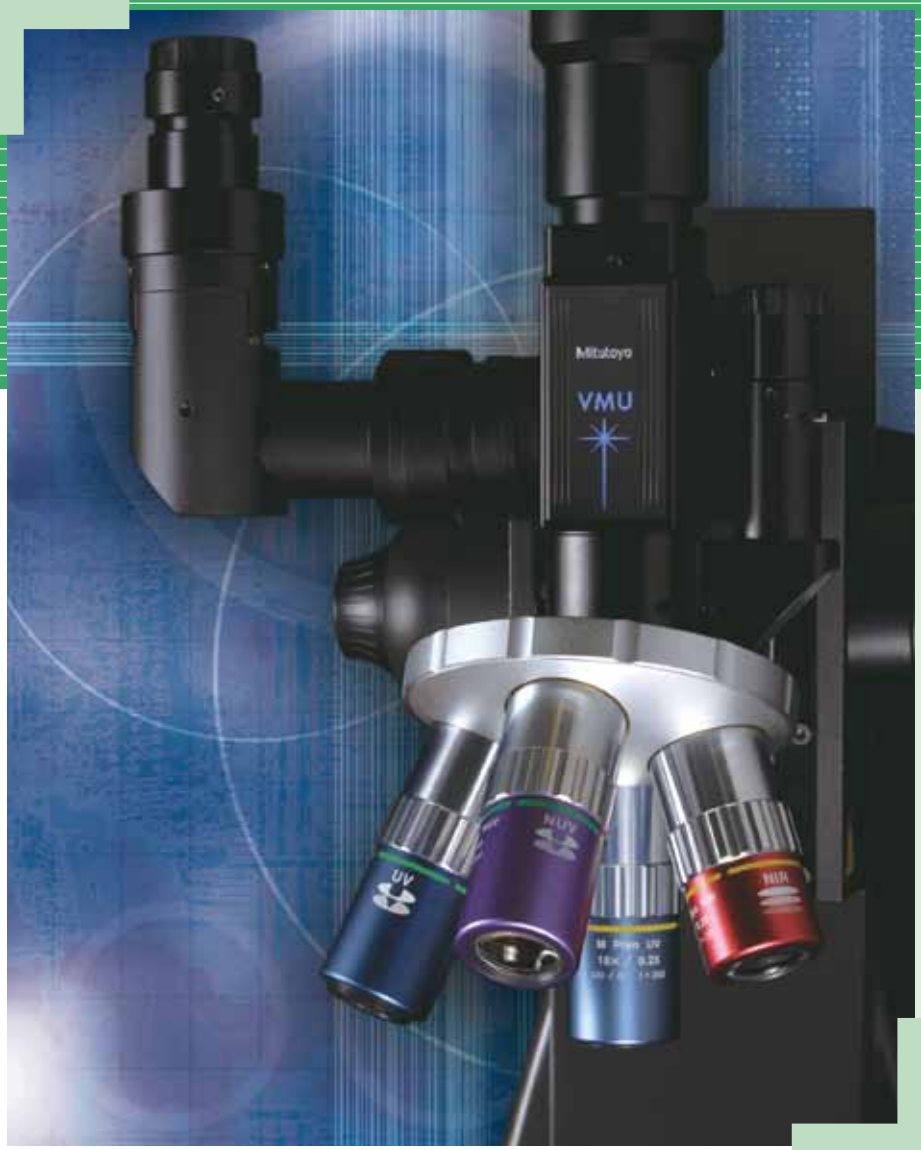
MICROSCOPE UNITS AND OBJECTIVE LENSES

PRE1299(2)



Microscope viewing units and objective lenses for UV, NUV, VISIBLE & NIR REGION

Mitutoyo

Many of today's ultra-microscopic manufacturing technologies require sub-micron accuracy. Mitutoyo produces microscope systems with advanced features that combine optical and precision measurement technologies developed by us over a long period of time. Mitutoyo microscopes can be integrated into manufacturing systems, research and development equipment, and product inspection lines. Contact your nearest Mitutoyo Sales Office for further details on standard product specifications as well as custom-designed microscopes to best fit your application.

Ref.: "Microbio-World Ver.7,
(http://elfe.miyakyo-u.ac.jp/opac/2008/03/cd_2.html)


Callisto
VMU

A wealth of Applications

System with digital camera

Digital microscopic system using VMU-V

By installing a digital camera on a microscope the VMU provides a simple and compact system which allows microphotography and simultaneous external monitor observations. The VMU can be used in vertical and inverted positions according to your application requirements.

> Microphotography and observation of metallic, resinous and printed surfaces
> Micro-fluid analysis
> Cell and microorganism observation/analysis

Dual-camera systems featuring high and low magnification and differential interference observation are also available.

Systems for laser applications

UV laser application using VMU-L4B

Flaking of polyimide membrane

SEM photograph of IC surface after removing upper layer

UV laser application using FS70L4

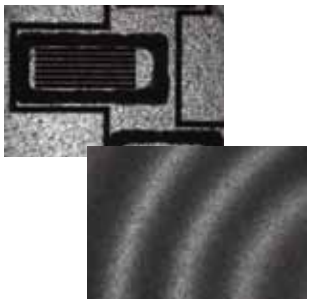
Color filter working

Microscope unit and objectives compatible with YAG lasers (1064nm, 532nm, 355nm and 266nm) allow high precision and quality working.

> Peeling off protective films and organic thin-films
> Cutting of IC wiring (Au, Al) and exposure of lower layer pattern
> FPD defects repair
> Photomask repair
> Marking, trimming, patterning, spot annealing and scribing

Ref: V Technology Co., Ltd.

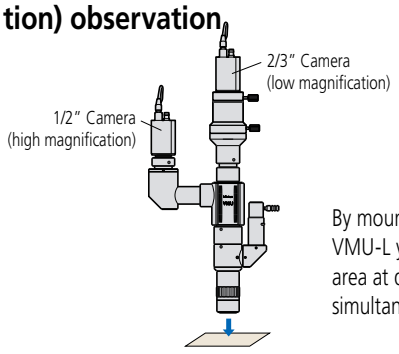
System for IR analysis/inspection



Optical systems using Mitutoyo M Plan Apo NIR objectives that cover a wide range of wavelength from visible to infrared are providing solutions on the production line and in the laboratory. Nondestructive inspection is made possible by using an infrared source.

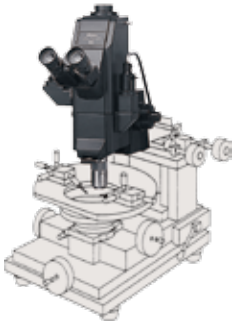
> Micro-fluid analysis
> Thickness measurement of LCD thin film and silicon board film
> Internal inspection/analysis and 3D evaluation of MEMS devices
> Internal observation of IC packages, void inspection/evaluation of wafer junctions, spectral characteristics analysis using infrared
> Femtosecond laser applications

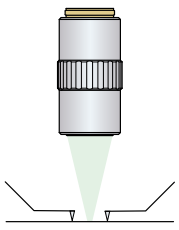
System for dual-camera (high & low magnification) observation



By mounting two cameras on VMU-L you can observe the same area at different magnifications simultaneously.

System for analysis





Probe (positioner tip)

The Mitutoyo M Plan Apo objectives provide a long working distance. This allows you to design an optical system for defects evaluation of semiconductor integrated circuits and precise repair with YAG lasers. The optical system for direct observation is also available.

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Contents

Video Microscope Unit
VMU


VMU-V


VMU-H


VMU-LB


VMU-L4B

*Objectives shown mounted on tubes are optional.

Features

> Small, lightweight microscope unit designed for a camera observation system
Suitable for observing a wide range of objects: metal, resin, printed surfaces, minute mechanisms, etc.

> Compatible with YAG lasers (1064 nm, 532 nm, 355 nm and 266 nm)
Suitable for cutting, trimming, repair and marking of IC wiring (Au, Al), removing and processing thin film (insulating film) and repair of color filters (defects repair).

> Compatible with infrared optical system
Available for internal observation of IC packages and spectral characteristics analysis using an infrared source and camera.

> Standard of telecentric reflective illumination system with aperture diaphragm
This is the best illumination system for image processing applications (e.g. dimension measurement, form inspection and positioning) which require even lighting.

> Extending the VMU series with high rigidity/performance VMU-LB and VMU-L4B models.

> Available for dual-camera (high & low magnification) observation (VMU-L, VLU-L4, VMU-LB and VMU-L4B).

Specifications

Model No.			VMU-V	VMU-H	VMU-L	VMU-L4	VMU-LB	VMU-L4B
Order No.			378-505	378-506	378-507	378-508	378-513	378-514
Camera mounting orientation			Vertical	Horizontal	Vertical		Vertical (rotatable)	Vertical (rotatable)
Observation			BF, erect image	BF, inverted image	BF, erect image			
Optical tube	Camera port	Optical features	Magnification: 1X; Wavelength (λ): visible radiation					
		Mount	C-mount (centering and parfocal adjustment)		C-mount with centering and parfocal adjustment	C-mount with centering and parfocal adjustment and green filter switch	C-mount with centering and parfocal adjustment	C-mount with centering and parfocal adjustment and green filter switch
	Tube lens (correction range)		1X (visible - NIR)		1X (NUV - visible - NIR)	1X (UV - visible)	1X (NUV - visible - NIR)	1X (UV - NUV - visible - NIR)
	Laser port	Optical features	—		λ: 355/532/1064 nm	λ: 266 /532 nm	λ: 355/532/1064 nm	λ: 266/355/532/1064 nm
		Mount	—		With parfocal adjustment			
		Suitable YAG laser type*2	—		Fundamental, second and third-harmonic mode	Second and fourth - harmonic mode	Fundamental, second and third-harmonic mode	Fundamental, second, third and fourth-harmonic mode
	Polarizer*1		Available for observation				Available for observation and laser applications	
Suitable objective (optional)	For observation		M Plan Apo/HR/SL, G Plan Apo					
	For laser cutting		—		M/LCD Plan Apo NIR, M/LCD Plan Apo NUV	M Plan UV	M/LCD Plan Apo NIR, M/LCD Plan Apo NUV	M/LCD Plan Apo NIR, M/LCD Plan Apo NUV, M Plan UV
Suitable camera			2/3" or smaller C-mount compatible type					
Optical system illumination			Telecentric reflective with aperture diaphragm					
Fiber-optic illuminator (optional)			12V/100W (**378-700D**), 12V/150W (**178-316D**)					
Mass (Dimensions: Refer to page 27.)			650 g	750 g	980 g	1010 g	1270 g	1300 g

*1: M Plan Apo 1X objective should be used together with the polarizer (**378-710** or **378-715**).
*2: When mounting a laser, ensure all safety precautions are observed and be aware of laser output power, beam energy density and the unit's weight. Please consult Mitutoyo if in doubt.

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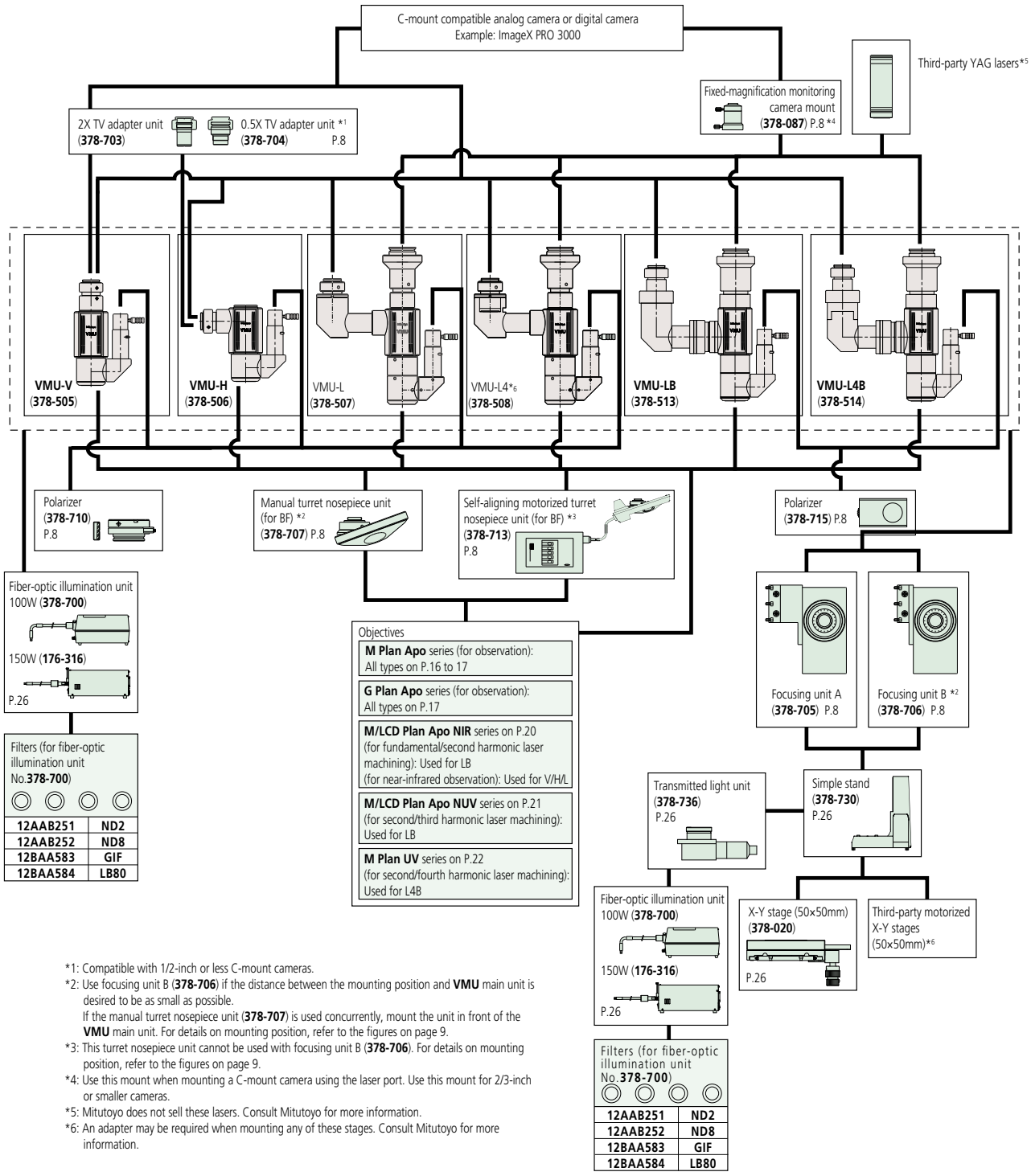
System diagram



*1: Compatible with 1/2-inch or less C-mount cameras.
*2: Use focusing unit B (**378-706**) if the distance between the mounting position and **VMU** main unit is desired to be as small as possible.
If the manual turret nosepiece unit (**378-707**) is used concurrently, mount the unit in front of the **VMU** main unit. For details on mounting position, refer to the figures on page 9.
*3: This turret nosepiece unit cannot be used with focusing unit B (**378-706**). For details on mounting position, refer to the figures on page 9.
*4: Use this mount when mounting a C-mount camera using the laser port. Use this mount for 2/3-inch or smaller cameras.
*5: Mitutoyo does not sell these lasers. Consult Mitutoyo for more information.
*6: An adapter may be required when mounting any of these stages. Consult Mitutoyo for more information.

Optional Accessories for VMU

Manual turret

Has 4 objective mounts and can be fixed in the desired position relative (inward, outward, etc.) to the mounting surface.

Order No.	**378-707**
Observation method	Bright field
No. of objective mounts	4
Mass	780 g

Installed on VMU-V with optional objectives

Focus unit A and B

Manual focus units for the VMU.
An optional stand (**378-730**) and XY stage (**378-020**) are provided to be used in combination.
A power focus unit is also available. Refer to page 12.

Focus unit A mounted on VMU-V with an optional objective

	Focus unit A	Focus unit B
Order No.	**378-705**	**378-706**
Travel range	50 mm	
Coarse/fine feed	Coarse: 3.8 mm/rev., Fine: 0.1 mm/rev.	
Loading capacity	Approx. 17.4 kg	Approx. 17.7 kg
Mass	2.9 kg	2.7 kg

TV adapter unit

C-mount adapters for changing to a higher or lower magnification.

2X TV adapter unit

0.5X TV adapter unit

	2X TV adapter unit	0.5X TV adapter unit
Order No.	**378-703**	**378-704**
Magnification	2X	0.5X
Suitable camera	2/3″ or smaller type	1/2″ or smaller type
Mass	25 g	25 g

Power turret

Has 5 objective mounts and can be fixed in the desired position relative (inward, outward, etc.) to the mounting surface.

Console box

Installed on VMU-V with optional objectives

Order No.	**378-713**
Observation method	Bright field
No. of objective mounts	5, with centering adjustment
View field adjustment	±0.5 mm
Positioning accuracy	2σ=3 µm
Durability (life-time)	1 million repositioning operations
Drive method	DC motor
Power supply	AC100V - 240V, 10W
Output interface	RS-232C* for external PC control
Cable length	3 m
Dimensions (WxHxD) and mass	Turret: 130 x 47 x 186 mm, 1.8 kg, Console box: 108 x 63 x 176 mm, 810 g

*Optional RS-232C Cable: **12AAA807**

Polarizer

Provides simplified polarized light observation. Also enhances contrast of low-magnification objectives.

378-710: For VMU-V and VMU-H
For VMU-L and VMU-L4
378-715: For VMU-LB and VUM-L4B

No.378-710

No.378-715

Installed on VMU-L4B

Order No.	**378-710**	VMU-V • VMU-H • VMU-L • VMU-L4
Order No.	**378-715**	VMU-LB • VMU-L4B

Camera mount

378-087 Mass: 180 g

Can be attached to the laser mount (VMU-LB and VMU-L4B) for dual-camera system. It is compatible with 2/3″ or smaller C-mount cameras.

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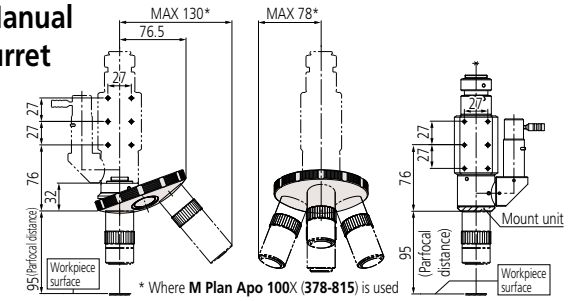
Dimensions of Optional Accessories for VMU Series

Manual turret

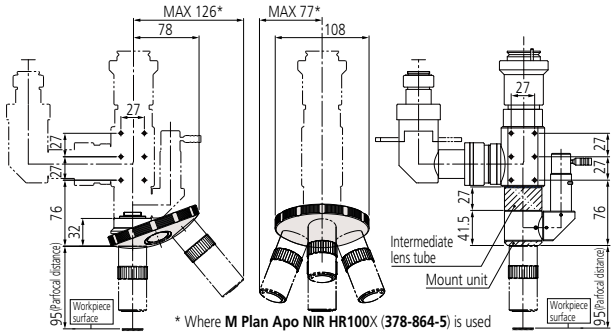


* Where **M Plan Apo 100**X (**378-815**) is used

When mounting the turret on **VMU-V** or **VMU-H**

Note 1: The lens mount must be removed from VMU.

Note 2: The turret can be fixed in the desired position relative (inward, outward, etc.) to the mounting surface. (VMU-H only)



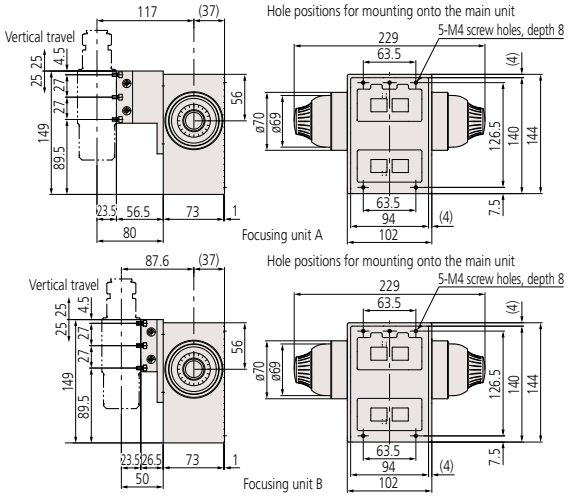
* Where **M Plan Apo NIR HR100**X (**378-864-5**) is used

When mounting the turret on **VMU-LB** or **VMU-L4B**

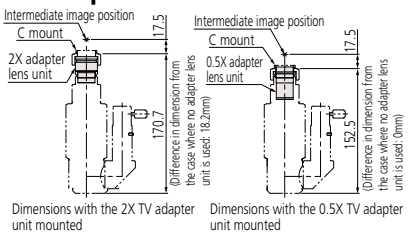
Note 1: The middle optical tube and lens mount must be removed from VMU.

Note 2: The turret can be fixed at 45° intervals around the optical axis.

Focus unit A and B



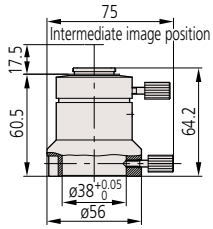
TV adapter unit



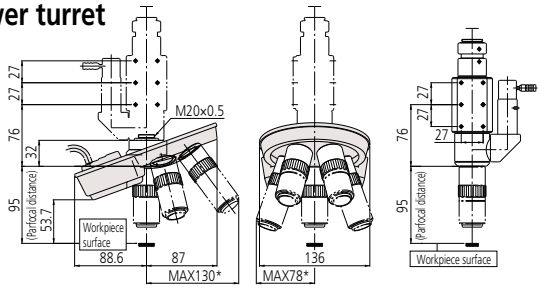
Dimensions with the 2X TV adapter unit mounted

Dimensions with the 0.5X TV adapter unit mounted

Camera mount



Power turret

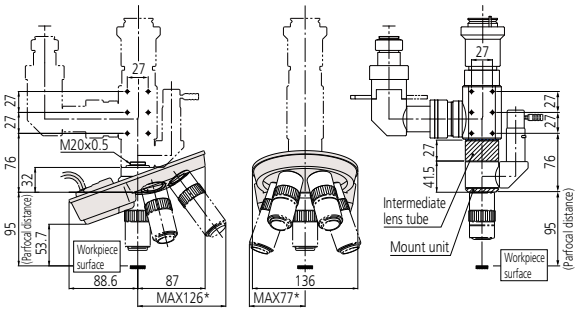


* Where **M Plan Apo 100**X (**378-815**) is used

When mounting the turret on **VMU-V** or **VMU-H**

Note 1: The lens mount must be removed from VMU.

Note 2: The turret can be fixed in the desired position relative (inward, outward, etc.) to the mounting surface. (VMU-H only)



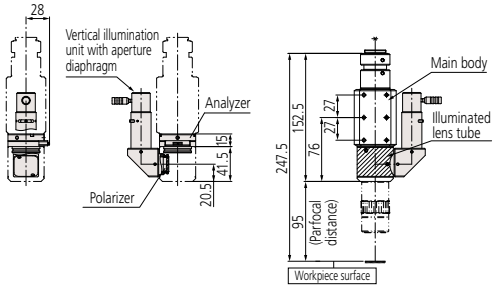
* Where **M Plan Apo NIR HR100**X (**378-864-5**) is used

When mounting the turret on **VMU-LB** or **VMU-L4B**

Note 1: The middle optical tube and lens mount must be removed from VMU.

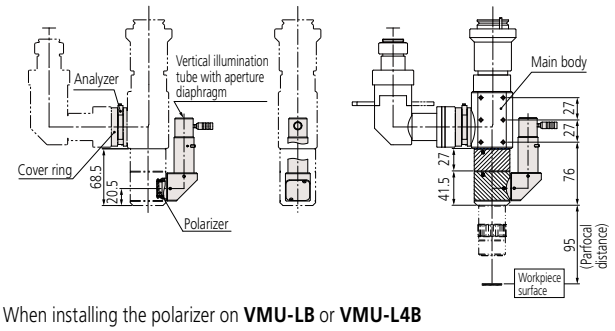
Note 2: The turret can be fixed in the desired position relative to the optical axis.

Polarizer and Analyzer



Installing the polarizer and analyzer on **VMU-V** or **VMU-H and VMU-L/VMU-L4**

Note: The analyzer is installed by opening the main body mirror head. The polarizer is installed by removing the illumination tube.



When installing the polarizer on **VMU-LB** or **VMU-L4B**

Note: The analyzer is installed by loosening the cover ring. The polarizer is installed by removing the illumination tube.

Microscope Unit
FS70 Series

FS70Z

FS70L

FS70L4

*Objectives and eyepieces shown mounted are optional.

Features

> Compact microscope unit with trinocular eyepiece tube
Suitable for observation of many different types of object: metal surfaces, semiconductors, LCDs, resins, etc.

> Compatible with YAG lasers (1064 nm, 532 nm, 355 nm and 266 nm)
Suitable for cutting, trimming, repair and marking of IC wiring (Au, Al), removing and processing thin films (insulating film) and repair of color filters (defects repair). Also ideal as the microscope unit of a prober station for semiconductor substrates.

> Compatible with infrared optical systems
Available for inner observation of silicon package and spectral characteristics analysis by using infrared light source and camera.

> Available for various observations in bright field, dark field*, simplified polarized and differential interference contrast (DIC).
*Made-to-order

> Telecentric reflective illumination system with aperture diaphragm.

> High operability due to the inward turret design and long-working-distance objectives.

Specifications

Standard head type (w/short focus unit)		Model No.	**FS70Z (FS70Z-S) *1**	**FS70L (FS70L-S)**	**FS70L4 (FS70L4-S)**
		Order No.	**378-165-1 (-2)**	**378-166-1 (-2)**	**378-167-1 (-2)**
Tilting head type		Model No.	**FS70Z-TH *1**	**FS70L-TH**	**FS70L4-TH**
		Order No.	**378-165-3**	**378-166-3**	**378-167-3**
Observation			BF/simplified polarized/DIC, erect image	BF/simplified polarized, erect image	
Applicable eyepiece (optional)			10X (field number 24), 15X (field number 16), 20X (field number 12),		
Optical tube	Trinocular tube	Field number	24		
		Puiple distance	Siedentopf type, adjustment range: 51 to 76 mm		
		Tilt angle	0 to 20°, displacement of eye point: 114 mm (only for tilting head type)		
		Optical pass ratio	Eyepiece: Camera mount = 50%: 50% (fixed)	Eyepiece: Camera mount = 100%: 0% or 0%: 100% (switchable)	
		Camera mount	C-mount with parfocal adjustment (In combination with an optional adapter B)		C-mount with parfocal adjustment and green filter switch
		Protective filter	—	Laser cutting filter	
	Tube lens (correction range)		1- 2X zoom (visible)	1X (NUV - visible - NIR)	1X (UV - visible)
	Laser port	Optical features	—	Magnification: 1X λ: 355/532/1064 µm	Magnification: 1X λ: 226/532 µm
		Suitable YAG laser type*2	—	Fundamental, second and third-harmonic waves	Second and fourth-harmonic waves
Focus unit	Coarse/fine feed		Coaxial feeding knob (right and left), Coarse feed: 3.8 mm/rev., Fine feed: 0.1 mm/rev.		
	Travel range		50 mm		
Suitable turret (optional)			4-mount manual or 5-mount power turret	4-mount manual or 5-mount power turret	
Suitable objective (optional)		For observation*3	M Plan Apo/HR/SL, G Plan Apo		
		For laser cutting	—	M/LCD Plan Apo NIR, M/LCD Plan Apo NUV	M Plan UV
Optical system of illumination			Koehler reflective illumination with aperture diaphragm		
Fiber-optic illuminator (optional)			12V/100W (**378-700D**), 12V/150W (**178-316D**)		
Loading capacity of camera mount			Approx. 14kg (tilting head type: 13.2 kg)	Approx. 13 kg (tilting head type: 13.1 kg)	
Mass (Dimension: Refer to page 28.)			6.6 kg (tilting head type: 7.4 kg)	6.7 kg (tilting head type: 7.5 kg)	
Mass			6.6 kg (-**TH**: 7.4 kg)	6.7 kg (-**TH**: 7.5 kg)	

*1: A FS70ZD type providing bright field/dark field observation is a available on special request.
*2: When mounting a laser, ensure all safety precautions are observed and be aware of laser output power, beam energy density and the unit's weight. Please consult Mitutoyo if in doubt.
*3: M Plan Apo 1x objective should be used together with the polarizer (378-092 or 378-094).

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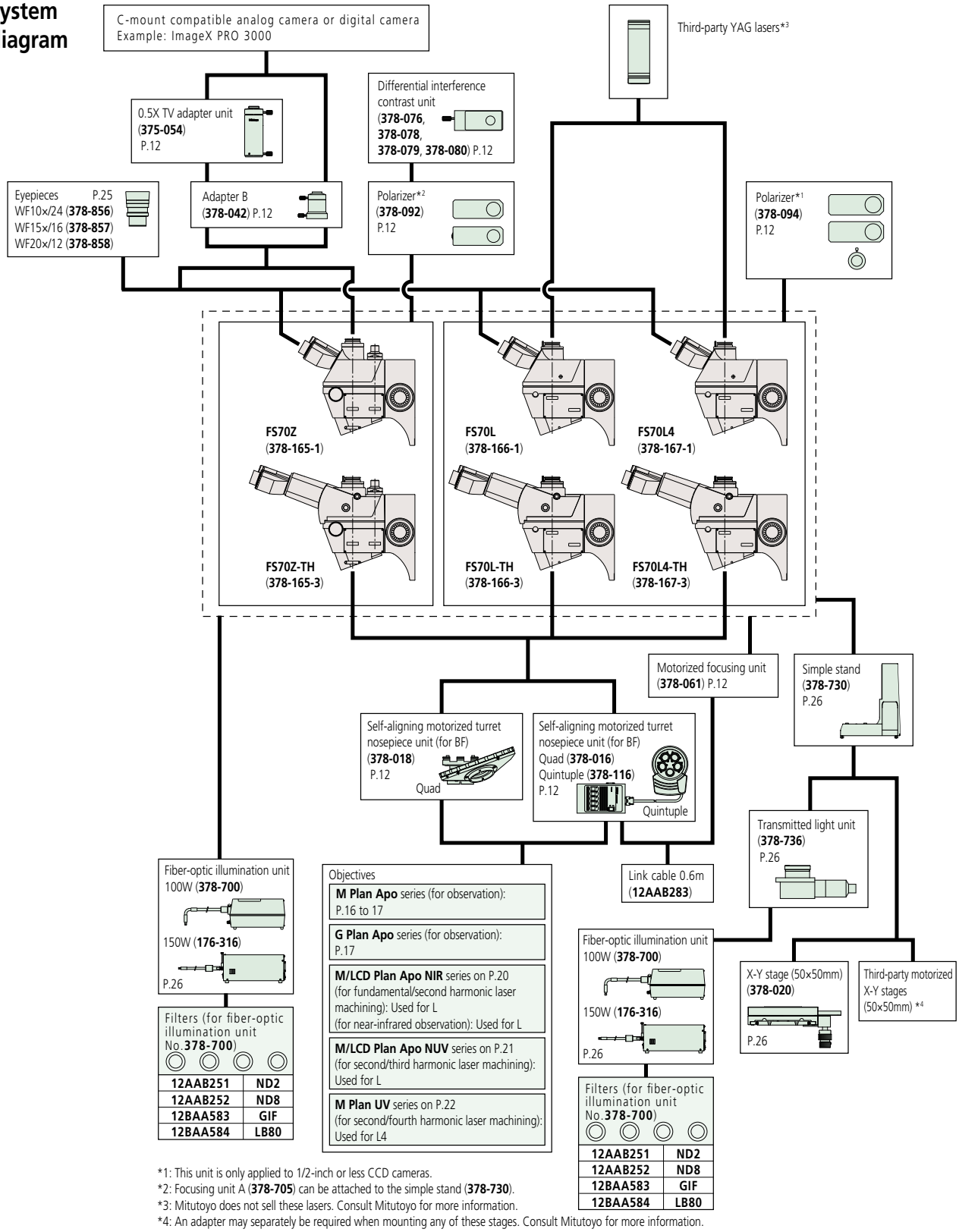
System diagram



*1: This unit is only applied to 1/2-inch or less CCD cameras.
*2: Focusing unit A (**378-705**) can be attached to the simple stand (**378-730**).
*3: Mitutoyo does not sell these lasers. Consult Mitutoyo for more information.
*4: An adapter may separately be required when mounting any of these stages. Consult Mitutoyo for more information.

Optional Accessories for FS70

Manual turret

Order No.	**378-018**
Observation method	Bright field
No. of objective mounts	4, with centering and parfocal adjustment (**378-018**)
View field adjustment	±0.5 mm
Parfocal adjustment	±0.5 mm
Mass	1.9 kg

Polarizer

For simplified polarized-light observation. Also suitable for enhancing contrast of low-magnification objectives.

For **FS70Z**
378-092

For **FS70L • FS70L4**
378-094

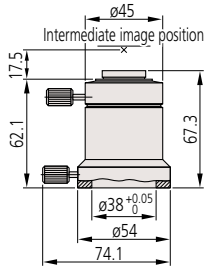
DIC unit

Used for differential interference contrast observation in conjunction with the polarizer.

Order No.	Magnification
378-076	100X, SL80X, SL50X
378-078	50X, SL20X
378-079	20X
378-080	10X, 5X

Adapter B

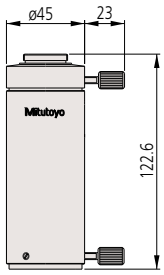
Used for mounting a C-mount camera.



378-042 Mass: 170g

0.5X TV adapter unit

Allows observation over a wide field of view on the monitor (2X wide) due to the 0.5X relay optics.
It is used in conjunction with the optional adapter B.



378-054
View field of image: ø 11 mm
Mass: 300 g

Power turret

378-016

Console box

Order No.	**378-116**	**378-016**
Observation method	Bright field	
No. of objective mounts	5, with centering adjustment	4
View field adjustment	±0.5 mm	
Positioning accuracy	2σ=3 µm	—
Durability (life-time)	1 million repositioning operations	—
Drive method	DC motor	
Power supply	AC100V - 240V, 10W	
Output interface	RS-232C* for external PC control	
Cable length	3 m	
Dimensions (WxHxD) and mass	Turret: 164 x 65 x 137 mm, 1.4 kg (**378-116**: 130 x 47 x 186 mm, 1.8 kg) Console box: 108 x 72 x 193 mm, 810 g (**378-116**: 108 x 63 x 176 mm, 810 g)	

*Optional RS-232C Cable: **12AAA807**

Power focusing unit

This unit is provided with a handy console box that is capable of external PC control. The power focus device is also retrofitable for the focus unit A/B for VMU series.

Power focus device mounted on FS70Z with optional objectives

Console box

Order No.	**378-061**
Minimum travel	0.2 µm
Feeding speed	1.6 mm/sec
Driving method	Stepping motor, jog-shuttle controls
Power supply	AC100V - 240V, 6W
Output interface	RS-232C* for external PC control
Cable length	3 m
Dimensions (WxHxD) and mass	Focus unit: ø 69 x L99 mm, 620 g Console box: 108 x 87 x 201 mm, 2.4 kg

*Optional RS-232C Cable: **12AAA807**

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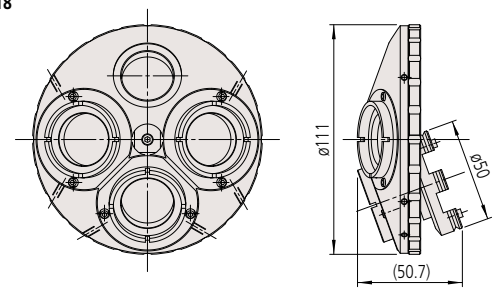
Dimensions of Optional Accessories for FS70

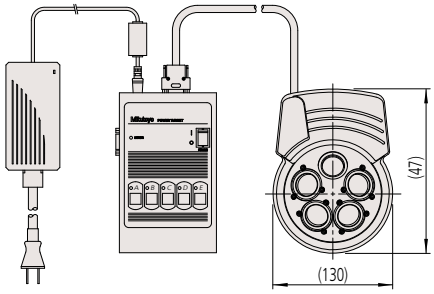
Manual turret

378-018



Power turret

378-116



Optional objective adapter: 378-026-1

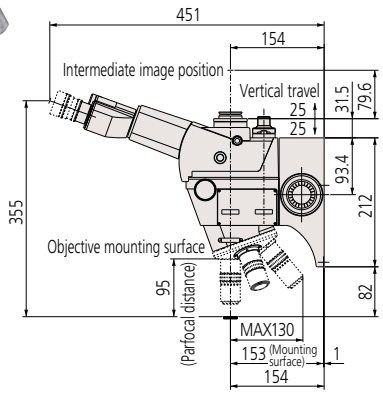
This objective adapter allows mounting the bright field objective on the bright/dark field turret (**176-211** and **176-210**) while maintaining the focus position (parfocal).
Suitable bright field objectives:
M Plan Apo/SL, G Plan Apo, M Plan Apo NIR, M Plan Apo NUV and M Plan UV

Focus point adjust shim set

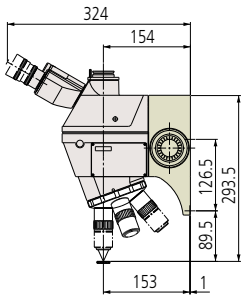
Order No.		
378-089	For bright field turret	The focus point adjust shim set includes 50 µm, 30 µm and 20 µm thickness SUS rings

Differences of FS70 models

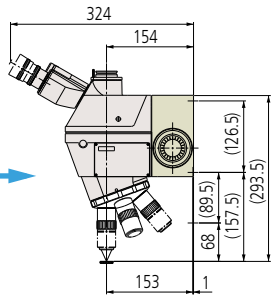
Tilting head type (Extension TH)



Short focus unit type (Extension S)



Standard focusing unit mounting dimensions



Manual focusing unit S mounting dimensions

Zoom Video Microscope Unit
VM-ZOOM

*Shown with optional stand and XY stage

Features

> Microscope unit with the high-zoom function
Capable of continuous zooming from 100X to 4000X on a monitor (15").

> Equipped with a unique sliding turret, to which an additional objective (optional) for laser applications, as well as the standard high-resolution objective (M Plan Apo HR 10X), can be attached.

> Compatible with YAG lasers (1064 nm, 532 nm, 355 nm and 266 nm)
Available for cutting, trimming, repair and marking of IC wiring (Au, Al), removing and processing thin film (insulating film) and repair of colour filter (defects repair). Also ideal as the microscope unit of a prober station for semiconductor substrates.

> Compatible with infrared system
Available for internal observation of silicon packages and spectral characteristics analysis using an infrared source and camera.

> Available for simplified polarized and differential interference contrast (DIC)*. *Made-to-order

> Telecentric reflective illumination system with aperture diaphragm.

Specifications

Without binocular unit type	Model No.	**VMZ40M**	**VMZ40M-L**	**VMZ40R**	**VMZ40R-L**	**VMZ40R-L4**
	Order No.	**378-171**	**378-173**	**378-175**	**378-177**	**378-181**
With binocular unit type	Model No.	**VMZ40M-B**	**VMZ40M-BL**	**VMZ40R-B**	**VMZ40R-BL**	**VMZ40R-BL4**
	Order No.	**378-172**	**378-174**	**378-176**	**378-178**	**378-182**
Radiation range		NUV - visible - NIR				UV - visible
Zoom type		Manual		Power drive		
Observation		BF, erect image	BF/DF/simplified polarized/DIC, erect image	BF/simplified polarized, erect image		
Main unit magnification		0.25X to 10X (zoom ratio: 40)				
Total magnification		100X to 4000X (when using standard 10X objective, 1/2" camera and 15" monitor)				
Observation range		1/2" camera: 2.56 x 1.92 mm to 0.064 x 0.048 mm, WF10X/24 eyepiece: ø 3.2 mm to ø 0.08 mm (when using standard 10X objective)				
Suitable eyepiece		10X (standard), 15X (optional), 20X (optional),				
Suitable objective	For observation	Standard: M Plan Apo HR 10X (NA: 0.42, WD: 15mm), Optional*[1]: M Plan Apo, G Plan Apo				
	For laser working (optional)	—	M/LCD Plan Apo NIR, M/LCD Plan Apo NUV	—	M/LCD Plan Apo NIR, M/LCD Plan Apo NUV	M Plan UV
Focusing unit	Coarse/fine feed	Coaxial feeding knob (right and left), Coarse feed: 3.8 mm/rev., Fine feed: 0.1 mm/rev.				
	Travel range	50 mm				
Turret		1-mount	2-mount with centering adjustment	1-mount	2-mount with centering adjustment	2-mount with centering adjustment
Optical system of illumination		Koehler reflective illumination with aperture diaphragm				
Fiber-optic illuminator (optional)		12V/100W (**378-700D**), 12V/150W (**178-316D**)				
Camera mount		C-mount with centering and parfocal adjustment and green filter switch:* *Only for VMZ40R-L4 and BL4				
Suitable camera		1/2" or smaller camera (C-mount compatible)				
Mass, *with binocular unit type (Dimension: Refer to page 29.)		6.5 kg/7.0 kg*	7.5 kg/8.0 kg*	7.0 kg/7.5 kg*	8.0 kg/8.5 kg*	7.5 kg (8.5 kg)

*[1]: Recommended magnification of objective: 2X to 50X

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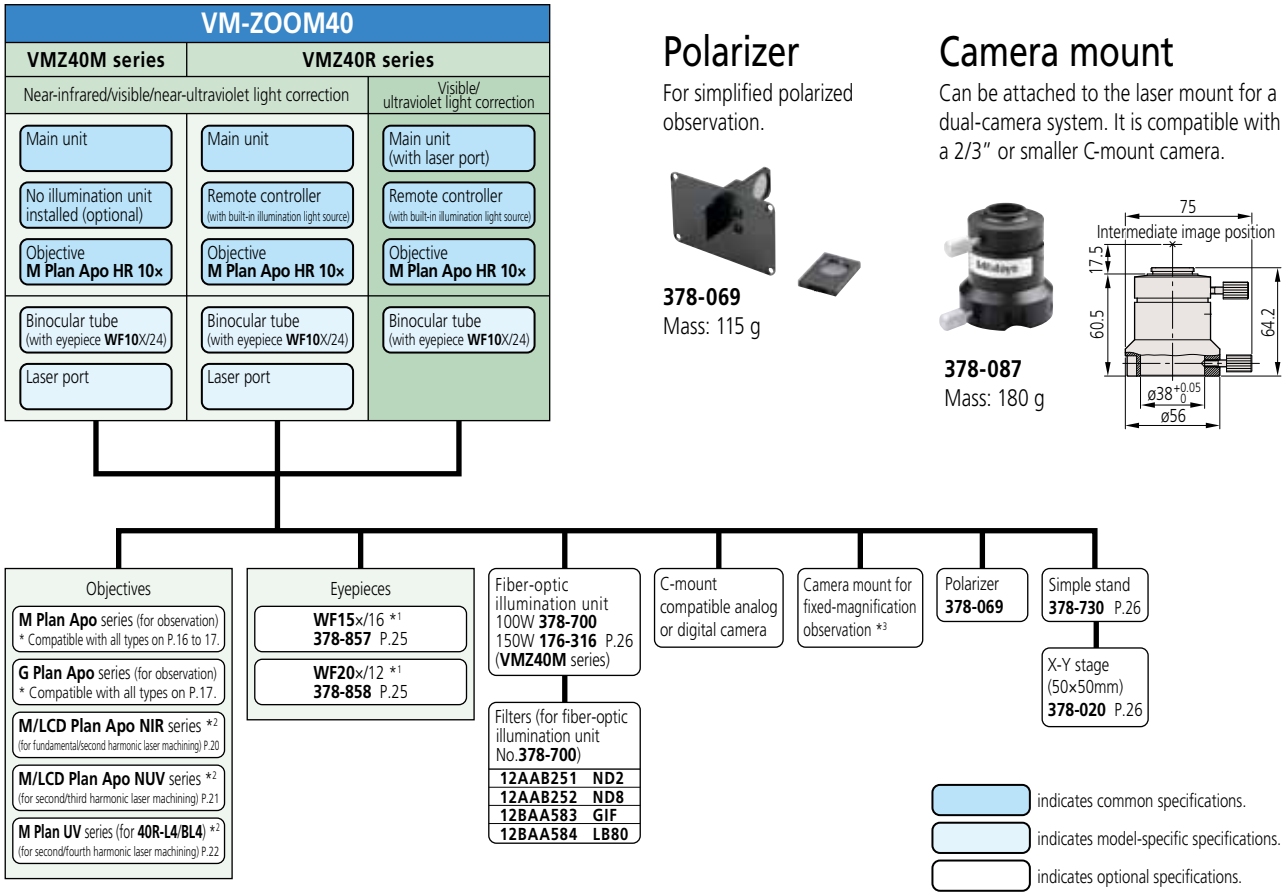
System diagram



Polarizer

For simplified polarized observation.

378-069
Mass: 115 g

Camera mount

Can be attached to the laser mount for a dual-camera system. It is compatible with a 2/3″ or smaller C-mount camera.

378-087
Mass: 180 g

*1: Compatible with models equipped with a binocular tube.
*2: Compatible with **VMZ40□-□L□** types (models equipped with a YAG laser). These types are recommended to use an objective with a magnification of 20X or 50X.
*3: The current position of a workpiece being observed with a camera on the zoom side can be checked by using a laser optical system (with a built-in 1X tube lens).
This camera mount is compatible with **VMZ40□-□L□** types (models equipped with a YAG laser oscillator). Use a 2/3-inch or less analog or digital camera (with a C mount).

Objectives for Bright Field Observation (long working distance)

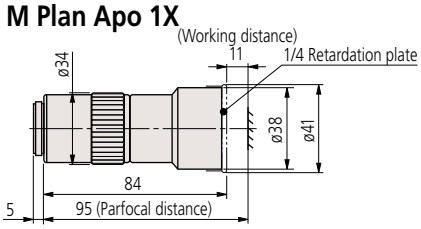
M Plan Apo / M Plan Apo HR

VMU FS70 MF-U Hyper MF-U FS300 VM-ZOOM

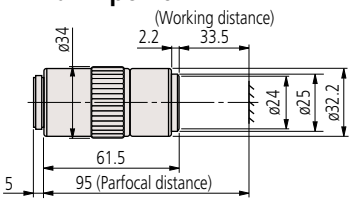
Features > Infinity corrected > Bright field observation
> Long working distance > Plan-Apochromat

Dimensions

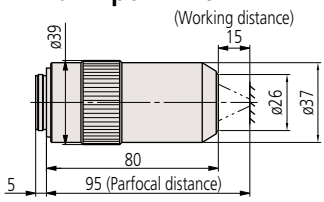
M Plan Apo 1X



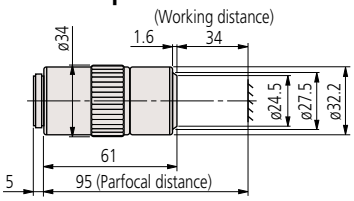
M Plan Apo 10X



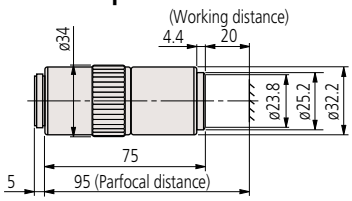
M Plan Apo HR 10X



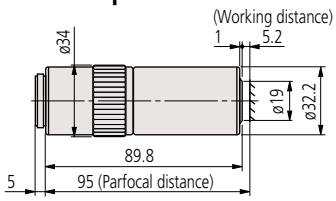
M Plan Apo 2X



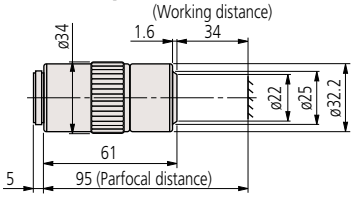
M Plan Apo 20X



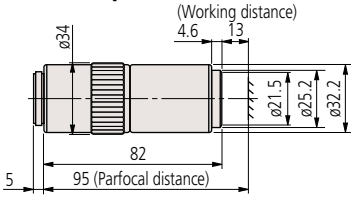
M Plan Apo HR 50X



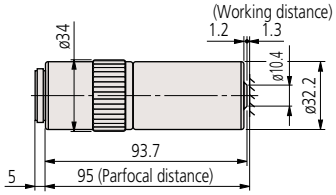
M Plan Apo 5X



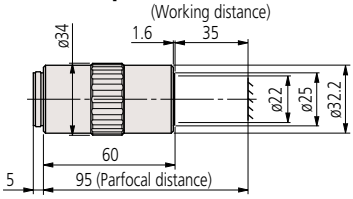
M Plan Apo 50X



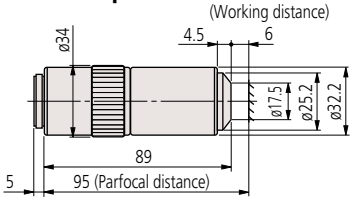
M Plan Apo HR 100X



M Plan Apo 7.5X



M Plan Apo 100X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2″ camera	
378-800-3*1	1X	0.025	11.0	200	11.0	440	ø 24	4.8 x 6.4	300
378-801-6*2	2X	0.055	34.0	100	5.0	91	ø 12	2.4 x 3.2	220
378-802-6	5X	0.14	34.0	40	2.0	14.0	ø 4.8	0.96 x 1.28	230
378-807-3	7.5X	0.21	34.0	26.67	1.3	6.2	ø 3.6	0.64 x 0.85	240
378-803-3	10X	0.28	34.0	20	1.0	3.5	ø 2.4	0.48 x 0.64	240
378-804-3	20X	0.42	20.0	10	0.7	1.6	ø 1.2	0.24 x 0.32	270
378-805-3	50X	0.55	13.0	4	0.5	0.9	ø 0.48	0.10 x 0.13	290
378-806-3	100X	0.70	6.0	2	0.4	0.6	ø 0.24	0.05 x 0.06	320
378-788-4*3	10X	0.42	15.0	20	0.7	1.60	ø 2.4	0.48 x 0.64	460
378-814-4	50X	0.75	5.2	4	0.4	0.49	ø 0.48	0.10 x 0.13	400
378-815-4	100X	0.90	1.3	2	0.3	0.34	ø 0.24	0.05 x 0.06	410

*1: It should be used together with an appropriate polarizer for the microscope used.
*2: It is recommended to be used together with the 1/4 wavelength plate A (02ALN370) and appropriate polarizer for the microscope used. (W.D.: 95.5mm, f: 30.0 mm)
*3: The specifications of this objective are as in the use with VM-ZOOM.
N.A.: Numerical aperture W.D.: Working distance f: Focal length R: Resolving power DOF: Depth of field FOV: Real field of view

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Objectives for Bright Field Observation (ultra-long working distance)

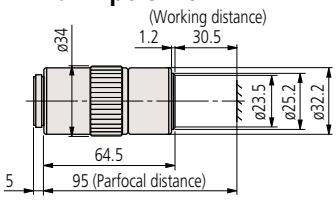
M Plan Apo SL

VMU FS70 MF-U Hyper MF-U FS300 VM-ZOOM

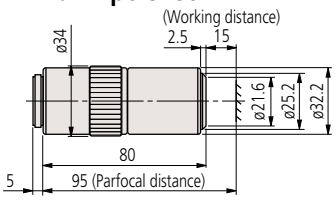
Features > Infinity corrected > Bright field observation > Ultra-long working distance > Plan Apochromat

Dimensions

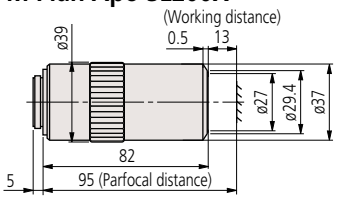
M Plan Apo SL20X



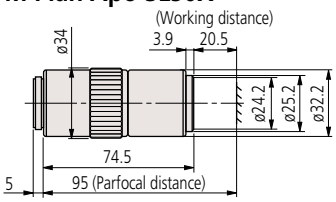
M Plan Apo SL80X



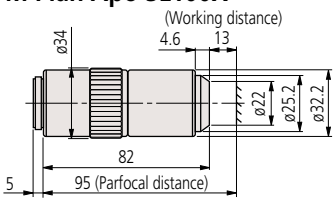
M Plan Apo SL200X



M Plan Apo SL50X



M Plan Apo SL100X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2″ camera	
378-810-3	20X	0.28	30.5	10	1.0	3.5	ø 1.2	0.24 x 0.32	240
378-811-3	50X	0.42	20.5	4	0.7	1.6	ø 0.48	0.10 x 0.13	280
378-812-3	80X	0.50	15.0	2.5	0.6	1.1	ø 0.3	0.06 x 0.08	280
378-813-3	100X	0.55	13.0	2	0.5	0.9	ø 0.24	0.05 x 0.06	290
378-816-3	200X	0.62	13.0	1	0.4	0.7	ø 0.12	0.025 x 0.03	490

Objectives for Bright Field Observation (with glass-thickness compensation)

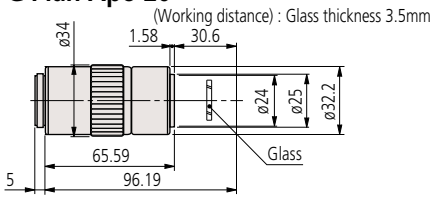
G Plan Apo

VMU FS70 MF-U Hyper MF-U FS300 VM-ZOOM

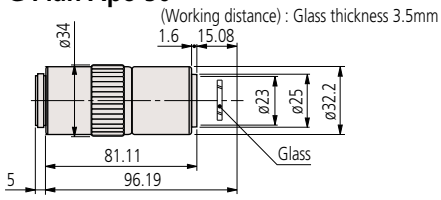
Features > Infinity corrected > Bright field observation > Ultra-long working distance > Plan Apochromat
> Designed to observe a specimen through glass 3.5 mm thick.

Dimensions

G Plan Apo 20X



G Plan Apo 50X



Specifications

Order No.	Mag./glass thickness (mm)	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2″ camera	
378-847	20X/t3.5	0.28	29.42	10	1.0	3.5	ø 1.2	0.24 x 0.32	270
378-848-3	50X/t3.5	0.50	13.89	4	0.6	1.1	ø 0.48	0.10 x 0.13	320

N.A.: Numerical aperture W.D.: Working distance f: Focal length R: Resolving power DOF: Depth of field FOV: Real field of view

Objectives for Bright/Dark Field Observation (long working distance)

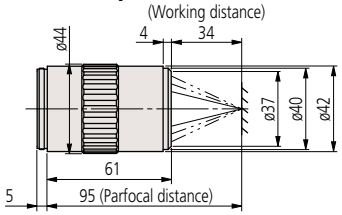
BD Plan Apo / BD Plan Apo HR

MF-U | Hyper MF-U | FS300 | (FS70)

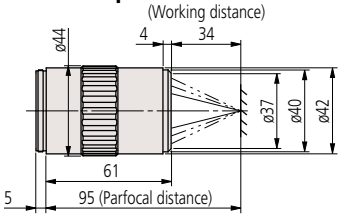
Features
> Infinity corrected
> Bright/dark field observation
Suited to the observation of scratches, concavity and convexity on a surface
> Long working distance
> Plan Apochromat

Dimensions

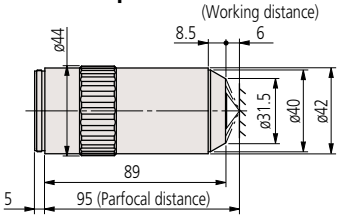
BD Plan Apo 2X



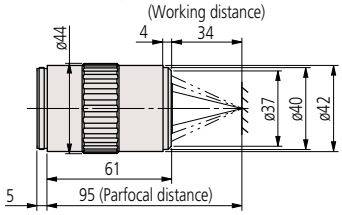
BD Plan Apo 10X



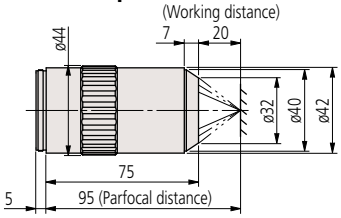
BD Plan Apo 100X



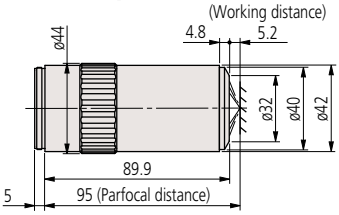
BD Plan Apo 5X



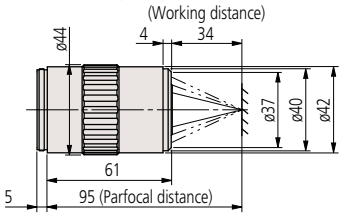
BD Plan Apo 20X



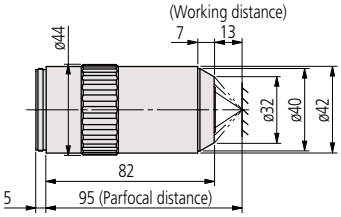
BD Plan Apo HR 50X



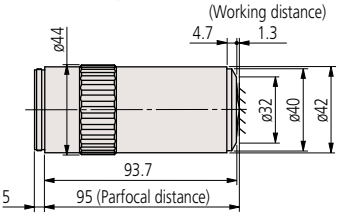
BD Plan Apo 7.5X



BD Plan Apo 50X



BD Plan Apo HR 100X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2″ camera	
378-831-7*1	2X	0.055	34.0	100	5.0	91	ø 12	2.4 x 3.2	340
378-832-7	5X	0.14	34.0	40	2.0	14.0	ø 4.8	0.96 x 1.28	350
378-830-7	7.5X	0.21	34.0	26.67	1.3	6.2	ø 3.6	0.64 x 0.85	350
378-833-7	10X	0.28	34.0	20	1.0	3.5	ø 2.4	0.48 x 0.64	350
378-834-7	20X	0.42	20.0	10	0.7	1.6	ø 1.2	0.24 x 0.32	400
378-835-7	50X	0.55	13.0	4	0.5	0.9	ø 0.48	0.10 x 0.13	440
378-836-7	100X	0.70	6.0	2	0.4	0.6	ø 0.24	0.05 x 0.06	460
378-845-7	50X	0.75	5.2	4	0.4	0.49	ø 0.48	0.10 x 0.13	530
378-846-7	100X	0.90	1.3	2	0.3	0.34	ø 0.24	0.05 x 0.06	545

*1: Recommended to be used together with the 1/4 wavelength plate A (02ALN380) and appropriate polarizer for the microscope used. (W.D.: 95.5 mm, f: 30.0 mm)
N.A.: Numerical aperture W.D.: Working distance f: Focal length R: Resolving power DOF: Depth of field FOV: Real field of view

Mitutoyo

Objectives for Bright/Dark Field Observation (ultra-long working distance)

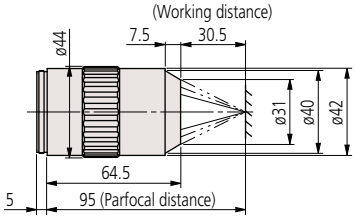
BD Plan Apo SL

MF-U | Hyper MF-U | FS300 | (FS70)

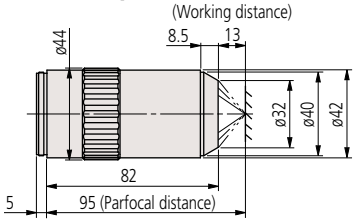
Features
> Infinity corrected
> Bright/dark field observation
Suited to the to observation of scratches, concavity and convexity on a surface
> Ultra-long working distance
> Plan-Apochromat

Dimensions

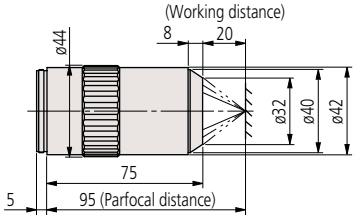
BD Plan Apo SL20X



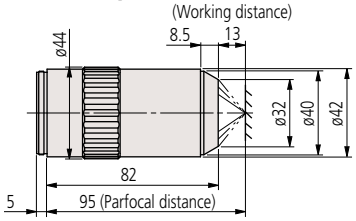
BD Plan Apo SL80X



BD Plan Apo SL50X



BD Plan Apo SL100X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (µm) (λ=550 nm)	±DOF (µm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2" camera	
378-840-7	20X	0.28	30.5	10	1.0	3.5	ø 1.2	0.24 x 0.32	350
378-841-7	50X	0.42	20.5	4	0.7	1.6	ø 0.48	0.10 x 0.13	410
378-842-7	80X	0.50	15.0	2.5	0.6	1.1	ø 0.3	0.06 x 0.08	430
378-843-7	100X	0.55	13.0	2	0.5	0.9	ø 0.24	0.05 x 0.06	440

Near-infrared Radiation Range Objectives for Bright Field Observation

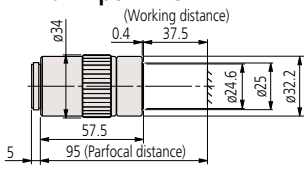
M Plan Apo NIR

VMU FS70 FS300 VM-ZOOM

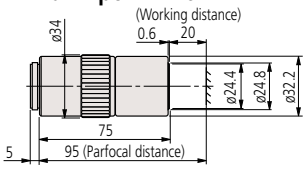
Features > Infinity corrected > Suitable for bright field observation and laser applications > Long working distance > Plan Apochromat
> Wavelength correction from visible to near-infrared (1800nm)
> Available high-power type (M Plan Apo NIR HR)

Dimensions

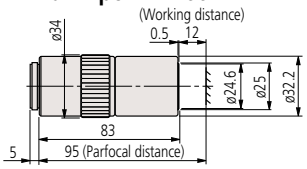
M Plan Apo NIR 5X



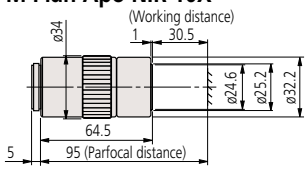
M Plan Apo NIR 20X



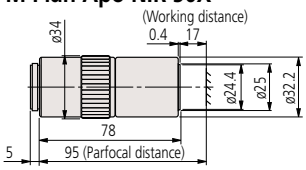
M Plan Apo NIR 100X



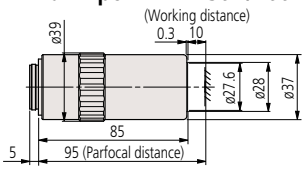
M Plan Apo NIR 10X



M Plan Apo NIR 50X



M Plan Apo NIR HR 50X/100X



Specifications

Note: If the wavelength used is 1100nm or longer, the focal point may deviate slightly from that in visible radiation.

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2″ camera	
378-822-5	5X	0.14	37.5	40	2.0	14.0	ø 4.8	0.96 x 1.28	220
378-823-5	10X	0.26	30.5	20	1.1	4.1	ø 2.4	0.48 x 0.64	250
378-824-5	20X	0.40	20.0	10	0.7	1.7	ø 1.2	0.24 x 0.32	300
378-825-5	50X	0.42	17.0	4	0.7	1.6	ø 0.48	0.10 x 0.13	315
378-826-5	100X	0.50	12.0	2	0.6	1.1	ø 0.24	0.05 x 0.06	335
378-863-5	50X	0.65	10.0	4	0.4	0.7	ø 0.48	0.10 x 0.13	450
378-864-5	100X	0.70	10.0	2	0.4	0.6	ø 0.24	0.05 x 0.06	450

Near-infrared radiation range objectives for bright field observation (with glass-thickness compensation)

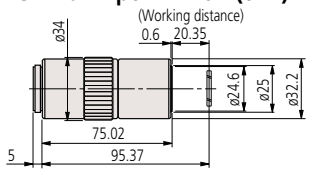
LCD Plan Apo NIR

VMU FS70 FS300 VM-ZOOM

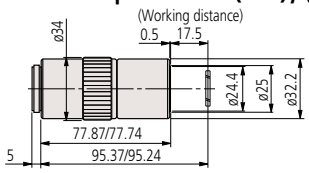
Features > Infinity corrected > Suitable for bright field observation and laser applications > Long working distance
> Plan Apochromat > Performance optimized for visible to near-infrared (1800 nm) wavelengths
> Designed to observe a specimen through glass 1.1 mm or 0.7 mm thick.

Dimensions

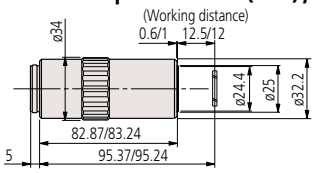
LCD Plan Apo NIR 20X (t1.1)



LCD Plan Apo NIR 50X (t1.1) / (t0.7)



LCD Plan Apo NIR 100X (t1.1) / (t0.7)



Specifications

Order No.	Mag./glass thickness (mm)	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2″ camera	
378-827-5	20X/t1.1	0.40	19.98	10	0.7	1.7	ø 1.2	0.24 x 0.32	305
378-829-5	50X/t0.7	0.42	17.26	3.9	0.7	1.6	ø 0.48	0.10 x 0.13	320
378-725-5*	100X/t1.1	0.50	12.13	2	0.6	1.1	ø 0.24	0.05 x 0.06	335
378-754-5	100X/t0.7	0.50	11.76	2	0.6	1.1	ø 0.24	0.05 x 0.06	335

*Made-to-order
N.A.: Numerical aperture W.D.: Working distance f: Focal length R: Resolving power DOF: Depth of field FOV: Real field of view

Mitutoyo

Near-ultraviolet Radiation Range Objectives for Bright Field Observation

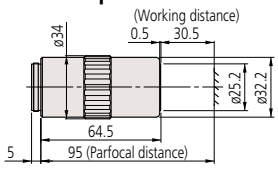
M Plan Apo NUV

VMU FS70 VM-ZOOM

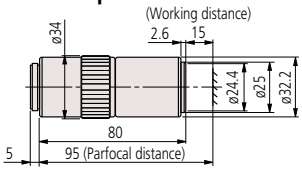
Features > Infinity corrected > Suitable for bright field observation and laser applications > Long working distance > Plan Apochromat
> Performance optimized for near-ultraviolet (355nm) to visible
> High-power type available (M Plan Apo NUV HR)

Dimensions

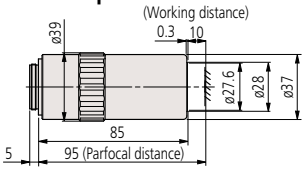
M Plan Apo NUV 10X



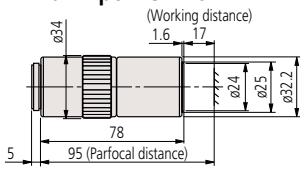
M Plan Apo NUV 50X



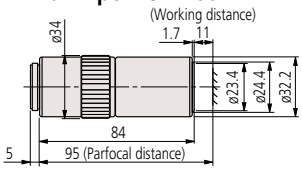
M Plan Apo NUV HR 50X



M Plan Apo NUV 20X



M Plan Apo NUV 100X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2" camera	
378-809-5	10X	0.28	30.5	20	1	3.5	ø 2.4	0.48 x 0.64	255
378-817-4	20X	0.40	17.0	10	0.7	1.7	ø 1.2	0.24 x 0.32	340
378-818-4	50X	0.42	15.0	4	0.7	1.6	ø 0.48	0.10 x 0.13	350
378-819-4	100X	0.50	11.0	2	0.6	1.1	ø 0.24	0.05 x 0.06	380
378-888-4	50X	0.65	10.0	4	0.42	0.65	ø 0.48	0.10 x 0.13	500

Near-ultraviolet radiation range objectives for bright field observation (with glass-thickness compensation)

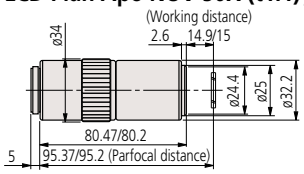
LCD Plan Apo NUV

VMU FS70 VM-ZOOM

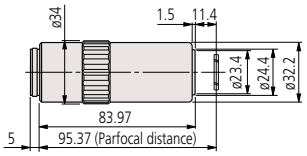
Features > Infinity corrected > Suitable for bright field observation and laser applications > Long working distance
> Plan Apochromat > Wavelength correction from near-ultraviolet (355nm) to visible
> Designed to observe a specimen through glass 1.1mm or 0.7mm thick.

Dimensions

LCD Plan Apo NUV 50X (t1.1) / (t0.7)



LCD Plan Apo NUV 100X (t1.1)



Specifications

Order No.	Mag./glass thickness (mm)	N.A.	W.D. (mm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
							ø 24 eyepiece	1/2" camera	
378-753-4*	50X/t1.1	0.42	14.53	4	0.7	1.6	ø 0.48	0.10 x 0.13	310
378-820-4	50X/t0.7	0.42	14.76	4	0.7	1.6	ø 0.48	0.10 x 0.13	310
378-751-4*	100X/t1.1	0.50	11.03	2	0.6	1.1	ø 0.24	0.05 x 0.06	380

*Made-to-order
N.A.: Numerical aperture W.D.: Working distance f: Focal length R: Resolving power DOF: Depth of field FOV: Real field of view

Ultraviolet Radiation Range Objectives for Bright Field Observation

M Plan UV

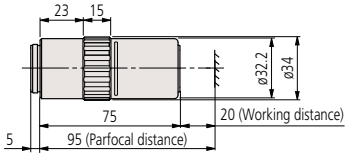
VMU FS70 VM-ZOOM

Features

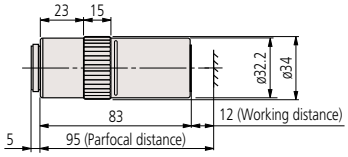
> Infinity corrected
> Suitable for bright field observation and laser applications
> Long working distance > Plan Apochromat
> Performance optimized for ultraviolet (266nm) and visible wavelengths
> High-transmittance in the ultraviolet range

Dimensions

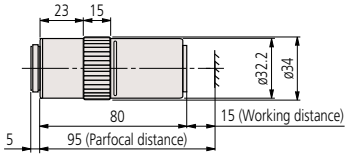
M Plan UV 10X



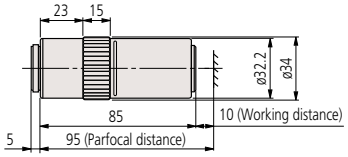
M Plan UV 50X



M Plan UV 20X



M Plan UV 80X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	f (mm) (λ=266 nm)	f (mm) (λ=550 nm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
								ø 24 eyepiece	1/2″ camera	
378-844-5	10X	0.25	20.0	20	20.3	1.1	4.4	ø 2.4	0.48 x 0.64	310
378-837-5	20X	0.36	15.0	10	10.4	0.8	2.1	ø 1.2	0.24 x 0.32	330
378-838-5	50X	0.40	12.0	4	4.5	0.7	1.7	ø 0.48	0.10 x 0.13	400
378-839-5	80X	0.55	10.0	2.5	2.9	0.5	0.9	ø 0.3	0.05 x 0.08	380

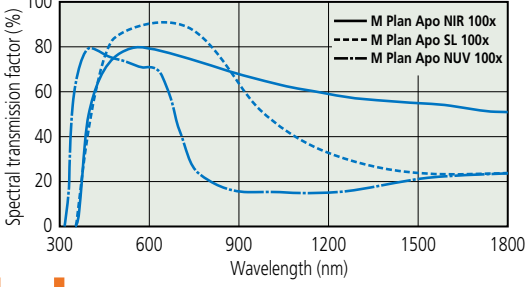
Note: When projecting a mask image on a specimen by using a YAG laser system mounted on a Mitutoyo microscope unit, the mask image will be scaled by the factor f/200 times (f=200mm, Mitutoyo tube lens). Since the focal length (f) in ultraviolet radiation (λ=266 nm) is slightly smaller than that in visible radiation (λ=550 nm) as above, the working area in ultraviolet radiation also becomes slightly smaller than the mask image in visible radiation.

Reference: Transmission of Mitutoyo Objectives

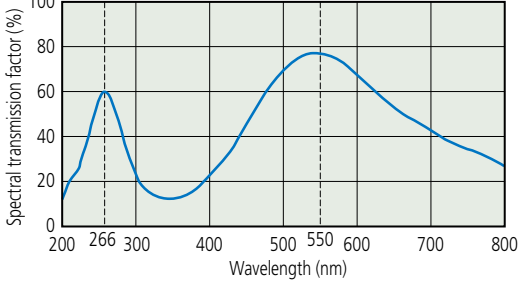
Mitutoyo's long working-distance objectives are grouped by working wavelength range: ultraviolet, near-ultraviolet, visible, and near-infrared. The M Plan UV series (for ultraviolet), M Plan Apo NUV series (for near-ultraviolet), and M Plan Apo NIR series (for near-infrared) are designed especially for YAG laser working applications in cutting thin films. Each series is designed for optimal spectral transmission factor within its respective wavelength range.

M (BD) Plan Apo series: Wavelength range 436 nm to 656 nm
M Plan Apo NIR series: Wavelength range 480 nm to 1800 nm
M Plan Apo NUV series: Wavelength range 355 nm to 620 nm
M Plan UV series: Optimized for wavelengths of 266 nm and 550 nm

Spectral transmission characteristics of 100X objective



Spectral transmission characteristics of M Plan UV 80X



Mitutoyo

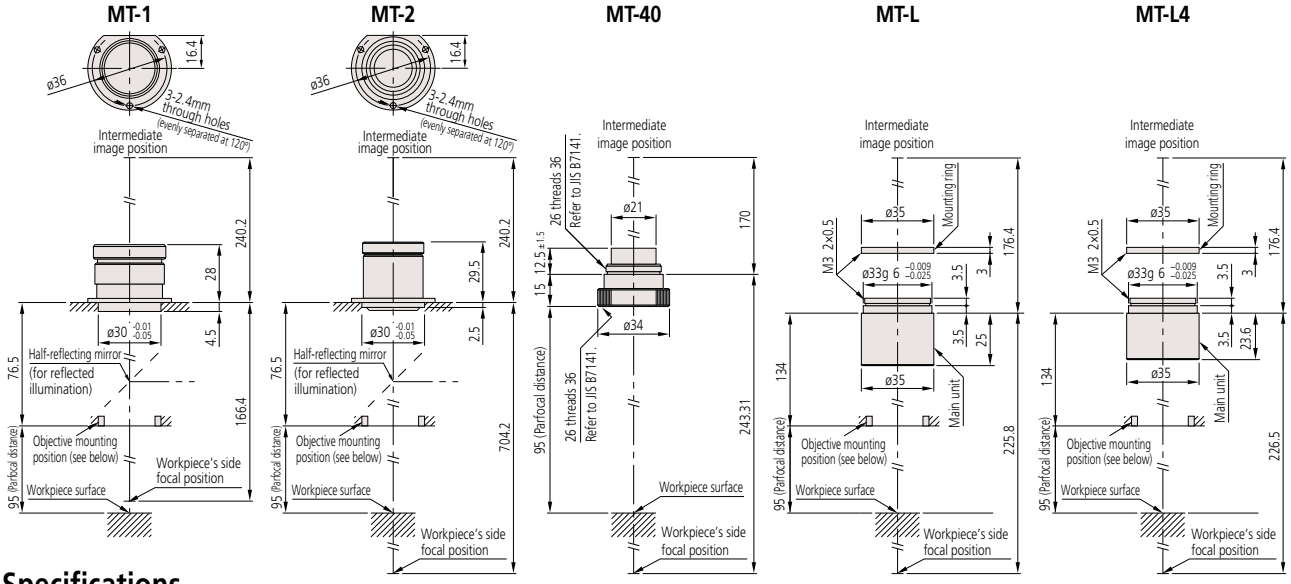
N.A.: Numerical aperture W.D.: Working distance f: Focal length R: Resolving power DOF: Depth of field
FOV: Real field of view

Tube Lens
MT

Aberration correction range

MT-1, **2**, **40**: Visible wavelength range (435.8 – 656.3 nm)
MT-L: Near-ultraviolet (355 nm) to near-infrared (1064 nm)
MT-L4: Ultraviolet (266 nm) to visible (620 nm).

Dimensions



Specifications

Order No.	Focal length (mm)	Magnification (tube lens)	Image field (mm)	Effective lens dia. (mm)	Dimensions (mm)	Mass (g)
970208	200	1X	ø 30	ø 24.0	ø 40 x 32.5	43
970209	400	2X	ø 30	ø 18.0	ø 40 x 32.0	42
378-010	200	1X	ø 24	ø 11.2	ø 34 x 27.5	45
378-008	200	1X	ø 24	ø 22.0	ø 35 x 32.0	30
378-009	200	1X	ø 24	ø 23.0	ø 35 x 30.6	30

Note: A distance of 76.5mm in 970208 and 970209 drawings is for an image field of ø30 (without vignetting). For an image field of ø 24 or ø 11 (the latter is the image field of a 2/3-inch camera), use the formula (1) and (2) below to calculate the distance.

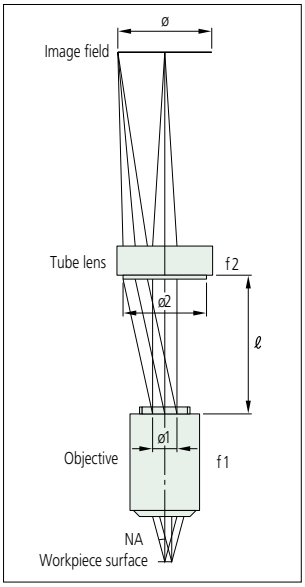
Reference: Placement of Objective and Tube Lens

Mitutoyo's long working-distance objective lenses are designed to cover a field of view of up to ø30mm (ø24mm), when the tube lens **970208** or **970209** (**378-008**, **378-009** or **378-010**) is placed at the specified distance from the objective. However, use the following formula to calculate the approximate distance, when a distance other than that as specified is required in order to insert your own optical system or other optical elements:

$\ell = (\varnothing_2 - \varnothing_1) \bullet f_2 / \varnothing$ [mm] ·····(1)

$\varnothing_1 = 2 \bullet f \bullet$ N.A. [mm] ·····(2)

$\varnothing_1$: Objective exit pupil diameter (mm)
$\varnothing_2$: Effective diameter of tube lens (mm)
f_2 : Focal length of tube lens
$\varnothing$: Image field diameter



Example: What is the distance (L), when using **M Plan Apo 10X*** (**378-803-3**) and tube lens** (**970208**) to cover an image field of ø24?

*f=20 mm, N.A.=0.28 (Refer to page 15.) **$\varnothing_2$=24 mm, f_2=200 mm (Refer to the above chart.)

From formula (2): $\varnothing_1$=2x20x0.28
=11.2 (mm)
From formula (1): L=(24–11.2)x200/24
=106.6 (mm)
Therefore a distance (L) up to 106 mm can cover an image field of ø 24 without shading.

In other words a distance (L) smaller than the specification does not affect optical performance. Contact Mitutoyo for detailed information.

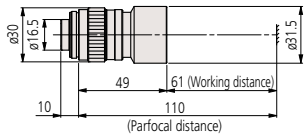
Objectives for Measuring Microscopes
ML

MF Hyper MF

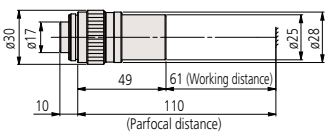
Features > Finite-correction (image-object distance: 280mm, parfocal length: 110 mm) > Bright field observation > Long working distance > Telecentric for lenses lower than 10X magnification

Dimensions

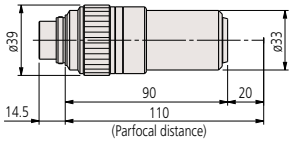
ML 1X



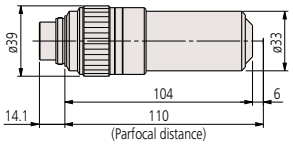
ML 5X



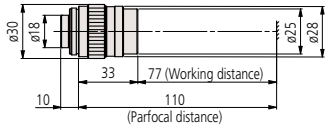
ML 20X



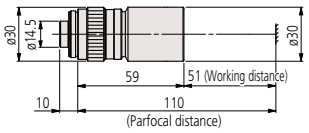
ML 100X



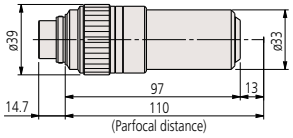
ML 3X



ML 10X



ML 50X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
						ø 24 eyepiece	1/2" camera	
375-036-2	1X	0.03	61.0	9.2	306	ø 24	4.8 x 6.4	80
375-037-1	3X	0.09	77.0	3.06	34	ø 8	1.6 x 2.1	55
375-034-1	5X	0.13	61.0	2.12	16.3	ø 4.8	0.96 x 1.28	60
375-039	10X	0.21	51.0	1.31	6.2	ø 2.4	0.48 x 0.64	95
375-051	20X	0.42	20.0	0.65	1.6	ø 1.2	0.24 x 0.32	310
375-052	50X	0.55	13.0	0.5	0.9	ø 0.48	0.10 x 0.13	350
375-053	100X	0.70	6.0	0.4	0.6	ø 0.24	0.05 x 0.06	380

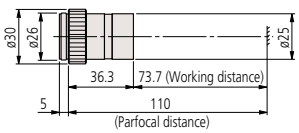
Objectives for Centering Microscopes
CF

CF

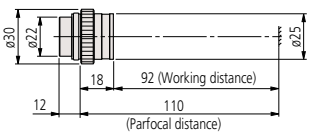
Features > Finite-correction (image-object distance: 280 mm, parfocal length: 110 mm) > Bright field observation > Long working distance > Available zoom type

Dimensions

CF 1X

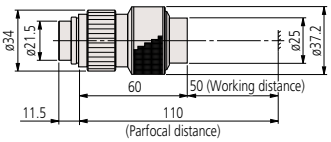


CF 2X



CF 3X

CF Zoom 1X - 5X



Specifications

Order No.	Mag.	N.A.	W.D. (mm)	R (μm) (λ=550 nm)	±DOF (μm)	Real FOV (mm)		Mass (g)
						ø 24 eyepiece	1/2" camera	
375-031	1X	0.03	73.7	9.2	306	ø 24	4.8 x 6.4	45
375-032	2X	0.06	92.0	4.6	76	ø 12	2.4 x 3.2	35
375-033	3X	0.07	77.8	3.9	56	ø 8	1.6 x 2.1	35
375-038 (zoom lens)	1X	0.04	50.0	6.9	171	ø 24	4.8 x 6.4	200
	3X	0.1		2.75	27	ø 8	1.6 x 2.1	
	5X	0.1		2.75	27	ø 4.8	0.96 x 1.28	

N.A.: Numerical aperture W.D.: Working distance R: Resolving power DOF: Depth of field FOV: Real field of view

Mitutoyo

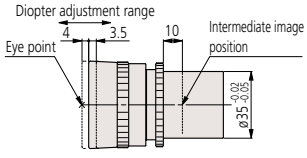
Wide Field of View Eyepieces and Reticles
WF / UWF

MF | MF-U | Hyper MF | Hyper MF-U | FS70 | FS300

Features > Wide field of view, especially the UWF 10X type (30 field number)
> External focusing system* allows installing an optional reticle. *Except for UWF 10X

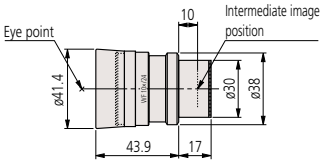
Dimensions

UWF 10X/30



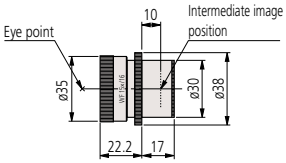
10X eyepiece

WF 10X/24



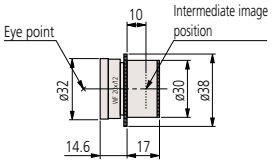
10X eyepiece

WF 15X/16



15X eyepiece

WF 20X/12



20X eyepiece

Specifications

Order No. (2pcs.)	Magnification	Field number	Visibility adjustment	Eye point	Reticle	Mass (g)
378-851	10X	30	-8D to +4D	High eye point	—	250
378-856	10X	24	-10D to +5D	High eye point	Available	45
378-857	15X	16	-8D to +5D	Normal	Available	35
378-858	20X	12	-8D to +5D	Normal	Available	35

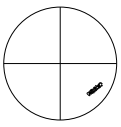
Reticles

FS70 | FS300

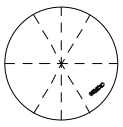
Features > Fitted to the eyepiece at the intermediate image position for simple measurement. *Not available for UWF 10X
> Outside diameter of 25 mm and thickness of 1 mm
> Reticle line widths: 10 µm (**516577**: 7 µm)

Dimensions

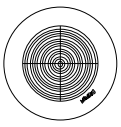
No.516848



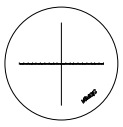
No.516576



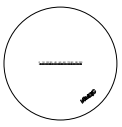
No.516578



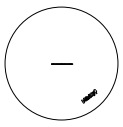
No.516577



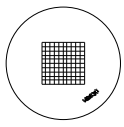
No.516849



No.516850



No.516851



Specifications

Order No.	516848	516576	516578	516577	516849	516850	516851
Remarks	90° full lines	90°, 60° chain lines	Crosshairs, one line graduated (P=0.1/20 mm)	Concentric circles with crosshairs (P=ø1.2/ø1.2 - 18 mm)	Graduation marks (P=0.1/10 mm)	Graduation marks (P=0.05/5 mm)	Grids (P=1 mm/10 mm square)

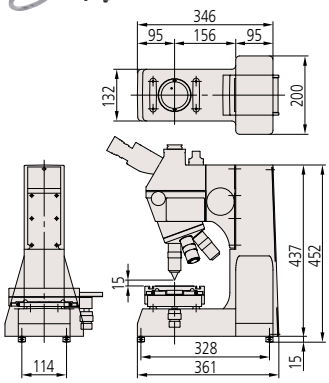
Optional Accessories for VMU, FS70 and VM-ZOOM

Stand

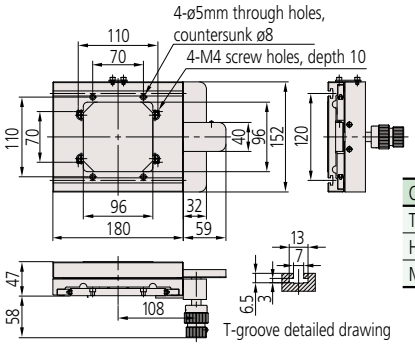
For mounting the VMU, FS70, or VM-ZOOM microscope unit. Can be combined with an XY stage, stage illumination unit and fiber-optic illuminator to work as a compact microscope for surface observation.

Order No.	**378-730**
Mass	6.7 kg

Stand with XY stage and stage illumination unit mounted on FS70Z with optional objectives and eyepieces



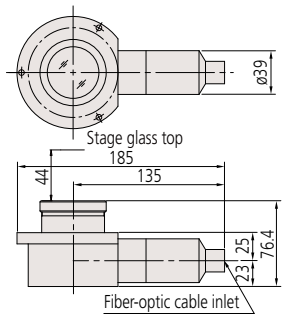
XY stage



Order No.	**378-020**
Travel range	50 x 50 mm
Handle feed	34 mm/rev.
Mass	3.3 kg

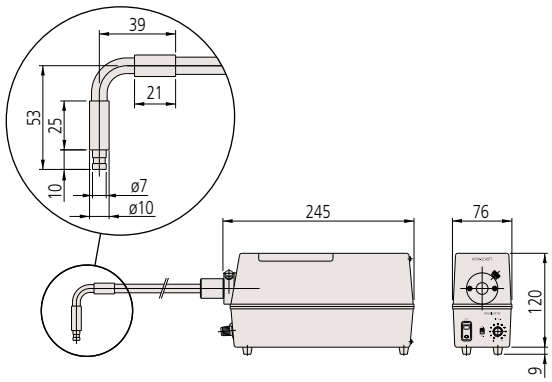
Stage illumination unit

Attaches to the stand to provide contour illumination in conjunction with a fiber-optic illuminator (100W or 150W).



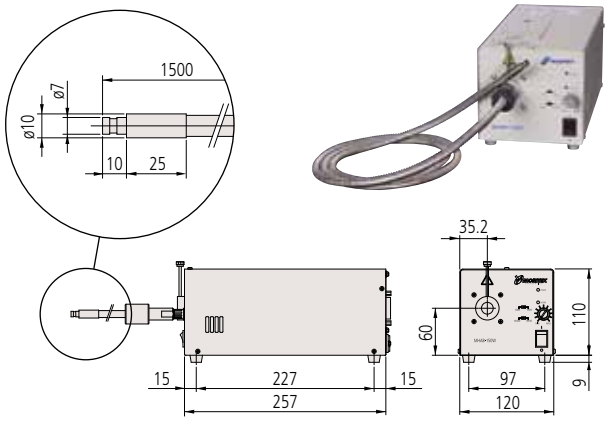
Order No.	**378-736**
Mass	0.8 kg

Fiber-optic illuminator (100W)



Order No.		**378-700D**
Light source		12V/100W parabolic-type halogen bulb (**517181**), 100h service life
Light guide		Fiber-optic cable (1.5 m length, 5 mm dia.)
Brightness		Adjustable by volumn
Filter (optional)	**LB80**	Color temperature conversion filter (**12BAA584**)
	ND2	For 1/2 light intensity (**12AAB251**)
	ND8	For 1/8 light intensity (**12AAB252**)
	GIF	Green filter (**12BAA253**)

Fiber-optic illuminator (150W)



Order No.		**176-316D**
Light source	Long-life type	15V/100W parabolic-type halogen bulb (**12BAJ076**), 500h service life
	High-brightness type	15V/100W parabolic-type halogen bulb (**12BAJ075**), 50h service life
Light guide		Fiber-optic cable (1.5 m length, 5 mm dia.)
Brightness		Adjustable by rotary control

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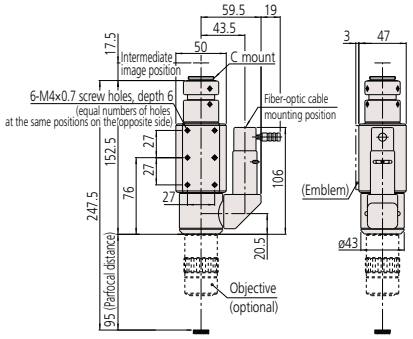
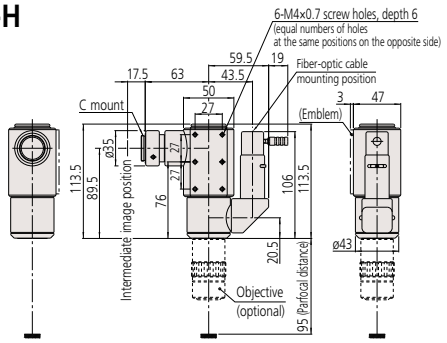
Dimensions

VMU series

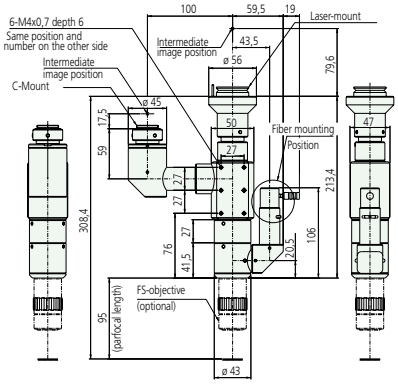
VMU-V



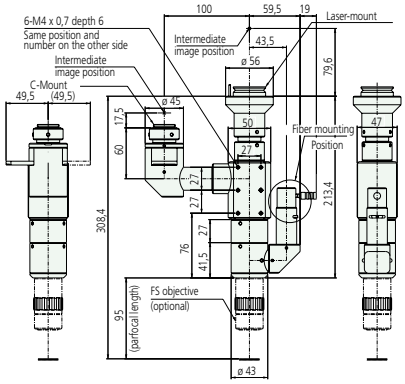
VMU-H



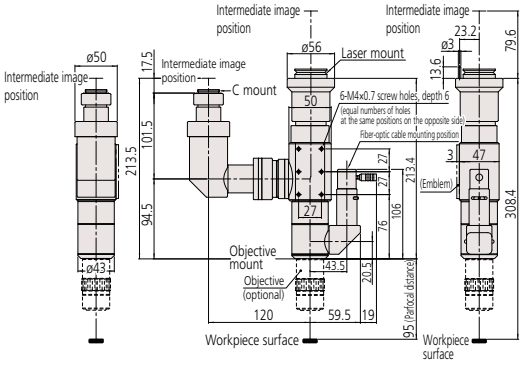
VMU-L

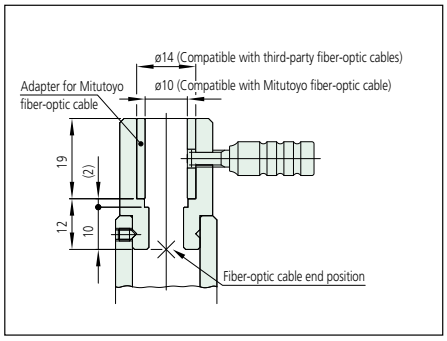


VMU-L4

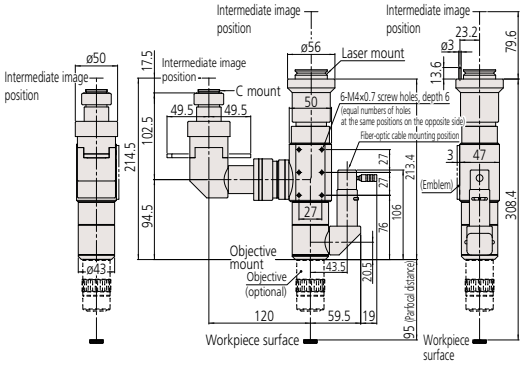


VMU-LB





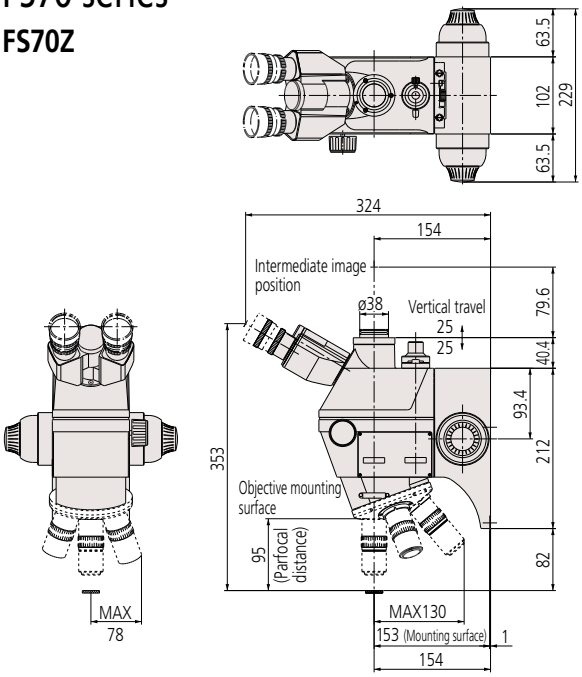
VMU-L4B



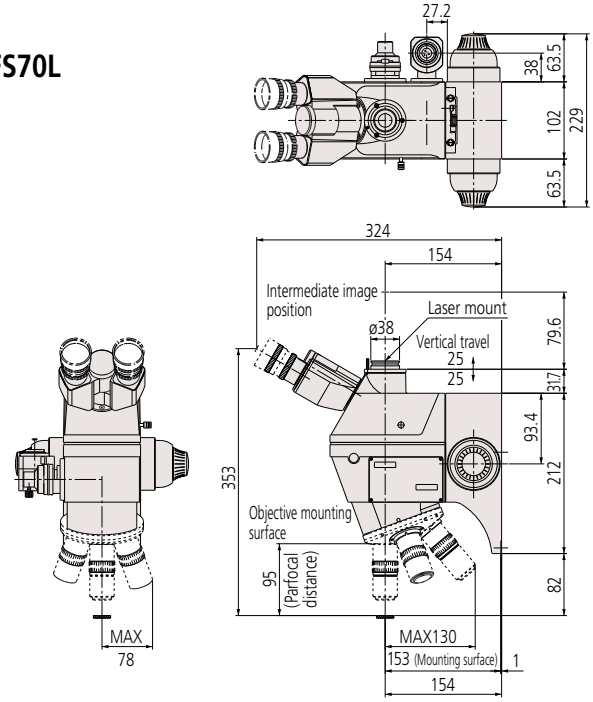
Dimensions

FS70 series

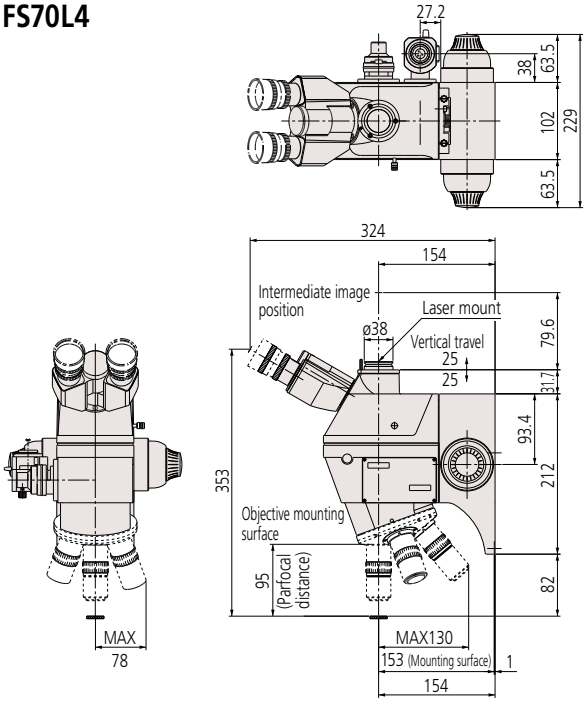
FS70Z

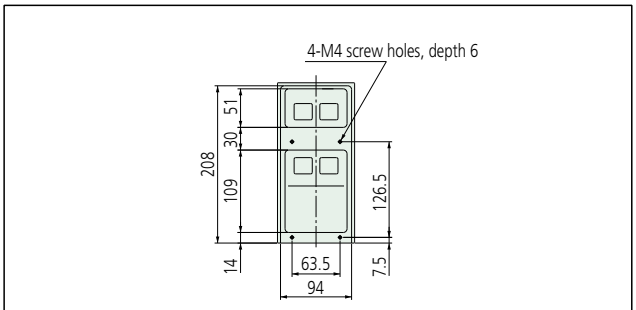


FS70L

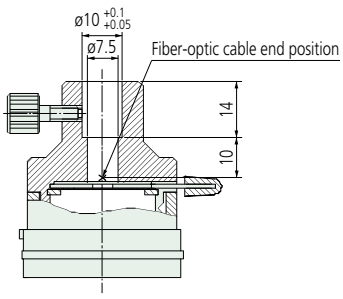


FS70L4





Back of standard focus unit (for all models)



Detail of fiber mount (for all models)

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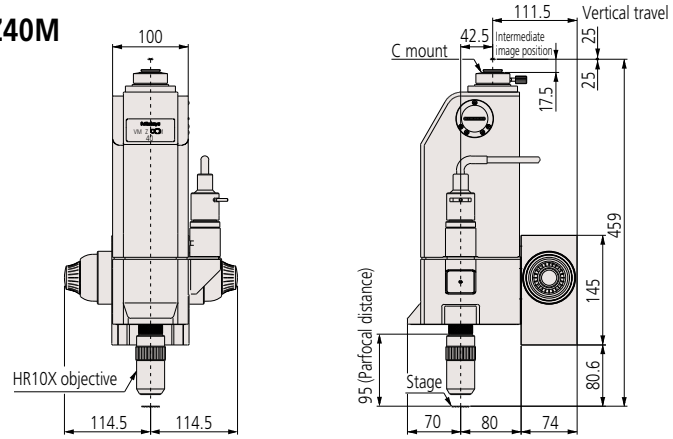
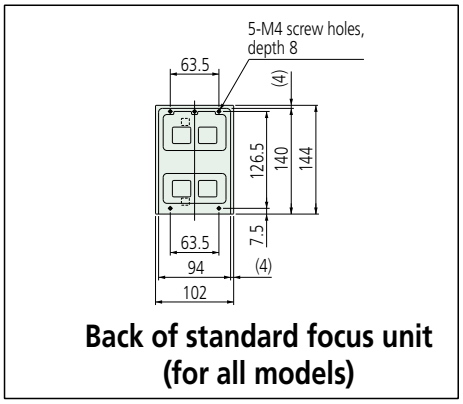
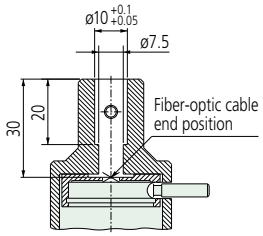
VM-ZOOM series

VMZ40M



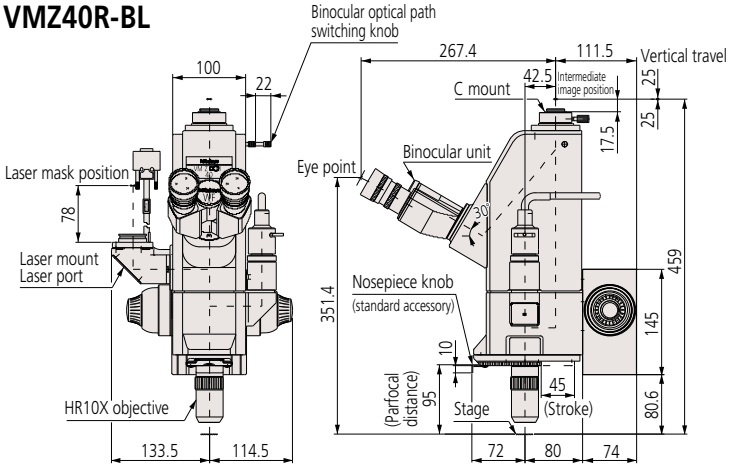


Back of standard focus unit (for all models)

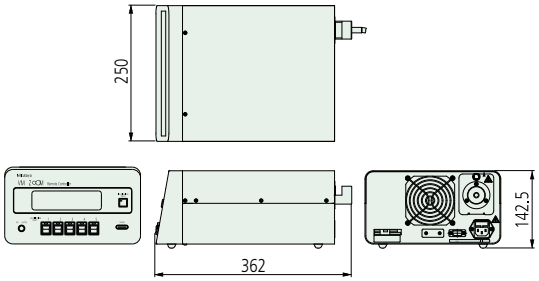


Detail of fiber mount (for all models)

VMZ40R-BL

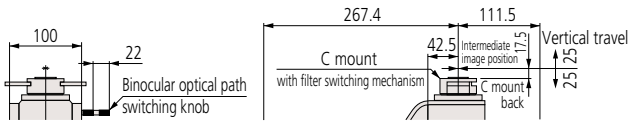


Remote Controller

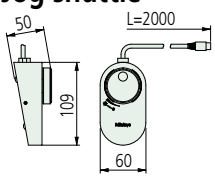


VMZ40R-BL4 (camera mount position)

Other dimensions except for camera mount are same as those for VMZ40R-BL.



Jog shuttle



Glossary

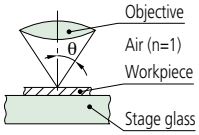
1. N.A. (Numerical Aperture)

N.A. determines resolving power, depth of field, and luminosity of the image. The larger the N.A. the higher is the resolving power and smaller is the depth of field.

$$N.A.=n\bullet Sin\theta$$

n is the index of refraction of the medium in which the lens is working. n=1.0 for air.

θ is the half-angle of the maximum cone of light that can enter or exit the lens.



2. R (Resolving Power)

Minimum distance between points or lines that are just distinguishable as separate entities.

Resolving power is determined by N.A. and wavelength λ.

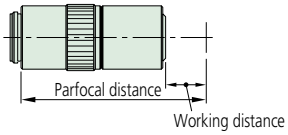
$$R\ (\mu m) = \frac{\lambda}{2\bullet N.A.}$$

3. W.D. (Working distance)

Distance between the surface of the specimen and the front face of the objective when in focus.

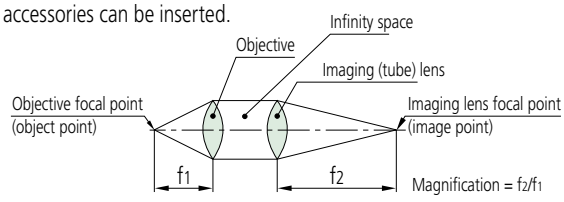
4. Parfocal Length

Distance between the surface of the specimen and the objective mounting position when in focus.



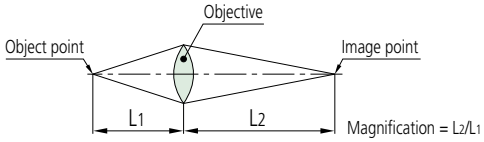
5. Infinity-corrected system

An optical system in which the image is formed by an objective and a tube lens with an 'Infinity Space' between them, into which optical accessories can be inserted.



6. Finite-corrected optical system

An optical system in which the image is formed only by an objective.



7. F (Focal Length)

Distance between a principal point and a focal point. f_1 is a focal length of an objective, f_2 is a focal length of a tube lens. Magnification is determined by the ratio of the focal length of the tube lens to that of the objective. (For an infinity-corrected optical system.)

$$\text{Magnification of objective} = \frac{\text{Focal length of tube lens}}{\text{Focal length of objective}}$$

$$\text{(Ex.) 1X} = \frac{200\ (mm)}{200\ (mm)} \qquad \text{(Ex.) 10X} = \frac{200\ (mm)}{20\ (mm)}$$

8. Field number and FOV (Real Field of View)

The field number of an eyepiece is determined by the field stop diameter of the eyepiece and it is expressed in mm.

FOV is the area of specimen observable and is determined by the field number of the eyepiece and magnification of the objective.

$$FOV\ (mm) = \frac{\text{Field number of eyepiece}}{\text{Magnification of objective}}$$

(Ex. Using an eyepiece of field number 24)

$$\text{FOV for 1X objective} = \frac{24}{1} = ø24\ (mm)$$

$$\text{FOV for 10X objective} = \frac{24}{10} = ø2.4\ (mm)$$

Area of specimen observable on TV monitor

$$\text{Area of specimen observable on TV monitor} = \frac{\text{Area of camera image element (VxH)}}{\text{Magnification of objective}}$$

Indication magnification on TV monitor

$$\text{Indication magnification on TV monitor} = \text{Magnification of objective} \times \frac{\text{Diagonal line length of monitor indication}}{\text{Diagonal line length of camera image element}}$$

* Size of camera image element (V x H x Diagonal)
1/3 inch image element: 3.6x4.8x6.0 mm 1/2 inch image element: 4.8x6.4x8.0 mm
2/3 inch image element: 6.6x8.8x11.0 mm

9. DOF (Depth of Focus)

Vertical distance in the specimen, measured from above and below the exact plane of focus, which still yields an acceptable image.
The larger the N.A., the smaller the depth of field.

Eyepiece observation (Formula of Berek)

$$\pm DOF\ (\mu m) = \frac{\omega \times 250.000}{N.A. \times M} + \frac{\lambda}{2x(N.A.)^2}$$

λ= Radiation wavelength

ω: Resolution of human eye (Visual angle: 5 minute)
M: Total magnification (Objective mag. x Eyepiece mag.)

TV monitor observation

$$\pm DOF\ (\mu m) = \frac{\lambda}{2x(N.A.)^2}$$

λ=550nm (Standard wavelength)

Mitutoyo

10. Bright field illumination and dark field illumination

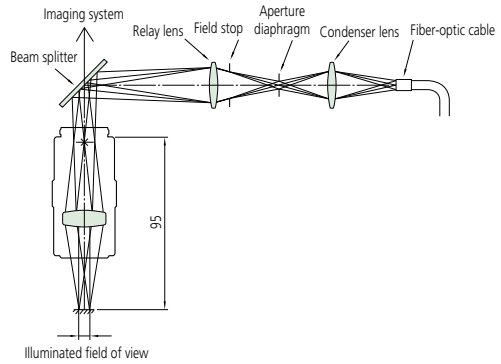
Bright field illumination directly lights the specimen with a solid cone of rays and is the simplest method available. Dark field illumination uses a hollow cone of rays formed by an opaque stop at the center of the condenser large enough to prevent direct light from entering the objective. The specimen is placed at the concentration of the light cone, and is seen with light scattered or diffracted by it, therefore scratches and dents on the specimen surface are illuminated while the rest remains dark.

11. Apochromatic objective and achromatic objective

An apochromatic objective is corrected for chromatic aberration at the red, blue, and yellow wavelengths. An achromatic objective is corrected for chromatic aberration at the red and blue wavelengths only.

12. Koehler illumination

Koehler illumination overcomes the disadvantages of other schemes by causing parallel rays to light the specimen so that, because they will not be in focus, the image of the specimen will not include an image of the light source.



13. Telecentric illumination

This illuminating optical system is designed so that principal light passes through the focal point. This system has the advantage of retaining the size of the image center even if it is out of focus (although the circumference of the image is defocused). This illumination system provides an even illumination intensity over the entire field of view.

14. Aperture diaphragm

This diaphragm adjusts the amount of light passing through and is related to the brightness and resolving power of an optical system. This diaphragm is especially useful in width dimension measurement of cylindrical objects with contour illumination, and provides the highest degree of correct measurement/observation by suppressing diffraction in an optimal aperture.

15. Field stop

This diaphragm is used for blocking out unwanted light and thereby preventing it from degrading the image.

16. Plan

Denotes an objective lens that produces a flat (planar) image by correcting the spherical aberration/curvature of the field of an achromatic lens or an apochromatic lens. All Mitutoyo FS series objectives are plan apochromat.

17. Vignetting

This unwanted effect is the reduction of an image's brightness or saturation at the periphery compared to the image center. May be caused by external (lens hood) or internal features (dimensions of a multi-element lens).

18. Flare

Lens flare is typically seen as several starbursts, rings, or circles in a row across the image or view, caused by unwanted image formation mechanisms, such as internal reflection and scattering of light.

19. Double image

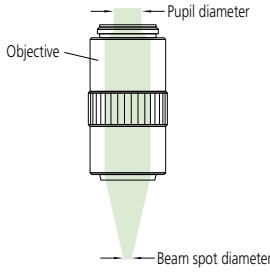
An image degrading a phenomenon in which an image appears as if it is a double image due to redundant light projection and optical interference within the optical system.

20. Pupil Diameter and Spot Diameter of an Objective

• Pupil diameter

Denotes the maximum diameter of a parallel light flux along the optical axis that can enter an objective from the rear. The pupil diameter is calculated according to the following expression.

$$ø\ mm = 2 \times N.A. \times f$$



• Spot diameter

If a beam of light with a uniformly distributed intensity enters an objective from the rear, the beam is condensed to a spot of finite size. This size is known as the spot diameter. The approximate value of a spot diameter is calculated from the following expression.

$$ø\ \mu m = 1.22 \times \frac{\lambda}{N.A.}$$

However, the above expression cannot be applied if the light source is a laser beam of which the intensity forms a Gaussian distribution on the cross section. The diameter of a laser beam is generally indicated by $1/e^2$ of the peak value, i.e. 13.5% of the peak value. The spot diameter of a laser beam is calculated from the following expression.

$$ø\ \mu m = \frac{4 \times \lambda \times f}{\pi \times D}$$

Coordinate Measuring Machines

Vision Measuring Systems

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Sensor Systems

Test Equipment and Seismometers

Digital Scale and DRO Systems

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