

MF SERIES 176 — Measuring Microscopes

- An easy-to-operate standard measuring microscope using specially designed long working distance **ML** objectives.
- Measuring accuracy is the highest in its class (and conforms to JIS B 7153).
- Illumination can be selected from an LED unit, which has a longer life, or a powerful halogen unit for high-magnification applications.
- Excellent usability, a high-NA and long working distance objectives enable effective observation.

Manual type

- Stages range in size from 100x100 mm to 400x200 mm.
- The XY stage is equipped with a quick-release mechanism that enables switching between coarse and fine feed to provide swift and precise stage movement, even over a large distance.



MF-B2017D
Note: The binocular tube (eyepiece) and illumination unit are optional accessories.

SPECIFICATIONS

		MF-A1010D	MF-A2010D	MF-A2017D	MF-A3017D	MF-A4020D
Without Z-axis scale	Model No.	MF-A1010D	MF-A2010D	MF-A2017D	MF-A3017D	MF-A4020D
	Order No.	176-861*1	176-862*1	176-863*1	176-864*1	176-865*1
With Z-axis scale	Model No.	MF-B1010D	MF-B2010D	MF-B2017D	MF-B3017D	MF-B4020D
	Order No.	176-866*1	176-867*1	176-868*1	176-869*1	176-870*1
Observation image		BF (Bright-field)/Erect image				
Eyepiece with diopter adjustment		10X (eyepiece field number: 24), 15X, 20X Note: Monocular - one 10X eyepiece provided as standard; Binocular - two 10X eyepieces provided as standard				
Objective		ML objective 3X (provided as standard), 1X, 5X, 10X, 20X, 50X, 100X				
Illumination unit (One of the two options must be selected.)	LED illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, White LED light source, stepless light intensity control with cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, White LED light source, stepless light intensity control Control unit: Power ON/OFF switch (main switch), AC100 to 240 V power input connector				
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (50 W), stepless light intensity control, With cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, Halogen bulb (50 W), stepless light intensity control, With cooling fan Control unit: Power ON/OFF switch (main switch), AC100 to 240 V power input connector				
Stage	Measuring range	100x100 mm	200x100 mm	200x170 mm	300x170 mm	400x200 mm
	Quick-release mechanism	Provided as standard for the X and Y axes				
	Zero-set button	Provided as standard for the X and Y axes (and for the Z axis only for the MF-B type)				
Z axis	Max. workpiece height	150 mm		220 mm		
	Feed mechanism	Coaxial coarse and fine feed, handles on both sides (coarse: 30 mm/rotation, fine: 0.2 mm/rotation)				
Measuring accuracy*2 (X and Y axes, when not loaded)		(2.2 + 0.02L) μm L=measuring length (mm)				
	Resolution	1/0.5/0.1 μm 0.0001/0.00005/0.00001 in (switchable)				
Digital display	Display axes	X and Y (or X, Y, and Z only for the MF-B type)				
	Functions	Zero-setting, direction switching, RS-232C output, USB output (specific to QSPAK)				

*1 The following suffixes are added to the order No. to specify the User Manual's language: -10 for English; -11 for Simplified Chinese; No suffix for Japanese.

*2 Measuring method complies with JIS B 7153.

Motor-Driven Z-axis

- Freedom from burdensome focus adjustment even on a workpiece with many asperities allows the operator to perform stress-free measurement.
- Using the Vision Unit (optional) enables the image AF function.



MF-J2017D
Note: The binocular tube (eyepiece) and illumination unit are optional accessories.

SPECIFICATIONS for Motor-Driven Z-axis MF models

		MF-J2017D	MF-J3017D	MF-J4020D
Model No.		MF-J2017D	MF-J3017D	MF-J4020D
Order No.		176-891*1	176-892*1	176-893*1
Vision AF*2		Available		
Stage	Quick release mechanism	Fitted to X and Y axes		
	Zero set switch	Fitted to X and Y axes		
Z axis	Max. workpiece height	220 mm		
	Feed mechanism	Motordrive (Maximum measuring speed: 20 mm/s)		

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix is required for PSE.

*2 Vision Unit and an image AF cable are separately required.

Note: The specification other than the above is subject to the **MF** Series.



Refer to the **MF/MF-U Series Brochure (E14003)** for more details.

Microscopes

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MF-U SERIES 176 — Universal Measuring Microscopes

- Integration of metallurgical and measurement microscope functions provides high-resolution observation and a high-accuracy measurement solution.
- Measuring accuracy is the highest in its class (and conforms to JIS B 7153).
- Illumination can be selected from an LED unit, which has a longer life, or a powerful halogen unit for high-magnification applications.
- Excellent usability, a high-NA and long working distance objectives enable effective observation.



MF-UB2017D

Note: The turret, objectives and illumination unit are optional accessories.

Manual type

- Stages range in size from 100×100 mm to 400×200 mm.
- The XY stage is equipped with a quick-release mechanism that enables switching between coarse and fine feed to provide swift and precise stage movement, even over a large distance.



Refer to the **MF/MF-U Series Brochure (E14003)** for more details.

SPECIFICATIONS

	Without Z-axis scale	Model No.	MF-UA1010D	MF-UA2010D	MF-UA2017D	MF-UA3017D	MF-UA4020D
BF (Bright-field)	Without Z-axis scale	Order No.	176-871*1	176-872*1	176-873*1	176-874*1	176-875*1
	With Z-axis scale	Model No.	MF-UB1010D	MF-UB2010D	MF-UB2017D	MF-UB3017D	MF-UB4020D
BD (Bright-field/Dark-field)	Without Z-axis scale	Order No.	176-876*1	176-877*1	176-878*1	176-879*1	176-880*1
	With Z-axis scale	Model No.	MF-UC1010D	MF-UC2010D	MF-UC2017D	MF-UC3017D	MF-UC4020D
	Without Z-axis scale	Order No.	176-881*1	176-882*1	176-883*1	176-884*1	176-885*1
	With Z-axis scale	Model No.	MF-UD1010D	MF-UD2010D	MF-UD2017D	MF-UD3017D	MF-UD4020D
		Order No.	176-886*1	176-887*1	176-888*1	176-889*1	176-890*1
Observation image	BF (Bright-field), DF (Dark-field) (MF-UC and MF-UD models only), Polarization, Differential Interference Contrast (DIC)/Erect image						
Eyepiece (optional) with diopter adjustment	10X (eyepiece field number: 24, two eyepieces provided as standard), 15X, 20X						
Turret (required)	Bright-field (BF)	Manual/Motor (select either one)					
	Bright-field/dark-field (BD)						
Objective (optional)	Bright-field (BF)	M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo					
	Bright-field/dark-field (BD)	BD Plan Apo					
Illumination unit (One of the two options must be selected.)	LED illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, White LED light source, stepless light intensity control, With cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, White LED light source, stepless light intensity control Control unit: Power ON/OFF switch (main switch), AC100 to 240 V power input connector					
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (50 W), stepless light intensity control, With cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, 100 W or 150 W halogen bulb (selectable), external fiber-optic illumination, stepless light intensity control Control unit: Power ON/OFF switch (main switch), AC100 to 240 V power input connector					
Stage	Measuring range	100×100 mm	200×100 mm	200×170 mm	300×170 mm	400×200 mm	
	Quick-release mechanism	Provided as standard for the X and Y axes					
	Zero-set button	Provided as standard for the X and Y axes (and for the Z axis only for the MF-UB and -UD types)					
Z axis	Max. workpiece height	150 mm			220 mm		
	Feed mechanism	Coaxial coarse and fine feed, handles on both sides (coarse: 10 mm/rotation, fine: 0.1 mm/rotation)					
Measuring accuracy*2 (X and Y axes, when not loaded)		(2.2 + 0.02L) μm L=measuring length (mm)					
	Resolution	1/0.5/0.1 μm 0.0001/0.00005/0.00001 in (switchable)					
Digital display	Display axes	X and Y (or X, Y, and Z only for the MF-UB and -UD types)					
	Functions	Zero-setting, direction switching, RS-232C output, USB output (specific to QSPAK)					

*1 The following suffixes are added to the order No. to specify the User Manual's language: -10 for English; -11 for Simplified Chinese; No suffix for Japanese.

*2 Measuring method complies with JIS B 7153.

Motor-Driven Z-axis

- Freedom from burdensome focus adjustment even on a workpiece with many asperities allows the operator to perform stress-free measurement.
- Using Vision Unit (optional) enables the image AF function.



MF-UJ2017D

Note: The turret, objectives and illumination unit are optional accessories.

SPECIFICATIONS for Motor-Driven Z-axis MF-U models

BF (Bright-field)	Model No.	MF-UJ2017D	MF-UJ3017D	MF-UJ4020D
	Order No.	176-894^{*1}	176-895^{*1}	176-896^{*1}
BD (Bright-field/Dark-field)	Model No.	MF-UK2017D	MF-UK3017D	MF-UK4020D
	Order No.	176-897^{*1}	176-898^{*1}	176-899^{*1}
Eyepiece (optional) with diopter adjustment		10X (eyepiece field number: 24, two eyepieces provided as standard), 15X, 20X		
Objective (optional)	Bright-field (BF)	M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo		
	Bright-field/dark-field (BD)	BD Plan Apo		
Vision AF ^{*2}		Available		
Stage	Measuring range	200x170 mm	300x170 mm	400x200 mm
	Quick release mechanism	Fitted to X and Y axes		
	Zero set switch	Fitted to X and Y axes		
Z axis	Max. workpiece height	220 mm		
	Feed mechanism	Motor drive (measuring speed: max. 20 mm/s)		
Measuring accuracy ^{*3} (X and Y axes, when not loaded)		(2.2 + 0.02L) μm L=measuring length (mm)		
	Resolution	1/0.5/0.1 μm 0.0001/0.00005/0.00001 in (switchable)		
Digital display	Display axes	X, Y and Z		
	Functions	Zero-setting, direction switching		

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix is required for PSE.

*2 Vision Unit and an image AF cable are separately required.

*3 Measuring method complies with JIS B 7153.

Note: For all specifications not included above see page J-7.

Microscopes

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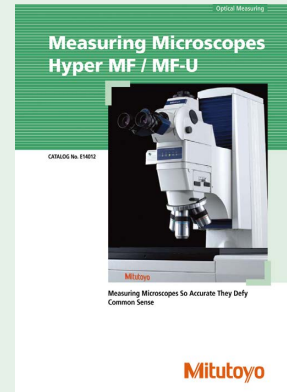
Hyper MF/MF-U SERIES 176 — High-Accuracy Measuring Microscopes

- Ultra-high accuracy measuring microscopes achieving $(0.9 + 3L/1,000)$ μm of accuracy.
- Three-axis motorized front operation joystick control, which makes a refreshing change from conventional microscope operation, allows fine positioning even during fast movement.
- Large workstage with stroke of 250×150 mm provides enough margin for the measurement of larger workpieces.
- The Vision Unit can be integrated to provide an effective and stable measurement environment.



Hyper MF-U

Note: The optical tube, turret, and objectives are optional.



Refer to the Hyper MF/MF-U Brochure (E14012) for more details.

SPECIFICATIONS

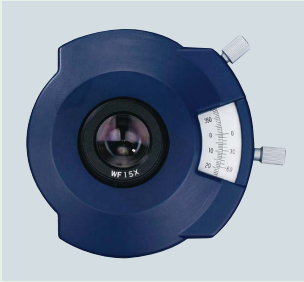
Model No.	HyperMF-B2515B	HyperMF-UB2515B	HyperMF-UD2515B	HyperMF-UE2515B	HyperMF-UF2515B
Order No.	176-430*1	176-431*1	176-432*1	176-433*1	176-434*1
Optical tube	Finite correction optical system BF (Bright-field)	Infinity-correction optical system BF (Bright-field)	Infinity-correction optical system BD (Bright/Dark-field)	Infinity-correction optical system BF (Bright-field) with the LAF function	Infinity-correction optical system BD (Bright/Dark-field) with the LAF function
	Standard reticle (Built-in)	90° broken-cross line (line width 5 μm)			
	Pupil distance adjustment	Siedentopf type Adjustment range: 51 to 76 mm			
	Optical path switching ratio	Observation/TV-photomicrography=50/50			
	Vertical tilt angle	25°	Tilting		
	TV port	Provided as standard			
Observation image	Erect image				
Eyepiece Magnification	10X, 15X, 20X				
Objective (optional)	Selectable from the monocular unit (equipped with one eyepiece) or binocular tube (equipped with two eyepieces)	Equipped with two 10X eyepieces			
	ML Series objective	1X, 3X, 5X, 10X, 20X, 50X, 100X	—		
	BF (Bright-field)	—	M Plan Apo, M plan Apo SL, G plan Apo		
Turret (optional)	BD (Bright/Dark-field)	—	BD Plan Apo		
	BF (Bright-field)	—	(Equipped with a four-hole manual turret/motorized five-hole turret*2)		
Focusing section	BD (Bright/Dark-field)	—	(Equipped with a four-hole manual turret/motorized four-hole turret*3)		
	Maximum height of workpiece	150 mm			
	Measuring accuracy	$(1.5 + 10L/1000)$ μm L=Measuring length (mm)			
Drive method	Motorized control using a joystick				
Illumination unit	Transmitted illumination device	Telecentric system, Built-in aperture diaphragm, Halogen bulb (50 W), 100-step light intensity control, Fiber-optic cable cold light illumination			
	Reflected illumination unit	Koehler illumination, Variable aperture diaphragm mechanism, Halogen bulb (100 W), 100-step light intensity control, Fiber-optic cable cold light illumination			
Workstage	Measuring range (X×Y)	250×150 mm			
	Measuring accuracy*4 (When no load is put on the X or Y axis)	$(0.9 + 3L/1000)$ μm L=Measuring length (mm)			
	Dimensions of the top plane	460×350 mm			
	Usable dimensions of the stage glass	300×200 mm			
	Swiveling angle	$\pm 3^\circ$			
	Maximum loading mass	30 kg			
	Drive method	Motorized control using a joystick			
Detector	High precision digital scale (Patented)				
Digital display	Resolution	0.01 μm			
	Axes to be displayed	X, Y, Z			
	Data processing unit	Vision Unit (required)			
Operation section	LAF (just focus)	—	—	Available	
	LAF (tracking focus)	—	—	Available	

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix is required for PSE.

*2 and *3 are factory-installed options.

*4 Measurement accuracy complies with JIS B 7153.

Angle Index (Standard Accessory)



TM
SERIES 176 — Toolmakers' Microscopes

- Compact universal toolmakers' microscope that can be installed on any site.
- Newly designed LED illuminators provide enhanced observation for higher accuracy and resolution.
- Optional LED circular illuminator available for applications requiring all-round lighting.
- Achieves a maximum measuring height of 115 mm despite the compact size.
- Installation of Digimatic micrometer heads (**164-163**, optional) makes measurement easy and precise.
- A vernier scale (Angle Index) built into the eyepiece mount enables accurate angular measurements.
- Lenses are available for a wide range of magnifications (20X to 200X in total).



TM-505B



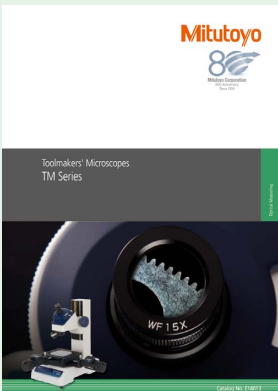
TM-1005B

Note: Micrometer heads are optional.

SPECIFICATIONS

Model No.		TM-505B	TM-1005B
Order No.		176-818	176-819
Optical tube		Monocular type (Vertical tilt angle: 30°)	
Observation image		Erect	
Eyepiece protractor		Resolution (graduation): 1°, Rotation angle: 360°, Resolution (angle): 6', Adjustable zero point	
Eyepiece		Standard accessory: 15X (field number: 13), Options: 10X, 20X	
Objective		Standard accessory: 2X, Optional: 5X, 10X	
Microscope head	Maximum height of workpiece	115 mm	107 mm
	Focusing method	Manual (Coarse feed)	
Illumination unit	Transmitted illumination	Stepless brightness adjustment, White LED light source with green filter	
	Reflected illumination	Oblique single-source type, Stepless brightness adjustment, White LED light source	
Cross-travel stage	Measuring range	50x50 mm	100x50 mm (An optional 50 mm gauge block is required to cover full range. A CERA block is recommended.)
	Table size	152x152 mm	240x152 mm
	Usable area of the stage glass	96x96 mm	154x96 mm
	Maximum stage glass loading	5 kg	
Linear measurement method		Micrometer head*	
Resolution		Depends on the micrometer head specifications* (for 164-163 : 0.001 mm)	
Micrometer head travel range		For 164-163 : 50 mm	
Power supply		AC 100 to 240 V 50/60 Hz Maximum power consumption: 4.2 W	
Main unit mass		14 kg	15 kg

* Micrometer heads are optional for **TM-505B** and **TM-1005B**.
Note: The main unit with Digimatic micrometer head (**164-164**) is provided in the **TM** Series.
TM-A505B (176-820A)
TM-A1005B (176-821A)
Other specifications are the same as the other **TM** Series.



Refer to the **TM** Series Brochure (**E14013**) for more details.

Microscopes

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Vision Unit SERIES 359 — Vision System Retrofit for Microscopes

- The measurement tools and various macro icons allow measurement in one easy step.
- The graphics and measurement navigation functions facilitate operation.
- The image saving function and the data output function to the spreadsheet software are standard.
- Combined use with the **MF/MF-U** Series (Motor-Driven Z-axis) achieves the image AF (auto focus) function.



MF-J2017D plus Vision Unit



Foot switch
12AAJ088

SPECIFICATIONS

Model	Vision Unit
Order No.	359-763
Magnification of the optical system	When installed on the microscope 0.5X (using the 0.5X TV adapter)
Image detection	High-sensitivity 1/2 inch color CMOS camera 3 megapixel
Resolution	0.1 μ m
Accuracy (Measurement environment: 20 °C)	Depends on the accuracy specification of the Mitutoyo measuring microscope to which the unit is fitted. For reference: When using an ML Series 3X objective (In an inspection using a sample workpiece based on the Mitutoyo standards) Measurement accuracy in the screen: Within $\pm 2.5 \mu$ m Repetitive accuracy in the screen ($\pm 2 \sigma$): Within $\pm 1 \mu$ m
Software (optional)	QSPAK VUE

Note: Software (**QSPAK VUE**) and calculation processor are required separately.

Applicable Models

Mitutoyo **MF** Series, **MF-U** Series, **Hyper MF** Series, **Hyper MF-U** Series



Refer to the **QM-Data200** and Vision Unit Brochure (**E14008**) for more details.

QM-Data200 SERIES 264 — 2D Data Processing Unit

- 2D Data Processor designed to perform arithmetic processing of XY coordinate data acquired from projectors and measuring microscopes for local display or output to a printer.
- Informative color-graphic displays on the large LCD screen make for easy measurement operations.
- The AI measurement function (automatic identification of measuring item) eliminates switching between the measurement command keys.
- Equipped with a measurement procedure teaching function and measuring position navigation in Repeat mode.
- The user menu function allows users to register measurement commands or part programs to create their own menus.
- Measurement result output to CSV format in spreadsheet software.
- Measurement procedures and calculation results can be saved on a USB-compatible memory device.



QM-Data200
(stand type)



Foot switch
12AAJ088

SPECIFICATIONS

Model No.	QM-Data200		
	Stand type	Flexible arm type	Stand type
Order No.	264-155*1	264-156*1	264-159*1
Applicable models (Conventional models)*2	PJ-PLUS Series PJ-H30 Series PV-5110 PH-3515F MF Series MF-U Series	PJ-PLUS Series PJ-H30 Series PV-5110*3 PH-3515F*3	Hyper MF/MF-U
Unit of measurement	Length: mm Angle: Switchable between decimal degree and sexagesimal notation		
Resolution	0.1 μm		0.01 μm
Program function	Creating, performing, and editing of measurement procedures		
Statistical processing	Number of data, maximum value, minimum value, mean value, standard deviation, range, histogram, Statistics classified by each measurement function (Statistics classified by each command)		
Display unit	Color graphic LCD (equipped with LED backlight)		
ABS point	—		Available (Automatic movement)
LAF (Laser AF)	—		Available
Edge sensor position correction	Available (Profile Projectors with OPTOEYE 200)		—
Input/output	XYZ: Data input from linear scales (Maximum number of axes: 3) RS-232C 1: Connection to an external PC RS-232C 2: Connection to a measuring unit counter OPTOEYE: Connection to an OPTOEYE edge signal (OPTOEYE 200) FS: For the connection to the foot switch PRINTER: For the connection to an external printer USB-MEMORY: For the connection to a USB memory		
Measurement result file output	RS-232C output (CSV format, MUX-10 format)		
Display language	16 languages (Japanese, English, German, French, Italian, Spanish, Portuguese, Czech, Chinese (simplified/traditional), Korean, Turkish, Swedish, Polish, Dutch, Hungarian)		
Power supply	AC100 to 240 V		
Maximum power consumption	17 W (excluding optional accessories)		
External dimensions (W×H×D)	260×242×310 mm (including the stand section)	318×153×275 mm (when the arm is horizontal)	260×242×310 mm (including the stand section)
Mass	Approx. 2.9 kg	Approx. 2.8 kg	Approx. 2.9 kg
Standard Accessories	AC adapter, Power cable, Quick Operation Guide		

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, E for BS, K for KC, C and No suffix is required for PSE, and 00 for power cord other than A, D, E, K, C, No suffix.

*2 Please contact Mitutoyo sales office with respect to the models that are applicable to the models other than mentioned above.

*3 The flexible arm type cannot be used concurrently with a counter stand.



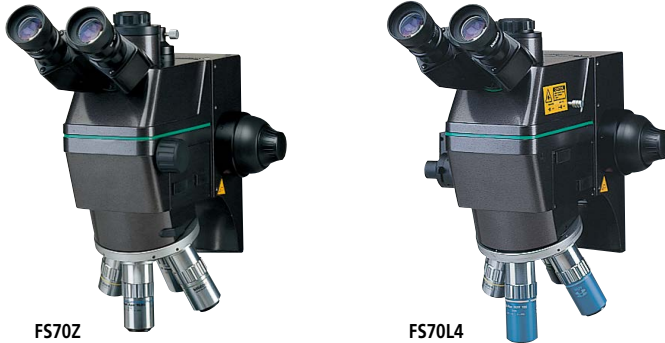
Refer to the **QM-Data200** and Vision Unit Brochure (**E14008**) for more details.

Microscopes

FS70 SERIES 378 — Microscope Unit for Semiconductor Inspection

- Compact microscope unit equipped with an eyepiece observation section.
 - Can be used with YAG (near-infrared, visible, near-ultraviolet, or ultraviolet) lasers.*¹
 - Usable in infrared optical systems*². Applications: observation of silicon wafers; spectral characteristics analysis using infrared.
- *¹ The performance and safety of laser-equipped system products is not guaranteed.
*² An infrared source and infrared camera are necessary.

- Models supporting BF (Bright-field), DF (Dark-field), Polarization, and Differential Interference Contrast (DIC) are available.
- The inward-facing turret and long working distance objectives maintain the high operability of the microscope.



Note: The parfocal manual turret, eyepieces and objectives are optional.



Refer to the Microscope Units and Objectives Brochure (E14020) for more details.

SPECIFICATIONS

Standard head type	Model No.	FS70	—	FS70Z	—	FS70ZD	FS70L	FS70L4
Order No.		378-184-1	—	378-185-1	—	Made-to-order	378-186-1	378-187-1
Tilting head type	Model No.	—	FS70-TH	—	FS70Z-TH	FS70ZD-TH	FS70L-TH	FS70L4-TH
Order No.		—	378-184-3	—	378-185-3	Made-to-order	378-186-3	378-187-3
Focus adjustment	50 mm travel range with concentric coarse (3.8 mm/rev) and fine (0.1 mm/rev) focusing wheels (right/left)							
Observation image	Erect image							
	BF (Bright-field)	✓	✓	✓	✓		✓	✓
	BD (Bright-field/Dark-field)					✓		
	Polarization	✓	✓	✓	✓	✓	✓	✓
	Differential Interference Contrast (DIC)	✓	✓	✓	✓	✓		
Optical tube type	Siedentopf, adjustable interpupillary distance range: 51 to 76 mm							
Field number	24 mm							
Tilt angle	0 to 20°, displacement of eye point: 114 mm (only for tilting head type)							
Optical pass ratio	Fixed type (Eyepiece/TV= 50/50)	Switchable type (Eyepiece/Tube= 100/0: 0/100)	Fixed type (Eyepiece/TV= 50/50)	Switchable type (Eyepiece/Tube= 100/0: 0/100)	Fixed type* ¹ (Eyepiece/TV= 50/50)	Switchable type (Eyepiece/Tube= 100/0: 0/100)		
Protective filter	—					Built-in laser beam filter		
Tube lens	1X		—			1X to 2X zoom		1X
Applicable laser	—					1064/532/355 nm		532/266 nm
Camera mount	C-mount (using optional adapter B* ²)					Use a laser with TV port.		C-mount receptacle (with green filter switch)
Optical system epi-illumination	Epi-illumination for Bright-field (Koehler illumination, with aperture diaphragm)							
Illumination unit (optional)	Fiber-optic illumination unit (100 W), stepless adjustment, light guide length: 1.5 m							
Objective, optional (for observation)	M Plan Apo/HR/SL, G Plan Apo				BD Plan Apo		M Plan Apo/HR/SL, G Plan Apo	
Objective, optional (for laser-cutting)	—						NIR Series NUV Series	UV Series
Loading* ³	14.5 kg	13.6 kg	14.1 kg	13.2 kg	14.1 kg (tilting head type: 13.2 kg)	14.2 kg (tilting head type: 13.5 kg)	13.9 kg (tilting head type: 13.1 kg)	
Mass (main unit)	6.1 kg	7.1 kg	6.6 kg	7.5 kg	6.6 kg (tilting head type: 7.5 kg)	6.4 kg (tilting head type: 7.2 kg)	6.7 kg (tilting head type: 7.5 kg)	

*¹ It is a switchable type when using FS70ZD-TH (Tilting head type).

*² Installation is optional.

*³ Loading on optical tube excluding weight of objectives and eyepieces

Note: Observe the following precautions when using FS70L or FS70L4 with YAG laser source attached.

- Be aware of the laser power and energy density limitations of the optical system to avoid damage.
- Check the mass of the laser source. When mounting on a high-speed device or acceleration/deceleration device, please contact us.

- Compact and lightweight microscope designed to be built in for camera observation
- Can be used with YAG (near-infrared, visible, near-ultraviolet, or ultraviolet) lasers.*1
- *1 The performance and safety of laser-equipped system products is not guaranteed.
- For **VMU-LB** and **VMU-L4B**, the rigidity and general performance of the microscope main unit have been enhanced compared with previous models.
- Compatible with infrared optical systems*2
- *2 An infrared source and infrared camera are necessary.

VMU SERIES 378 — Microscope unit for incorporating in Equipment

- Telecentric system equipped with an aperture diaphragm is standard on the epi-illumination optical system.
- Design and manufacture are flexible to meet your demands such as double camera mounting or double (low/high) magnification.
- Best suited to process images for which uniform illumination is required.



SPECIFICATIONS

Model No.	VMU-V	VMU-H	VMU-LB	VMU-L4B
Order No.	378-505	378-506	378-513	378-514
Camera mounting direction	Vertical	Horizontal	Vertical (Rotatable)	
Observation	Bright-field/Erect image	Bright-field/Inverted image	Bright-field/Erect image	
Optical tube	TV adapter Image forming (tube) lens Available for lasers	Equipped with a C-mount Built-in 1X (visible/near-infrared calibration)		Equipped with a C-mount (Equipped with a green filter switching mechanism) Built-in 1X (ultraviolet/visibility compensation) YAG laser source (Second/Third/Fourth harmonic) mountable
Objective (optional)	For observation For laser processing	M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo		NIR Series NUV Series UV Series Note 1: Selected depending on the wavelength of the laser source Note 2: Selected depending on the wavelength of the laser source
Applicable camera (s)	2/3 type or less cameras (C-mount type)			
Optical system epi-illumination	Telecentric system equipped with an aperture diaphragm			
Illuminated lens tube	Bright-field illuminated lens tube			
Illumination unit (optional)	Fiber-optic cable illumination unit (100 W) (378-700)			
Main unit mass	650 g	750 g	1270 g	1300 g

Note 3: The **M Plan Apo 1X** objective is used with the polarization unit (**378-710** or **378-715**).



Refer to the Microscope Units and Objectives Brochure (**E14020**) for more details.

- Observation over a wide field of view (Image field of $\phi 30$ mm)
- Greatly enhanced brightness on the periphery of the field of view (Reduces the dependence on the light distribution characteristics.)
- Compatible with infrared optical systems*
- * An infrared source and infrared camera are necessary. For more details on infrared observation, contact your local Mitutoyo sales office.
- Small optical observation system
- Compatible with **HR** series of high resolving power lens (Designed with pupil diameter of $\phi 16.8$ mm)
- Available for various observation methods (Including bright-field, dark-field for visual or scratch inspection, and polarized observation of objects with polarization characteristics)

WIDE VMU

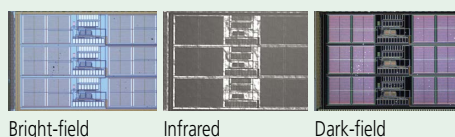


SPECIFICATIONS

	For Bright-field Observation	For Bright/Dark-field Observation	
Model No.	WIDE VMU-HR	WIDE VMU-BDV	WIDE VMU-BDH
Order No.	378-519	378-517	378-518
Camera mounting orientation	Vertical	Vertical	Horizontal
Observation	Bright-field/Erect image	Bright/Dark-field/Erect image	Bright/Dark-field/Inverted image
Optical system	Magnification: 1X Visible light - Near-infrared light	Magnification: 1X Visible light	
Camera Mount	F-Mount, C-Mount (with aligning and parfocal adjustment mechanism)		
Optical tube	Imaging forming (tube) lens Image field Polarized unit*1	Built in 1X (visible - NIR) $\phi 30$ Mountable	Built in 1X (visible)
Objective (required option)	M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo, NIR Series		BD Plan Apo
Applicable camera	Diagonal line length: 30 mm or less (equivalent to APS-C format)		
Optical system epi-illumination	Telecentric (Pupil diameter of $\phi 16.8$) Note: Coaxial epi-illumination, with aperture diaphragm	Telecentric illumination, Bright/Dark-field illumination optical tube (Dual-port fiber-optic illumination) Bright/Dark-field switching with light source on-off	
Illuminated lens tube	Bright-field illuminated lens tube (rotatable)*3, selectable between LED adapter and fiber adapter (both supplied as standard)	Bright-field illuminated lens tube (rotatable)*3	
Illumination unit (optional)*2	Fiber-optic illumination unit (100 W) (378-700)		
Main unit mass	1400 g	2000 g	2150 g

*1 Polarized observation by Bright-field illumination *2 Support for third-party LED illuminators (**WIDE VMU-HR** only)

*3 The fiber (light source) mount orientation can be changed.



Bright-field Infrared Dark-field

Microscopes

FS Objectives

SERIES 378 — Ultra-long working distance Objectives

- **M/BD Plan Apo** (M Plan Apochromat Bright/Dark-field) objectives feature the image evenness over the entire view field needed to achieve high color reproducibility.
- The following objectives support a wide range of wavelength including near infrared, visible, and ultraviolet lasers. Specialty LCD laser objectives are available: **NIR (-HR)** Series (Near-infrared lenses for laser processing featuring ultra-long working distances), **NUV** Series (Near-ultraviolet lenses), **UV** Series (Ultraviolet lenses), and **G Plan Apo** (Cover Glass corrected lenses that allow focusing through a window for vacuum and high temperature applications).
- Uses environment-friendly glass (no lead or arsenic) for the lens material.

BF (Bright-field) for observation/measurement



BD (Bright/Dark-field) for observation/measurement



For near-infrared calibration (NIR)



For near-ultraviolet calibration (NUV)



For the ultraviolet calibration (UV)



Refer to the Microscope Units and Objectives Brochure (E14020) for more details.

Varifocal Lens TAGLENS

- Without changing the required magnification, ultra-high speed variable focal length enables obtaining perfectly focused images in real-time with stress-free operation.
- The time required for auto-focusing is drastically reduced, and the optical system focus range is extended without the expense of a mechanical drive.

TAGLENS-T1

Ultra-high speed, varifocal lens. A dedicated controller and software are equipped as standard.

SPECIFICATIONS

Operating principle	Variable refraction index
Resonance frequency	70 kHz
Effective aperture	ø11 mm*
Transmittance	90% or more (λ400 to 700 nm)*

* The above value are based on optical design theoretically.

Video Microscope Unit VMU-T1

Microscope unit for configuring a varifocal optical system by incorporating TAGLENS-T1, the objective and the camera.

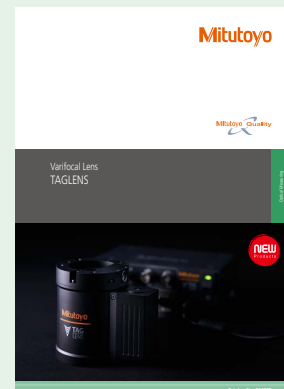
SPECIFICATIONS

Compatible TAGLENS	TAGLENS-T1
Imaging lens magnification	1X
Imaging area	ø11 mm
Applicable objective	M Plan Apo Series
Options	Manual turret, Power turret, Polarizer, Focusing unit A or B, XY stage, Simplified stand.



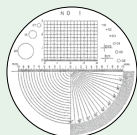
M Plan Apo Series

Objective	1X	2X	5X	7.5X	10X	20X	50X
Depth of focus×2 (mm)	0.88	0.18	0.028	0.012	0.007	0.003	0.0018
Total scanning width (mm)	16	4.0	0.64	0.28	0.16	0.04	0.007
Real FOV							
1/2 inch camera	4.8×6.4	2.4×3.2	0.96×1.28	0.64×0.85	0.48×0.64	0.24×0.32	0.096×0.128
2/3 inch camera	6.6×8.8	3.3×4.4	1.32×1.76	0.88×1.17	0.66×0.88	0.33×0.44	0.132×0.176



Refer to the Varifocal Lens TAGLENS Brochure (E14025) for more details.

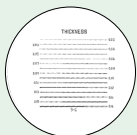
Optional Reticles for pocket comparators



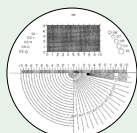
183-141



183-142



183-143



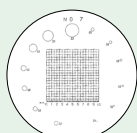
183-144



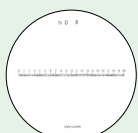
183-145



183-146



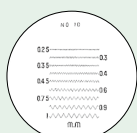
183-147



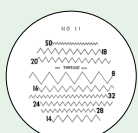
183-148



183-149



183-150



183-151



183-152

Mini Scope
SERIES 183

- Portable and easy to carry. Provides 25X magnification for high-resolution observation.



183-210

SPECIFICATIONS

Magnification	Order No.	Remarks
25X	183-210	Pen type

Note: Not compatible with the interchangeable reticles.

Pocket Comparators
SERIES 183

- By replacing optional reticles, dimensional, angle, and other types of measurement can be performed.



183-140

SPECIFICATIONS

Magnification	Order No.	Remarks
10X	183-140	Optional reticles available

Clear Loupe
SERIES 183

- Three magnification options selectable according to your application.



183-310



183-311



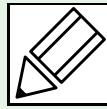
183-312

SPECIFICATIONS

Magnification	Order No.	Remarks
5X	183-310	Drawtube removable
10X	183-311	Drawtube removable
15X	183-312	Drawtube removable

Note: Not compatible with the interchangeable reticles.

Quick Guide to Precision Measuring Instruments



Microscopes

Numerical Aperture (NA)

The NA figure is important because it indicates the resolving power of an objective. The larger the NA value the finer the detail that can be seen. A lens with a larger NA also collects more light and will normally provide a brighter image with a narrower depth of focus than one with a smaller NA value.

$$NA = n \cdot \sin \theta$$

The formula above shows that NA depends on n , the refractive index of the medium that exists between the front of an objective and the specimen (for air, $n=1.0$), and angle θ , which is the half-angle of the maximum cone of light that can enter the lens.

Resolving Power (R)

The minimum detectable distance between two image points, representing the limit of resolution. Resolving power (R) is determined by numerical aperture (NA) and wavelength (λ) of the illumination.

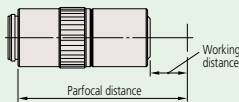
$$R = \frac{\lambda}{2 \cdot NA} \quad (\mu\text{m}) \quad \lambda = 0.55 \mu\text{m} \text{ is often used as the reference wavelength}$$

Working Distance (W.D.)

The distance between the front end of a microscope objective and the surface of the workpiece at which the sharpest focusing is obtained.

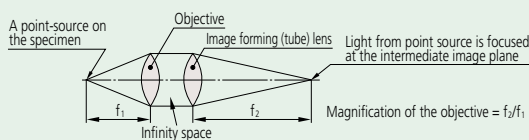
Parfocal Distance

Distance between the surface of the specimen and the objective's seating surface when in focus.



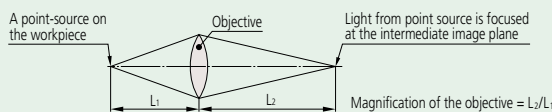
Infinity-corrected Optical System

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.



Finite-corrected Optical System

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



Focal Length (f)

The distance from the principal point to the focal point of a lens; if f_1 represents the focal length of an objective and f_2 represents the focal length of an image forming (tube) lens then magnification is determined by the ratio between the two. (In the case of the infinity-correction optical system.)

$$\text{Objective magnification} = \frac{\text{Focal length of the image-forming (tube) lens}}{\text{Focal length of the objective}}$$

$$\text{Example: } 1X = \frac{200}{200} \quad \text{Example: } 10X = \frac{200}{20}$$

Focal Point

Light rays traveling parallel to the optical axis of a converging lens system and passing through that system will converge (or focus) to a point on the axis known as the rear focal point, or image focal point.

Depth of Focus (DOF)

unit: mm

This is the distance (measured in the direction of the optical axis) between the two planes which define the limits of acceptable image sharpness when the microscope is focused on an object. As the numerical aperture (NA) increases, the depth of focus becomes shallower, as shown by the expression below:

$$DOF(\mu\text{m}) = \frac{\lambda}{2 \cdot (NA)^2} \quad \lambda = 0.55 \mu\text{m} \text{ is often used as the reference wavelength}$$

Example: For an **M Plan Apo 100X** lens (NA = 0.7)

The depth of focus of this objective is

$$\frac{0.55 \mu\text{m}}{2 \times 0.7^2} = 0.6 \mu\text{m}$$

Bright-field and Dark-field Illumination

In bright-field illumination a full cone of light is focused by the objective on the specimen surface. This is the normal mode of viewing with an optical microscope. With dark-field illumination, the inner area of the light cone is blocked so that the surface is only illuminated by light from an oblique angle. Dark-field illumination is good for detecting surface scratches and contamination.

Apochromat and Achromat Objectives

An apochromat objective is a lens corrected for chromatic aberration (color blur) in three colors (red, green, blue). An achromat objective is a lens corrected for chromatic aberration in two colors (red, blue).

Magnification

The ratio of the size of a magnified object image created by an optical system to that of the object. Magnification commonly refers to lateral magnification although it can mean lateral, vertical, or angular magnification.

Principal Ray

A ray considered to be emitted from an object point off the optical axis and passing through the center of an aperture diaphragm in a lens system.

Aperture Diaphragm

An adjustable circular aperture which controls the amount of light passing through a lens system. It is also referred to as an aperture stop and its size affects image brightness and depth of focus.

Field Stop

An aperture which controls the field of view in an optical instrument.

Telecentric System

An optical system where the light rays are parallel to the optical axis in object and/or image space. This means that magnification is nearly constant over a range of working distances, therefore almost eliminating perspective error.

Erect Image

An image in which the orientations of left, right, top, bottom and moving directions are the same as those of a workpiece on the workstage.

Field number (FN), real field of view, and monitor display magnification

unit: mm

The observation range of the sample surface is determined by the diameter of the eyepiece's field stop. The value of this diameter in millimeters is called the field number (FN). In contrast, the real field of view is the range on the workpiece surface when actually magnified and observed with the objective. The real field of view can be calculated with the following formula:

(1) The range of the workpiece that can be observed with the microscope (diameter)

$$\text{Real field of view} = \frac{\text{FN of eyepiece}}{\text{Objective magnification}}$$

$$\text{Example: The real field of view of a 10X lens is } 2.4 = \frac{24}{10}$$

(2) Monitor observation range

$$\text{Monitor observation range} = \frac{\text{The size of the camera image sensor (Length} \times \text{Height)}}{\text{Objective magnification}}$$

Size of image sensor	Format	Diagonal length	Length	Height
	1/3 in	6.0	4.8	3.6
	1/2 in	8.0	6.4	4.8
	2/3 in	11.0	8.8	6.6

(3) Monitor display magnification

Monitor display magnification =

$$\text{Objective magnification} \times \frac{\text{Display diagonal length on the monitor}}{\text{Diagonal length of camera image sensor}}$$