

Microscopes

Microscope lineups that systemize observation, measurement and processing

MF series

SERIES 176 — Measuring Microscopes

- Observation with a clear and flareless erect image along with a wide field of view.
- Measuring accuracy is the highest in its class (and conforms to JIS B 7153).
- ML series, high-NA objectives that are specially designed for the MF series (long working distance type).
- Illumination unit (reflected/transmitted) can be selected from a high-intensity LED or halogen bulb.
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction.
- Variety of standardized stages in sizes up to 400×200mm.
- Quick-release mechanism useful for moving the stage quickly when measuring workpieces that are large in size or quantity.
- Coarse/fine feed handles are as standard on both sides allowing precise focus and observation measurement regardless of handedness.
- High-magnification eyepiece observation up to 2000X.
- Standard measuring microscope that has a wide variety of optional accessories including a Vision Unit and various digital CCD cameras.



MF-B2017C

• The binocular tube (eyepiece) and illumination unit are optional accessories.

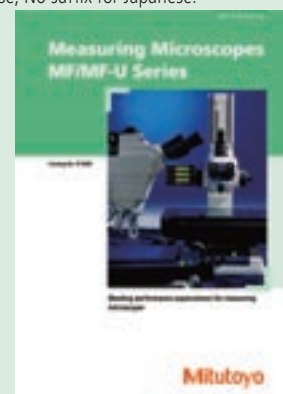
SPECIFICATIONS

X- and Y-axis (2 axes)	Model No.	MF-A1010C	MF-A2010C	MF-A2017C	MF-A3017C	MF-A4020C
	Order No.	176-662*1	176-663*1	176-664*1	176-665*1	176-666*1
X-, Y- and Z-axis (3 axes)	Model No.	MF-B1010C	MF-B2010C	MF-B2017C	MF-B3017C	MF-B4020C
	Order No.	176-682*1	176-683*1	176-684*1	176-685*1	176-686*1
Observation image		BF (Bright field)/Erect image				
Eyepiece	Diopter adjustment	10X (field number: 24), 15X, 20X				
		Note: Monocular unit: a 10X eyepiece (standard accessory), Binocular tube: two 10X eyepieces (standard accessory)				
Objective lens		ML series 3X objective lens (standard accessory), 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), 100 - 240V AC power input connector				
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), stepless light intensity control, With cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, Halogen bulb (12V, 50W), stepless light intensity control, With cooling fan Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector				
XY-axes	Measuring range	100×100mm	200×100mm	200×170mm	300×170mm	400×200mm
Z-axis	Maximum height of workpiece	150mm		220mm		
Measuring accuracy*2	(When no load is put on the X- or Y-axis)	(2.2+0.02L) μm L: Measuring length (mm)				
Digital counter	Resolution	1/0.5/0.1μm .0001"/.00005"/.00001" switchable				

*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 B7153.

**Bulb replacement for transmitted/reflected illumination Standard: Halogen bulb (12V, 50W) (No.513667)
Bulb life: 1,100 hours**



Refer to the MF /MF-U series (Catalog No.E14003) for more details.

MF series (Motorized Type) SERIES 176 — Measuring Microscopes

- Motorized model of the MF Series. The X-, Y- and Z-axes are motorized, and the stage can be operated using a remote box.
- Using the optional Vision Unit enables the image AF function.



MF-G2017D

• The binocular tube (eyepiece) and illumination unit are optional accessories.

- Illumination unit (reflected/transmitted) can be selected from a high-intensity LED or halogen bulb (required).
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction.
- A wide variety of optional accessories including various digital CCD cameras are offered.
- ML series, high-NA objectives that are specially designed for the MF series. (long working distance type)
- High-magnification observation up to 2000X.

SPECIFICATIONS

Model No.		MF-G2017D	MF-G3017D	MF-G4020D
Order No.		176-781*1	176-782*1	176-783*1
Observation image		BF (Bright field)/Erect image		
Eyeiece	Diopter adjustment	10X (field number: 24), 15X, 20X Note: Monocular unit: a 10X eyepiece (standard accessory), Binocular tube: two 10X eyepieces (standard accessory)		
Objective lens		ML series 3X objective lens (standard accessory), 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), 100 - 240V AC power input connector		
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), stepless light intensity control, With cooling fan Reflected illumination: Koehler illumination, Variable aperture diaphragm mechanism, Halogen bulb (12V, 50W), stepless light intensity control, With cooling fan Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector		
Vision AF*2		✓		
XY-axis	Vision Measuring range	200×170mm	300×170mm	400×200mm
Z-axis	Measuring range	220mm		
Measuring accuracy*3	(When no load is put on the X- or Y-axis)	(2.2+0.02L) μm L: Measuring length (mm)		
Digital counter	Resolution	1/0.5/0.1μm .0001"/.00005"/.00001" switchable		

*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 are required for PSE.

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

*3: Measuring method complies with JIS B7153.

**Bulb replacement for transmitted/reflected illumination Standard: Halogen bulb (12V, 50W) (No.513667)
Bulb life: 1,100 hours**



Refer to the MF/MF-U series
(Catalog No.E14003) for more details.

Microscopes

Microscope lineups that systemize observation, measurement and processing

MF-U series

SERIES 176 — Universal Measuring Microscopes

- Observation with a clear and flareless erect image and a wide field of view.
- Measuring accuracy is the highest in its class (and conforms to JIS B 7153).
- Proven high-NA objectives from the FS optical system (long working distance type).
- Integration of metallurgical and measurement microscope functions provide high-resolution observation and a high-accuracy measurement solutions.
- Illumination unit (reflected/transmitted) can be selected from a high-intensity LED or halogen bulb (required).
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction.
- Variety of standardized stages in sizes up to 400x200mm.
- Quick-release mechanism useful for moving the stage quickly.
- Coarse/fine feed handles are standard on both sides allowing precise focus and observation measurement regardless of handedness.
- High-magnification observation up to 4000X.



MF-UB4020C

- The turret, objectives and illumination unit are optional accessories.



Refer to the MF /MF-U series (Catalog No.E14003) for more details.

SPECIFICATIONS

		Model No.	MF-UA1010C	MF-UA2010C	MF-UA2017C	MF-UA3017C	MF-UA4020C
			Order No.	176-668*1	176-669*1	176-670*1	176-671*1
BF (Bright field)	X- and Y-axis (2 axes)	Model No.	MF-UB1010C	MF-UB2010C	MF-UB2017C	MF-UB3017C	MF-UB4020C
		Order No.	176-688*1	176-689*1	176-690*1	176-691*1	176-692*1
BD (Bright / Dark field)	X- and Y-axis (2 axes)	Model No.	MF-UC1010C	MF-UC2010C	MF-UC2017C	MF-UC3017C	MF-UC4020C
		Order No.	176-674*1	176-675*1	176-676*1	176-677*1	176-678*1
	X-, Y- and Z-axis (3 axes)	Model No.	MF-UD1010C	MF-UD2010C	MF-UD2017C	MF-UD3017C	MF-UD4020C
		Order No.	176-694*1	176-695*1	176-696*1	176-697*1	176-698*1
Observation image			BF (Bright field), DF (Dark field) (MF-UC and MF-UD models only), Polarization, Differential Interference Contrast (DIC) / Erect image				
Eyepiece	Diopter adjustment		10X (standard accessory) (Field number: 24), 15X, 20X				
Turret (One of the two options must be selected.)	BF (Bright field)		Parfocal manual turret / Motorized turret (Either of them can be selected.)				
	BD (Bright / Dark field)		Manual turret / Motorized turret (Either of them can be selected.)				
Objective lens (optional)	BF (Bright field)		M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo (All lenses)				
	BD (Bright / Dark field)		BD Plan Apo, D Plan Apo HR, BD plan Apo SL (All lenses)				
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), 100 - 240V AC power input connector				
	Halogen illumination unit		Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), stepless light intensity control, With cooling fan Reflected: BF/BD Kohler illumination with adjustable aperture diaphragm, 12V100W or 12V15W halogen lamp (selectable), external fiber illumination, stepless brightness adjustment Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector				
XY-axis	Measuring range		100x100mm	200x100mm	200x170mm	300x170mm	400x200mm
Z-axis	Maximum height of workpiece		150mm		220mm		
Measuring accuracy*2	(When no load is put on the X- or Y-axis)		(2.2+0.02L) μm L: Measuring length (mm)				
Digital counter	Resolution		1/0.5/0.1μm .0001"/.00005"/.00001" switchable				

*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.

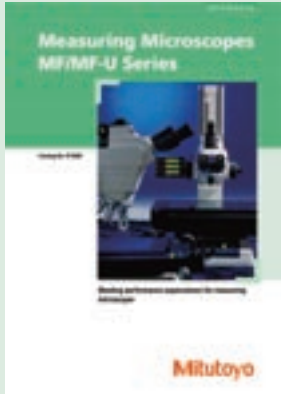
*2: Measuring method complies with JIS B7153.

Bulb replacement for transmitted/reflected illumination Standard: Halogen bulb (12V, 50W) (No.513667), Bulb life: 1,100 hours
For replacement for reflected illumination (from separate light source) Standard: Halogen bulb (12V, 100W) (No.517181),
High-intensity bulb (12V, 100W) (No.12BAD602)

*At the time of purchase, a standard bulb and a high-intensity bulb are provided. (Only for the Reflected illumination models.)

MF-U series (Motorized Type) SERIES 176 — Universal Measuring Microscopes

- Motorized model of the MF-U Series. The X-, Y- and Z-axes are motorized, and the stage can be operated using a remote box.
- Using the optional Vision Unit enables the image AF function.
- Illumination unit (reflected/transmitted) can be selected from a high-intensity LED or halogen bulb (required).
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction.
- A wide variety of optional accessories including various digital CCD cameras are offered.
- Proven high-NA objectives from the FS optical system (long working distance type).
- Integration of metallurgical and measurement microscope functions provides high-resolution observation and a high-accuracy measurement solution.
- High-magnification observation up to 4000X.
- MF-UE/UF is capable of performing Laser AF. The standard Laser AF function is equipped with the tracking function which keeps a focus even when the stage is moving.



Refer to the MF /MF-U series (Catalog No.E14003) for more details.



MF-UE2017D

- The turret, objectives and illumination unit are optional accessories.

SPECIFICATIONS

	Model No.	MF-UG2017D	MF-UG3017D	MF-UG4020D	MF-UE2017D	MF-UE3017D	MF-UE4020D
BF (Bright field)	Order No.	176-784* ¹	176-785* ¹	176-786* ¹	176-790* ¹	176-791* ¹	176-792* ¹
BD (Bright / Dark field)	Order No.	176-787* ¹	176-788* ¹	176-789* ¹	176-793* ¹	176-794* ¹	176-795* ¹
Observation image		BF (Bright field), DF (Dark field) (MF-UC and MF-UD models only), Polarization, Differential Interference Contrast (DIC) / Erect image					
Eyepiece	Diopter adjustment	10X (standard accessory) (Field number: 24), 15X, 20X					
	BF (Bright field)	M Plan Apo, M Plan Apo HR, M Plan Apo SL, G Plan Apo (All lenses)					
Objective lens (optional)	BD (Bright / Dark field)	BD Plan Apo, D Plan Apo HR, BD plan Apo SL (All lenses)					
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, Non-step light intensity control Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector					
	Halogen illumination unit	Transmitted illumination: Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), stepless light intensity control, With cooling fan Reflected: BF/BD Kohler illumination with adjustable aperture diaphragm, 12V100W or 12V15W halogen lamp (selectable), external fiber illumination, stepless brightness adjustment Control unit: Power ON/OFF switch (main switch), 100 - 240V AC power input connector					
Vision AF* ²		✓			✓		
Laser AF* ²		—			✓		
XY-axis	Measuring range	200x170mm	300x170mm	400x200mm	200x170mm	300x170mm	400x200mm
	Z-axis	220mm					
Measuring accuracy* ³	(When no load is put on the X- or Y-axis)	(2.2+0.02L) μm L: Measuring length (mm)					
Digital counter	Resolution	1/0.5/0.1μm .0001"/.00005"/.00001" switchable					

*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 are required for PSE.

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

*3: Measuring method complies with JIS B7153.

Bulb replacement for transmitted/reflected illumination Standard: Halogen bulb (12V, 50W) (No.513667), Bulb life: 1,100 hours
For replacement for reflected illumination (from separate light source) Standard: Halogen bulb (12V, 100W) (No.517181),
High-intensity bulb (12V, 100W) (No.12BAD602)

*At the time of purchase, a standard bulb and a high-intensity bulb are provided. (Only for the Reflected illumination models.)

Microscopes

Microscope lineups that systemize observation, measurement and processing

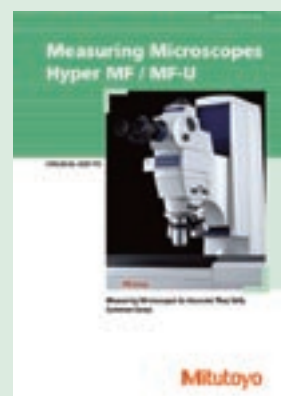
Hyper MF/MF-U SERIES 176 — High-Accuracy Measuring Microscopes

- Ultimate automated world's highest accuracy Measuring Microscope (Minimum display Resolution 0.01 μm).
- The front-operation design of the main unit is based on the concept of UD (universal design).
- Three-axis motorized front operation joystick control, which makes a refreshing change from conventional microscope operation, allows fine positioning even during fast movement.
- User selection of a conventional microscope optical tube or one equipped with built-in Laser AF has improved measurement throughput due to the diversified observation methods available.
- Large workstage with stroke of 250×150mm provides enough margin for the measurement of larger workpieces.
- Utilizes ultra-high-precision glass scales with low thermal expansion and a detector head with high resolution.
- The best-selling data processing unit, QM-Data200, and the Vision Unit can be integrated to provide an effective and stable measurement environment.
- A wafer holder (available for wafers of less than 8") and high rigidity center supports meet the needs for high precision measurement.
- Motorized turret models are equipped with a retracting function that works when the objective lens is changed.



Hyper MF-U

- An optical tube, turret, and objective lens are optional.



Refer to the Hyper MF/MF-U
(Catalog No.E4267) 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				
Standard reticle (Built-in)	90° broken-cross line (line width 5 μm)				
Pupil distance adjustment	Siedentopf type Adjustment range: 51 to 76mm				
Optical path switching ratio	Observation/TVphotomicrography = 50/50				
Vertical tilt angle	25°	Tilting			
TV port	Provided as standard				
Observation image	Erect image				
Eyepiece Magnification	10X, 15X, 20X				
Objective lens (optional)	Selectable from the monocular unit (equipped with an eyepiece) or binocular tube (equipped with two eyepieces)		Equipped with two 10X eyepieces		
ML series objective lens	1X, 3X, 5X, 10X, 20X, 50X, 100X		—		
BF (Bright field)	—		M Plan Apo, M plan Apo SL, G plan Apo		
BD (Bright / Dark field)	—		BD Plan Apo, BD Plan Apo SL		
Turret (optional)	BF (Bright field)		(Equipped with a four-hole manual sensor / motorized five-hole sensor*2)		
BD (Bright / Dark field)	—		(Equipped with a four-hole manual sensor / motorized four-hole sensor*3)		
Focusing section	Maximum height of workpiece 150mm				
Measuring accuracy	(1.5+0.01L) μm L: Measuring length (mm)				
Drive method	Motorized control with the use of a joystick				
Illumination unit	Transmitted illumination device Telecentric system, Built-in aperture diaphragm, Halogen bulb (12V, 50W), 100-step light intensity control, Fiber optics cable cold light illumination				
Reflected illumination unit	Koehler illumination, Variable aperture diaphragm mechanism, Halogen bulb (12V, 100W), 100-step light intensity control, Fiber optics cable cold light illumination				
Workstage	Measuring range (XxY) 250×150mm				
Measuring accuracy*4 (When no load is put on the X- or Y-axis)	(0.9+0.003L) μm L: Measuring length (mm)				
Dimensions of the top plane	460×350mm				
Usable dimensions of the stage glass	300×200mm				
Swiveling angle	±3°				
Maximum loading mass	30kg				
Drive method	Motorized control with the use of a joystick				
Detector	High precision digital scale (Patented)				
Digital display	Resolution 0.01 μm				
Axes to be displayed	X, Y, Z				
Data processing unit	QM-Data200 or Vision Unit				
Operation section	Joystick lock Available				
Fine pitch	Available				
Data output	Available				
Digital display reset	Available				
Illumination light intensity control:	Available				
LAF (just focus)	—	—	—	Available	Available
LAF (tracking focus)	—	—	—	—	—
Turret remote control	—	—	—	Available (when installing a motorized turret)	—
Mass	Microscope main unit Approx. 250kg		Approx. 255kg		
Power unit	14kg		—		
Power supply	100 - 240V AC, 50/60 Hz Maximum power consumption: 700W				

*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 are required for PSE.
*2 and *3 are the factory-installed options.

*4: Measurement accuracy complies with JIS B7153.

When replacing the bulb, please request a halogen bulb for transmitted illumination (12V, 50W) (No.02APA527) or for Reflected illumination (12V, 100W) (No.517181). A high-intensity model (12V, 100W) (No.12BAD602) is also available.

Angle Index (Standard Accessory)



TM-500 series SERIES 176 — Toolmakers' Microscopes

- Compact universal toolmakers' microscope that can be installed on any site.
- Achieves a maximum measuring height of 115mm despite the compact size.
- Installation of digimatic micrometer heads (MHD-50MB) facilitates makes measurement easy and precise.
- A vernier scale (Angle Index) built into the eyepiece mount enables accurate angular measurements.
- Overall magnification is 30X using the standard accessory lenses but can be changed to lie within the 20-200X range by using optional objectives and/or eyepieces.



TM-505



TM-510

* micrometer heads is option.

SPECIFICATIONS

Model No.	TM-505 (Without Micrometer head)		TM-510 (Without Micrometer head)	
Order No.	176-811*1		176-816*2	
Order No.	176-816*2		176-812*1	
Order No.	176-812*1		176-817*2	
Optical tube	Monocular type (Vertical tilt angle: 30°)			
Observation image	Erect			
Protractor	Resolution(gradation):1°, Resolution(angle): 6', Rotation angle: 360°, Adjustable zero point			
Eyepiece	15X (standard accessory), 10X, 20X			
Objective lens	2X (standard accessory), 5X, 10X			
Focusing section	Maximum height of workpiece	115mm		107mm
	Focusing method	Manual (Coarse feed)		
Illumination unit	Transmitted illumination	Stepless brightness adjustment, Tungsten bulb (24V, 2W) (No.383038), With green filter		
	Surface illumination	Oblique single-source type, Stepless brightness adjustment, Tungsten bulb (24V, 2W) (No.383038)		
Cross-travel stage	Measuring range	50×50mm		100×50mm Combination use with a 50mm CERA block
	Table size	152×152mm		240×152mm
	Usable area of the stage glass	96×96mm		150×92mm
	Maximum stage glass loading	5kg		
Measuring method	Micrometer head			
Resolution	Depends on the micrometer head specifications*3 (for MHD-50MB: 0.001mm)			
Micrometer head travel range	Depends on the micrometer head specifications*3 (for MHD-50MB: 50mm)			
Power supply	100/110/120/220/230/240V AC	220/230/240V AC		100/110/120/220/230/240V AC
	50/60Hz	Maximum power consumption: 15W		
Main unit weight	14kg		15kg	

Note: The main unit with digimatic micrometer head(MHD-2"MB) is provided in the TM-500 series. To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA.

Model TM-505D (176-808)

Model TM-510D (176-809)

Other specifications are the same as the other TM-500 Series.

*1: The Main unit is NOT compatible with CE. To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, E for BS, C and No suffix are required for PSE.

*2: The main unit is compatible with CE. To denote your AC power cable add the following suffixes to the order No.: D for CEE, DC for CCC, E for BS, K for KC.

*3: Micrometer heads is option.

Spare bulb No.383038 (24V, 2W incandescent for transmitted/reflected illumination)

Microscopes

Microscope lineups that systemize observation, measurement and processing

QM-Data200

SERIES 264 — 2-D Data Processing Unit

- 2-D 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.
- One-key operation for combined measurements (circle-circle distance, etc.).
- 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 the user to register measurement commands or part programs to create custom menus.
- Tolerance zone testing of data processing results and various statistical processing routines for each item are available.
- Measurement result output to "MS-Excel"* in spreadsheet (CSV) format.
* Microsoft Excel is a registered trademark of Microsoft Corporation.
- Part programs and calculation results can be saved on a USB-compatible memory device.
- Two models are available: a stand-alone type with tilt system, and a flexible arm type that can be mounted on a Profile Projector.



QM-Data200
(stand type)

SPECIFICATIONS

Model No.	QM-Data200		
Order No.	Standard type	Flexible arm type	Standard type
	264-155* ¹	264-156* ¹	264-159* ¹
Applicable models (Conventional models)* ²	PJ-A3000 series PJ-H30 series PV-5110 PH-3515F PH-A14 MF series MF-U series	PJ-A3000 series PJ-H30 series PV-5110 PH-3515F PH-A14	HyperMF/MF-U
Unit of measurement	Length: mm Angle: Switchable between decimal degree and sexagesimal notation		
Resolution	0.1μm		0.01μm
Program function	Creating, performing, and editing of the 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 a backlight)		
ABS point	—		Available (Automatic movement)
LAF (Laser AF)	—		Available
Edge sensor position correction	Available (Profile Projectors with OPTOEYE)		—
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, Cheskey, Chinese (simplified/traditional), Korean, Turkish, Swedish, Polish, Dutch, Hungarian)		
Power supply	100 - 240V AC		
Maximum power consumption	17W (excluding optional accessories)		
External dimensions (W×H×D)	260×242×310mm (including the stand section)	318×153×275mm (when the arm is horizontal)	260×242×310mm (including the stand section)
Mass	Approx. 2.9kg	Approx. 2.8kg	Approx. 2.9kg
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 are required for PSE, and 00 for power cord other than A, D, E, K, C, No suffix.

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



Refer to the QM-Data200 and Vision Unit
(Catalog No.E14008) for more details.

Vision Unit SERIES 359 — Vision System Retrofit for Microscopes

- Installation of this unit can upgrade your measuring microscope to a vision measuring machine.
- 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 focus pilot provides high-accuracy in height measurements.



MF-G2017D plus Vision Unit



Foot switch
12AAJ088

SPECIFICATIONS

	Vision Unit
Magnification of the optical system	When installed on the microscope 0.5X (using the 0.5X TV adapter)
Image detection	High-sensitivity 1/2" color CMOS camera 3 million pixels
Resolution	0.1 μ m
Measuring accuracy for each axis (Measurement environment: 20°C)	Depends on the accuracy specification of the Mitutoyo measuring microscope to which the unit is fitted.
Accuracy (Measurement environment: 20°C)	Depends on the accuracy of Mitutoyo measuring microscopes. For reference: When using an ML series 3X objective lens (In an inspection using a sample workpiece based on the Mitutoyo standards) Measurement accuracy in the screen: Less than $\pm 2.5\mu$ m Repetitive accuracy in the screen ($\pm 2\sigma$): Less than $\pm 1\mu$ m
Software (option)	QSPAK Vision Unit Edition

Note: QSPAK and a data processor are required separately.

Applicable Models

- Mitutoyo **MF series**, **MF-U series** (Connection to the **MF-H series** is not available.)
Hyper MF series, **Hyper MF-U series**



Refer to the QM-Data200 and Vision Unit
(Catalog No.E14008) for more details.

Microscopes

Microscope lineups that systemize observation, measurement and processing

FS-70 series

SERIES 378 — Microscope Unit for Semiconductor Inspection

- Compact microscope unit equipped with an eyepiece observation section. Suitable for inspecting metal surfaces, semiconductors, liquid crystal substrates, resin, etc.
- A versatile microscope head typically used as an OEM product suitable for fitting to specialist machines, such as those designed for inspection and repair of semiconductor wafers using YAG (near-infrared, visible, near-ultraviolet, or ultraviolet) lasers*.
- * The performance and safety of the laser-equipped system products is not guaranteed. Applications: cutting, trimming, correcting, marking of semiconductor circuits / clearing & processing of thin films (insulation films), repairing (correcting failure) of liquid crystal color filters. Also suited for use as the optical observation section for a probe analyzing semiconductor failures.
- Usable in infrared optical systems*. Applications: internal observation of silicon systems; spectral characteristics analysis using infrared. * An infrared source and infrared camera are necessary.
- Models supporting BF (Bright field), DF (Dark field), Polarization, and Differential Interference Contrast (DIC) are available.
- Koehler illumination equipped with an aperture diaphragm is provided as standard on the surface illumination optical system.
- The inwardly slanting turret and ultra-long working distance objective lens maintains the high operability under the microscope. Koehler illumination is equipped with the aperture diaphragm as standard on the surface illumination optical system.



*A parfocal manual turret, eyepiece and objective lens are optional.

SPECIFICATIONS

Model No.	FS70	FS70-TH	FS70Z	FS70Z-TH	FS70L	FS70L-TH	FS70L4	FS70L4-TH
Order No.	378-184-1	378-184-3	378-185-1	378-185-3	378-186-1	378-186-3	378-187-1	378-187-3
Short base model No.	FS70-S	FS70-THS	FS70Z-S	FS70Z-THS	FS70L-S	FS70L-THS	FS70L4-S	FS70L4-THS
Order No.	378-184-2	378-184-4	378-185-2	378-185-4	378-186-2	378-186-4	378-187-2	378-187-4
Focus adjustment	50mm travel range with concentric coarse (3.8mm/rev) and fine (0.1mm/rev) focusing wheels (right / left)							
Image	Erect image							
Optical tube type	Siedentopf, adjustable interpupillary distance range: 51 - 76mm							
Field number	24mm							
Tilt angle	—	0° - 20°	—	0° - 20°	—	0° - 20°	—	0° - 20°
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)				
Protective filter	—				Built-in laser beam filter			
Tube lens	1X		1X - 2X zoom		1X			
Applicable laser	—				1064/532/355nm		532/266nm	
Camera mount	C-mount (using optional adapter B*1)				Use a laser with TV port.		C-mount receptacle (with green filter switch)	
Illumination system, optional	Reflective illumination for bright field (Koehler illumination, with aperture diaphragm) 12V 100W fiber-optics, stepless adjustment, light guide length: 1.5m							
Objective, optional (for observation)	M Plan Apo, M Plan Apo SL, G Plan Apo							
Objective, optional (for laser-cutting)	—				M/LCD Plan NIR, M/LCD Plan NUV		M Plan UV	
Loading *2	14.5kg	13.6kg	14.1kg	13.2kg	14.2kg	13.5kg	13.9kg	13.1kg
Mass (main unit)	6.1kg	7.1kg	6.6kg	7.5kg	6.4kg	7.2kg	6.7kg	7.5kg

*1: Installation is optional.

*2: Loading on optical tube excluding weight of objective lenses and eyepieces

Bulb replacement Standard: Halogen bulb (12V, 100W) (No.517181) For the fiber optics cable illumination unit (12V, 100W) (No.378-700)

VMU SERIES 378 — Video Microscope Unit

- Compact and lightweight microscope unit dedicated observation by camera. Suitable for inspecting metal surfaces, semiconductors, liquid crystal substrates, resin, etc.
- A versatile microscope head typically used as an OEM product suitable for fitting to specialist machines, such as those designed for inspection and repair of semiconductor wafers using YAG (near-infrared, visible, near-ultraviolet, or ultraviolet) laser*.
 - * The performance and safety of the laser-equipped system products is not guaranteed.
 - Applications: cutting, trimming, correcting, marking of semiconductor circuits / clearing & processing of thin films (insulation films), repairing (correcting failure) of liquid crystal color filters. Also suited for use as the optical observation section for a prober analyzing semiconductor failures.
- For VMU-LB and VMU-L4B, the rigidity and general performance of the microscope main unit have been enhanced compared with previous models.
- Applications*: internal observation of silicon systems, spectral characteristics analysis using infrared, etc.
 - * An infrared source and infrared camera are necessary.
- Telecentric system equipped with an aperture diaphragm is standard on the surface illumination optical system. Best suited to process images for which the uniform illumination is required. Available for the dimensional measurement, form inspection, positioning, etc.
- Design and manufacture are available to meet your demands such as double camera mounting, double (low/high) magnification.



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	Vertical
Observation	Bright field/Erect image	Bright field/Inverted image	Bright field/Erect image	Bright field/Erect image
Optical tube	TV adapter	Equipped with a C-mount		Equipped with a C-mount (Equipped with a green filter switching mechanism)
	Image forming (tube) lens	Built-in 1X (visible/near-infrared calibration) zoom		Built-in 1X (near-infrared/visible/near-ultraviolet calibration) zoom Built-in 1X (visible/ultraviolet) zoom
Available for lasers	—		YAG laser source (Basic, Second/Third harmonic) mountable	YAG laser source (Second/Third/Fourth harmonic) mountable
For observation	M Plan Apo series, M Plan Apo HR series, M Plan Apo SL series, G Plan Apo series			
Objective lens (required option)	—		M/LCD Plan Apo NIR series M/LCD Plan Apo NUV series Note: Selected depending on the wavelength of the laser source	M/LCD Plan Apo NIR series M/LCD Plan Apo NUV series M Plan UV series Note: Selected depending on the wavelength of the laser source
Applicable camera(s)	2/3" or less cameras (C-mount type)			
Reflected illumination optical system	Telecentric system equipped with an aperture diaphragm			
Illumination unit (optional)	Fiber optics cable illumination unit (12V, 100W) (No.378-700*)/(15V, 150W) (No.176-316*)			
Main unit weight	650g	750g	1270g	1300g

Note1: Besides the models shown above, products equipped with a compact Koehler illumination system intended for general observation are also available.

Note2: The **M Plan Apo 1X** objective lens is used with the polarization unit (No.378-710).

* Order numbers differ depending on the power supply cord.

Microscopes

Microscope lineups that systemize observation, measurement and processing

FS series objective lens

SERIES 378 — Ultra-long working distance objective lens

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

BF (Bright field) for observation/measurement



BD (Bright / Dark field) for observation/measurement



For near-infrared calibration (NIR series)



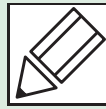
For near-ultraviolet calibration (NUV series)



For the ultraviolet calibration (UV series)



Quick Guide to Precision Measuring Instruments



Microscopes

Numerical Aperture (NA)

The NA figure is important because it indicates the resolving power of an objective lens. 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.

$$R = \frac{\lambda}{2 \cdot NA} \text{ (}\mu\text{m)}$$

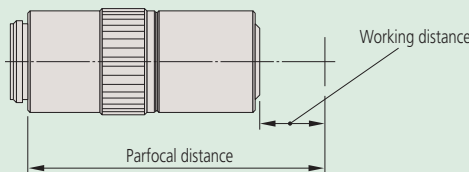
$\lambda = 0.55\mu\text{m}$ is often used as the reference wavelength

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.

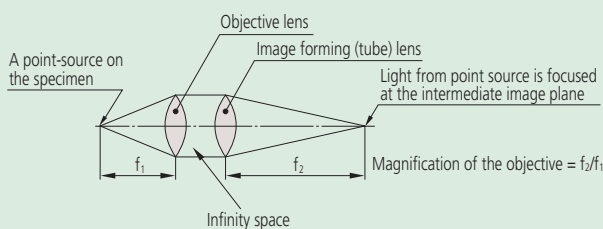
Parfocal Distance

The distance between the mounting position of a microscope objective and the surface of the workpiece at which the sharpest focusing is obtained. Objective lenses mounted together in the same turret should have the same parfocal distance so that when another objective is brought into use the amount of refocussing needed is minimal.



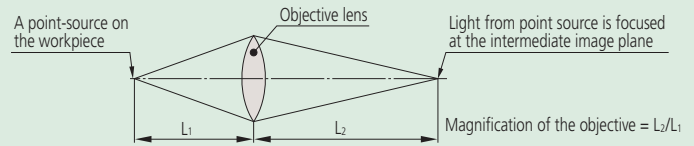
Infinity Optical System

An optical system where the objective forms its image at infinity and a tube lens is placed within the body tube between the objective and the eyepiece to produce the intermediate image. After passing through the objective the light effectively travels parallel to the optical axis to the tube lens through what is termed the 'infinity space' within which auxiliary components can be placed, such as differential interference contrast (DIC) prisms, polarizers, etc., with minimal effect on focus and aberration corrections.



Finite Optical System

An optical system that uses an objective to form the intermediate image at a finite position. Light from the workpiece passing through the objective is directed toward the intermediate image plane (located at the front focal plane of the eyepiece) and converges in that plane.



Focal Length (f)

unit: mm

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

Also known as 'depth of field', 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:

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

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 Illumination and Dark-field Illumination

In brightfield 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 darkfield illumination, the inner area of the light cone is blocked so that the surface is only illuminated by light from an oblique angle. Darkfield 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, blue, yellow).

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

A stop 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 lens.

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)

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

Example: The real field of view of a 1X lens is $24 = \frac{24}{1}$
The real field of view of a 10X lens is $2.4 = \frac{24}{10}$

(2) Monitor observation range

$$\text{Monitor observation range} = \frac{\text{The size of the camera image sensor (diagonal length)}}{\text{Objective lens magnification}}$$

• Size of image sensor

Format	Diagonal length	Length	Height
1/3"	6.0	4.8	3.6
1/2"	8.0	6.4	4.8
2/3"	11.0	8.8	6.6

(3) Monitor display magnification

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

