  - MultiFile Analyzer Application
    This software can display, edit, measure and manage images and measurement data gathered using the Viewer Application.
    Since this can process images and measurement analysis contents at once for multiple files, differences and trends between data can be obtained and analyzed very quickly.
- Control PC
  This is the control PC for the VK-X3000 Series (KEYENCE-specified product).
- Display
  Use a display recommended by KEYENCE or a commercially available one.
  "Operating Environment" (Page 1-8)
- Optional devices
  For details about optional devices and installation, see "Accessory Installation" (Page 4-1).

Operating Environment

To run the VK-X3000 Series, an environment that meets the following conditions is required.

Note that specifications may be changed for improvements without notice.

Main control PC specifications

Required specifications

OS	Windows 10 Pro 64-bit English version must be preinstalled
CPU	A CPU that supports Intel® Xeon E3-1220 v3 or higher (a Haswell generation CPU or later) and AVX2 (Advanced Vector Extension 2)
Memory	16 GB or more
USB port	USB 2.0 x 2, USB 3.0 x 1
Video card	KEYENCE-specified products (equivalent to 1GB NVIDIA® Quadro® K420 or P400)
Display resolution	1920 x 1080 pixels

Recommended specifications

OS	Windows 10 Pro 64-bit English version must be preinstalled
CPU	A CPU that supports Intel® Core i5-9600 processor or higher (6 core 6 thread or higher is recommended) and AVX2 (Advanced Vector Extension 2)
Memory	32GB or more
USB port	USB 2.0 x 2, USB 3.0 x 1
Video card	Equivalent to 2 GB NVIDIA® Quadro® P400 or higher
Display resolution	1920 × 1080 pixels

▶ Important

- **Set all of the power settings to "None" on the Power Options Properties dialog box for the control PC.**
- **Do not use other software while the Viewer Application and Analyzer Application are running. Doing so may interfere with the device control.**
- **During measurement, the sleep feature of the energy saving function is disabled. (It is not necessary to disable the screen saver, etc.)**
- **When you perform the sleep operation from the Start Menu, the PC goes into sleep mode even if measurement is in progress. In this case, measurement is interrupted and the measurement result will not be saved.**
- **If the controller is connected while the Viewer Application is in use, using Windows sleep feature may result in the controller being disconnected when recovering from sleep mode. Turn the controller power off and turn it on again or pull out and re-insert the USB cable to reconnect the control unit.**
- **Performing the sleep operation during 3D display may result in the image on display disappearing. Switch to another image temporarily to display the 3D again.**
- **When using external media like a USB device or hard disk drive at the same time, connect them to ports attached to a different root hub.**
  Plugging or unplugging other USB devices with the same root hub as this device may result in this device malfunctioning.
- **Check the specifications for both products and prepare a cable to connect the display to the control PC that has the correct cable connector shape.**

Unpacking Procedure

NOTICE	• **Unpack after leaving it at 15 to 28°C for 24 hours or more.** **The VK-X3000 Series is a high precision optical instrument. Sudden changes in temperature may result in damage, including condensation and misalignment of the light beam.** • **Save the packaging after installing the device. Make sure to use this packing material when shipping.**

Unpacking the Controller and Control PC

Unpack the box containing the controller and take out the accessories and controller.

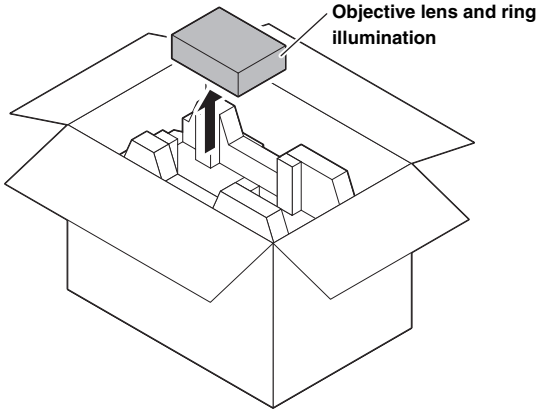
Also unpack the boxes for the control PC and the display.

Unpacking the Measurement Unit

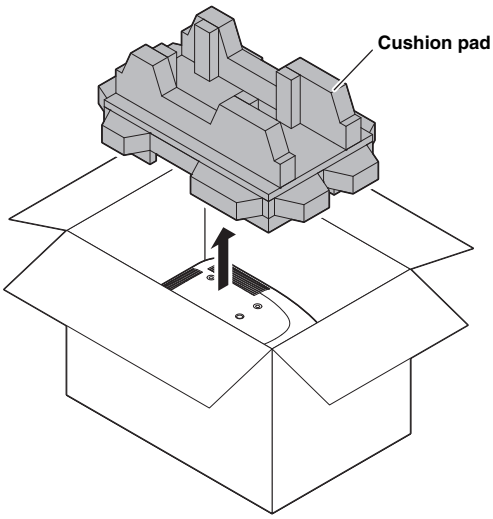
The measurement unit is packed in a special box.

Unpack according to the steps below.

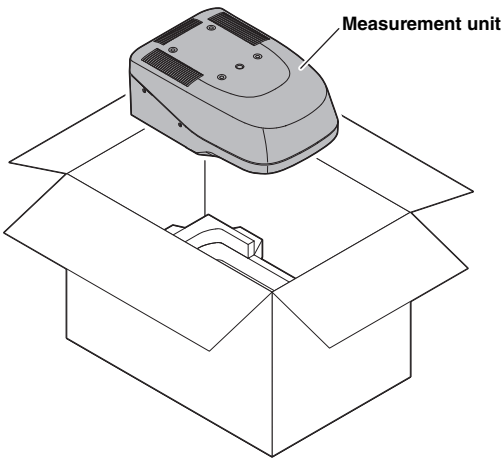
1 **Open the outside box and remove the inside box.**



2 **Remove the cushion pad.**



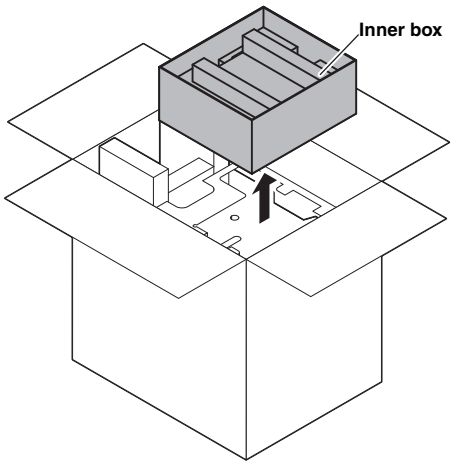
3 **Remove the measurement unit.**



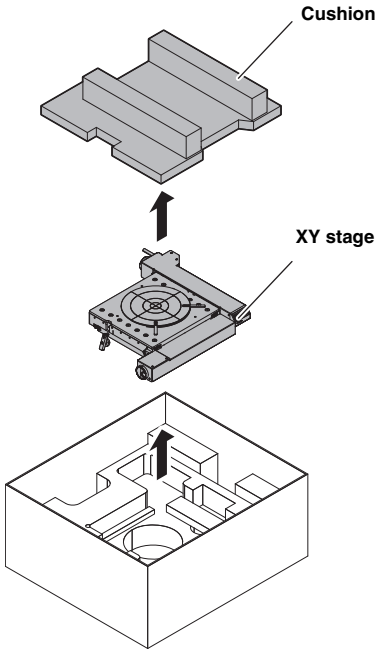
Unpacking the XY Stage and Base

The XY unit and base are packed in a special box.
Unpack according to the steps below.

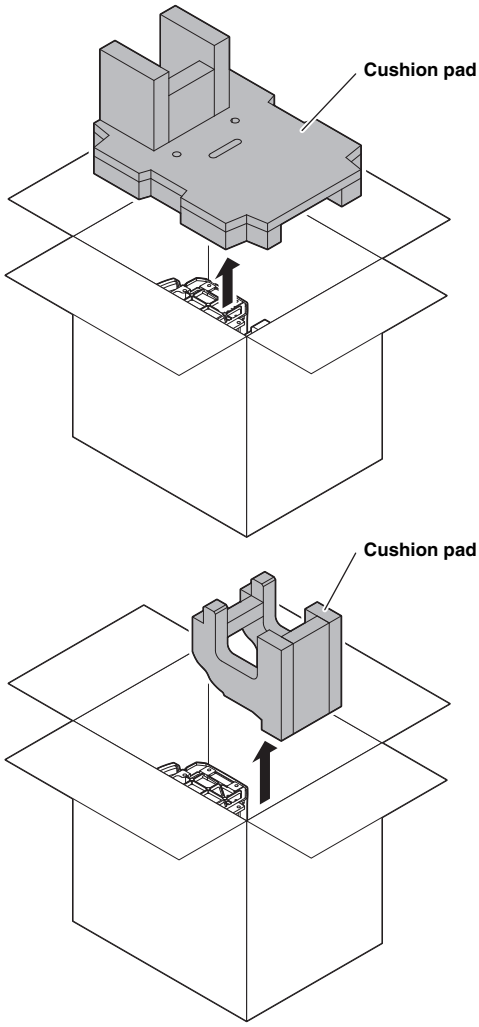
1 **Open the outside box and remove the inside box.**



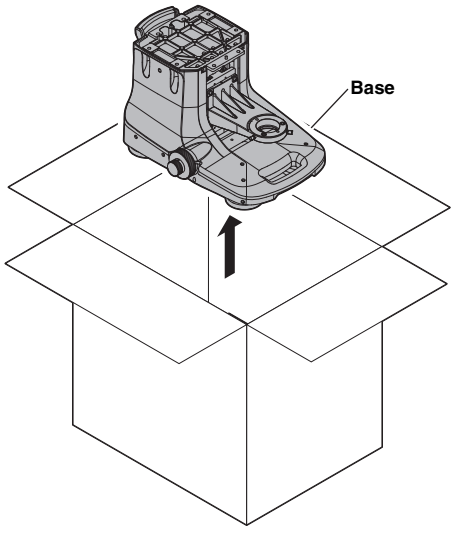
2 **Remove the cushion pads and take out the XY stage.**



3 **Remove the cushion pads.**



4 **Remove the base.**

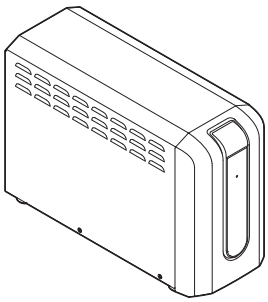


Checking the Package Contents

When you unpack the VK-X3000 Series, check that the parts and equipment listed below are included in the package. We have thoroughly inspected the package contents before shipment. However, in the event of defective or broken items, please contact the nearest KEYENCE office.

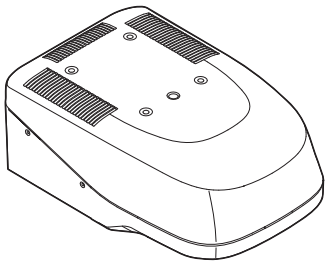
■ Controller (VK-X3000)

☐ Controller: 1

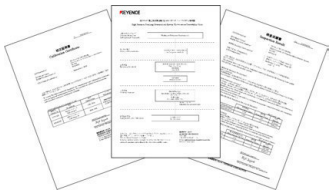


■ Measurement Unit (VK-X3100)

☐ Measurement unit: 1



☐ Calibration certificates

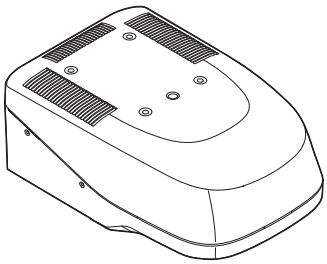


☐ One of each standard objective lens
CF IC EPI Plan 5X (Nikon)
CF IC EPI Plan 10X (Nikon)
CF IC EPI Plan 20X (Nikon)
CF IC EPI Plan Apo 50X (Nikon)

☐ One of each ring illumination
Ring Illumination for a 5.0x Objective Lens
Ring Illumination for a 10.0x Objective Lens

■ Measurement Unit (VK-X3050)

☐ Measurement unit: 1



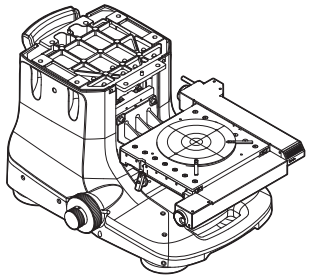
☐ Calibration certificates

☐ One of each standard objective lens
CF IC EPI Plan 5X (Nikon)
CF IC EPI Plan 10X (Nikon)
CF IC EPI Plan 20X (Nikon)
CF IC EPI Plan 50X (Nikon)

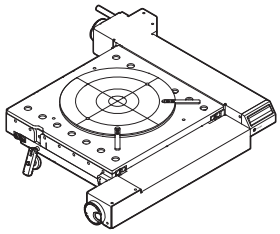
☐ One of each ring illumination
Ring Illumination for a 5.0x Objective Lens
Ring Illumination for a 10.0x Objective Lens

■ Motorized Base (VK-D3)

☐ Motorized Base: 1

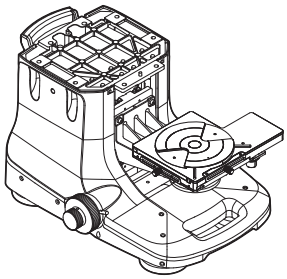


☐ Rotating stage: 1
☐ Motorized XY stage: 1

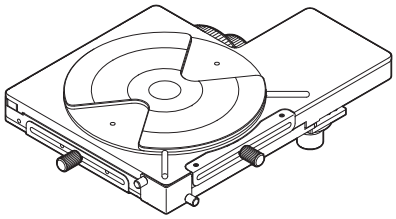


■ Manual Base (VK-S3)

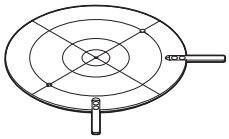
☐ Manual Base: 1



☐ Rotating stage for the manual stage: 1
☐ Standard XY stage: 1

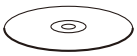


☐ Rotating stage for the tilt stage (OP-88549): 1

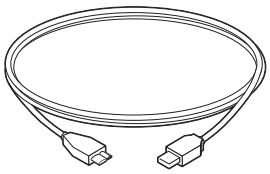


■ Software package (VK-A3E)

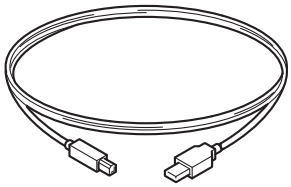
☐ VK-X3000 Series application Software installation DVD
Viewer Application
MultiFile Analyzer Application
(DVD-ROM)



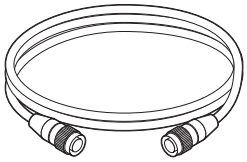
☐ USB 3.0 cable
(A connector - Micro B connector)
2 m: 1



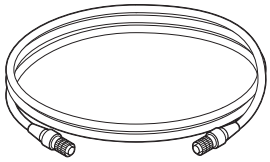
☐ USB2.0 cable 2 m: 1



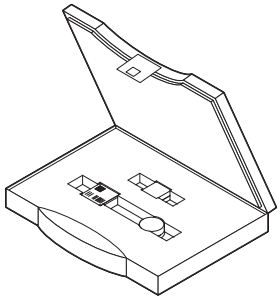
☐ Cable B 2 m: 1



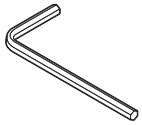
☐ Cable A 2 m: 1



☐ Maintenance kit



☐ Allen key
(for securing the measurement unit)



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

☐ User's manual
(This manual)

☐ Quick Start Guides (12)

Checking the Installation Environment

The installation location of the VK-X3000 Series needs to meet the following conditions.

Installation environment

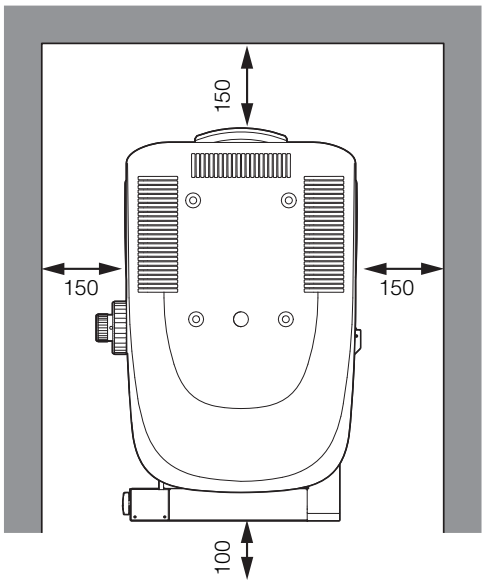
Item	Conditions
Ambient temperature	+15 to +28°C
Humidity	20 to 80% RH (No condensation)
Floor Vibration	VC-B (when white light interference is in use, VC-E is recommended)*

Reference cited:
Generic Vibration Criteria for Vibration-Sensitive Equipment, Colin G. Gordon, SPIE99
Evolving criteria for research facilities: I-Vibration

Space requirement

■ Measurement unit and base

Top view

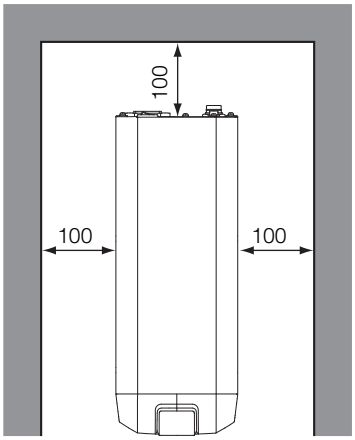


Unit: mm

- Leave at least 150 mm of space to insert the measurement unit and base cable.
- Use a flat and secure surface when installing the measurement unit on the base. Ensure the unit is installed so that vibrations from the frame are not transferred to the measurement unit or base.
- The body of the microscope acts as the ground for the measurement unit, base, and controller. Make sure that the device is properly insulated if installed in a high-noise environment or a positive ground situation.

■ Controller

Top view



Unit: mm

- It is recommended that the controller be installed at least 100 mm from any walls or other structural objects.
- Be sure to ground the earth terminal attached to the controller AC power connector.

■ Control PC and display

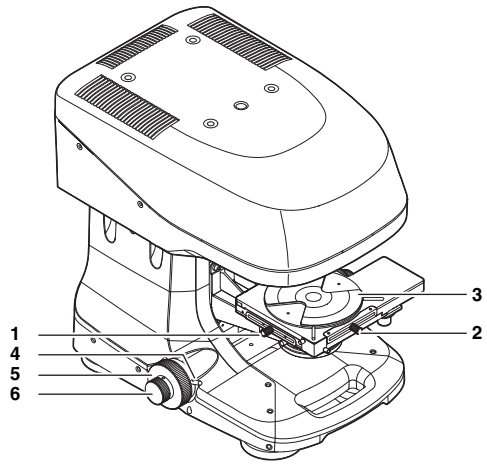
Make sure to check the manuals that come with the control unit and display to secure required installation space.

Power

Make sure that there are three power outlets for the controller, control PC, and display.

Measurement Unit and Base (Left Side and Front)

The VK-X3000 Series is comprised of a base, stage, and measurement unit, which contains a laser confocal optical system.



1 Y axis stage lock mechanism*
A knob that prevents the XY stage from moving in the Y axis direction.

2 X axis stage lock mechanism*
A knob that prevents the XY stage from moving in the X axis direction.

3 Rotating stage
Rotates, allowing the sample to be viewed from many angles.

4 Focusing handle lock
Locks the focusing handles for transporting the measurement unit and base.
LOCK: Locks the focusing handles.
RELEASE: Unlocks the focusing handles.

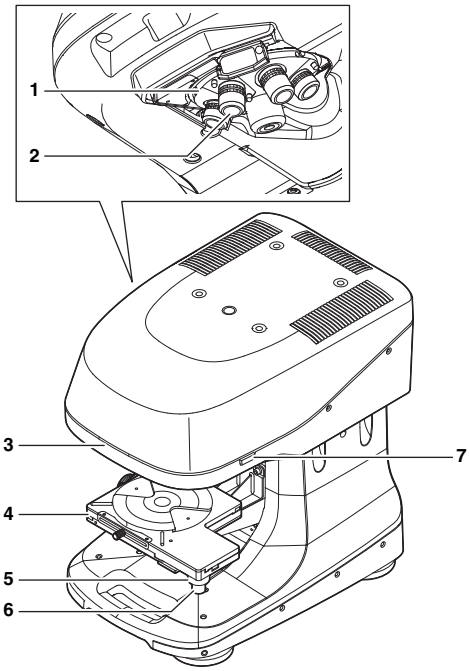
NOTICE	**Make sure the focusing handle lock mechanism is in the LOCK position when transporting the measurement unit and base.**

5 Focusing handle (Coarse)

6 Focusing handle (Fine)
The focus can be adjusted by moving the XY stage up and down.
Use Coarse for rough adjustment and Fine for precise movement.

*VK-S3 only

Measurement Unit and Base (Right Side and Front)



1 Revolver
Switches the lens magnification.

2 Objective lens
5x, 10x, 20x, and 50x are standard.

3 Laser radiation emission warning light
Lights when the power to the controller is turned on.

4 XY stage
A stand for the sample to rest on.

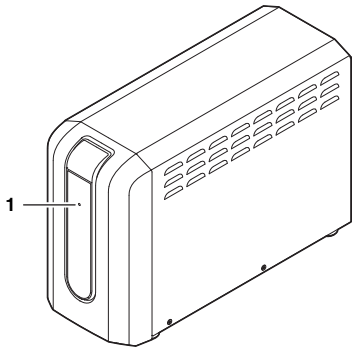
5 Y axis stage handle (forward/backward movement)*
Moves the XY stage forward or backward.

6 X axis stage handle (left/right movement)*
Moves the XY stage to the left or right.

7 POWER switch
Turns the power to the measurement unit on or off.
"Startup and Shutdown" (Page 3-3)

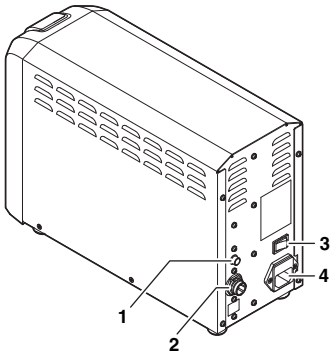
*VK-S3 only

Controller (Front)



1 POWER LED
Lights when the power to the controller is turned on.

Controller (Back)



1 Cable A connector
Connect the controller to the measurement unit with the provided Cable A cable.

2 Cable B connector
Connect the controller to the measurement unit with the provided Cable B cable.

3 Main power switch
Turns the main power to the controller on or off.
"Startup and Shutdown" (Page 3-3)

4 100 to 240 V (AC power inlet) connector
Connects to the power supply with the appropriate AC power cable.

Reference For details of how to connect each connector and the cable, see "Connections" (Page 2-9).

MEMO

Chapter 2

Set-Up

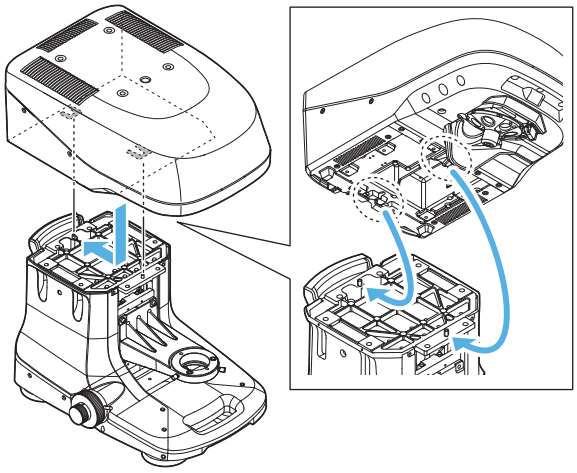
This chapter describes how to assemble the measurement unit and base, and how to connect each device.

Assembling the Measurement Unit and Base

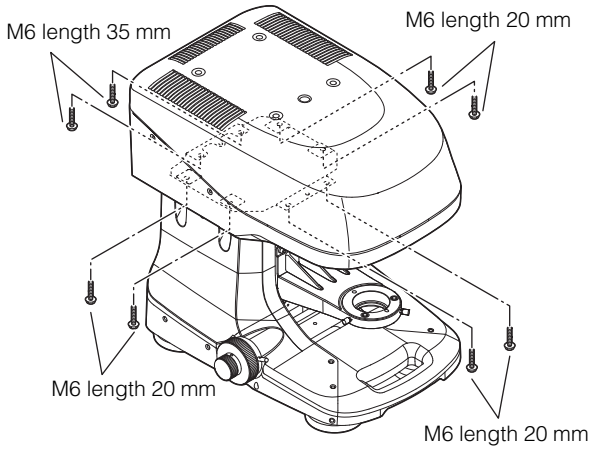
To prevent damage to the measurement unit and base from transportation, the XY stage, measurement unit, rotating stage, and the objective lenses have been detached. Before connecting each device, assemble the measurement unit and base using the procedure described below.

Mounting the Measurement Unit

1 Mount the measurement unit to the base.



2 Secure the measurement unit to the base with the eight bolts.

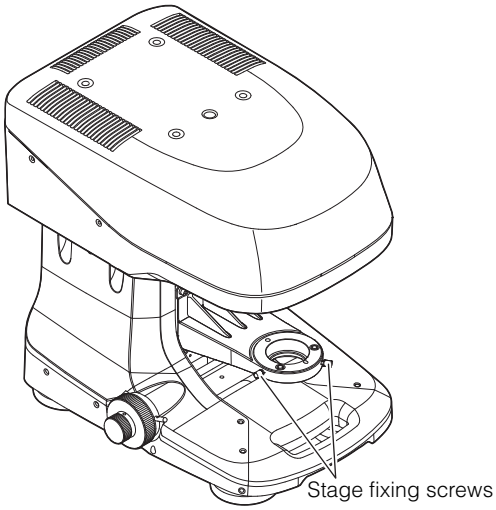


NOTICE	**Mount the measurement unit with 1.5 N•m or less torque. If the torque is too great, the bolts and screws may be damaged.**

Mounting the XY Stage

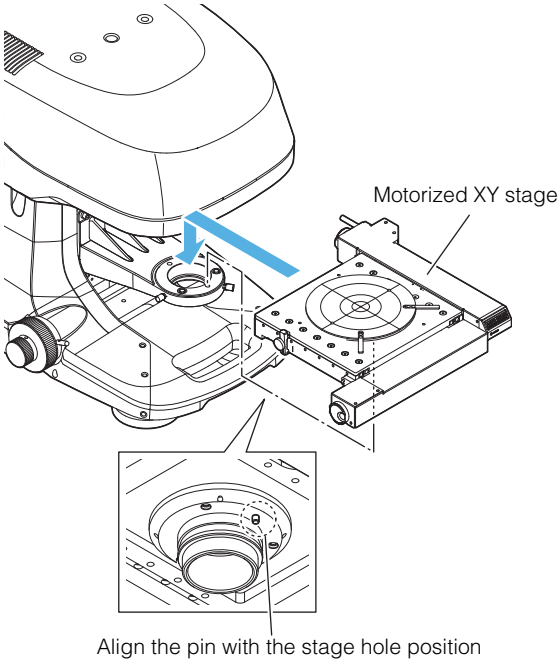
For the VK-D3

1 Loosen the stage fixing screws.

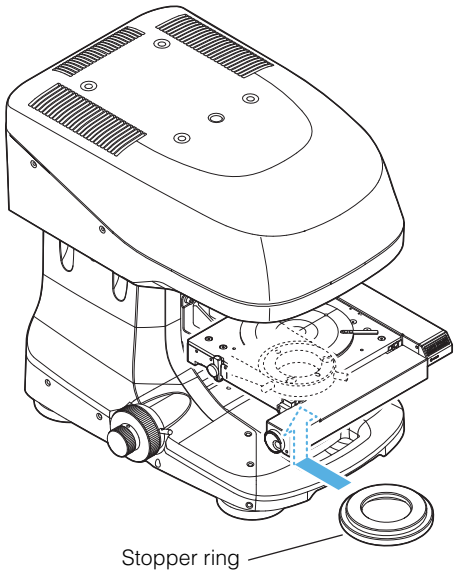


2 Remove the stopper ring from the bottom of the motorized XY stage and place the stage on the stage base.

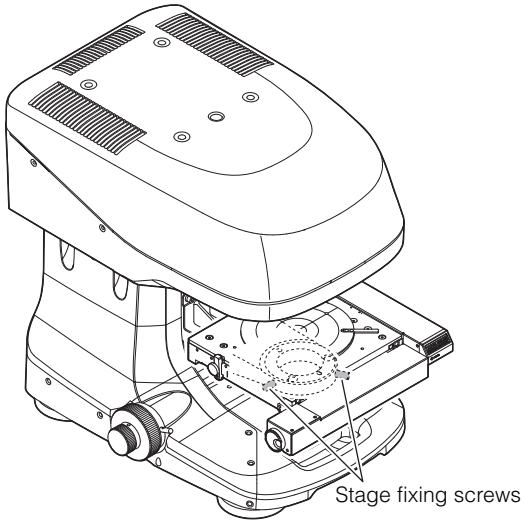
Place the stage so that the pin on the bottom of the motorized XY stage is aligned with the stage fixing position.



3 **Insert the stopper ring that was previously removed onto the bottom of the motorized XY stage.**



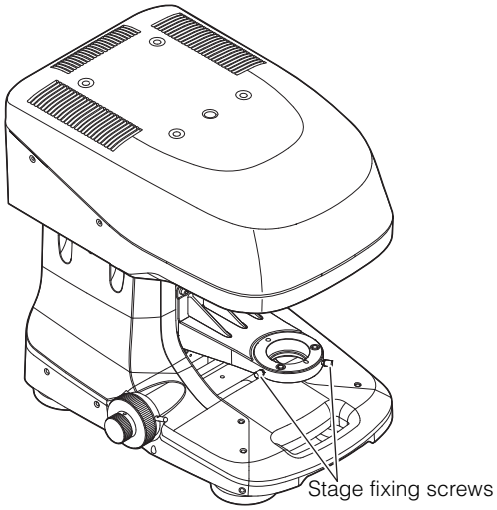
4 **Tighten the stage fixing screws.**



NOTICE	**The motorized XY stage can accommodate samples up to 70 mm in height and 3.0 kg in weight.**

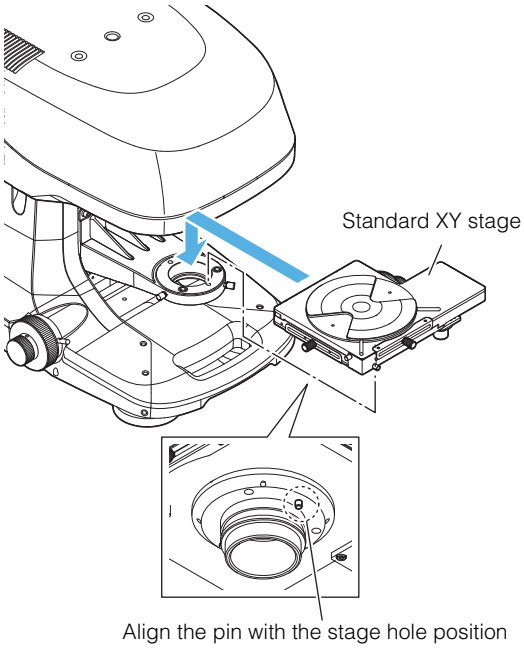
For the VK-S3

1 **Loosen the stage fixing screws.**

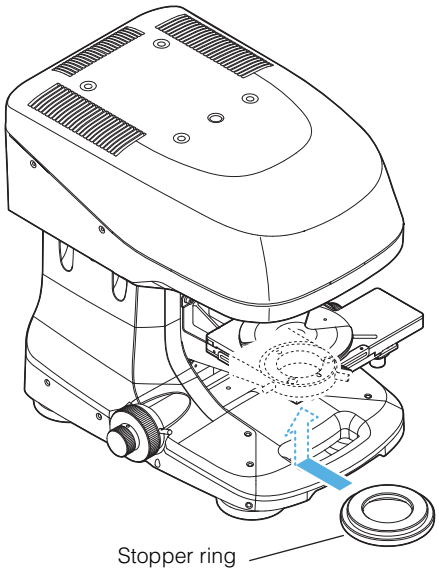


2 **Remove the stopper ring from the bottom of the standard XY stage and place the stage on the stage base.**

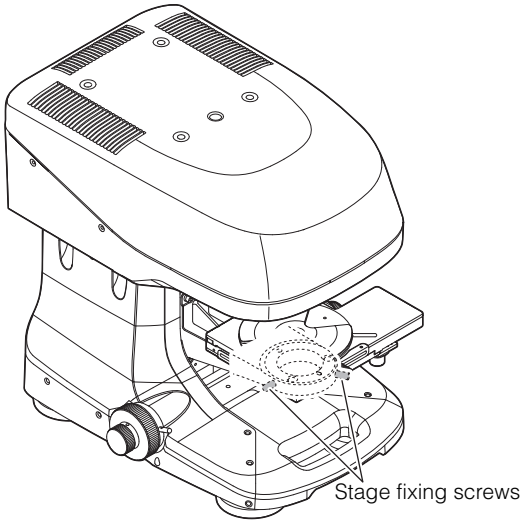
Place the stage so that the pin on the bottom of the standard XY stage is aligned with the stage fixing position.



3 **Insert the stopper ring that you removed into the standard XY stage and base.**



4 **Tighten the stage fixing screws.**



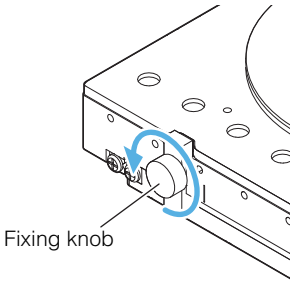
NOTICE	**The standard XY stage can accommodate samples up to 70 mm in height and 5.0 kg in weight.**

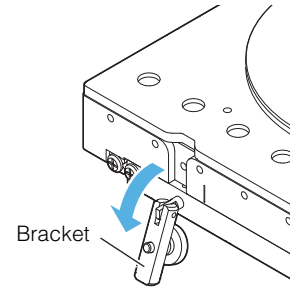
Unlocking the XY Stage Lock

Removing the brackets

■ For a motorized XY stage

1 **Turn the fixing knob and remove the XY stage brackets.**



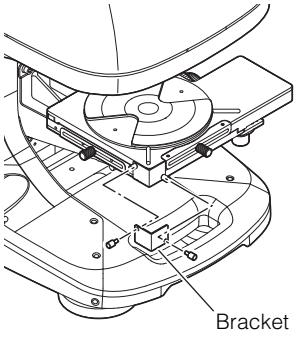


Removing the brackets allows the XY stage to move forward, backwards, left, and right.

■ For a standard XY stage

Point — A Phillips head screwdriver is required to remove the brackets.

1 **Remove the 2 screws that mount the brackets on the corners of the XY stage using a Phillips head screwdriver.**

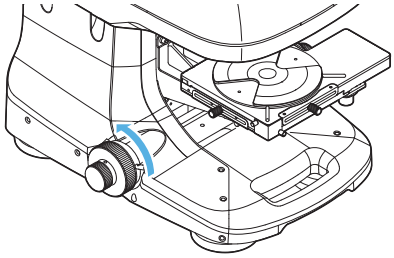


Removing the brackets allows the XY stage to move forward, backwards, left, and right.

Important — **The removed brackets are required when transporting the VK-X3000 Series. Be sure to keep them in a secure location.**

Unlocking the focusing handle lock

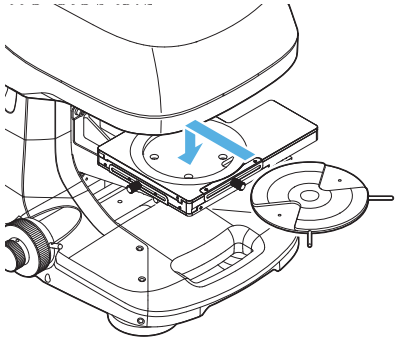
1 Tilt the lever for the focusing handle lock toward RELEASE.



The XY stage now can be moved up and down.

Mounting the Rotating Stage

1 Mount the rotating stage on the XY stage.



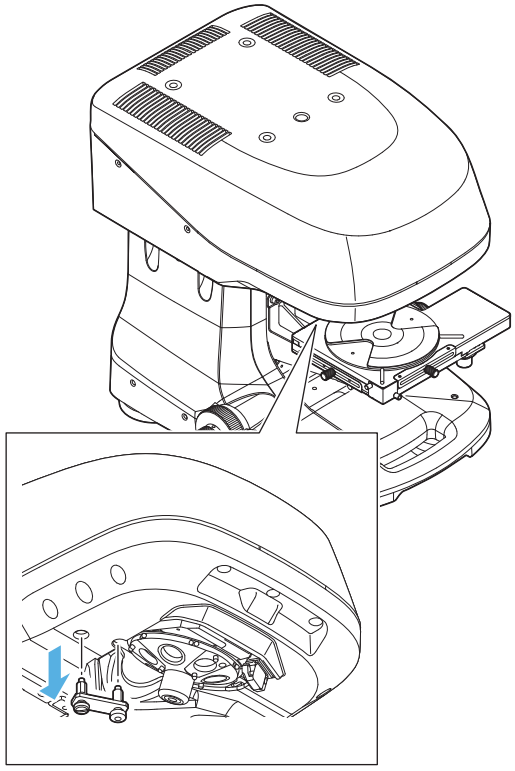
Accessory Installation

Install optional devices, such as spacers, before installing the objective lens.

"Accessory Installation" (Page 4-1)

Removing the Motorized Revolver Brackets

1 Remove the motorized revolver brackets.

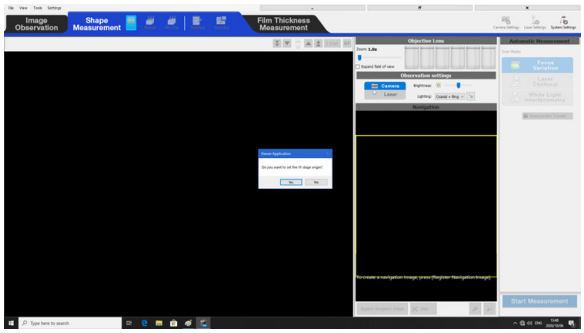


Mounting the Objective Lenses

1 **Remove the objective lenses out of the lens case.**

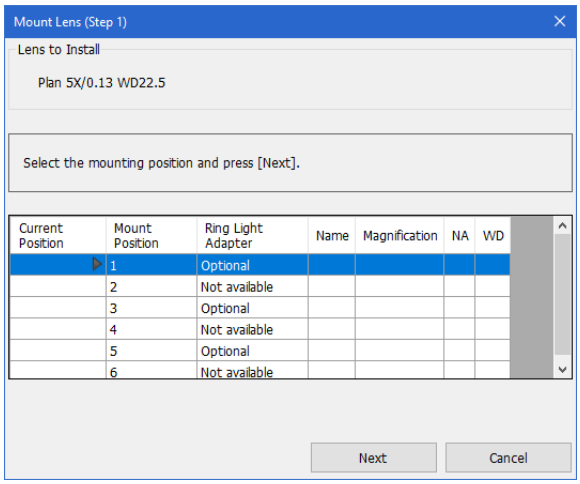
> Important
>
> **The lens case is required when transporting the VK-X3000 Series. Be sure to keep it in a secure location.**

2 **Start the Viewer Application and execute the objective lens attachment operation.**



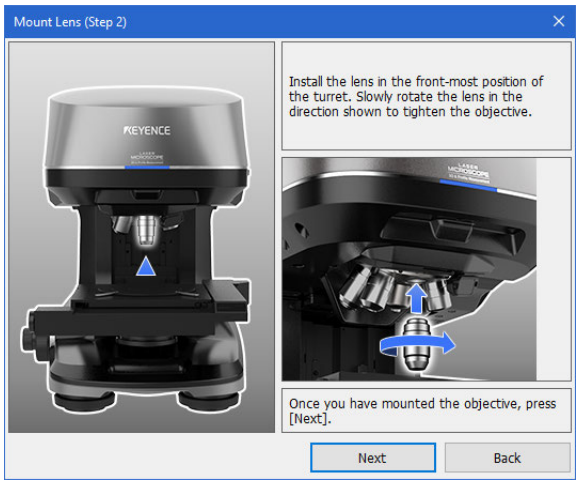
"VK-X3000 Series Viewer Application Reference Manual"

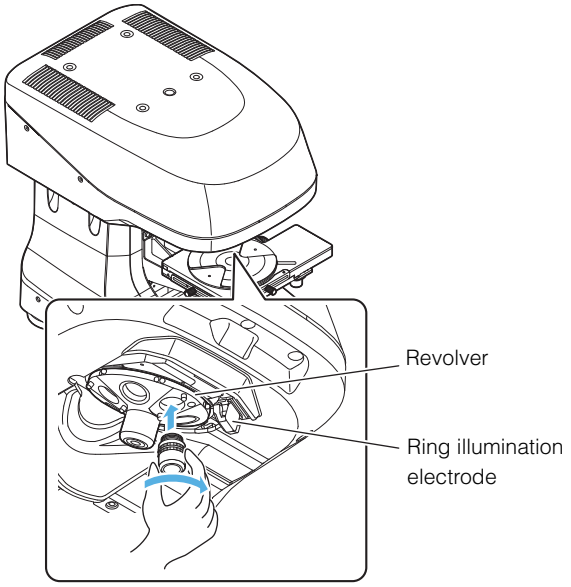
3 **Select the position to mount the objective lens.**



> Important
>
> - **To mount a ring illumination to an objective lens, you need to select a position to mount the ring illumination.**
> - **You can only mount a ring illumination onto 2.5x, 5x, and 10x objective lenses.**

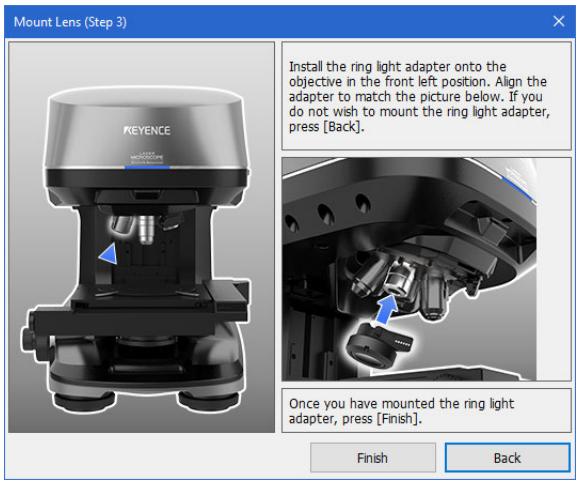
4 **Follow the on-screen instructions to mount the objective lens.**

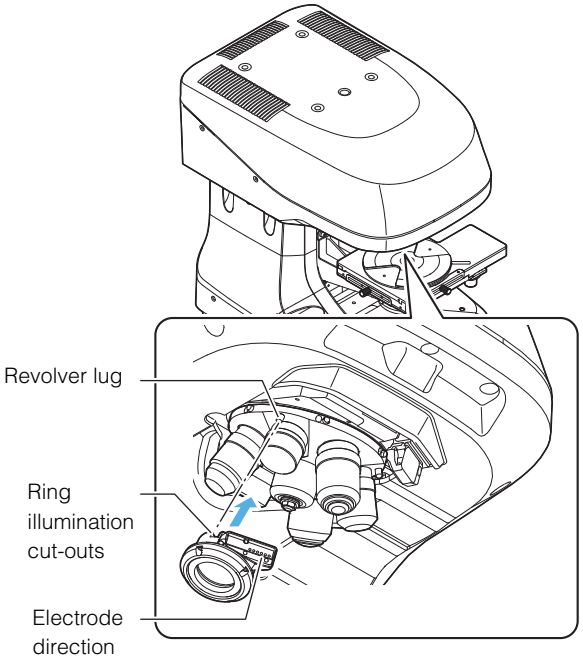




NOTICE	**Do not touch the ring illumination electrode when mounting the objective lens.**

5 Follow the on-screen instructions to attach the ring illumination adapter.





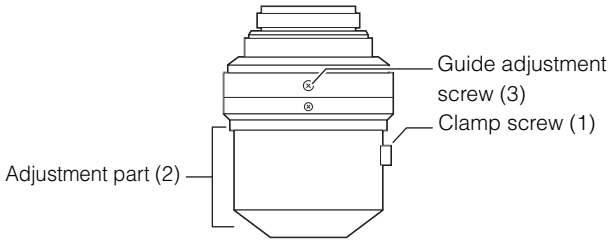
Important

- **Align the revolver lug and the ring illumination cut-out.**
- **Be careful of the electrode direction.**

Adjusting the Parfocality of the 50x Interference Objective Lens

The objective lens is adjusted in an environment at 23°C. If the observation environment is a different temperature, the sample surface and interference stripe may be out of focus. If this occurs, use the method below to adjust the position of the interference stripe.

Rotating the adjustment part



1 Loosen the clamp screw (1) using the tool packaged with the device.

The adjustment part (2) can now be independently rotated.

2 Rotate the adjustment part (2).

The position where interference stripes occur can be moved.

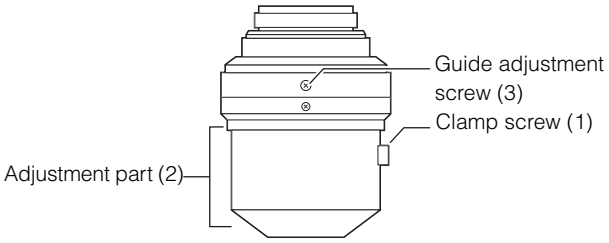
3 Adjust the part so that the sample surface and the position where the interference stripes occur matches.

4 Tighten the clamp screw (1) again.

The adjustment part (2) will be fixed.

NOTICE	**Do not overly tighten the clamp screw (1). This may shift the interference stripe from the adjusted position.** **It may also cause failure.** **Do not loosen any screw other than the clamp screw (1) and the guide adjustment screw (3).**

Changing the guide position



1 Loosen the guide adjustment screw (3).

This allows you to move the guide.

2 Adjust the guide position.

Change the guide attached to the scale marks on the side that guide the interference stripe position.

3 Tighten the guide adjustment screw (3).

The guide is now fixed.

NOTICE	**Do not loosen any screw other than the clamp screw (1) and the guide adjustment screw (3).**

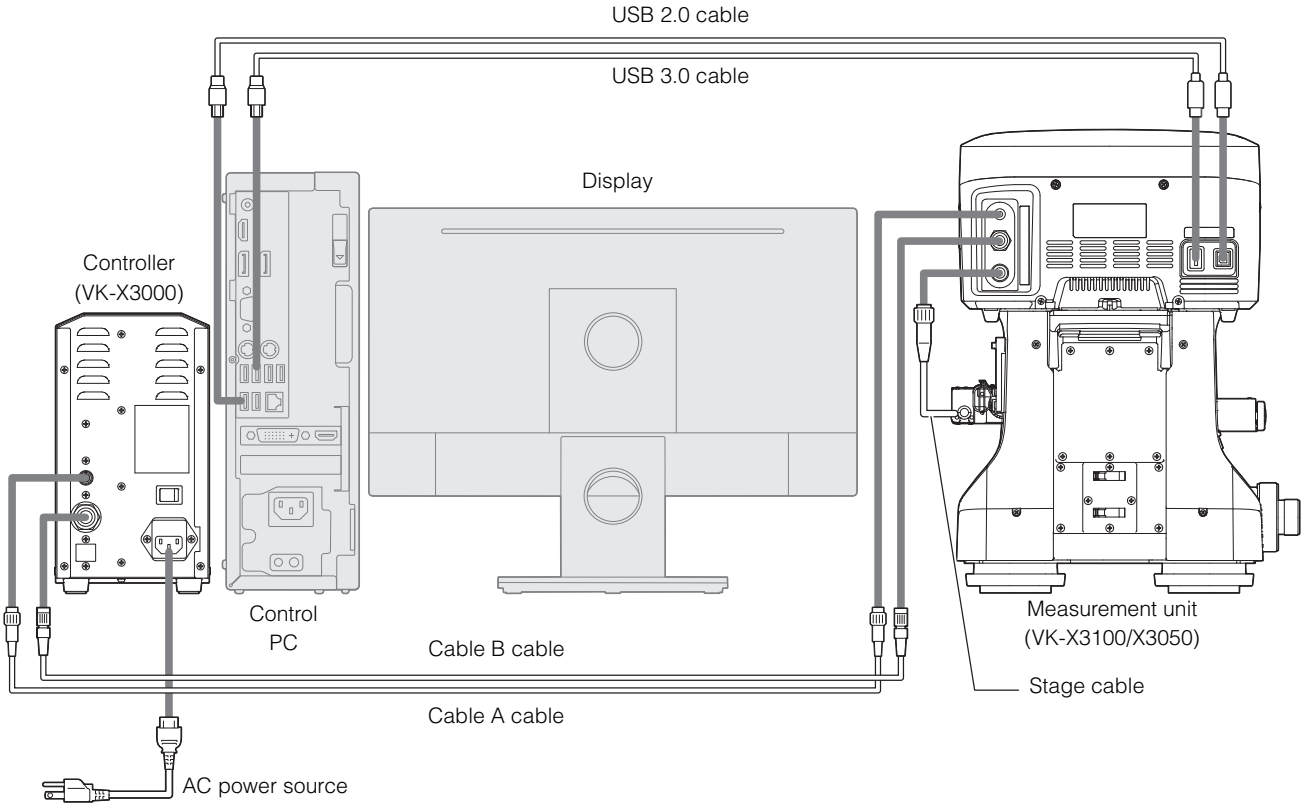
Connections

This section describes how to connect the equipment and accessories.

Connection Diagram

Measurement unit - Controller - Control PC

Connect the measurement unit (VK-X3100/X3050) to the controller (VK-X3000) and the control PC as shown below.
For details of the connection method, see "Connection Procedure" (Page 2-11).



WARNING	**Be sure to connect the power cable to an outlet that has a grounding terminal.**

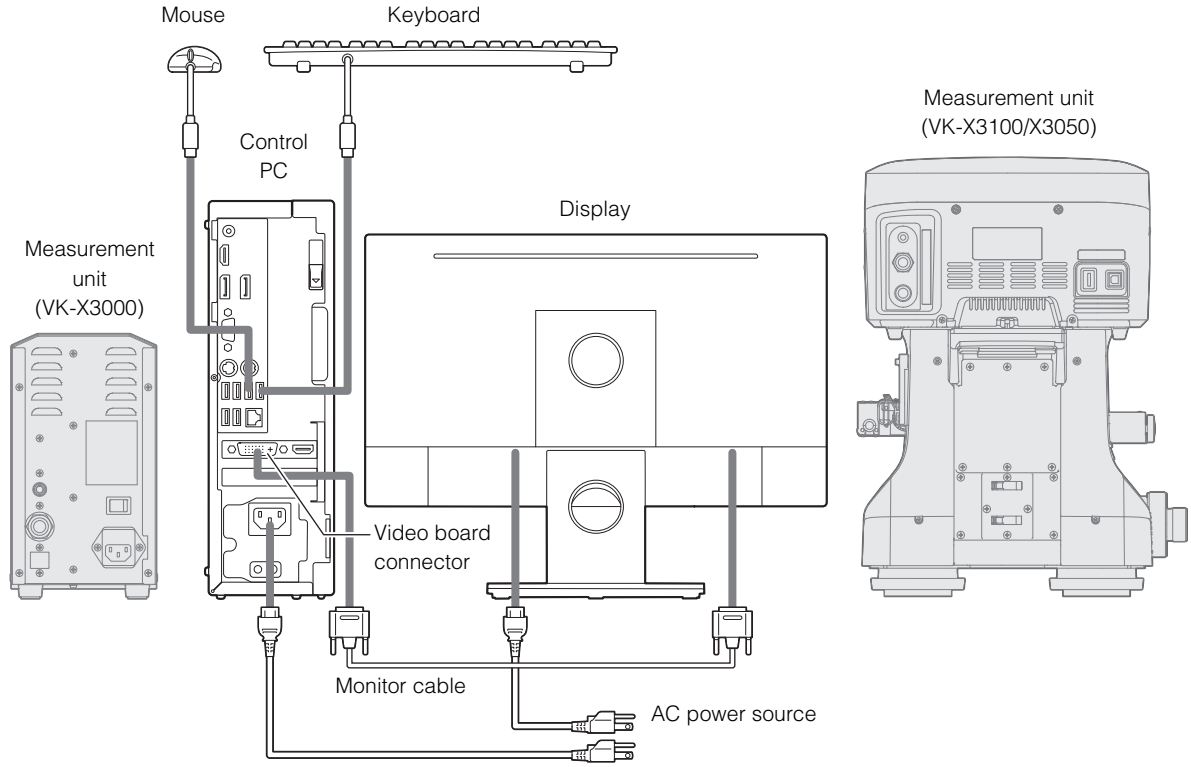
NOTICE	• **Make sure that power to the VK-X3000 Series and all peripherals is turned off when connecting cables.** • **Do not use too much force when connecting cables, as this can break the connector pins.** • **Use the connector screws to secure the connectors once they are connected.** • **When connecting the cable, use caution not to mistake the controller side for the measurement unit side. Doing so may cause damage.**

Reference

The standard length of Cable A and Cable B is 2 m.
If you want to extend the cables, use the OP-88249 5 m cable.

Control PC - Peripherals

Connect the control PC and peripherals (display, mouse, keyboard) as shown below.



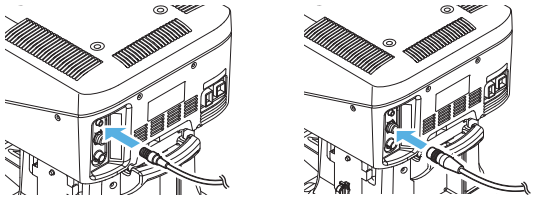
▶ Important **Specifications may be changed or updated without notice. This may cause the connection diagram to change.**

Connection Procedure

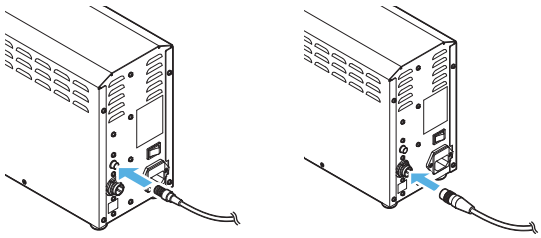
Connecting the measurement unit to the controller

NOTICE	**Turn off the power to the controller and control PC before connecting the cables. Connecting cables while the power is on could cause product failure.**

1 **Connect the Cable A cable/Cable B cable to the Cable A connector/Cable B connector on the back of the measurement unit.**



2 **Connect the Cable A cable/Cable B cable to the Cable A connector/Cable B connector on the back of the controller.**

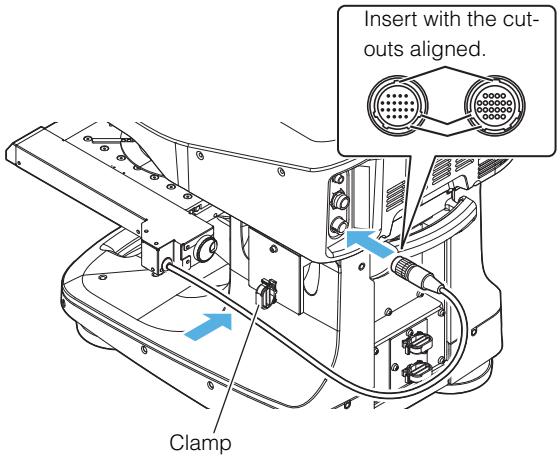


NOTICE	• **Use screws to secure the connectors when connecting the Cable A/Cable B cables.** • **Inserting the cables in the wrong orientation may cause the connector pins to break.** • **Do not use too much force when connecting cables, as this can break the connector pins.**

Connecting the motorized XY stage to the measurement unit

Important **This procedure is only required for customers who have the VK-D3 or VK-S3 and purchased the VK-S2100.**

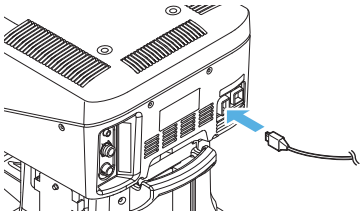
1 **Connect the stage cable to the stage connector on the back of the measurement unit and secure the cable with the clamp.**



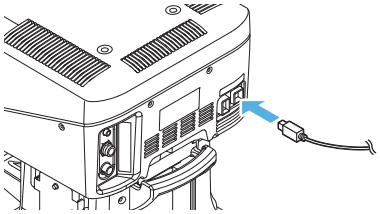
Point Warp the stage cable and clamp it on the side of the XY stage.

Connecting the measurement unit to the control PC

1 Connect the USB 3.0 cable to the USB 3.0 Micro-B connector on the back of the measurement unit and to the USB 3.0 connector on the back of the control PC.



2 Connect the USB 2.0 cable to the USB 2.0 connector on the back of the measurement unit and to the USB 2.0 connector on the back of the control PC.



Connecting the peripherals to the control PC

NOTICE	**Connect the peripherals to the control PC with the power of the controller and the control PC turned off.** **Connecting cables while the power is on could cause product failure.**

1 Connect the display, keyboard, and mouse to the control PC.

"Connection Diagram" (Page 2-9)

Connecting the power

Connect the controller, the control PC, and the display to an AC power source once all of the devices are connected.

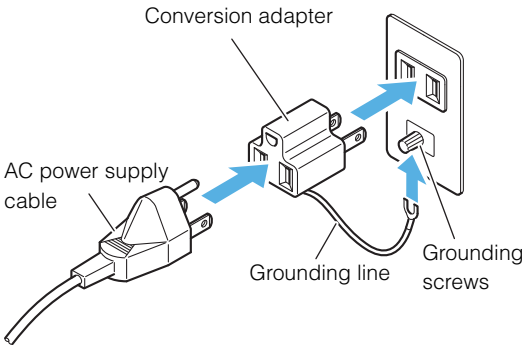
NOTICE	**Make sure that the power is turned off on the controller and the control PC when connecting the AC power cable.** **Connecting cables while the power is on could cause product failure.**

1 Connect the AC power cables to the controller and the control PC.

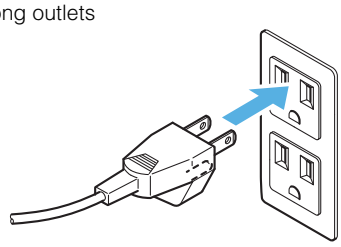
"Connection Diagram" (Page 2-9)

2 Connect the controller, control PC, and display cables to an AC power source.

For two-prong outlets



For three-prong outlets



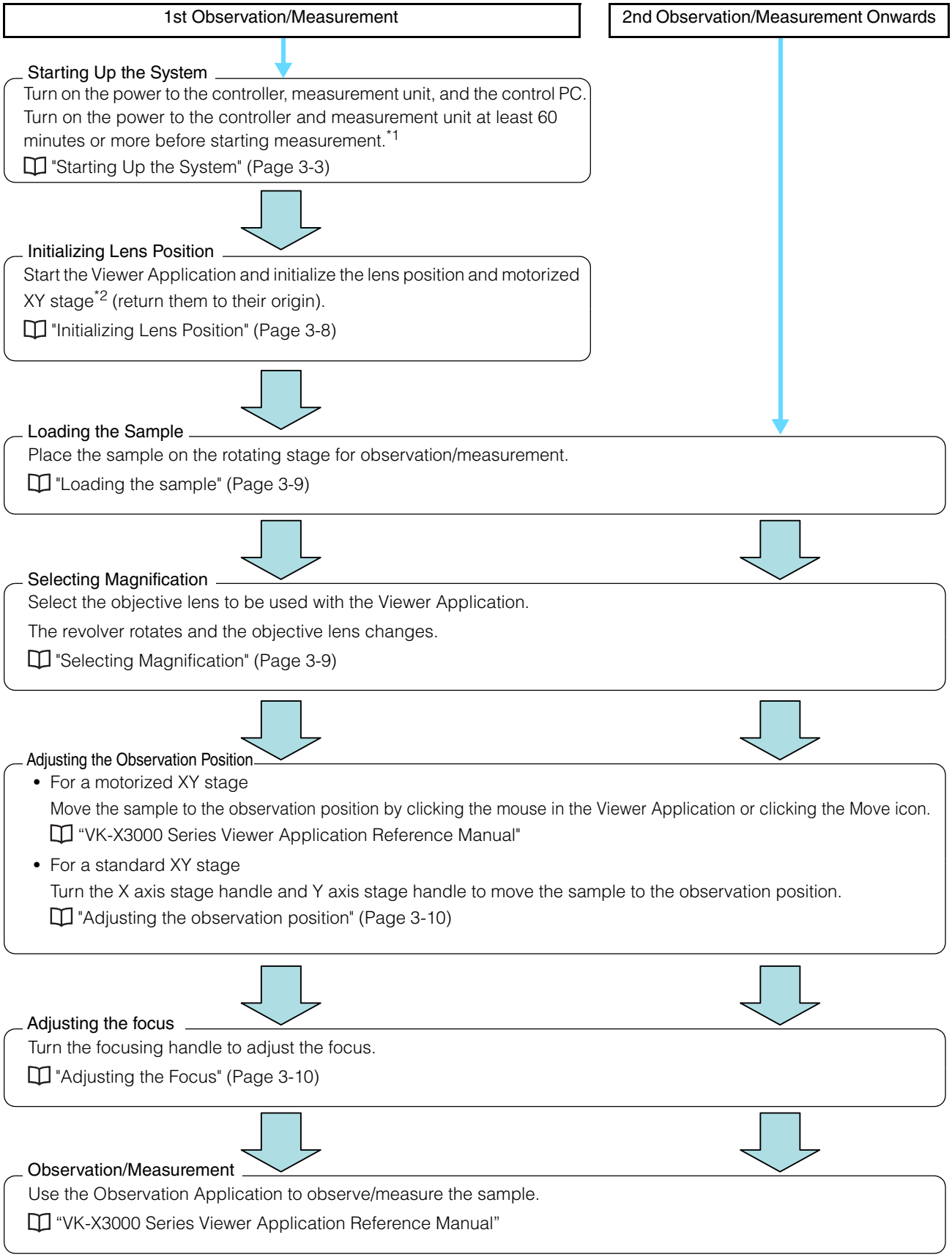
WARNING	• **Make sure that the earth terminal (the earth wire) of the AC power cable is grounded. Otherwise, an electric shock or malfunction may occur.** • **If the AC power source is a two-prong outlet, connect the cable using the supplied 3 to 2 conversion adapter. In this case, be sure to ground the earth cable.**

Chapter 3

Before Measuring

This chapter describes the preparation and basic adjustments to be made before taking measurements.

Steps to Prepare for Measuring



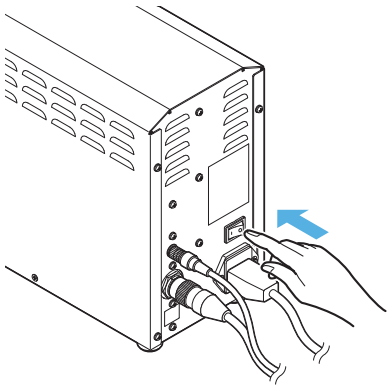
*1 Wait one hour after turning on the power to the controller before taking measurements.
Measurements may fluctuate with the default drift if the temperature of the device is not stable.

*2 When the motorized XY stage is mounted

Startup and Shutdown

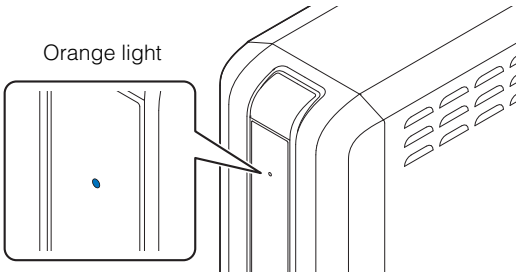
Starting Up the System

1 **If the controller power is not on, turn on the main power switch located on the back of the controller.**

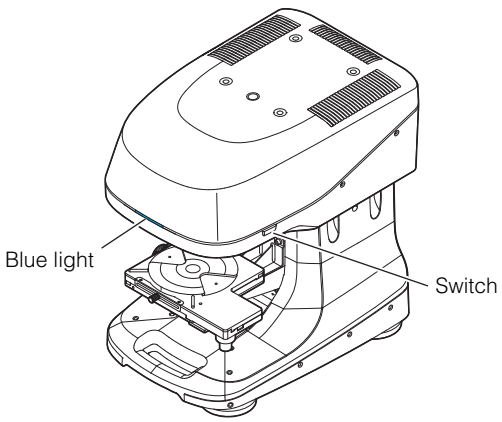


Point

When the power LED on the front of the controller is lit in orange, the power is already on. You do not need to turn on the main power switch on the back of the controller.



2 **Turn on the POWER switch located on the side of the measurement unit.**

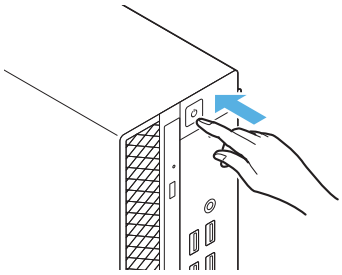


The power LED lights in blue. The controller power LED also lights in blue.

Important

Turn on the power switch on the side of the measurement unit at least 60 minutes or more before starting measurement. To prevent fluctuations in measurements caused by the default drift with the internal temperature kept stable, 60 minutes or more of the pre-heating time is required.

3 **Turn on the power for the control PC.**



Reference

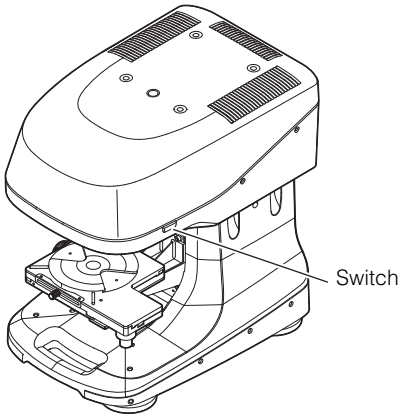
While the controller and the control PC may be turned on in a different order, it will take several seconds for communication to be established after the control PC recognizes the controller.

Shutting Down the System

1 **Shut down Windows.**

The control PC power turns off.

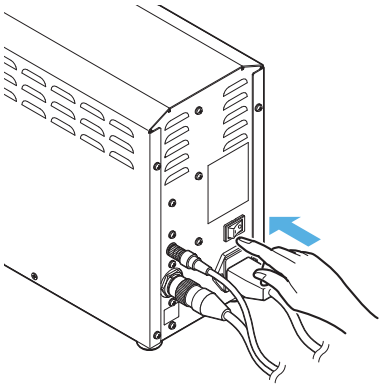
2 **Hold down the POWER switch located on the side of the measurement unit.**



The power LED turns off and the controller power LED turns orange.

Reference You do not need to turn off the controller's main power every time you finish an operation. Turn off the main power switch on the rear of the controller when the unit will not be used for a long time or when you are transporting the unit.

3 **Turn off the main power switch on the back of the controller.**



The controller power LED turns off.

Measurement Basics (For Proper Measurement)

This section describes what you need to know before taking measurements.

Types of Standard Objective Lenses

The VK-X3000 has the following four types of standard objective lenses that can be mounted. Select the lens that suits your purpose.

Model	Objective lens model	Total magnification*1	Field of view*2	Working distance (mm)	Numerical aperture	Depth of field (µm)*3	Angle characteristics
VK-X3050	CF IC EPI Plan 5X	84x - 960x	337 × 253 µm - 3699 × 2773 µm	22.5	0.13	39.11	7.47
	CF IC EPI Plan 10X	168x - 1920x	168 x 126 µm - 1849 x 1386 µm	16.5	0.3	7.34	17.5
	CF IC EPI Plan 20X	336x - 3840x	84 x 63 µm - 924 x 693 µm	3.1	0.46	3.12	27.4
	CF IC EPI Plan 50X	840x - 9600x	33.7 × 25.2 µm - 370 × 277 µm	0.54	0.8	1.03	53.1
VK-X3100	CF IC EPI Plan 5X	84x - 960x	337 × 253 µm - 3699 × 2773 µm	22.5	0.13	23.9	7.47
	CF IC EPI Plan 10X	168x - 1920x	168 × 126 µm - 1849 × 1386 µm	16.5	0.3	4.49	17.5
	CF IC EPI Plan 20X	336x - 3840x	84 x 63 µm - 924 x 693 µm	3.1	0.46	1.91	27.4
	CF IC EPI Plan Apo 50X	840x - 9600x	33.7 × 25.2 µm - 370 × 277 µm	0.35	0.95	0.45	71.8

*1 Magnification on the 23-inch monitor screen.

*2 The field of view varies depending on the differences between the individual lenses. These values indicate the smallest field of view size (the largest field of view is when an optical zoom of 0.7x (expand field of view) is enabled).

*3 This is the depth of field in the laser images. The values listed above are theoretical values.

Types of Optional Lenses

The optional lenses listed below can be used on the VK-X3000 Series.

■ Low and high magnification objective lenses

Model	Lens model	Total magnification*1	Field of view*2	Working distance (mm)*3	Numerical aperture
VK-X3050	CF IC EPI Plan 2.5X	42x - 480x	675 × 506 µm - 7398 × 5545 µm	8.8	0.075
	CF IC EPI Plan 100X	1680x - 19200x	16.8 × 12.6 µm - 185 × 138 µm	0.3	0.95
	CF IC EPI Plan Apo 50X	840x - 9600x	33.7 × 25.2 µm - 370 × 277 µm	0.35	0.95
	CF IC EPI Plan Apo 100X	1680x - 19200x	16.8 × 12.6 µm - 185 × 138 µm	0.32	0.95
	CF IC EPI Plan Apo 150X	2520x - 28800x	11 × 8.3 µm - 123 × 92 µm	0.2	0.95
VK-X3100	CF IC EPI Plan 2.5X	42x - 480x	675 × 506 µm - 7398 × 5545 µm	8.8	0.075
	CF IC EPI Plan Apo 100X	1680x - 19200x	16.8 × 12.6 µm - 185 × 138 µm	0.32	0.95
	CF IC EPI Plan Apo 150X	2520x - 28800x	11 × 8.3 µm - 123 × 92 µm	0.2	0.95

*1 Magnification on the 23-inch monitor screen.

*2 The field of view varies depending on the differences between the individual lenses. These values indicate the smallest field of view size (the largest field of view is when an optical zoom of 0.7x (expand field of view) is enabled).

*3 Depending on differences between the individual lenses, the operating distance may be smaller than the above stated values. Make a judgment upon confirming the actual conditions.

■ Objective lenses for white light interference

Lens model	Total magnification*1	Field of view*2	Working distance (mm)*3	Numerical aperture
CF IC EPI Plan DI 10X	168x - 1920x	168 × 126 µm to 1350 × 1012 µm	7.4	0.3
CF IC EPI Plan DI 20X	336x - 3840x	84 × 63 µm to 675 × 506 µm	4.7	0.4
CF IC EPI Plan DI 50X	840x - 9600x	33.7 × 25.2 µm to 270 × 202 µm	3.4	0.55

*1 Magnification on the 23-inch monitor screen.

*2 The field of view varies depending on the differences between the individual lenses. These values indicate the smallest field of view size (the largest field of view is when the optical zoom is 1.0x).

*3 Depending on differences between the individual lenses, the operating distance may be smaller than the above stated values. Make a judgment upon confirming the actual conditions.

■ Long range and ultra-long range objective lenses

When a long focal distance (Z measurement distance) is preferred, commercially-available long range and ultra-long range lenses can be used on the VK-X3000 Series.
Select the best objective lens according to the size and shape of the sample.

Type	Lens model	Total magnification*1	Field of view*2	Working distance (mm)*3	Numerical aperture
Long range objective lens ×20	CF IC EPI Plan ELWD 20X	336x - 3840x	84 × 63 µm - 924 × 693 µm	11.0	0.4
Long range objective lens ×50	CF IC EPI Plan ELWD 50X	840x - 9600x	33.7 × 25.2 µm - 370 × 277 µm	8.7	0.55
Long range objective lens ×100	CF IC EPI Plan ELWD 100X	1680x - 19200x	16.8 × 12.6 µm - 185 × 138 µm	2.0	0.80
Ultra long range objective lens ×20	CF IC EPI Plan SLWD 20X	336x - 3840x	84 × 63 µm - 924 × 693 µm	20.5	0.35
Ultra long range objective lens ×50	CF IC EPI Plan SLWD 50X	840x - 9600x	33.7 × 25.2 µm - 370 × 277 µm	13.8	0.45
Ultra long range objective lens ×100	CF IC EPI Plan SLWD 100X	1680x - 19200x	16.8 × 12.6 µm - 185 × 138 µm	4.7	0.73

*1 Magnification on the 23-inch monitor screen.

*2 The field of view varies depending on the differences between the individual lenses. These values indicate the smallest field of view size (the largest field of view is when an optical zoom of 0.7x (expand field of view) is enabled).

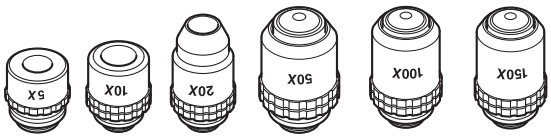
*3 Depending on differences between the individual lenses, the operating distance may be smaller than the above stated values. Make a judgment upon confirming the actual conditions.

Point

Some functions may not be available for measurement of the film thickness, top surface, or other items. For more details, contact our Sales Dept.

How to Select an Objective Lens

■ Points to note when selecting a lens



● When measuring the height in high precision

Under normal circumstances, the standard 10x, 20x, and 50x objective lenses are suited to height measurements.

In a measurement unit that is using the laser confocal optical system, the shallower the depth of field (range when the image is focused) of the objective lens, the better the repeat accuracy.

The highest magnification lens possible should be used for high-resolution height images.

● For measurements with a long Z measurement distance

The VK-X3000 Series can move a lens up to 7 mm in the Z axis. However, the objective lens will move up and down when performing actual measurements.
If the operating distance of the objective lens you are using is 7 mm or less, the measurable Z measurement distance will be the same as the operating distance of the objective lens.
If the operating distance of the objective lens you are using is 7 mm or more, the measurable Z measurement distance will be a maximum of 7 mm.

When taking measurements with broad Z measurement distance, it is recommended that you use the 10x or 20x objective lenses or a commercially-available lens (long range or ultra-long range lenses) and measure with the focus variation optical system.

● For high-resolution plane or width measurements

Plane measurements can be carried out with any standard objective lens.

When taking plane measurements, the narrower the field of view, the more you can improve the measurement resolution regardless of whether the measurement resolution is low or high magnification.

● For a large area plane measurement

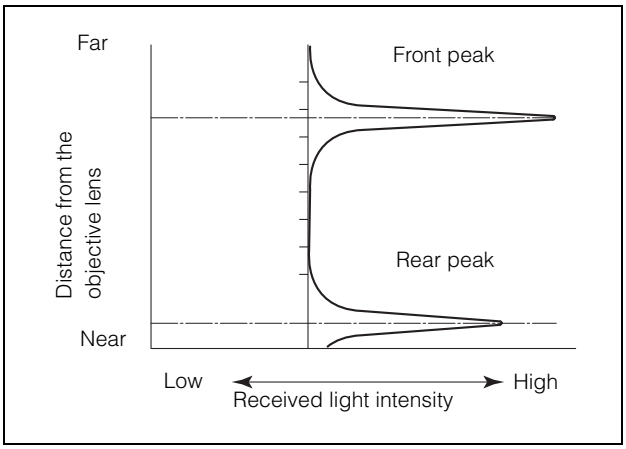
Under normal circumstances, the standard 10x and 20x objective lenses are suited for plane measurements.

Correcting the Film Thickness Measurement

There will be two focal points when measuring transparent samples, one in front and one behind. This means that the photoreceptor will also see two peaks. The VK-X3000 Series can measure the thickness of a film by measuring the distance between those two peaks.

The value returned when measuring film thickness may be less than the actual thickness due to the refractive index of the material. These errors can be corrected by inputting the value for a master sample.

For the error correction method, see 🕮 "VK-X3000 Series Viewer Application Reference Manual."



Adjusting the Positions of the Laser and the Camera

This feature allows you to correct for displacement of the camera or laser when optical or intensity images are blurred as a result of transportation of change in temperature.

You must also adjust the position of the laser and camera when registering a new lens.

For details about the laser and camera position adjustment method, see 🕮 "VK-X3000 Series Viewer Application Reference Manual."

Adjusting the Measurement Unit

Initializing Lens Position

Initialize the lens position (“Returning to the origin”).

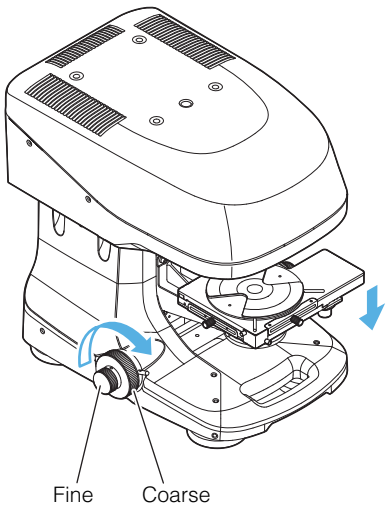
Important **It is recommended that you initialize the lens position once per day when starting up the system. The lens position does not need to be initialized after each measurement.**

NOTICE	**When initializing the lens position, do not place the sample on the rotating stage. Contact between the objective lens and the sample could damage either one.**

1 **Start the system.**

"Starting Up the System" (Page 3-3)

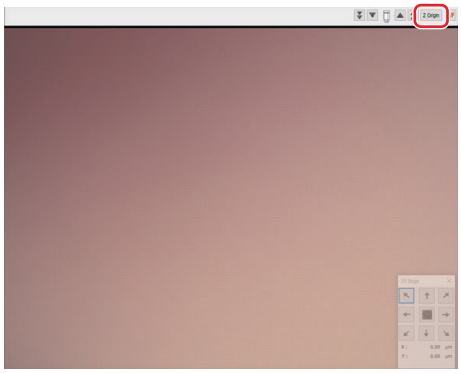
2 **Turn the focusing handle (Coarse/Fine) to lower the XY stage to the lowest level possible.**



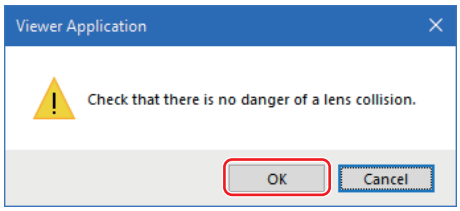
3 **Start the Viewer Application.**

"VK-X3000 Series Viewer Application Reference Manual"

4 **Click the [Z origin] button.**



5 **Click [OK] in the confirmation message.**

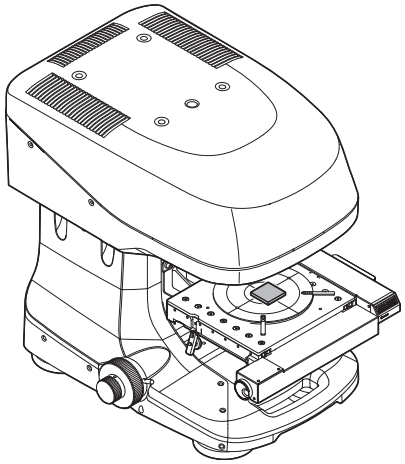


The revolver moves up and down automatically with the objective lens moving to the Z origin.

Adjusting the Observation Position and Magnification

Loading the sample

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



NOTICE	• **The motorized XY stage can accommodate samples up to 70 mm in height and 3.0 kg in weight.** • **The standard XY stage can accommodate samples up to 70 mm in height and 5.0 kg in weight.**

Reference

If the sample height is larger than what can be accommodated by the standard stage, it is recommended that you mount an optional spacer.

"Mounting the Spacers" (Page 4-10)

Selecting Magnification

1 Start the Viewer Application.

"VK-X3000 Series Viewer Application Reference Manual"

2 Select the objective lens that you want to use for the observation.

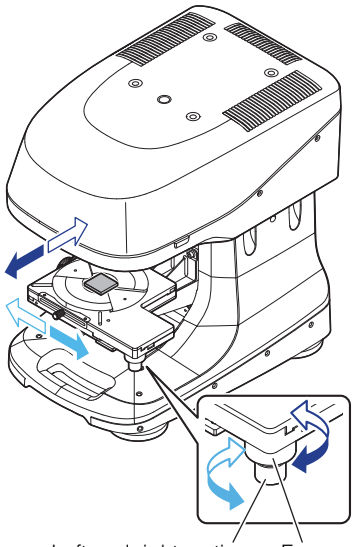
The revolver rotates automatically and the selected objective lens moves.

NOTICE	**Do not let the sample collide with the objective lens.** **Doing so may cause failure.**

Adjusting the observation position

■ For a standard XY stage

1 Turn the X axis stage handle (left/right) and Y axis stage handle (forward/backward) to move the sample to the observation position.



Handle	Maximum movement range	Distance covered by one rotation of the dial
X axis stage handle (left/right movement)	70mm	18mm
Y axis stage handle (forward/backward movement)	70mm	36mm

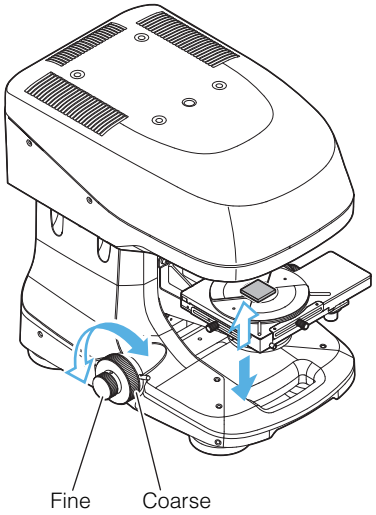
■ For a motorized XY stage

Adjust the observation position with the Viewer Application.

“VX-3000 Series Viewer Application Reference Manual”

Adjusting the Focus

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



Handle	Distance adjusted	Maximum movement range
Focusing handle (Coarse)	Approx. 4.0mm / turn	Approx. 70 mm
Focusing handle (Fine)	Approx. 0.46mm / turn	

NOTICE	**Do not let the sample collide with the objective lens when moving the XY stage up or down. Doing so may cause failure.**

Chapter 4

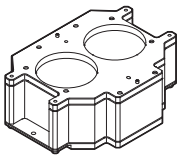
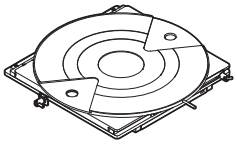
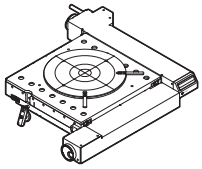
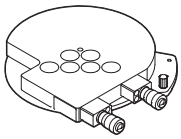
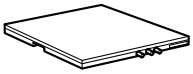
Accessory Installation

This chapter describes the optional devices and how to install them.

List of Optional Accessories

The following options can be used with the VK-X3000 Series.
Contact your nearest KEYENCE office for more details.

● Optional Accessories

Name	Model Number	Function
Ring Illumination for a 2.5x Objective Lens 	OP-88230	Ring illumination for 2.5x objective lens.
Spectral film thickness unit 	VK-T300	Use this when measuring film thickness between 0.1um and 5um.
Spacer 	OP-88232	Use this when the sample is taller than can be viewed on a standard setup. The height can be adjusted by a combination of spacers.
300 mm wafer XY stage 	OP-88231	A simple manual stage that allows wafers of 300 mm in diameter, LCD panels, circuit boards and other similar objects to be observed easily.
Motorized XY stage 	VK-S2100	This stage should be used when upgrading the VK-S3 manual base in order to enable automatic stitching.
Tilt stage 	OP-88549	Use this when the shape of the sample is angled. The maximum load is 2 kg.
Cable set (5M)	OP-88245	Use this when the standard cable length of 2 meters is not long enough to attach to large stages, specialized tools, and the like.
Anti-vibration stand 	972343 TAPC-45	Installing the measurement unit and base on an anti-vibration stand will improve their stability when exposed to vibration (made by Tokkyokiki Corporation).

● Application

Name	Model Number	Function
Image Stitching Module 	VK-H3J	Composes a single large image by processing a series of images measured by the Viewer Application. When combined with the motorized XY stage, samples can be measured continuously with automatic control.
White Light interferometry Module 	VK-H3I	Add the optical interferometry measurement function to the Viewer Application. When used in combination with the interference objective lens, objects can be measured with optical interferometry. Measurement over a wide area is also possible with the image stitching module.
CAD comparison module 	VK-H3CA	Extends the functionality of the MultiFile Analyzer Application. Comparitive analysis can be conducted on 2 parts or a part and CAD model.

Removing and Mounting the Measurement Unit

When mounting the spacer (OP-88232), the measurement unit must be removed from the base. This section describes how to remove and mount the measurement unit.

CAUTION	**The measurement unit weighs approximately 13 kg. Only place the device on stable, sturdy, level surfaces to prevent the device from falling and being damaged.**

NOTICE	**Work with the objective lenses and cables removed from the measurement unit.**

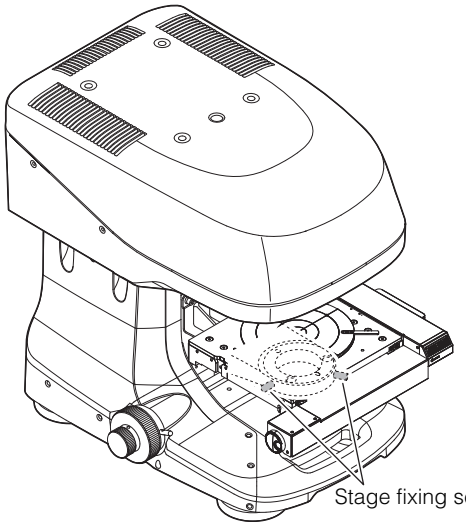
Point

Have a hexagonal wrench (M6) ready to unscrew and screw bolts.

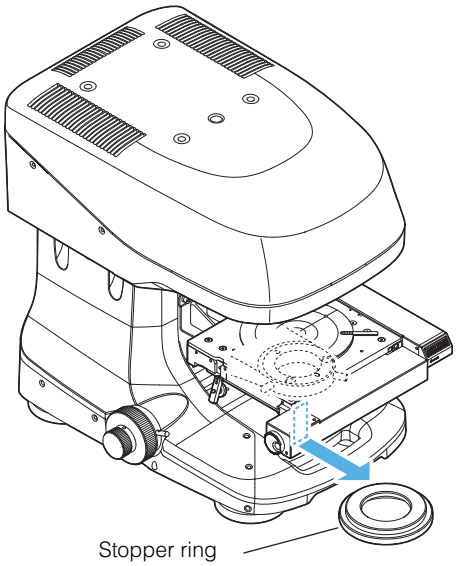
Removing the XY Stage

For the VK-D3

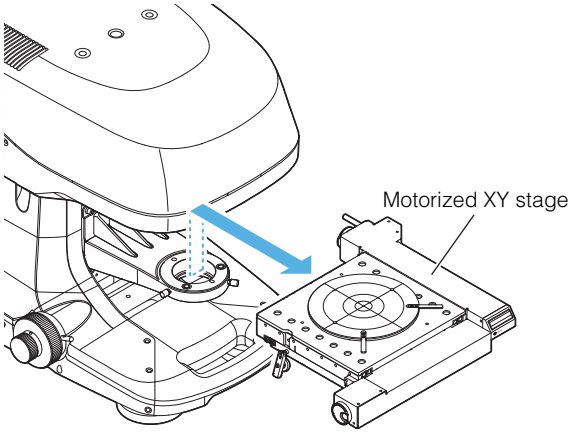
1 Loosen the stage fixing screws.



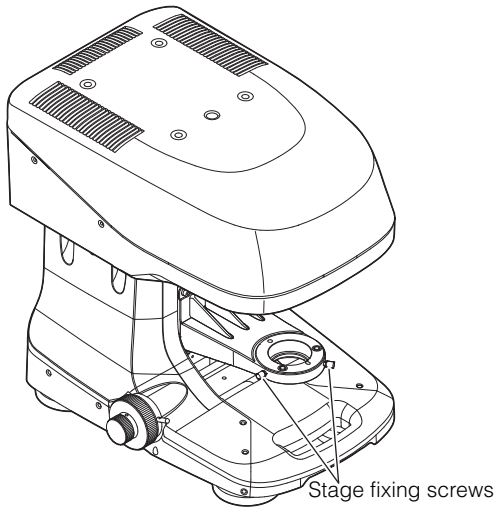
2 Remove the stopper ring.



3 Remove the motorized XY stage from the stage base, and attach the removed stopper ring on the bottom of the motorized XY stage.

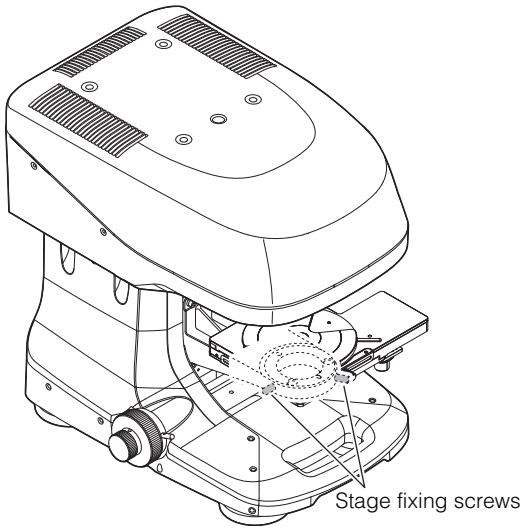


4 **Tighten the stage fixing screws.**

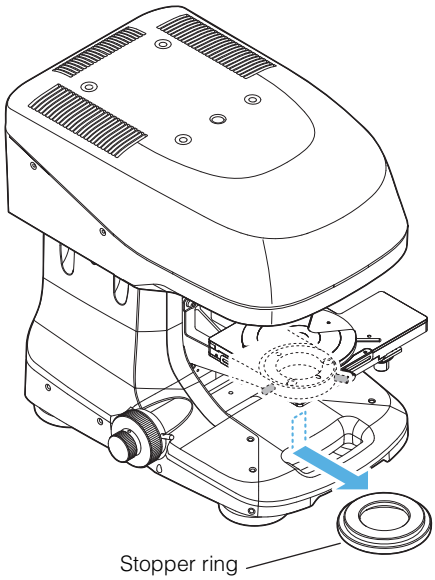


For the VK-S3

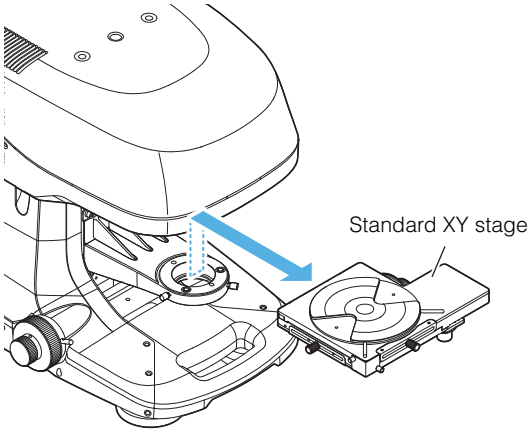
1 **Loosen the stage fixing screws.**



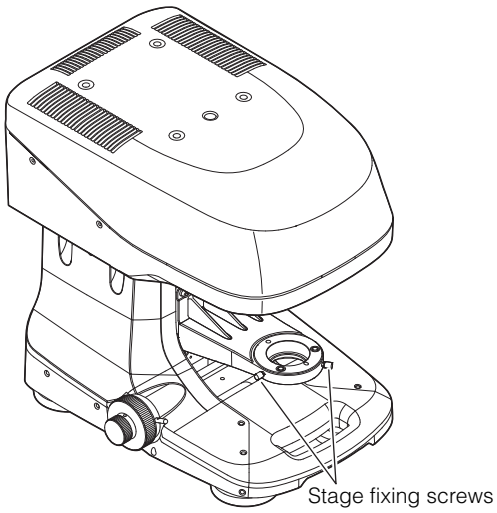
2 **Remove the stopper ring.**



3 **Remove the standard XY stage from the stage base, and attach the removed stopper ring on the bottom of the standard XY stage.**



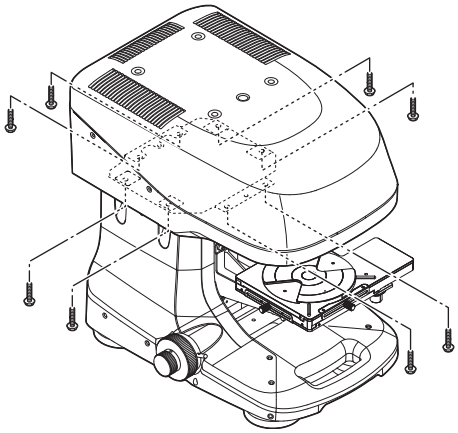
4 **Tighten the stage fixing screws.**



Removing the Measurement Unit

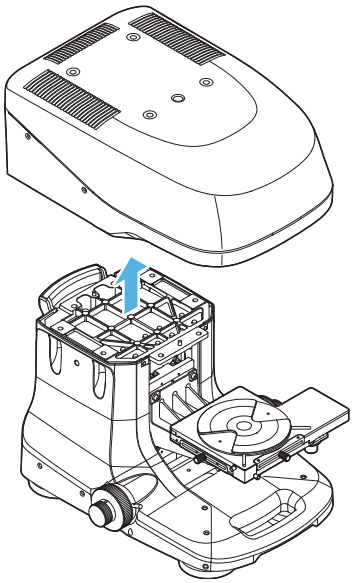
1 **Confirm all of the objective lenses and cables are removed.**

2 **Remove the eight bolts that secure the measurement unit and the base.**



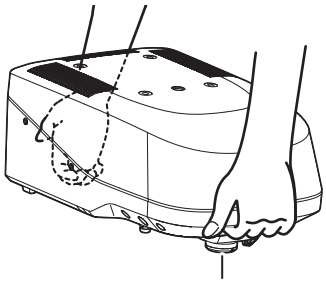
Important **The bolts are required for mounting the measurement unit when the spacer (OP-88232) is removed. Be sure to keep them in a secure location.**

3 **Remove the measurement unit from the base.**



NOTICE

- **To remove the measurement unit, hold the narrow part on the front and the indentation on the back of the unit, then lift it off of the base.**
- **Do not lift the measurement unit by holding the revolver handle. Doing so may cause failure.**



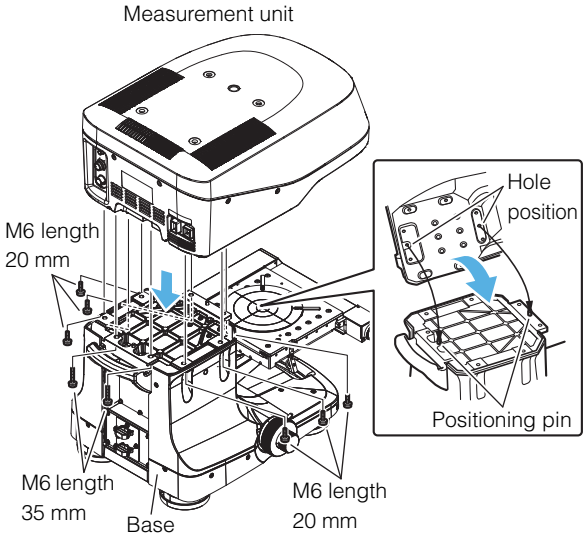
Mounting the Measurement Unit

After the spacer (OP-88232) is removed, mount the measurement unit.

NOTICE	**When removing the spacer (OP-88232) and mounting the measurement unit, perform the procedure with the objective lenses and cables removed from the measurement unit.**

1 **Mount the removed measurement unit to the base with the eight bolts.**

When mounting the measurement unit, align the holes on the bottom of the measurement unit with the fixing pins on the base.



2 **Mount the objective lenses and connect the cables.**

"Mounting the Objective Lenses" (Page 2-6)
"Connections" (Page 2-9)

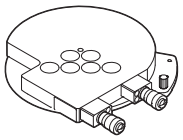
Mounting the Tilt Stage

Attaching the tilt stage (OP-88549) enables you to observe samples that are angled.

Package List

The tilt stage (OP-88549) consists of the following parts.

☐ Tilt stage: 1

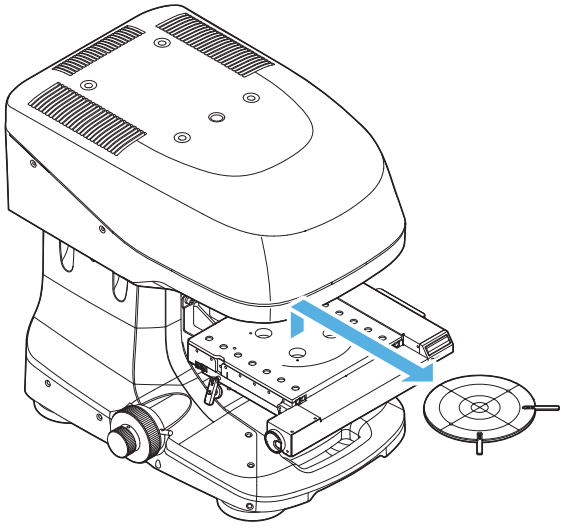


☐ Screw: 1

Mounting the Tilt Stage

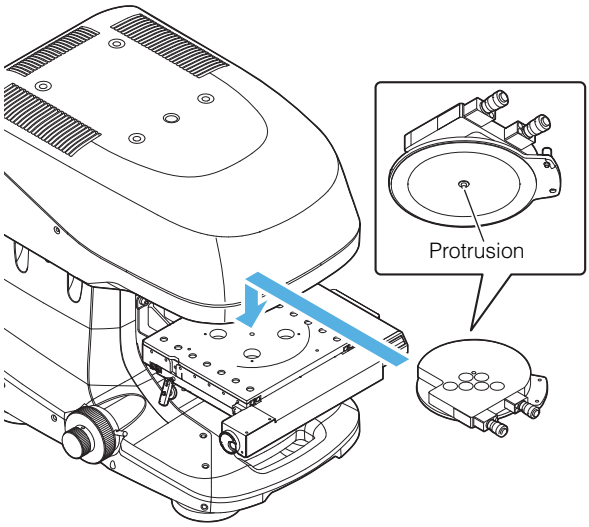
■ For a motorized XY stage

1 **Remove the rotating stage.**

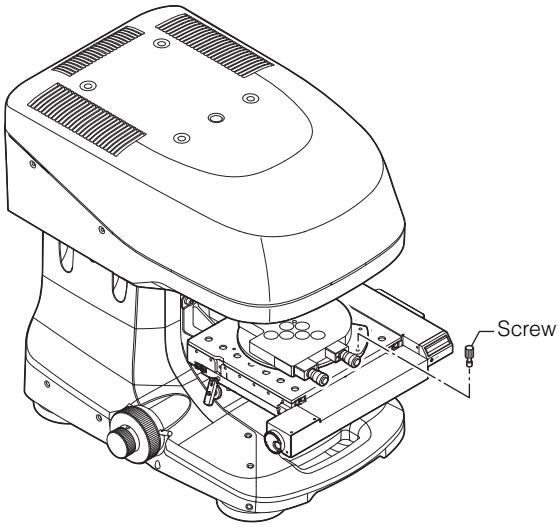


2 **Insert the protrusion on the base of the tilt stage into the recess in the center on the top of the XY stage.**

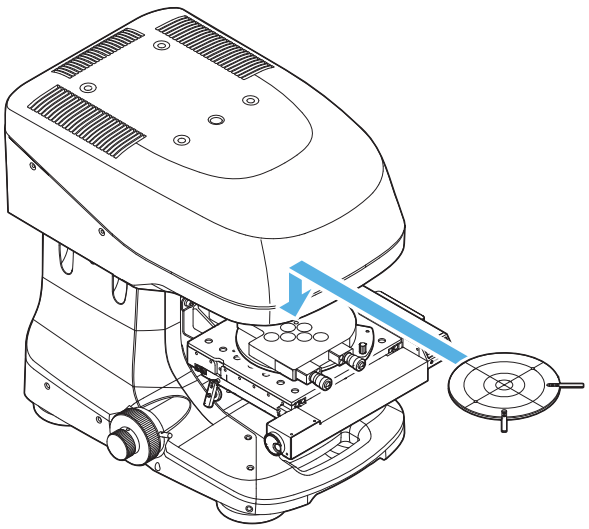
CAUTION	**Install the tilt stage with the rotation knobs pointing toward the front.**



3 **Secure with a screw.**

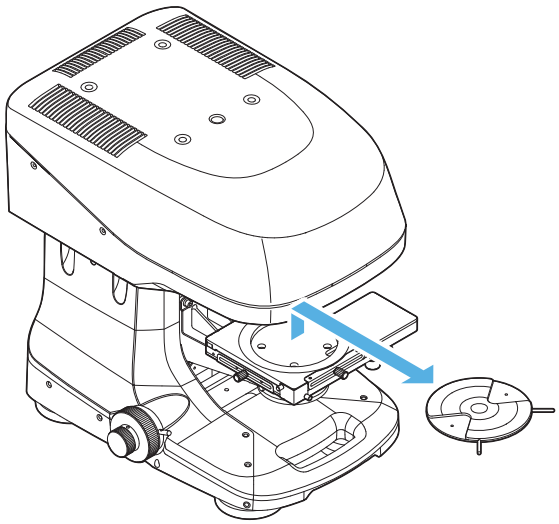


4 **Insert the protrusion on the base of the rotating stage into the recess in the center on the top of the tilt stage.**



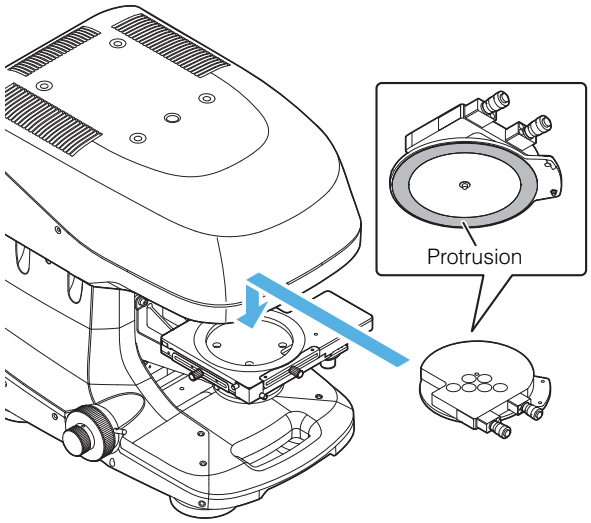
■ For a standard XY stage

1 **Remove the rotating stage.**

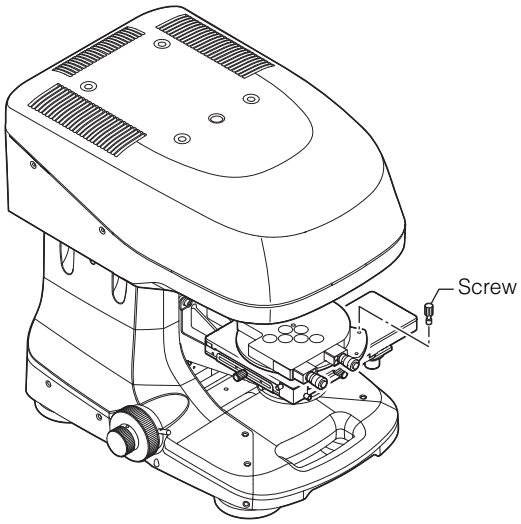


2 **Insert the protrusion on the base of the tilt stage into the recess in the center on the top of the XY stage.**

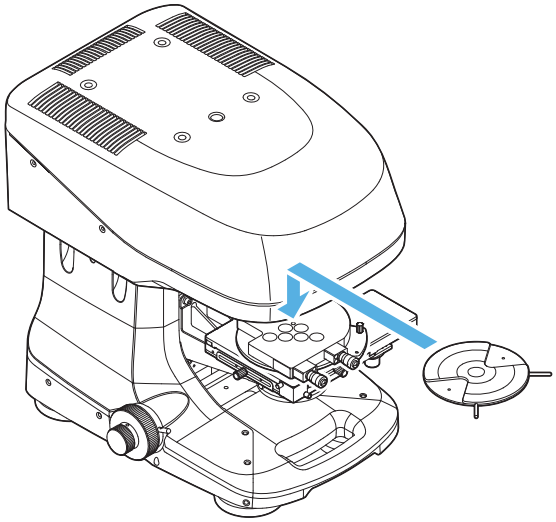
CAUTION	**Install the tilt stage with the rotation knobs pointing toward the front.**



3 **Secure with a screw.**



4 **Insert the protrusion on the base of the rotating stage into the recess in the center on the top of the tilt stage.**



Mounting the Spacers

Mounting the spacer (OP-88232) allows for observation of samples that are taller than the standard specifications.

Point

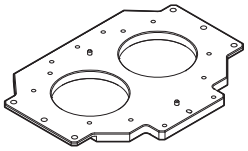
The spacer (OP-88232) is an optional part for the VK-X3000 Series. It cannot be used with other models.

Package List

The spacer (OP-88232) consists of the following parts.

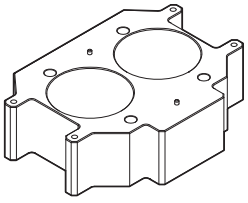
☐ Top spacer: 1

☐ Bottom spacer: 1



The thickness is the same as the top spacer, but its shape is different.

☐ Middle spacer: 1



☐ Hexagon socket bolts

M6 length 15 mm: 12
M6 length 35 mm: 4
M6 length 90 mm: 4

☐ Round washers

For M6: 4

☐ Spring washers

For M6: 4

How to Use the Spacers

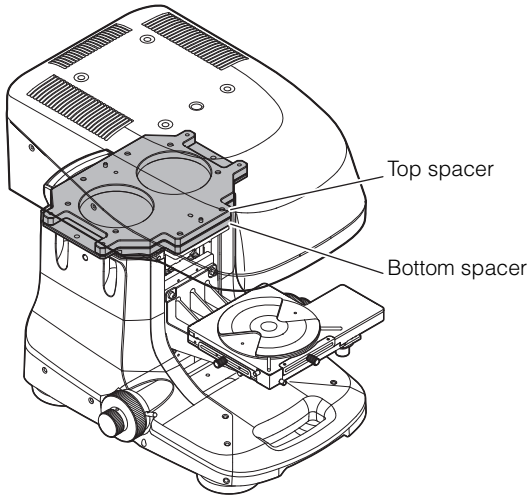
There are two ways to adjust the vertical clearance using the spacers as follows:

- Adjusting the height by 24 mm
  Combine the top and bottom spacers
- Adjusting the height by 100 mm
  Combine the top, middle, and bottom spacers

Adjusting the height by 24 mm: Top and bottom spacers

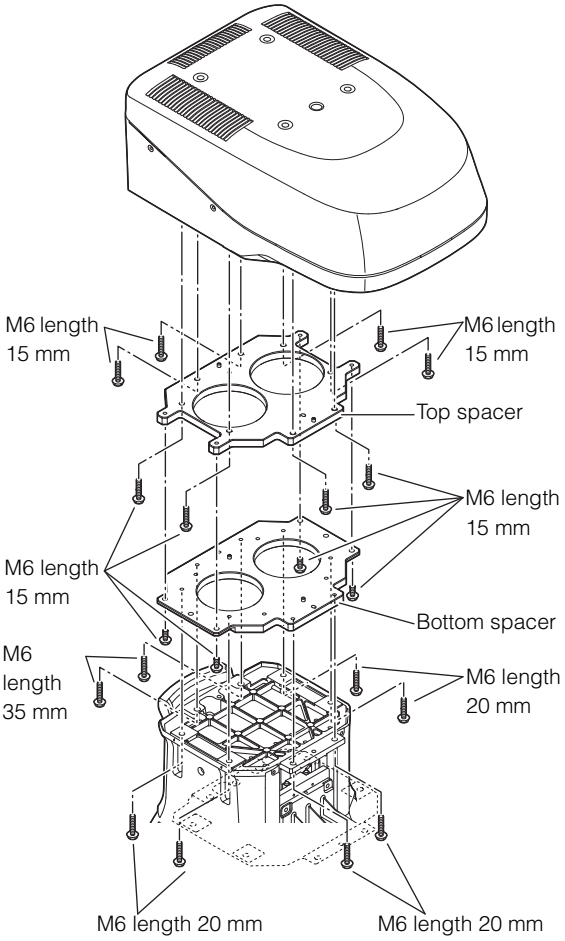
Combining the top and bottom spacers increases the vertical clearance by 24 mm.

The top and bottom spacers must be used together.



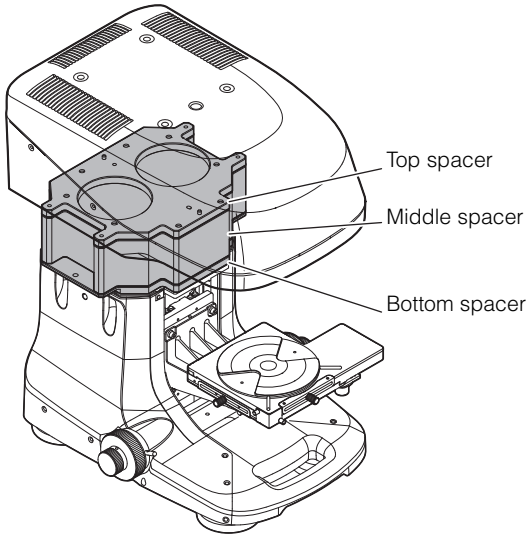
■ Bolts and washers to be used

Name	Description	How to use
hexagon socket bolts	M6 length 15 mm: 12	Securing the top spacer to the measurement unit 8
		Securing the top spacer to the bottom spacer 4
	M6 length 20 mm: 6	Securing the bottom spacer to the base 6
	M6 length 35 mm: 2	Securing the bottom spacer to the base 2



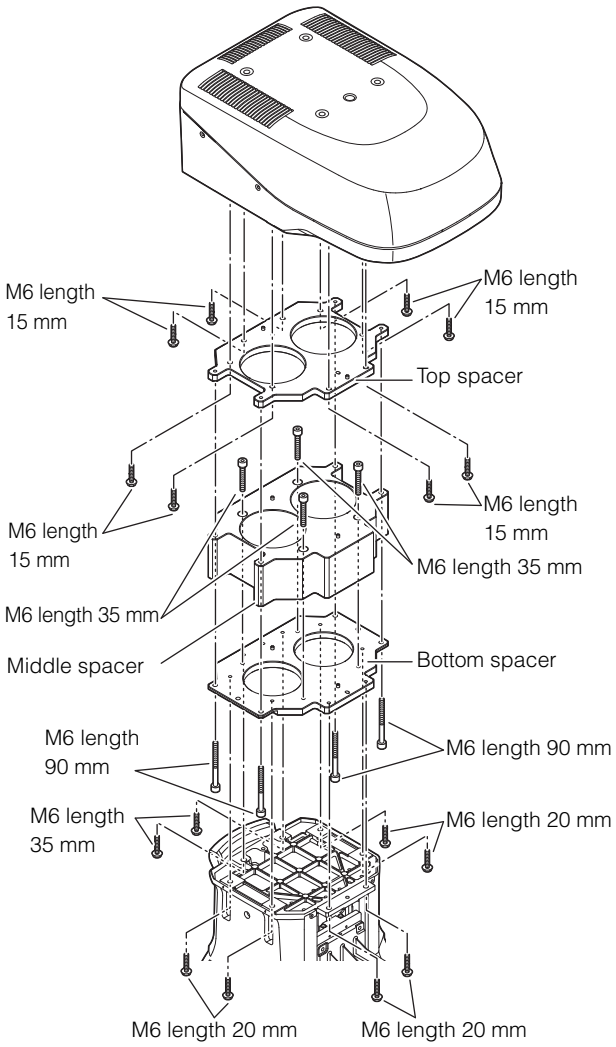
Adjusting the height by 100 mm: Top, middle, and bottom spacers

Combining the top, middle, and bottom spacers increases the vertical clearance by 100 mm.



■ Bolts and washers to be used

Name	Description	How to use
hexagon socket bolts	M6 length 15 mm: 12	Securing the top spacer to the measurement unit 8
		Securing the top spacer to the bottom spacer 4
	M6 length 20mm: 6	Securing the bottom spacer to the base 6
	M6 length 35mm: 6	Securing the bottom spacer to the base 2
		Securing the bottom spacer to the middle spacer 4
	M6 length 90 mm: 4	Securing the top spacer to the middle spacer 4
Round washer	For M6: 4	Use a M6 bolt 90 mm in length
Spring washer	For M6: 4	Use a M6 bolt 90 mm in length



Mounting the Spacers

CAUTION	**• The measurement unit weighs approximately 13 kg. Only place the device on stable, sturdy, level surfaces to prevent the device from falling and being damaged.** **• You may hurt your back. Make sure that at least two people carry the measurement unit when the spacers are mounted to it.**

Required items

- Take out the necessary number of bolts, round washers, and spring washers according to the number of spacers to be mounted.
  For details about the number of spacers, bolts, round washers, and spring washers, see "How to Use the Spacers" (Page 4-10).
- Have a hexagonal wrench (M6) ready.

How to Mount the Measurement Unit

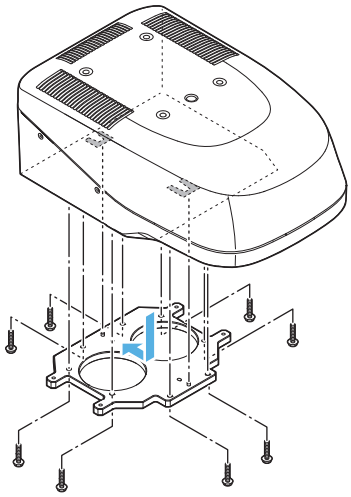
This section describes how to mount the measurement unit using the top, middle, and bottom spacers as an example.

Point

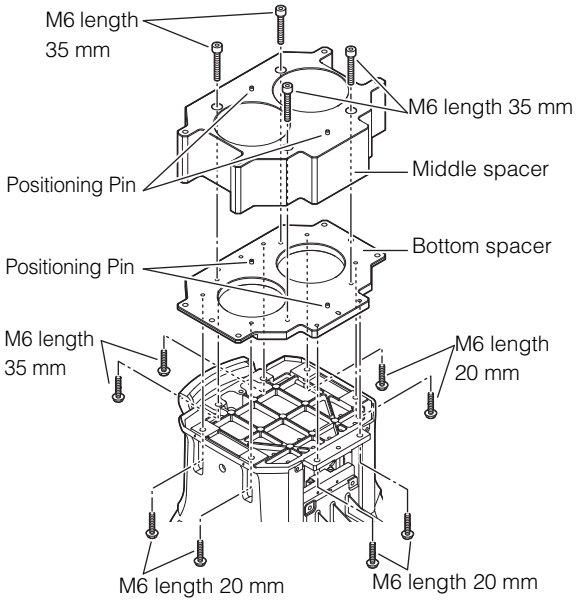
- Place the round washers and spring washers on the bolts when screwing in the bolts.
- When using spot-faced holes (bolt mounting hole), no round washers or spring washers are required.

1 Remove the measurement unit.
"Removing the Measurement Unit" (Page 4-6)

2 After aligning the holes on the measurement unit over the pins for positioning the top spacer, screw in eight M6 15 mm bolts into the measurement unit from the top spacer.



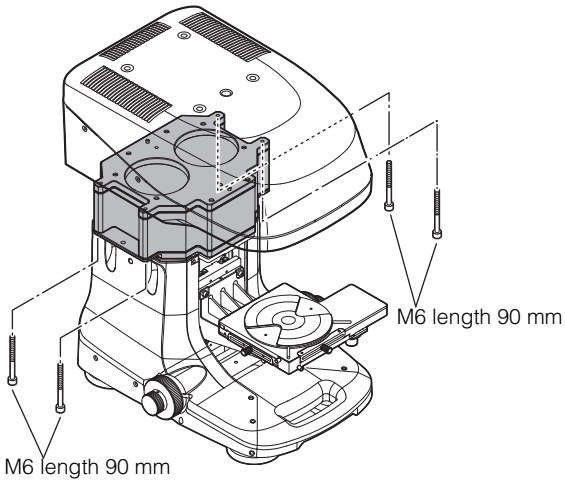
3 **Mount the bottom spacer and then the middle spacer to the base by aligning the positioning pin with the positioning hole and screw in six M6 20 mm bolts and six M6 35 mm bolts.**



Point

- Secure the bottom spacer to the base with six M6 20 mm bolts and two M6 35 mm bolts.
- Secure the middle and bottom spacers from the middle spacer with four M6 35 mm bolts.

4 **Secure the bottom, middle, and top spacers from the bottom spacer with four M6 90 mm bolts.**

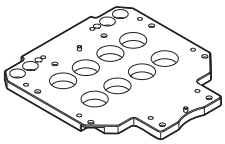


Mounting a 300 mm Wafer XY Stage

Package List

The 300 mm wafer XY stage (OP-88231) consists of the following parts.

- ☐ 300 mm wafer XY stage
- ☐ 12-inch wafer holder (θ stage)
- ☐ Spacer: 1

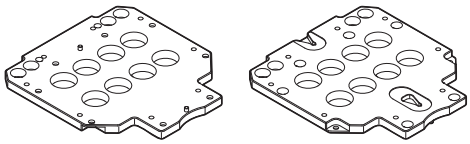


- ☐ Hexagon socket bolts
- ☐ M6 length 20 mm: 8 pieces
- ☐ Allen key

Mounting the Spacers

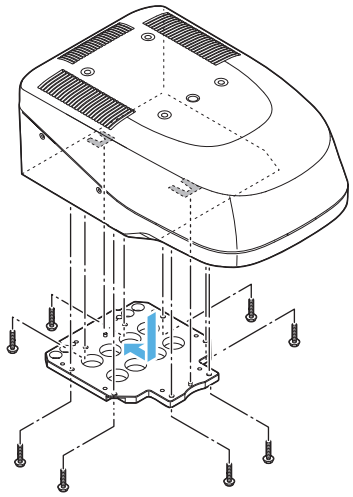
Point

The spacers have installation orientations (measurement unit side, base side). Do not mistake them.

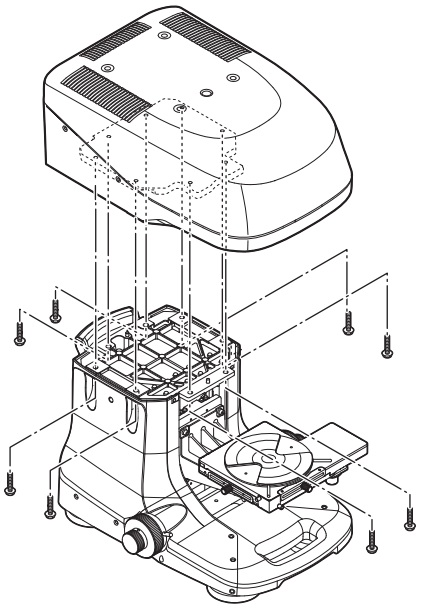


Measurement unit side　　Base side

1 After aligning the holes on the measurement unit over the pins for positioning the spacer, screw in eight M6 20 mm bolts into the measurement unit from the spacer.

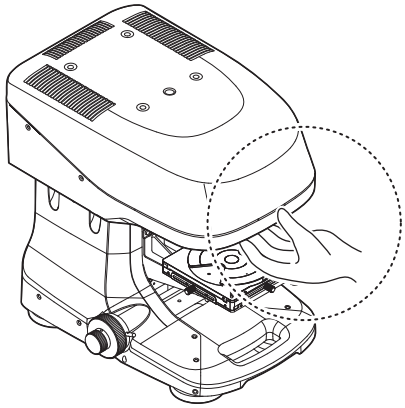


2 Mount the measurement unit with the spacers that has been removed onto the base with the bolts which secured the measurement unit and the base.



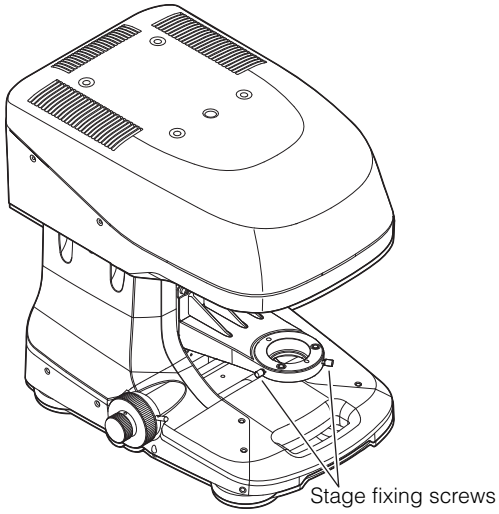
CAUTION

When mounting the measurement unit onto the base, be careful so that the measurement unit does not tilt over due to its weight.



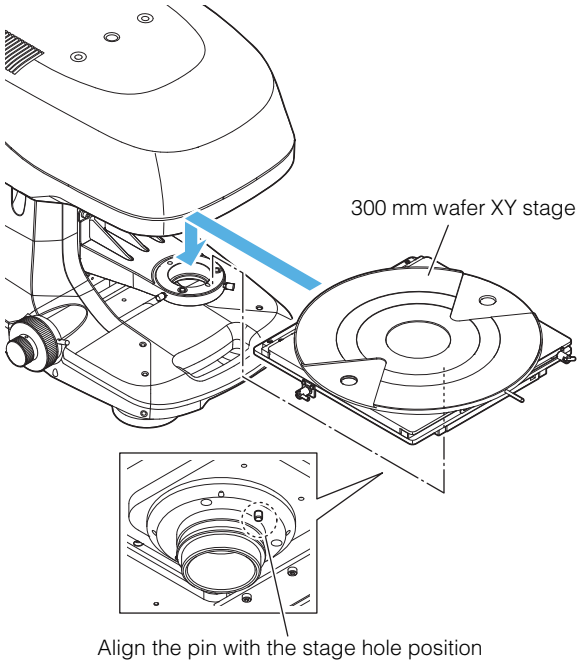
Setting the 300 mm Wafer XY Stage

1 **Loosen the stage fixing screws.**

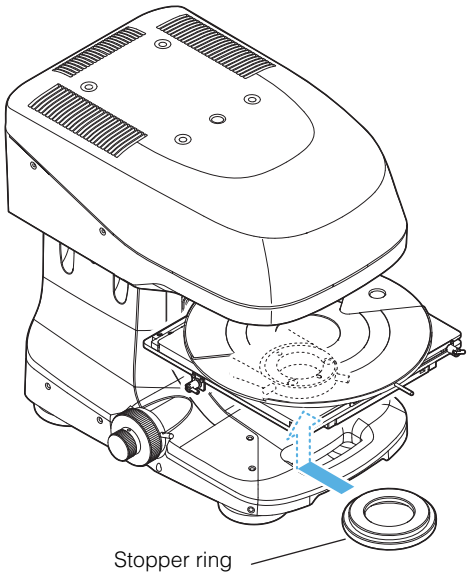


2 **Remove the stopper ring from the bottom of the 300 mm wafer XY stage and place the stage on the stage base.**

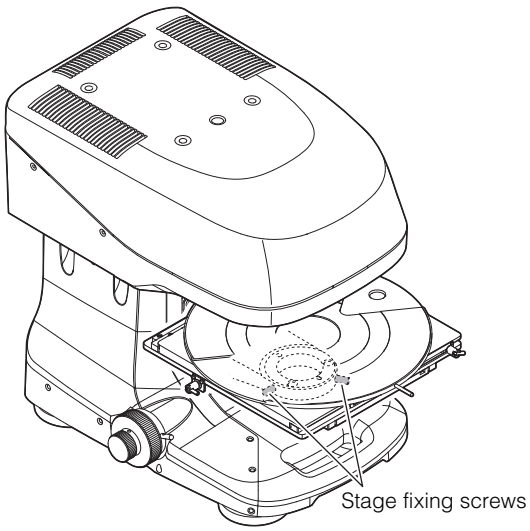
Place the stage so that the pin on the bottom of the 300 mm wafer XY stage is aligned with the stage fixing position.



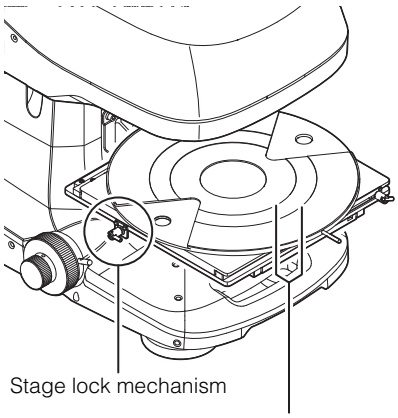
3 **Insert the stopper ring that you removed into the 300 mm wafer XY stage and base.**



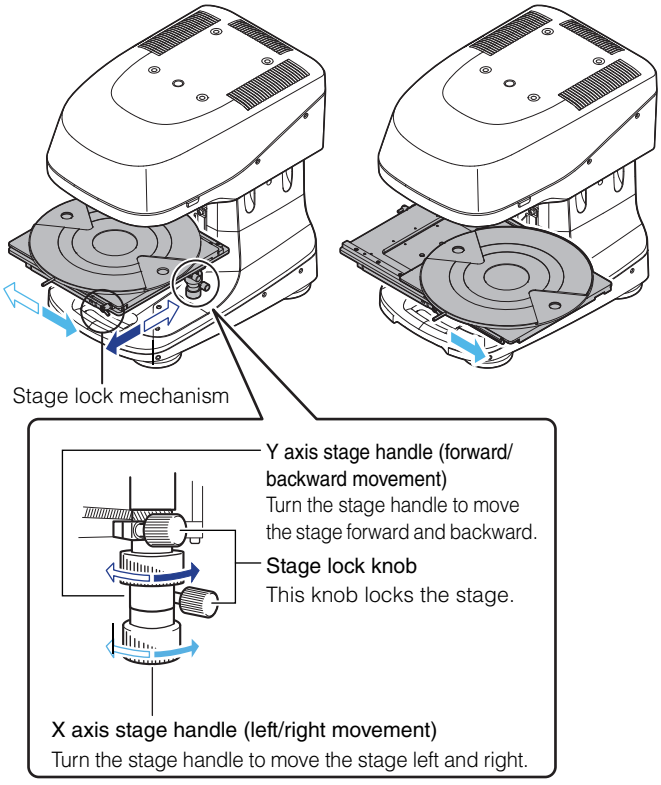
4 **Tighten the stage fixing screws.**



Names and Functions of the Components of the 300 mm Wafer XY Stage



When observing a 6- or 8-inch wafer, align the wafer to the edge of the stage and fix it there.



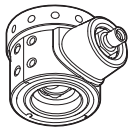
Moving range	X axis: 160 mm, Y axis: 160 mm
Rotating direction	360 degrees
Stroke of one rotation of the handle	X axis 18 mm, Y axis 36 mm
Load endurance	1.0kg

Mounting the Spectral Film Thickness Unit VK-T300

Package List

The spectral film thickness unit (VK-T300) consists of the following parts.

☐ Spectrum adapter



☐ Bracket
☐ Spectrometer
☐ Fiber optic cable
☐ USB cable
☐ Reference mirror (optical plane)
☐ Dark sample
☐ Removal tool
☐ Assist tool

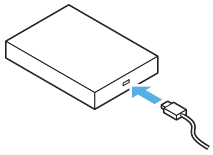
Mounting the Spectral Film Thickness Unit

NOTICE	**Make sure to start the Viewer Application when mounting the spectral film thickness unit and follow the on-screen instructions.**

1 Remove the spectral film thickness unit from the case.

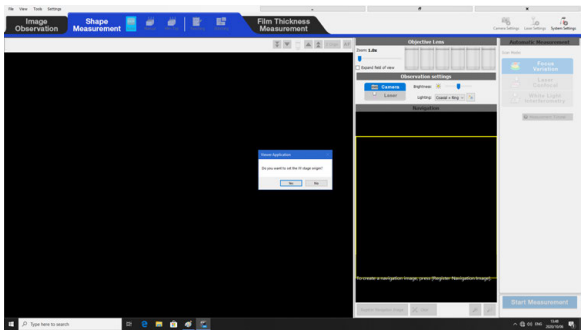
▶ Important **The case is required when transporting the spectral film thickness unit. Be sure to keep it in a secure location.**

2 Connect the USB cable to the Micro-B connector on the spectrometer.



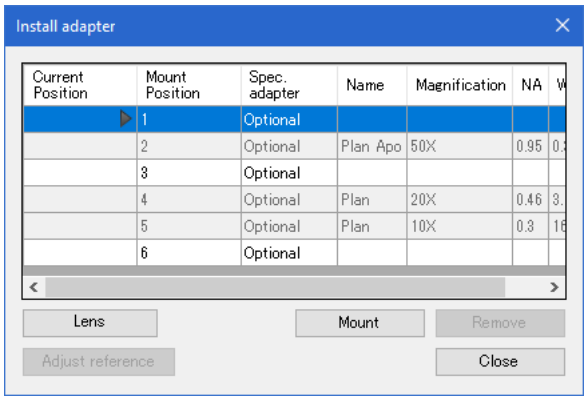
3 Connect the USB cable to the USB connector on the back of the control PC.

4 Start the Viewer Application and execute the attachment operation for the spectral film thickness unit VK-T300.

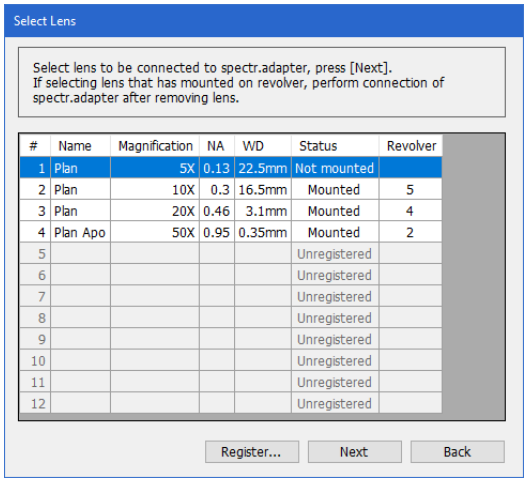


"VK-X3000 Series Viewer Application Reference Manual"

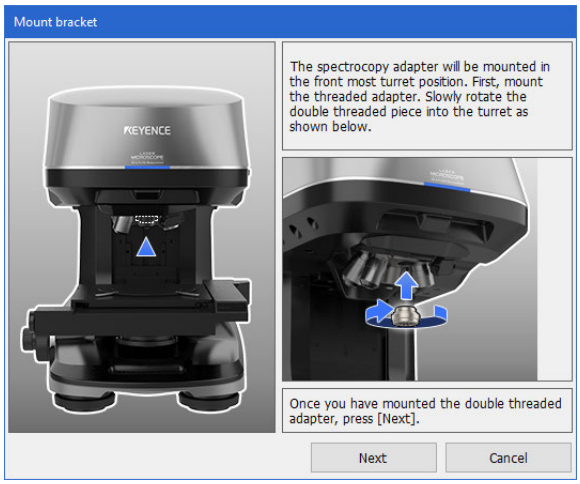
5 Select the position to mount the spectral film thickness unit.

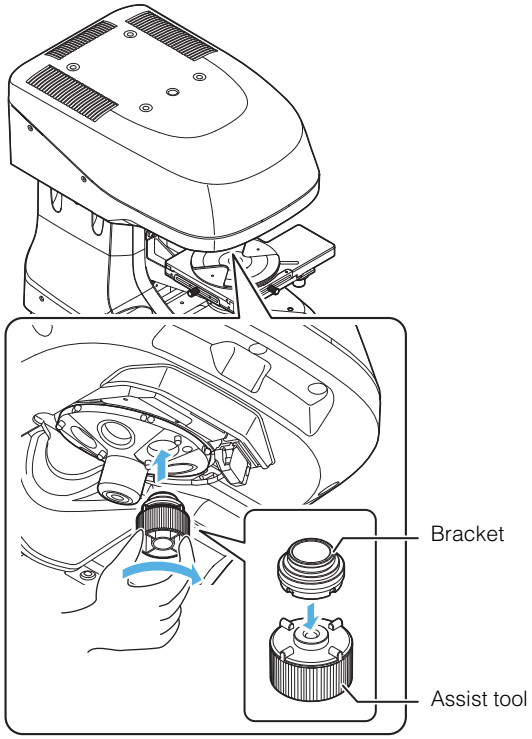


6 Select the lens to attach to the spectral film thickness unit.



7 Follow the on-screen instructions to attach the bracket.



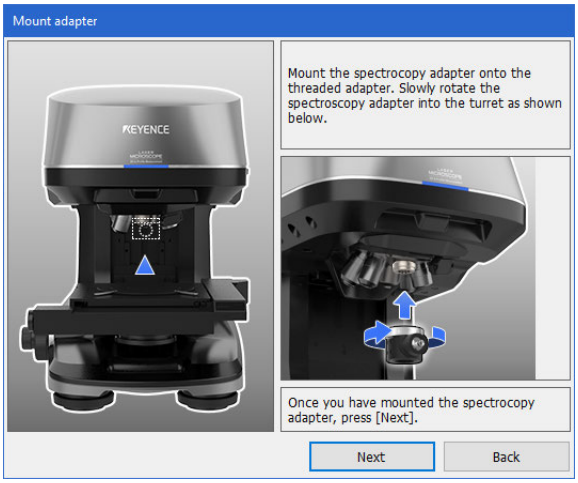


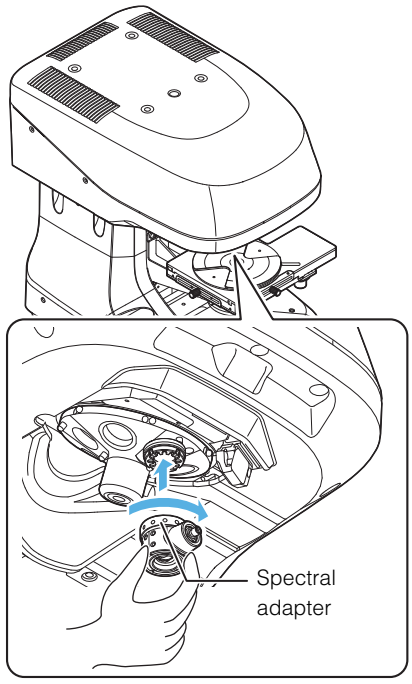
Important

- **Use the assist tool when attaching the bracket.**
- **Align the ridges on the assist tool with the grooves on the bottom of the bracket.**

8 Follow the on-screen instructions to attach the spectral adapter.

Attach the adapter such that the fiber optic cable port is at the front.



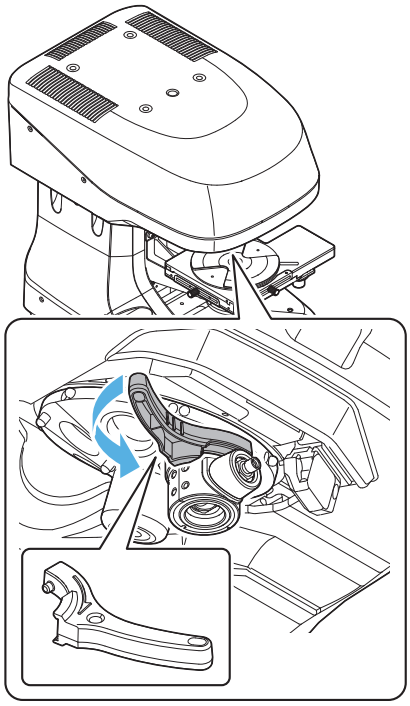


Important

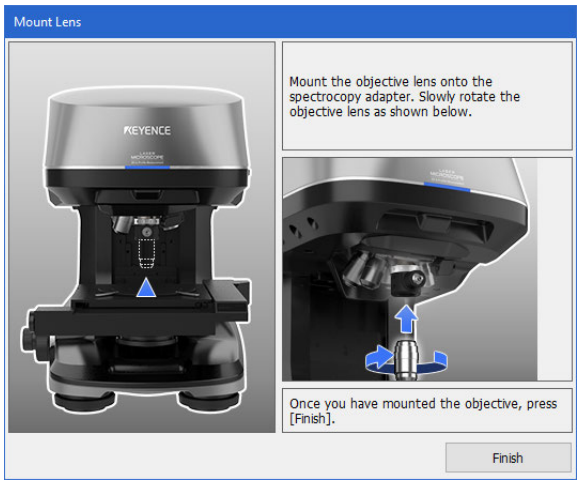
- **Attach the adapter without the fiber optic cable inserted.**
- **Attach the adapter in a way that it does not interfere with the ring illumination electrode.**

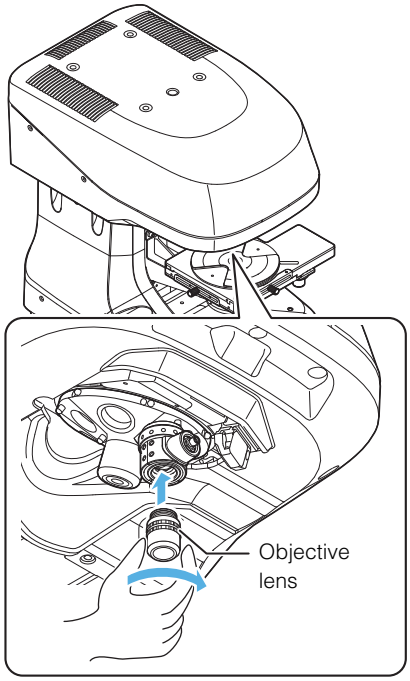
Point

If you are having problems removing the spectral adapter, use the removal tool.



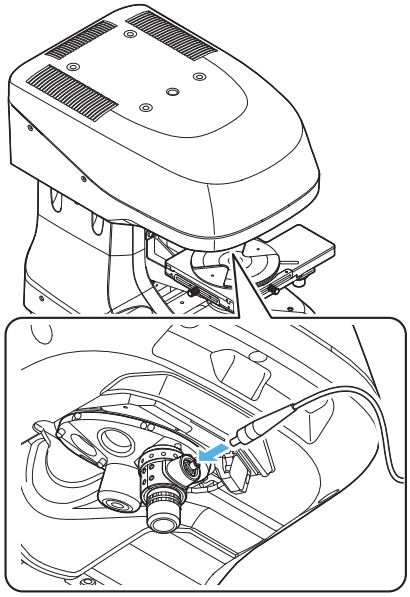
9 Follow the on-screen instructions to mount the objective lens.





10 Insert the fiber optic cable into the fiber optic cable port on the spectral adapter.

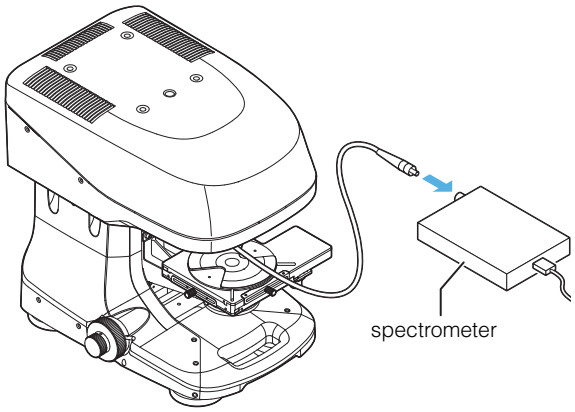
After inserting the fiber optic cable into the spectral adapter, rotate the ring.



NOTICE	• **Do not forcibly bend the fiber optic cable.** • **Do not touch the end of the fiber optic cable after removing the cover.**

11 Insert the fiber optic cable into the fiber optic cable port on the spectrometer.

After inserting the fiber optic cable into the spectrometer, rotate the ring.



Chapter 5

Maintenance

This chapter describes how to clean the objective lenses and mirror and replace the fuses.

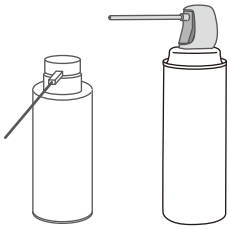
Cleaning the Objective Lenses, Adjustment Mirror, and Glass Chart

This section describes how to clean the objective lenses, adjustment mirror, and glass chart.

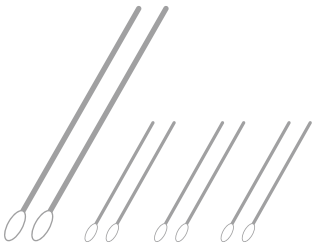
■ Setup

Prepare the items below.

- Compressed air
  Use this to remove dirt from the objective lenses, adjustment mirror, and glass chart.



- Polyester swabs or chopsticks made of willow or cedar (with a pointed tip)



  Used to remove dirt on the objective lenses.
  These are special swabs that do not shed materials, but you can substitute them with chopsticks made from willow or cedar.

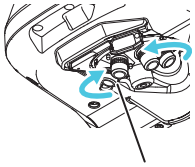
- Lens paper
  Used to remove dirt on the objective lenses.
- Lens cleaner, petroleum benzine, or dehydrated alcohol
  Used to remove dirt on the objective lenses.

Cleaning the Objective Lenses

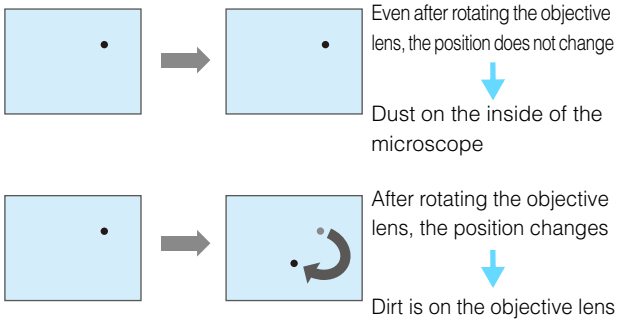
Clean the lenses when the camera or laser images have a white haze and are blurry.
Check whether there is any effect from dirt on the lens and remove it if necessary.

1 If any dirt appears on the image, check whether the dirt is inside the microscope or on the objective lens.

Rotate the objective lens using the procedure to remove it from the lens revolver and determine whether the shadows (black dots) on the monitor move.



Lens revolver



2 Blow off the dirt in the microscope or on the objective lens using compressed air.

To clean the microscope, blow the compressed air inside the microscope.
To clean the objective lens, blow the lenses on both the object side and image side.

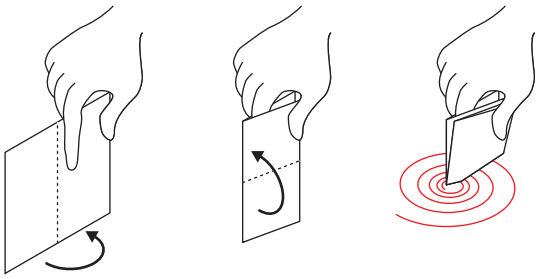
3 Repeat step 1 to check whether the dirt was removed.

4 If the situation does not improve even if you perform the procedure up to step 3 several times, proceed to step 5.

5 **Wrap lens paper around your finger and wipe the lens without applying anything to the paper.**

Point

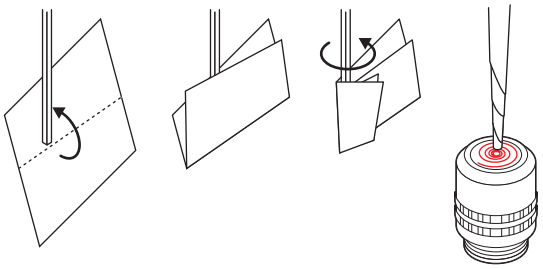
Wipe in a circle in the center gradually moving outwards.
Gradually wiping the lens will clean it. If you do not carefully wipe the lens, you may dirty it.



6 **Wrap lens paper around the tip of chopsticks made of willow or cedar, and soak the lens paper in a small amount of lens cleaner, petroleum benzine, or dehydrated alcohol.**

Point

Wipe in a circle in the center gradually moving outwards.
Gradually wiping the lens will clean it.



7 **Completely dry the lens with the compressed air.**

If you do not plan on using the lens for a long period of time, storing it in a desiccator will prevent it from getting moldy.

NOTICE	**Do not use a screw driver, tweezers made of metal, or chopsticks made of bamboo. Doing so may scratch the lens.**

Important

Wipe any dust or oil on the monitor or exterior of the device with a cloth.

Cleaning the Adjustment Mirror and Glass Chart

1 **Blow off any dirt on the adjustment mirror or glass chart surface with compressed air.**

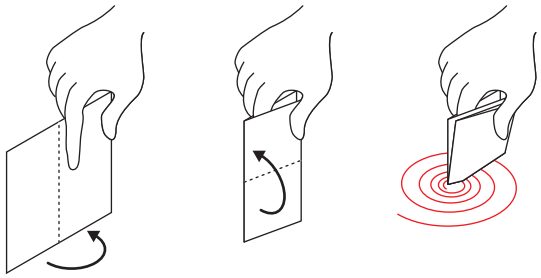
2 **If the situation does not improve even if you perform step 1 several times, proceed to step 3.**

NOTICE	**Do not wipe the plate for focus variation or the plane mirror for white light interference with lens paper. Doing so may scratch or damage the mirror.**

3 **Wrap lens paper around your finger and wipe the lens without applying anything to the paper.**

Point

Wipe in a circle in the center gradually moving outwards.
Gradually wiping the lens will clean it. If you do not carefully wipe the lens, you may dirty it.



Replacing the Fuses

This section explains how to change the fuses in the controller.

▶ Important **Use the product below as replacement fuses.**

SOC-made HT Series

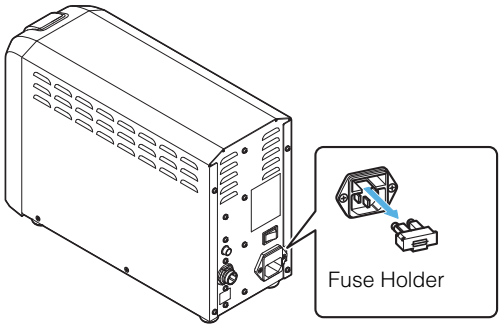
Rated voltage:	**250 V**
Rated current:	**4.0 A**
Blowout characteristic:	**Time lag**

1 Shut down the system and turn the controller's main power off.

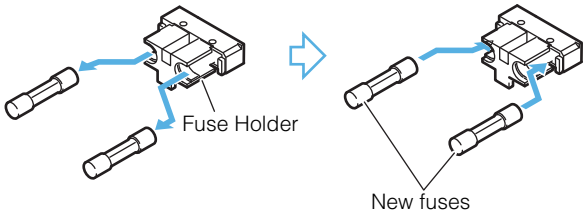
"Shutting Down the System" (Page 3-4)

2 Remove the power cable.

3 Pull out the fuse holder from the power connector.

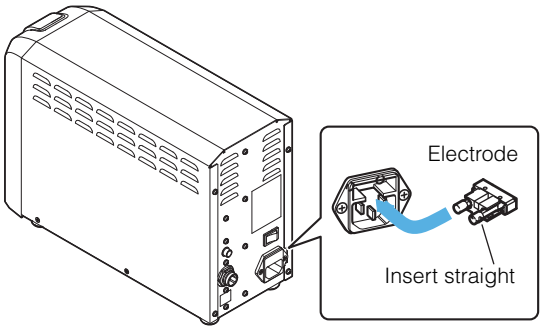


4 Insert the new fuses into the fuse holder.



5 Insert the fuse holder back into the power connector.

With the protrusion of the fuse holder facing down, insert it straight so that the fuses come in contact with the electrode of the fuse holder.



Appendix

This chapter describes the specifications and dimensions of the VK-X3000 Series.

Specifications

Model			Controller (VK-X3000)							
			Measurement Unit (VK-X3100)				Measurement Unit (VK-X3050)			
Total magnification[*1]			120	240	480	1200	120	240	480	1200
Field of view (minimum view range)[*2]	H (horizontal): µm		2700	1350	675	270	2700	1350	675	270
	V (vertical): µm		2025	1012	506	202	2025	1012	506	202
Working distance: mm			22.5	16.5	3.1	0.35	22.5	16.5	3.1	0.54
Numerical aperture (N.A.)			0.13	0.3	0.46	0.95	0.13	0.3	0.46	0.8
Measurement optical system			Pinhole confocal optical system							
			Focus variation optical system							
			White light interference (optional)							
			Spectral film thickness measurement (optional)							
Height measurement	Measurement Range		7 mm							
	Display resolution		0.1 nm (laser confocal/ focus variation) 0.01 nm (white light interference)				1 nm (laser confocal/ focus variation) 0.01 nm (white light interference)			
	Laser confocal	Repeatability σ[*3]	-	100 nm	40 nm	12 nm	-	100 nm	40 nm	20 nm
		Accuracy[*3]	10x lens: ±1.0+L/100 µm or less, 20x - 50x lens: ±0.2+L/100 µm or less (L = Measuring Length in µm)							
	Focus variation	Repeatability σ[*3]	500 nm	100 nm	50 nm	20 nm	500 nm	100 nm	50 nm	30 nm
		Accuracy: µm[*3]	5x - 10x lens: ±1.0+L/100 µm or less, 20x - 50x lens: ±0.2+L/100 µm or less (L = Measuring Length in µm)							
	White light interfer	Repeat surface shape[*9]	0.08 nm							
		Repeat RMS[*9]	0.008 nm							
Width measurement	Display resolution		0.1 nm (laser confocal/ focus variation) 0.01 nm (white light interference)				1 nm (laser confocal/ focus variation) 0.01 nm (white light interference)			
	Laser confocal	Repeatability 3σ[*4]	-	200 nm	100 nm	40 nm	-	400 nm	100 nm	50 nm
		Accuracy[*5]	-	±2%			-	±2%		
	Focus variation	Repeatability 3σ[*4]	400 nm	400 nm	120 nm	50 nm	400 nm	400 nm	120 nm	65 nm
		Accuracy[*5]	±2%				±2%			
Spectral interference film thickness measurement		Repeatability σ[*9]	0.1 nm							
		Accuracy[*9]	±0.6%							
		Measurement film thickness range[*10]	100 - 5,000 nm							
Measurement quality	Laser confocal	Superfine	2048 x 1536							
		Standard/High speed	1024 x 768							
		Part 1/12	1024 x 64							
Frame rate (Hz)	Laser confocal	Superfine	4 Hz							
		Standard/High speed	9 Hz							
		High speed (skip)	15 Hz							
		High speed (skip double)	25 Hz							
		Part 1/12	75Hz, skip double 125 Hz							
		Line peak/Line film thickness	7,900 Hz (when Z pitch is 0.1 µm or less)							
Optical zoom*6			0.7 to 8x							
Auto function			Setting the Auto-gain/Auto-focus/Auto-selection of up/down limits/ Double scan brightness							
Measurement laser light source	Wavelength		Violet laser 404 nm				Red laser 661 nm			
	Output		0.9 mW				0.9 mW			
	Class		Class 2 Laser Product (IEC60825-1, JIS C6802)							
Photoreceptor			PMT (Photomultiplier)							
Coaxial illumination light source	Light source		White light LED							
	Average life		50,000 hours (reference value)							
Ring illumination light source	Light source		White LED ring illumination (red/green/blue)							
	Average life		30,000 hours (reference value)							
	Compatible lenses		2.5x, 5x, and 10x							

Model			Controller (VK-X3000)	
			Measurement Unit (VK-X3100)	Measurement Unit (VK-X3050)
Optical observation light Color camera	Image pickup device		5.6 megapixel, color C-MOS	
	Resolution	Save as still image	Max. field of view: 5.6 megapixels	
			Standard field of view: 2.95 megapixels	
		3D data	3.14 megapixels (super fine), 0.78 megapixels (standard)	
	Gain		0 dB - 24 dB	
	Adjustment		Gain, Shutter speed	
	White balance		AUTO/MANUAL/PUSHSET	
Maximum sample size	Maximum sample height		70 mm*7	
	Maximum sample size		Diameter of 318 mm to observe the entire object at once	
Z stage	Stroke		72 mm	
	Maximum load		When the standard XY stage is mounted: 5.0 kg; when the motorized XY stage is mounted: 3.0 kg	
Rotating stage	Stroke		360 degrees	
Data processing unit			Dedicated PC specified by KEYENCE (OS: Windows 10 Pro) *8	
Power	Power voltage		100 to 240 VAC, 50/60 Hz	
	Current consumption		Max. 150 VA	
Environmental resistance	Ambient temperature		+15 to +28°C	
	Ambient humidity		20 to 80% RH (No condensation)	
	Floor vibration at the installation place		1.5×10-3m/s^2 or less (for frequencies less than 5 Hz, the amplitude should be less than 3 µm)	
Weight	Measurement unit		Approx. 13.0 kg	
	Base		Approx. 17.0 kg (add 2.5 kg when the motorized stage is mounted)	
	Controller		Approx. 3.0 kg	

*1 Magnification on the 23-inch monitor screen (with 1x optical zoom)

*2 The observation measurement range is set as the minimum field of vision (with 1x optical zoom).

*3 When the standard step is measured with the ambient temperature of 20 ± 2°C. With the exception of the 5x objective lens.

*4 When the known line width in the standard chart is measured with line peak (8x image averaging) with the ambient temperature of 20 ± 2°C.

*5 When the pitch width with the standard scale is measured with the ambient temperature of 20 ± 2°C. With the exception of the 5x objective lens.

*6 0.7x is available only in focus variation mode.

*7 This can be increased by up to 170 mm using the optional spacer.

*8 Windows 10 is a registered trademark of Microsoft Corporation (US).

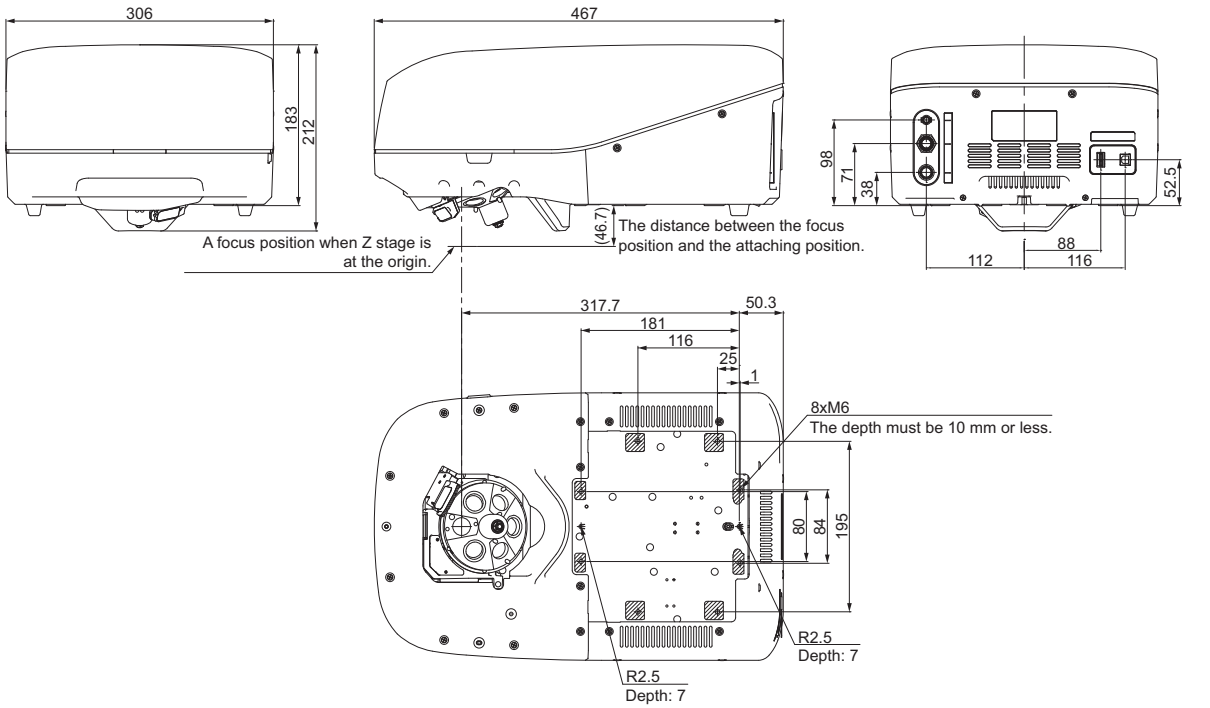
*9 Representative value in the KEYENCE default measuring environment.

*10 Measurement range when measuring SiO2. The measurement range changes according to the refractive index of the measurement target.

Dimensions

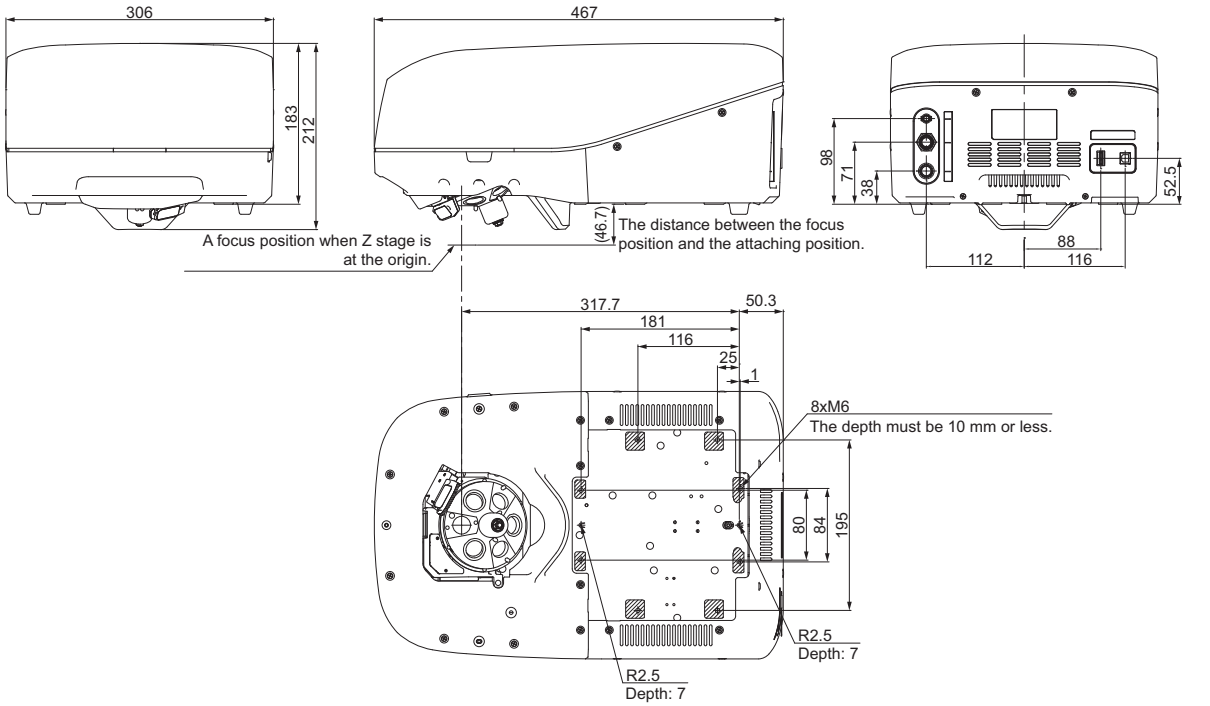
Measurement Unit (VK-X3100)

Unit: mm



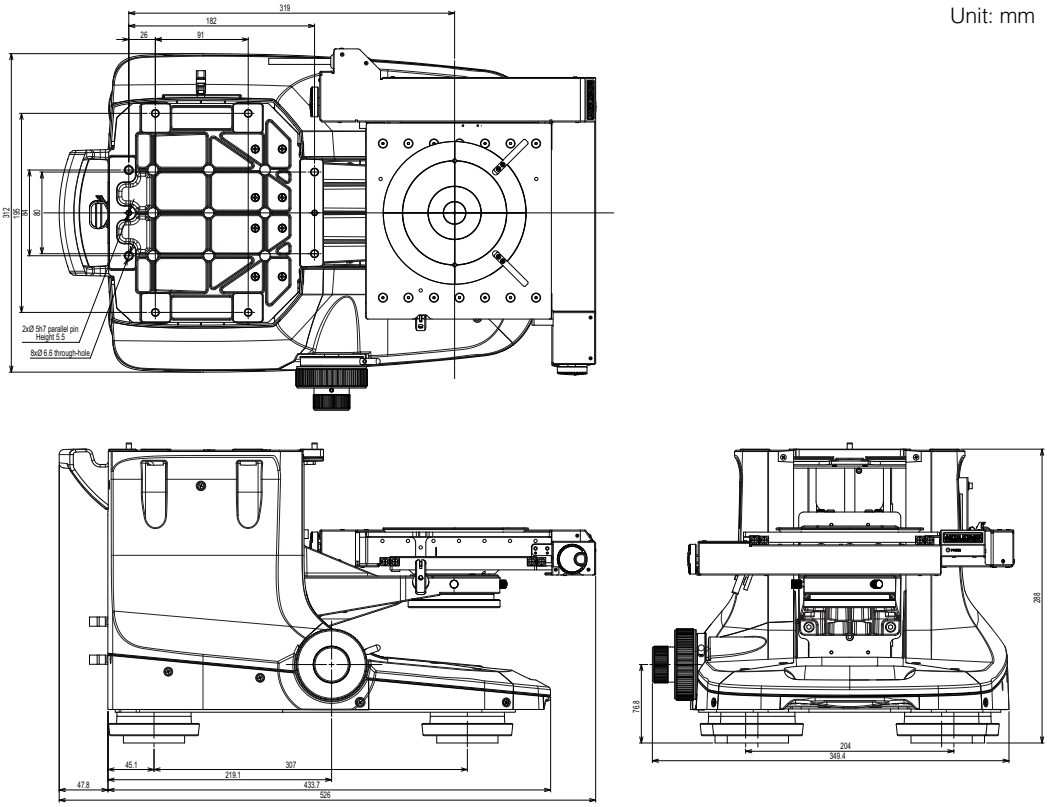
Measurement Unit (VK-X3050)

Unit: mm



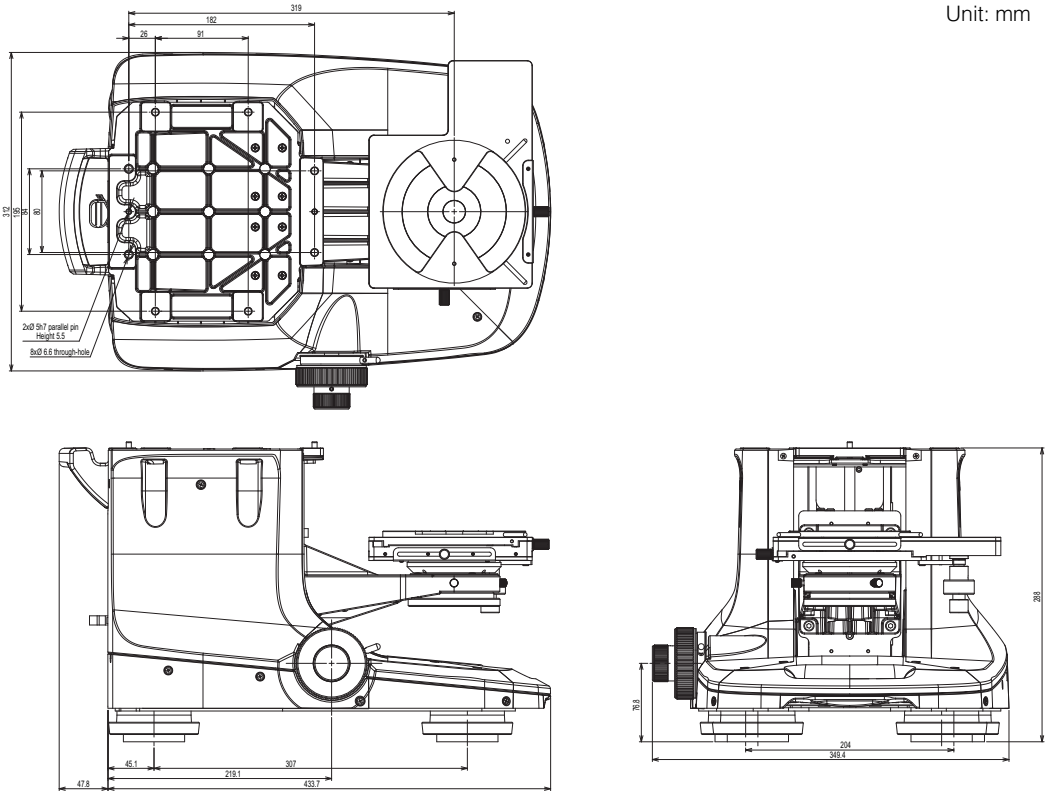
Motorized Base (VK-D3)

Unit: mm



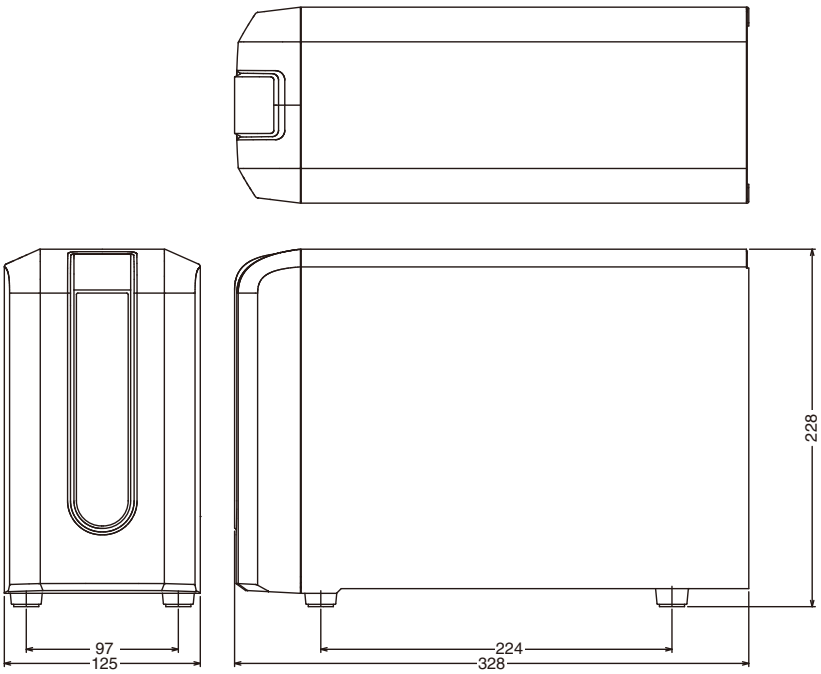
Manual Base (VK-S3)

Unit: mm



Controller (VK-X3000)

Unit: mm



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Revision History

Print date	Revision no.	Description
February 2021	Revised 1st edition	
March 2021	Revised 2nd edition	
March 2023	Revised 3rd edition	

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KEYENCE CORPORATION

1-3-14, Higashi-Nakajima, Higashi-Yodogawa-ku, Osaka, 533-8555, Japan PHONE: +81-6-6379-2211

www.keyence.com/glb

AUSTRIA
Phone: +43 (0)2236 378266 0

BELGIUM
Phone: +32 (0)15 281 222

BRAZIL
Phone: +55-11-3045-4011

CANADA
Phone: +1-905-366-7655

CHINA
Phone: +86-21-3357-1001

CZECH REPUBLIC
Phone: +420 220 184 700

FRANCE
Phone: +33 1 56 37 78 00

GERMANY
Phone: +49-6102-3689-0

HONG KONG
Phone: +852-3104-1010

HUNGARY
Phone: +36 1 802 7360

INDIA
Phone: +91-44-4963-0900

INDONESIA
Phone: +62-21-2966-0120

ITALY
Phone: +39-02-6688220

KOREA
Phone: +82-31-789-4300

MALAYSIA
Phone: +60-3-7883-2211

MEXICO
Phone: +52-55-8850-0100

NETHERLANDS
Phone: +31 (0)40 206 6100

PHILIPPINES
Phone: +63-(0)2-8981-5000

POLAND
Phone: +48 71 368 61 60

ROMANIA
Phone: +40 (0)269 232 808

SINGAPORE
Phone: +65-6392-1011

SLOVAKIA
Phone: +421 (0)2 5939 6461

SLOVENIA
Phone: +386 (0)1 4701 666

SWITZERLAND
Phone: +41 (0)43 455 77 30

TAIWAN
Phone: +886-2-2721-1080

THAILAND
Phone: +66-2-078-1090

UK & IRELAND
Phone: +44 (0)1908-696-900

USA
Phone: +1-201-930-0100

VIETNAM
Phone: +84-24-3772-5555

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