Mitutoyo

99MBA128B

Video Microscope Unit VMU Series

VMU-L / VMU-LB / VMU-L4 / VMU-L4B

User's Manual

To obtain the highest performance and the longest service life from this product, carefully read this manual thoroughly prior to use, and use the product properly.
After reading this manual, keep it safe close at hand for future reference.
Before this product is shipped from the factory, sufficient inspections are conducted in order to insure its mechanical and optical performance. However, if an abnormality occurs or if there is something you have a question about, please contact the nearest Mitutoyo sales office.

Conventions Used in This Document

WARNING Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

NOTICE Indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Tips Indicates referential information such as that for when the operating methods and procedures which are printed in these sentences are to be applied to specific conditions.

Indicates referential locations if there is information that should be referred to in this document or an extraneous manual.
Example: For details about xxx, see "3.3 Mounting the Camera".

Safety Precautions

Read the following thoroughly before operating the product to use it properly.

WARNING

- Do not use this product with any other laser unit than a laser unit that has a compatible wavelength. For the compatible wavelengths, see "7.2 Upper Limit Value of Input Laser and Upper Limit of Beam Diameter".
- The laser may cause loss of eyesight if it comes in direct contact with the naked eye. Never look at the laser directly. NIR (1064 nm), NUV (355 nm), and ultraviolet (266 nm) lasers are not visible to the eye, so be careful.
- When the laser unit is operating, always wear protective goggles designed for lasers. In addition, never look into inside of the main body from the camera mounting seat of the camera port.
- Laser reflected or scattered from the processed workpiece is also dangerous. Do not look at the processed workpiece directly when the laser unit is operating. Also, install an appropriate shield around the processed workpiece.
- Do not disassemble or modify this product. These actions may cause a performance deterioration, electric shock, injury or damage to this product.

Precautions for Use

- Be careful not to apply excessive shock or force to any of the parts when setting up or operating this product.
- If the product is disassembled by the user, its performance cannot be guaranteed even within the warranty period. Also, if a failure occurs, it will be subject to a repair charge.
- When transporting this product, make sure to hold and carefully support the main unit. Furthermore, be careful not to touch any movable parts.
- The performance of this product may be degraded if it is fallen over or dropped.
- Avoid using this product in areas subjected to direct sunlight, dirt, dust, high temperature, high humidity and excess vibration.
- Please contact the nearest Mitutoyo sales office when this product will be installed in high-speed or high-acceleration equipment.

Warranty

In the event that this product should prove defective in workmanship or material, within one year from the date of original purchase for use, it will be repaired or replaced free of charge. Please contact your dealer or the nearest Mitutoyo sales office.
If this product fails or is damaged for any of the following reasons, it will be subject to a repair charge even if it is still under warranty.

- Failure or damage owing to inappropriate handling or to unauthorized modification or repair
- Failure or damage owing to transport, dropping, or relocation of the product after purchase
- Failure or damage owing to fire, salt, gas, abnormal voltage, or natural disaster

Export Control Compliance

This product falls into the Catch-All-Controlled Goods and/or Catch-All-Controlled Technologies (including Programs) under Category 16 of Appended Table 1 of the Export Trade Control Order or under Category 16 of the Appended Table of Foreign Exchange Control Order, based on the Foreign Exchange and Foreign Trade Act of Japan.
If you intend re-export of the product from a country other than Japan, re-sale of the product in a country other than Japan, or re-provision of the technology (including program), you are obligated to observe the regulations of your country.

1 Outline

This product is a compact and light-weight microscope specifically for a camera observation. At the same time, a YAG laser can be mounted to support detailed machining (such as cutting/trimming of semiconductor circuits, cleaning/machining of thin films, repair of liquid crystal color filters).

Date of publication: December 1, 2017

2 Checking Accessories

In addition to this document and the warranty card, the following accessories are included with this product. Check whether anything such as accessories are missing or have been damaged in transport when unpacking this product.

Revolver wrench*1 | Hexagon socket screw key Nominal 2.5 *1 | Hexagon socket screw key Nominal 2 | Hexagon socket screw key Nominal 1.5 | GIF unit*2

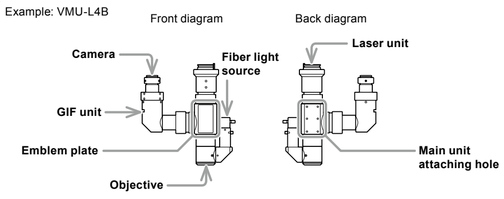
*1 VMU-LB/L4B only *2 VMU-L4/L4B only

3 Setup

This product is used by securing it on a device or stand and mounting instruments such as the objective, camera and laser unit.

Position to mount each instrument

Example: VMU-L4B

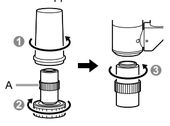


Tips The front side of the main body has main unit attaching holes (6 threaded holes, M4, 0.7 pitch, 6 mm depth) to mount the main body on a device that are the same as on the back side. An emblem plate is affixed to the front side of the main body as shown in the diagram above. To mount a device on the front side, remove the emblem plate and secure it on the back side of the main body.

3.1 Mounting the Objective

NOTICE When mounting the objective, hold the knurled part (A) of the objective with care so that it does not drop. The performance of the objective may deteriorate if dropped.

1. Remove the case of the objective.
2. Remove the cap of the objective.
3. Screw in the threaded section of the objective into the objective mount.

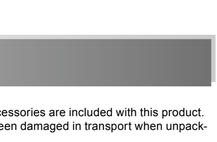


3.2 Mounting the Fiber Light Source

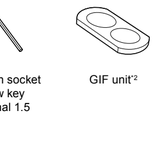
Mounting the fiber light source

A fiber light source made by Mitutoyo (ø10) mounts directly into the fiber port. If a third-party fiber light source (ø14) is used, remove the fiber spacer (A) from the fiber port.
For the dimensions of the fiber light sources that can be mounted, see the right diagram.

NOTICE If a fiber light source that is not supported is used, performance is not guaranteed.
Please contact the nearest Mitutoyo sales office.



1. Remove the fiber spacer.
(Only if using a third-party fiber light source)
2. Insert the fiber light source into the fiber port.
3. Tighten the clamping screw.



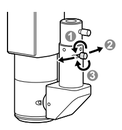
Adjusting the aperture diaphragm

The aperture diaphragm is for adjusting the numerical aperture (NA) of the illumination system. The NA is related to the image resolution, contrast and the depth of focus. Closing the aperture to a NA of about 80% for the objective generally gives a quality image with the appropriate contrast.

NOTICE Make sure not to close the aperture diaphragm too much because the resolution deteriorates.

1. Loosen the aperture diaphragm knob slightly.
2. Move the aperture diaphragm knob in the horizontal direction to adjust the aperture diaphragm.
3. Tighten the aperture diaphragm knob.

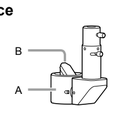
NOTICE Do not tighten the aperture diaphragm knob with excessive force because it can cause damage.



To change the direction to mount the fiber light source

NOTICE

- The illumination optical tube (A) has half mirror (B) built-in. Be careful not to scratch the half mirror during operation.
- When a laser that has polarization characteristics is installed, the laser transmittance may become unstable if the illumination optical tube is rotated.



For VMU-LB/L4B

1. Remove the objective mount with the supplied revolver wrench.
2. Loosen and remove the illumination optical tube set screws (hexagon M3 × 3), and then remove the illumination optical tube.
3. Loosen and remove the intermediate optical tube set screws (hexagon M3 × 3).
4. Rotate the intermediate optical tube to an arbitrary position so as to align the position of the pin attached to the top surface of the intermediate optical tube and the pin hole (45° intervals) on the bottom of the main body.
5. Insert the pin in the pin hole.
6. Mount the intermediate optical tube, illumination optical tube, and objective mount as they were.

For VMU-L/L4

1. Loosen the illumination optical tube set screws (hexagon M4 × 3).
2. Rotate the illumination optical tube to an arbitrary position so as to align the position of the pin attached to the top surface of the illumination optical tube and the pin hole (45° intervals) on the bottom of the main body.
3. Insert the pin in the pin hole.
4. Tighten the illumination optical tube set screws.

3.3 Mounting the Camera

Mounting the camera

1. Loosen the C-mount fixing screws (hexagon M4 × 3), and then remove the C-mount.
2. Set the C-mount on the camera.
3. Mount the C-mount with the camera to its original position.
4. Tighten the C-mount fixing screws.

To change the direction to mount the camera port (VMU-LB/L4B only)

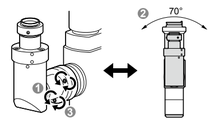
The direction to mount the camera can be changed to an arbitrary direction in the 360°.

NOTICE

- The optical performance may deteriorate due to an insufficient maximum loading capacity depending on the weight and direction of the camera to mount. Add an auxiliary fixture in addition to the C-mount to support the weight of the camera.
- When removing the camera port rotation screws, support the camera port using your hands with care so that it does not drop. The camera port may become damaged if it is dropped.

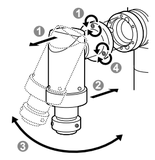
To rotate the camera port within 70°

1. Loosen the camera port rotation screws (hexagon M3 × 3).
2. Rotate the camera port to an arbitrary position.
3. Tighten the camera port rotation screws.



To rotate the camera port more than 70°

1. Loosen and remove the camera port rotation screws (hexagon M3 × 3), and then remove the camera port.
2. Change the mounting position of the camera port rotation screws, and then tighten the screws tentatively. (Mounting can be done at intervals of 60°.)
3. Rotate the camera port to an arbitrary position.
4. Tighten the camera port rotation screws.



Checking the observation center and focus

Check the observation center and focus in the following cases:

- When mounting and using multiple objectives with the revolver
- When installing a laser unit with a mask

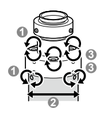
This section explains the procedure when using multiple objectives as an example.

1. Switch the objective to the one with a maximum magnification.
2. Move the specimen in the X-axis direction and Y-axis direction of the device to adjust the specimen from an arbitrary position to the center of the monitor.
3. Move the specimen in the Z-axis direction of the device to adjust the focus.
4. Switch the objective to the one with a minimum magnification, and then confirm the observation center and focus.
5. If adjustments are necessary, make the adjustments following the procedures in "■ Adjusting the observation center" and "■ Adjusting the focus", and then check the observation center and focus again. (Repeat this procedure as necessary.)

Adjusting the observation center

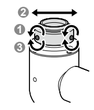
For VMU-LB/L4B

1. Loosen the camera port set screws (hexagon M3 × 3) and the camera port centering screws (hexagon M4 × 3).
2. Move the camera port in the horizontal direction to adjust the observation center.
3. Tighten the camera port set screws and the camera port centering screws.



For VMU-L/L4

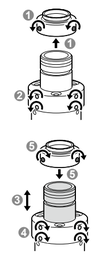
1. Loosen the C-mount fixing screws (hexagon M4 × 3).
2. Move the C-mount in the horizontal direction to adjust the observation center.
3. Tighten the C-mount fixing screws.



Adjusting the focus

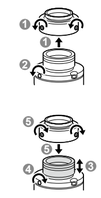
For VMU-LB/L4B

1. Loosen the C-mount fixing screws (hexagon M4 × 3), and then remove the C-mount.
2. Loosen the focus adjusting screws (hexagon M4 × 4).
3. Move the C-mount adjusting frame up and down by rotating it to adjust the focus.
4. Tighten the focus adjusting screws.
5. Mount the C-mount in its original position, and then tighten the C-mount fixing screws.



For VMU-L/L4

1. Loosen the C-mount fixing screws (hexagon M4 × 3), and then remove the C-mount.
2. Loosen the C-mount adjusting frame fixing screws (hexagon M3 × 2).
3. Move the C-mount adjusting frame up and down by rotating it to adjust the focus.
4. Tighten the C-mount adjusting frame fixing screws.
5. Mount the C-mount in its original position, and then tighten the C-mount fixing screws.



Adjusting the inclination of the observation image

1. Loosen the C-mount fixing screws (hexagon M4 × 3).
2. Rotate the camera together with the C-mount to adjust the inclination.
3. Tighten the C-mount fixing screws.

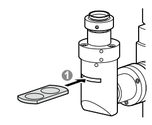
3.4 Mounting the GIF Unit (Only VMU-L4/L4B)

The GIF unit is composed of the Green Filter (GIF) and parallel flat plates.
When using the UV objective, switch to GIF to increase the resolution.

1. Insert the supplied GIF unit into the slot of the camera port.

NOTICE The focal point is adjusted with the GIF unit inserted. When using the UV objective, be sure to insert the GIF unit because the focus may be lost.

Tips Check that the filter glass of the GIF unit is not dirty from contaminants such as dust or fingerprints. If the filter glass is dirty, gently wipe it off using a lens paper or gauze soaked in a small amount of alcohol.



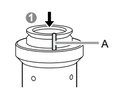
3.5 Mounting the Laser Unit

NOTICE

- Before mounting the laser unit, be sure to read all of the warnings in the manual for the laser unit. For details about the laser unit, see "Laser Unit Manual".
- When removing the laser unit, be sure to turn off the laser unit.
- For details about the wavelengths and input upper limit value of the laser that can be used with this product, see "7.2 Upper Limit Value of Input Laser and Upper Limit of Beam Diameter".
- When the laser unit is mounted on this product to install in high-speed or high-acceleration equipment, prepare not only the laser mount for the laser unit but also support for the customer equipment according to the weight of the laser unit. Please contact the nearest Mitutoyo sales office if you have any trouble.

1. Align the safety interlock release button of the laser unit and the release pin (A) of the laser port, and then mount the laser unit to the laser port.

Tips The direction to mount the laser unit can be changed by changing the position to mount the release pin. (Mounting can be done at intervals of 90°.) However, if a laser with polarization characteristics is used, be careful because the laser transmittance may move up or down.



2. Tighten the set screws of the laser unit.

If the mask position of the laser unit and the image position of this product do not align with the focal direction

1. Loosen the laser mount set screws (hexagon M4 × 4).
2. Rotate the laser mount to adjust the image position.
3. Change the mounting position of the release pin, and then return the laser unit to its original position.
4. Tighten the laser mount set screws.

4 Mounting the Options

4.1 Revolver

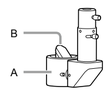
The following revolvers can be mounted to this product:

- Manual revolver: Code No. 378-707
- Manual revolver (with centering and parfocal): Code No. 378-717
- Motorized revolver (BF, 5-holes): Code No. 378-713

1. Remove the intermediate optical tube.

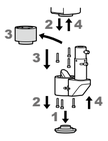
NOTICE

- Revolvers can be mounted without removing the intermediate optical tube. However, be careful if laser machining is performed with the intermediate optical tube mounted, because the objective may become damaged.
- The illumination optical tube (A) has half mirror (B) built-in. Be careful not to scratch the half mirror during operation.



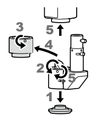
For VMU-LB/L4B

1. Remove the objective mount with the supplied revolver wrench.
2. Loosen and remove the illumination optical tube set screws (hexagon M3 × 3), and then remove the illumination optical tube.
3. Loosen and remove the intermediate optical tube set screws (hexagon M3 × 3), and then remove the intermediate optical tube.
4. Mount the illumination optical tube to the main body, and then tighten the illumination optical tube set screws.

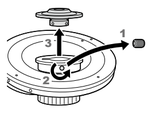


For VMU-L/L4

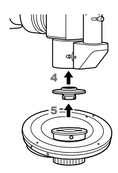
1. Remove the objective mount with the revolver wrench supplied with the revolver.
2. Loosen the illumination optical tube set screws (hexagon M4 × 3).
3. Loosen the intermediate optical tube set screws (hexagon M4 × 3).
4. Remove the intermediate optical tube.
5. Mount the illumination optical tube to the main body, and then tighten the illumination optical tube set screws.



2. Mount the revolver to the illumination optical tube.
1. Remove the locking screws (hexagon M4 × 3).
2. Loosen the set screws (hexagon M4 × 3) behind the locking screws.
3. Remove the revolver base.

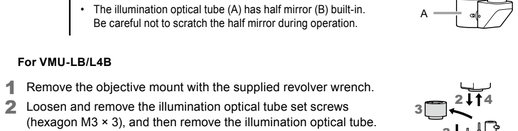


4. Insert the revolver base into the illumination optical tube.
5. Mount the revolver to the revolver base.
6. Tighten the set screws, and then tighten the locking screws as they were.



4.2 Focusing Unit A and B

1. Loosen and remove the VMU adapter set screws (hexagon M4 × 2), and then remove the VMU adapter.
2. Mount the VMU adapter to the main unit attaching holes by inserting and tightening the set screws supplied with the focusing unit (hexagon M4 × 6).
3. Mount the focusing unit to the main body by inserting and tightening the VMU adapter set screws.



NOTICE

- When combining the focusing unit B and the manual revolver, mount the revolver on the opposite side of the VMU adapter.
- The focusing unit B and the motorized revolver cannot be used together.

Tips

- When combining the focusing unit A and the simple stand, the stage center and optical axis of the main body are matched.
- When the focusing unit B is used, the distance between the focusing unit and the main body can be shortened.

4.3 Polarization Unit

NOTICE

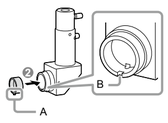
- For the VMU-L/L4, when the polarization unit is mounted, the total length becomes 15 mm longer. If laser machining is performed in this state, the analyzer unit may become damaged.
- For the VMU-LB/L4B, laser machining can be performed with the polarization unit mounted.

Tips For the VMU-L/L4, when the illumination optical tube is rotated, the illumination intensity during polarized observation is changed. Use the optimal position.

Mounting the polarizer

1. Loosen the vertical illumination tube set screws (hexagon M3 × 2), and then remove the vertical illumination tube from the main body.

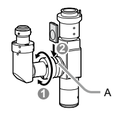
2. Align and mount the protrusion (A) of the polarizer with the notch (B) of the vertical illumination tube, and then tighten the set screw (hexagon M3 × 1) supplied with the polarization unit.
3. Mount the vertical illumination tube to the main body, and then tighten the vertical illumination tube set screws.



Mounting the analyzer unit

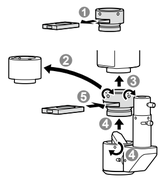
For VMU-LB/L4B

1. Rotate the covering until the slot (A) appears.
2. Insert the analyzer unit into the slot.



For VMU-L/L4

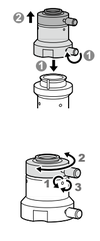
1. Remove the polarization plate from the analyzer unit.
2. Remove the intermediate optical tube by following the procedure ❶ in "4.1 Revolver".
3. Insert the analyzer unit into the main body, and then tighten the analyzer set screws (hexagon M4 × 3).
4. Mount the illumination optical tube to the analyzer unit, and then tighten the illumination optical tube set screws.
5. Insert the polarization plate into the analyzer unit.



4.4 Constant-Magnification Camera Mount

If the laser unit has been mounted, remove the laser unit before mounting the constant-magnification camera mount.

1. Mount the constant-magnification camera mount with the C-mount attached to the laser port of the main body, and then tighten the laser port set screws.
2. Remove the C-mount from the constant-magnification camera mount, and then screw in the camera.
3. Mount the C-mount with the camera to the constant-magnification camera mount.
4. Adjust the focus of the observation image.
   1. Loosen the focus adjusting screws (hexagon M3 × 3).
   2. Move the C-mount up and down by rotating it to adjust the focus.
   3. Tighten the focus adjusting screws.
5. Adjust the inclination of the observation image.
   1. Loosen the C-mount fixing screws.
   2. Rotate the camera together with the C-mount to adjust the inclination.
   3. Tighten the C-mount fixing screws.



5 Maintenance/Inspections

5.1 Daily Maintenance

Dust and dirt are particularly harmful to the product. It should be cleaned daily and stored carefully.

Cleaning optical parts

When cleaning optical parts such as lenses and filters, clean those parts carefully using the following methods.

- Dust: Remove dust on the lenses with a lens brush or soft brush, or lightly wipe it off with gauze.
- Fingerprints and oily substances: Wipe off fingerprints and oil with lens paper or gauze soaked in a small amount of alcohol.

Cleaning metal parts

Gently wipe away dust or other contaminants with a silicon cloth.

NOTICE Do not use agents, solvents, or metal polish when cleaning, as they may result in surface discoloration or paint peeling.

Storing when not in use

Store this product in areas with minimal humidity that are free from mold. Store optical parts in a case such as the objective in particular.

5.2 Regular Inspections

Regular inspections by a professional technician are recommended to maintain the performance of this product over the long term.
Please contact the dealer where you purchased this product or the nearest Mitutoyo sales office.

6 Troubleshooting

If trouble occurs while this product is in use, try the following troubleshooting methods. Please contact the dealer where you purchased this product or the nearest Mitutoyo sales office if you cannot resolve the problem.

Issue	Check point	Remedy
There is a obstruction or dark portion in the view field.	Is the aperture diaphragm closed too tightly?	Adjust the aperture diaphragm.
	Is the lens or specimen contaminated?	Wipe the dirty area clean.
The image quality, such as the contrast or resolution, is poor.	Is the lens or specimen contaminated?	Wipe the dirty area clean.
	Is the brightness of the illumination sufficient?	Increase the illumination brightness.
	Is the aperture diaphragm closed too tightly?	Adjust the aperture diaphragm.
	Is the specimen observed through another medium other than air (such as cover glass)?	Prepare the dedicated objective. Remove parts such as the cover glass.
The image is out of focus or the image sways.	Is the specimen tilted?	Fix the inclination of the specimen.
	Is the objective screwed all the way in?	Screw in the objective firmly.

7 Specification

7.1 Basic Specifications

Model			VMU-L	VMU-L4	VMU-LB	VMU-L4B
Code No.			378-507	378-508	378-513	378-514
Direction to mount camera			Vertical direction		Vertical direction (rotatable)	
Observation image			Bright-field, erect image			
Camera port						
	Optical system	Magnification	1x			
		Wavelength	Visible ray			
	Mounting		C-mount (The parfocal adjustment and the centering adjustment are performed independently.)			
Laser port						
	Optical system	Magnification	1x	1x	1x	1x
		Wavelength (nm)	1064/532/355	532/266	1064/532/355	1064/532/355/266
	Mounting		Supports installation of YAG laser unit (fundamental wave, 2nd/3rd harmonic wave)	Supports installation of YAG laser unit (2nd/4th harmonic wave)	Supports installation of YAG laser unit (fundamental wave, 2nd/3rd harmonic wave)	Supports installation of YAG laser unit (fundamental wave, 2nd/3rd/4th harmonic wave)
Applicable objective (option)						
	For observation		M/G Plan Apo series			
	For laser machining*1		M/LCD Plan Apo NIR/NUV series	M/LCD Plan Apo NIR series M Plan UV series	M/LCD Plan Apo NIR/NUV series	M/LCD Plan Apo NIR/NUV series M Plan UV series
Applicable camera			CCD camera 2/3-type or less (C-mount specifications)			
Vertical illumination optical system			Telecentric illumination with aperture diaphragm			
Main unit mass			1020 g	1050 g	1270 g	1300 g

*1 Select a wavelength to use in the laser unit.

7.2 Upper Limit Value of Input Laser and Upper Limit of Beam Diameter

Model	VMU-L			VMU-L4		VMU-LB			VMU-L4B			
Wavelength of laser to be used (nm)	1064	532	355	532	266	1064	532	355	1064	532	355	266
Input upper limit value of laser (J/cm²)	0.095	0.075	0.025	0.080	0.015	0.099	0.075	0.025	0.110	0.080	0.035	0.015
Pulse width (ns)	10 or more			10 or more		10 or more			10 or more			
Transmittance (%)	63	39	69	37	75	60	39	69	54	36	48	72

NOTICE

- The transmittance is included as reference for the design values without polarized light. The laser that enters the optical system should be collimated.
- If the pulse width of the laser becomes shorter, the input upper limit value of the laser is the square root for the ratio of the pulse width.
  Example: When the pulse width is 2.5 ns, the input upper limit value of the laser for 1064 nm in VMU-LB is 0.050 (J/cm²).

	NIR/NUV 20x	UV 20x	NIR/NUV/UV 50x	UV 80x	NIR/NUV 100x
Upper limit of the beam diameter [TEM00] (Mask size) (mm)	ø10 (□7)	ø9.1 (□6.5)	ø4.3 (□3)	ø3.5 (□2.5)	ø2.8 (□2)

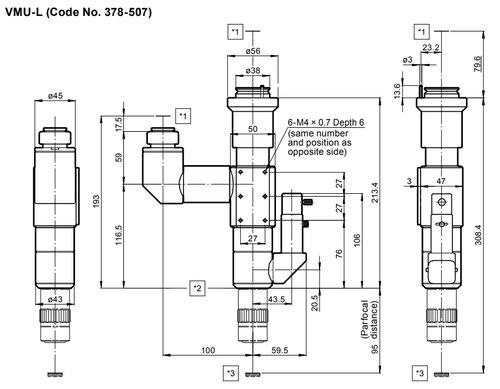
NOTICE Laser machining that exceeds the mask sizes in the table above cannot be performed.

7.3 Common Options

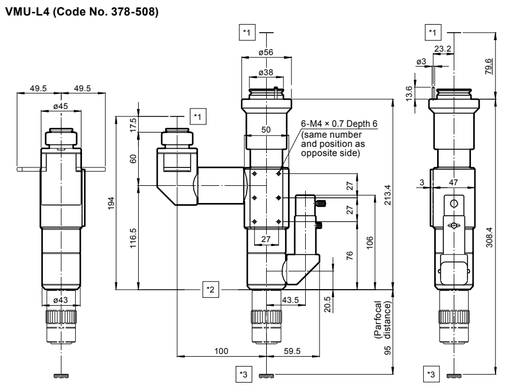
Part name	Code No.	Remark
Fiber optics cable illumination unit	378-700	-
Digital camera: ImageX PRO 3000	00AAB008	-
Constant-magnification camera mount	378-087	-
Focusing unit (A)	378-705	-
Focusing unit (B)	378-706	-
Simple stand	378-730	-
X-Y stage	378-020	-
Manual revolver (BF)	378-707	-
Manual revolver (with centering and parfocal)	378-717	-
Motorized revolver (BF, 5-holes)	378-713	-
Polarization unit	378-710	VMU-L/L4 only
Polarization unit (B)	378-715	VMU-LB/L4B only
Objective: M/G Plan Apo series	-	-
Objective: M/LCD Plan Apo NIR series	-	-
Objective: M/LCD Plan Apo NUV series	-	VMU-L/LB/L4B only
Objective: M Plan UV series	-	VMU-L4/L4B only

7.4 Dimensions of Each Part

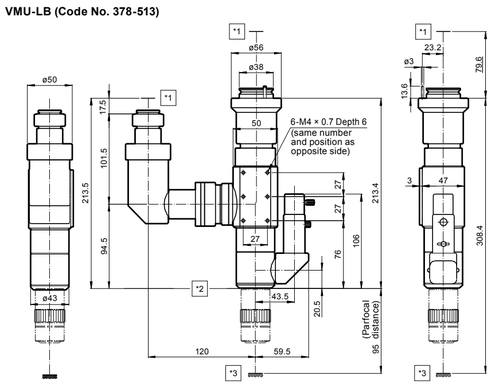
VMU-L (Code No. 378-507)



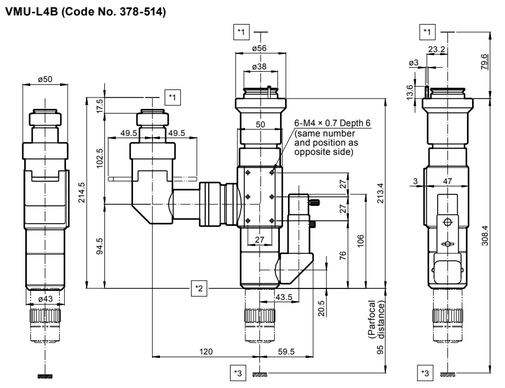
VMU-L4 (Code No. 378-508)



VMU-LB (Code No. 378-513)



VMU-L4B (Code No. 378-514)



*1 Image position *2 Objective mounting surface *3 Workpiece surface

Mitutoyo Corporation 20-1, Sakado 1-Chome, Takatsu-ku, Kawasaki-shi, Kanagawa 213-8533, Japan

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