Mitutoyo

Mitutoyo Quality

Varifocal Lens
TAGLENS™

NEW Products

TAGLENS

Ultra-deep focus eliminates the limitations of the conventional lens

Optical imaging can be complicated: observation target distance may vary due to a tilt or complex geometry, target may be in motion, and more than one target may be captured in the frame. In such situations, TAGLENS keeps the entire imaging volume in focus resolving the inevitable problem of the conventional optical systems. Omnifocal shooting provides improved productivity through enhanced imaging efficiency and reduced costs.

TAGLENS-T1

Ultra-high-speed varifocal lens.
A dedicated controller and a control software TAGPAK-C are offered
as a standard product.

TAGLENS main unit

Resonance frequency	70 kHz
Effective aperture	ø11 mm
Transmittance	90% or more (λ 400 nm to 700 nm)
Max. amplitude of optical power	1 D (total range 2D)
Min. amplitude of optical power	0.7 D (total range 1.4D)
Mounting angle	Any
Guaranteed operational temperature range	15 ℃ to 30 ℃
Operating Environment / Humidity	10 ℃ to 40 ℃ / 40% to 70% RH (non-condensing)
Storage Environment / Humidity	-10 ℃ to 50 ℃ / 80% RH or less (non-condensing)
Mass	Approx. 0.6 kg

Controller

Dimensions（W×D×H）	144.2 mm × 107 mm × 51.2 mm
Mass	Approx. 0.4 kg
Input	+12V (Attached AC adapter)
Power supply voltage	AC 100 V to 240 V 50 Hz / 60 Hz
Power consumption	Max. 20 W

Video Microscope Unit　VMU-T1

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

Tube lens magnification	1X
Imaging FOV (diagonal)	ø11 mm
Applicable objective lenses	M Plan Apo Series
Options	Manual turret, Power turret, Polarizer and Analyzer, Focusing unit, X-Y stage, Simple stand

■ Variable focal length range

Objective lens	M Plan Apo Series						
	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
Z scan range (mm)	16	4	0.64	0.28	0.16	0.04	0.007
Real FOV (mm) 1/2" 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
Real FOV (mm) 2/3" 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

Note: Not available for M Plan Apo HR 5X and 10X.
* Total in focus range without TAGLENS.

Illumination light source: Pulsed Light Source (PLS)

In combination with TAGLENS-T1, this ultra-high-speed LED pulsed light
source device captures focused images at the desired height as well as focus
stacking, etc.
Using this product and TAGLENS software (TAGPAK-C), you can adjust the
brightness and focus position.

Lighting system		Pulsed lighting
Luminous color		White
Maximum light output[*1]		30 lm
Dimming range		0 to 100 %
Dimming system (Controlled by TAGPAK-C)		1) Variable input pulse width 2) Pulse decimation
Light guiding system		Optical fiber light guide system
Number of optical fiber output channels		1 ch
Pulse input Trigger IN jack	Frequency (resonant frequency of the TAGLENS-T1)	75 kHz or less
	input pulse width	10 ns to 85 ns
Pulse output	Optical pulse width (full width at half maximum) [*2]	50 ns to 100 ns
Extenal trigger input [*3]		· Trigger IN: Periodic signal from the TAG controller Input synchronized pulse signal · Camera IN: Camera trigger signal (as needed)
Interface		USB 2.0
Power consumption		Max. 25W
Operating temperature range		5 to 40 ℃,80 % RH max.
Dimensions		169.2 mm (W) × 133.2 mm (D) × 115.6 mm (H)
Mass		2.7 kg

*1 Lighting frequency: 70 kHz, Input pulse width: 80 ns Light guide: 2 m long, multicomponent glass fiber
*2 Width of emission pulse (Varies with input pulse width)
*3 SMB connector, 5V TTL

APPLICATIONS

TAGLENS gives prompt solutions to problems in inspection and observation.
Some application examples using TAGLENS are introduced hereafter.

Inspection of electronic / precision components

Problem

- Inspection time for electronic and precision parts, etc., needs to be reduced.
- Equipment costs need to be reduced.

Solution

- A large depth of focus even in a high-magnification observation eliminates the need for focus adjustment, improving the inspection efficiency.
- Eliminates the use of a mechanical auto focus drive unit, achieving cost saving of inspection devices.

Proposed Functions

- EDOF ・ Auto Focus
- Multi Focus ・ Focus Stacking ・ TAGLENS-3D

Example: Semiconductor flaw inspection
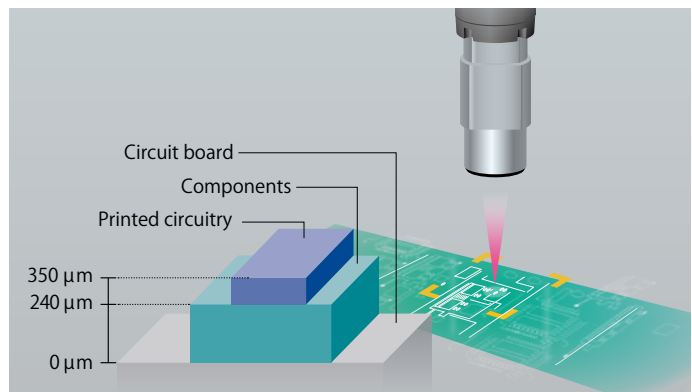
Eliminates the need for focus adjustment, thus achieving effective inspection.

High-speed imaging

Problem

- Instantaneous shooting of a crash test results in defocusing of scattered chips.
- Completion with a single trial is needed because of destructive test.

Solution

- Allows shooting of deep images at a time, thus capturing all scattered chips.

Proposed Functions

- EDOF ・ Focus Stacking

Example: Crash test
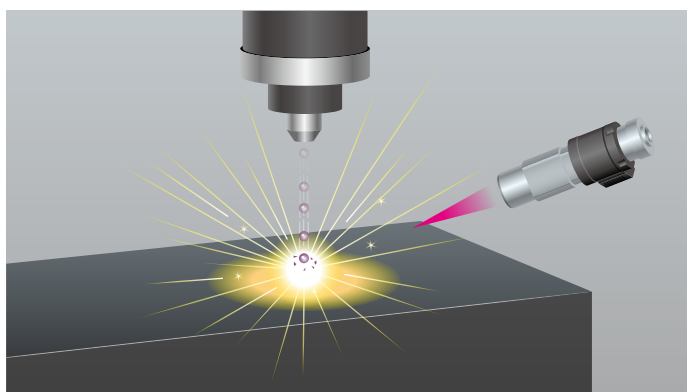
The high-speed shooting of a costly crash test is successfully completed at one try thanks to a large depth of focus.

Machine vision

· Observation target heights and distances require the use of robots, leading to a complex and expensive system.
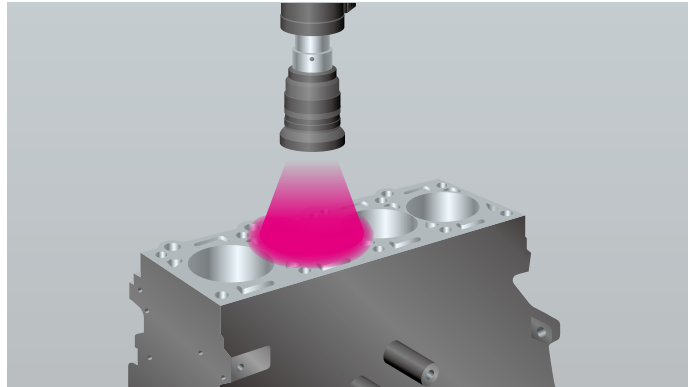
Solution

· Excellent focus expansion effects and long scan range.
· Wide field of view
· Realizes reduced system costs.

Proposed Functions

· Auto Focus · Multi Focus · Mixed Image
· TAGLENS-3D · EDOF

Example: Inspection of large parts for defects

Distant observation is possible with a machine vision lens

Measurement of minute particles and floating matter

Problem

· The 3D positions of particles cannot be captured.
· The deeply-located particles cannot be focused sharply.
· Focus on floating matter in liquids is not possible.

Solution

· Allows all the particles spread in a wide range to come into focus.
· Enables the 3D positions of spatially-moving particles to be determined from each focusing position.
· TAGLENS can be used in microfluidic channels.

Proposed Functions

· Auto Focus · Multi Focus · Mixed Image
· TAGLENS-3D

Example: Observation of minute bubbles in glass / liquid
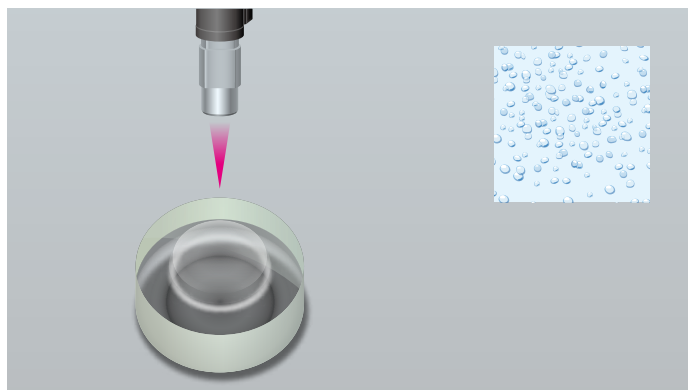
Absolutely allows observation of target objects with a large depth of focus.

On a robot

Problem

· It takes time to observe a workpiece from various angles with the camera mounted on a robot arm.
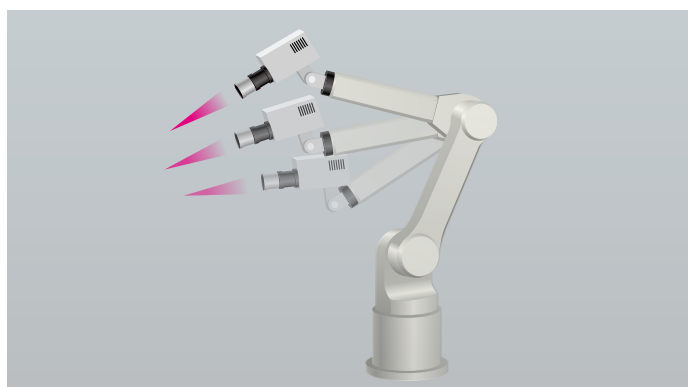
Solution

· The large depth of focus eliminates the need for focus adjustment and allows observation from various angles, thus contributing to time-saving of observation.

Proposed Functions

· EDOF · Multi Focus · Mixed Image

Example: Inspection using a robot.

Allows inspection of a workpiece with the camera mounted on a robot arm.

ABILITY

TAGLENS, the breakthrough ultra-fast varifocal lens, will always keep your sample in focus, enabling the highest observation and measurement efficiency.

Function List

	EDOF	3ch	Mixed Image	Multi Focus	Focus Stacking	TAGLENS-3D
Function	All-focused image generation	Arbitrary cross-section observation	Simultaneous observation of multiple focal planes within one frame	Simultaneous observation of multiple focal planes in individual windows	All-focused image generation	3D display height map generation
Lighting equipment	Continuous light source	Pulsed light source	Pulsed light source	Pulsed light source	Pulsed light source	Pulsed light source
Image quality	Good	Excellent	Very good	Excellent	Excellent	—
Throughput	Fast: Postprocessing is also possible	Very fast	Very fast	Fast: Depends on number of divisions	Fast: Depends on number of stacked images	Good
Height output	—	—	—	—	—	Available

Improve inspection efficiency using TAGLENS with its ultra-wide focus range

EDOF (Extended Depth of Focus)

The focus range is variable without changing the camera position

Until now, imaging of objects with differing heights and depths was performed by taking multiple photographs while moving the camera vertically (Z-axis motion). In contrast, TAGLENS allows simultaneous probing of multiple heights or depths. Moreover, a captured image is displayed in real time.

During normal focusing

When using TAGLENS
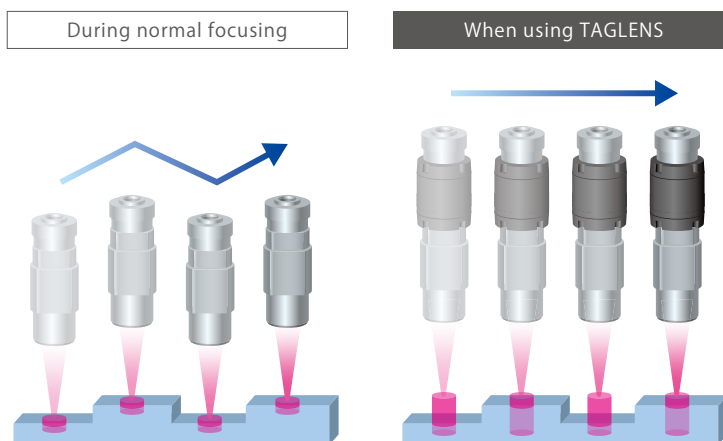
Multi Focus

Up to 20 cross-sectional images at arbitrary heights can be captured simultaneously

· A focused image in any specified Z-position can be captured without mechanical drive system within the observation range at an extended depth of focus.

· Multiple images focused in given Z-positions can be captured.

Capturing various Z planes is now possible without moving parts
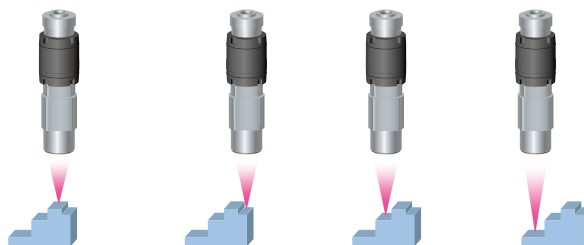
TAGLENS-3D/Z-Adjust

3D shapes can be captured without mechanical action in the height direction

・Select Z-Adjust with dedicated chart or Nominal Z-Adjust with theoretical values.
・Using the height information obtained from Z-Adjust/Nominal Z-Adjust for TAGLENS-3D, point cloud data can be generated.
*Z-Adjust can be used only in combination with VMU-T1.
*3D shape data display/analysis software is to be prepared by the customer.

500 μm
Base GB
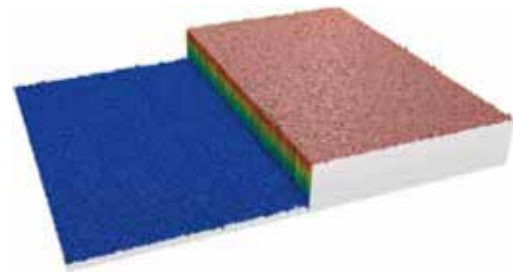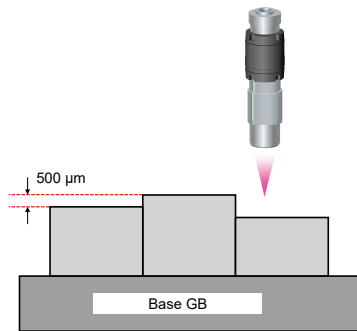
2D image composite from Z-stack and 3D image
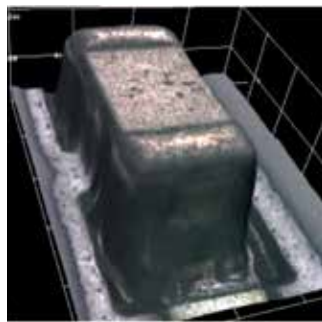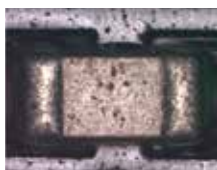
Furthermore, 3D imaging with the aid of commercial 3D Viewer software
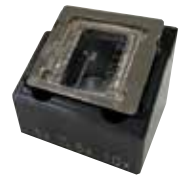
Dedicated Chart for Z-Adjust

For 1X   For 2X   For 5X / 7.5X / 10X

Auto Focus

High-speed focusing without mechanical action

・Contrast peak position is determined from the images captured during the focal sweep.
・After image acquisition, It takes only 10 ms to determine the focus position.
*With Mitutoyo demonstration system

Objective Lens M Plan Apo	1X	2X	5X	7.5X	10X	20X
Depth of focus (DOF) [mm] without TAGLENS-3D	0.88 (± 0.44)	0.18 (± 0.09)	0.028 (± 0.014)	0.012 (± 0.006)	0.007 (± 0.0035)	0.003 (± 0.0015)
TAGLENS Scan Range [mm]	16	4.0	0.640	0.280	0.160	0.040
AF Range [mm] with TAGLENS-3D ( ) shows extension ratio with normal objective lens	12 (13.6 times)	3.0 (16.6 times)	0.500 (17.8 times)	0.225 (18.8 times)	0.120 (17.1 times)	0.025 (8.3 times)

Focus Stacking

All-focused images generated from multiple cross-sectional images

· Contrast peak position is extracted and synthesized from images captured while changing focal position (image stack).
· After obtaining the image stack, output to other companies' focus stacking software is also possible.
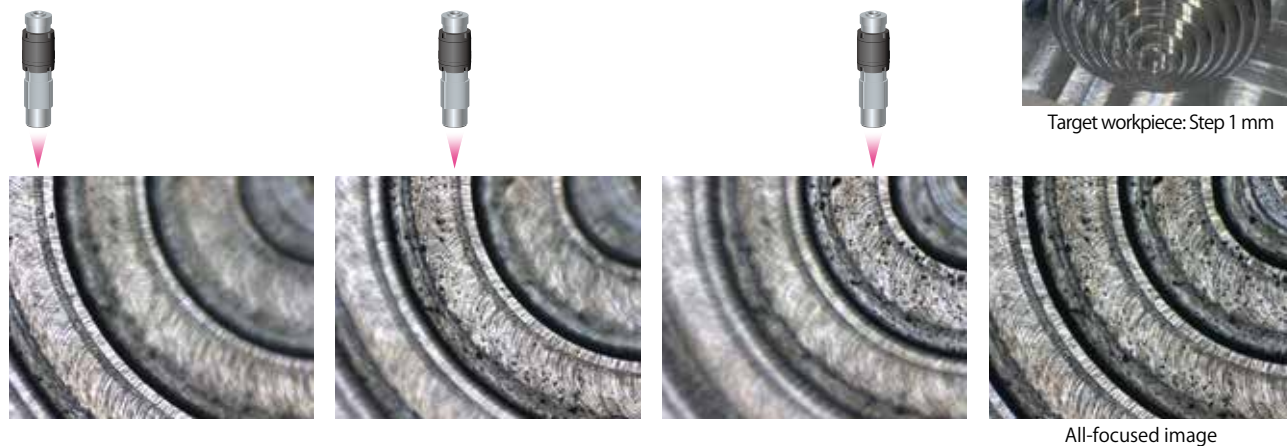*Image upload file type varies by company specifications

Target workpiece: Step 1 mm

All-focused image

Image Stacking Range (Z range)

As well as 1X to 20X objective lenses, 50X, HR50X, SL20X, and SL50X can also be used.

| Objective Lens M Plan Apo	1X	2X	5X	7.5X	10X	20X
Depth of focus (DOF) [mm] without TAGLENS	0.88 ($\pm$ 0.44)	0.18 ($\pm$ 0.09)	0.028 ($\pm$ 0.014)	0.012 ($\pm$ 0.006)	0.007 ($\pm$ 0.0035)	0.003 ($\pm$ 0.0015)
Stacking range [mm] with TAGLENS ( ) shows extension ratio with normal objective lens	16 (18.2 times)	4.0 (22.2 times)	0.640 (22.8 times)	0.280 (23.3 times)	0.160 (22.8 times)	0.040 (13.3 times)

Mixed Image

Up to 3 cross-sectional images can be mixed for display within one frame

· Multiple height observation with TAGLENS at camera maximum frame rates.
· Ideal for observation targets requiring different brightness, as multiple pulsed light sources can be exposed within one frame.

TAGLENS ON
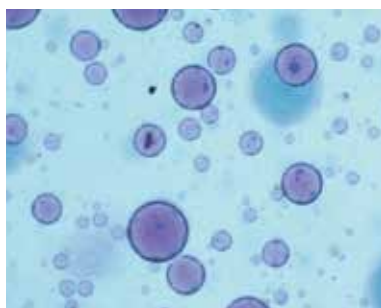
TAGLENS OFF

SOFTWARE

TAGPAK-C Supplied as standard

TAGPAK-C is software for setting the parameters to control "TAGLENS" and "Pulsed Light Source for TAGLENS".
This is included "TAGLENS-T1".

Software for setting the parameters controlling TAGLENS and Pulsed Light Source (PLS) for TAGLENS.

Pulse output functions in available for the following modes:

Multi Focus, Mixed Image, and 3ch.

As well, a software development kit (SDK) is included to enable use of functions such as Auto Focus, Focus Stacking, TAGLENS-3D, and Z-Adjust, thus making it easy to equip on the system in use.

*The software required to use this function is to be prepared by the customer.

*To view camera images, use the optional TAGPAK-E Viewer function or prepare a viewer compatible with the camera in use.

TAGPAK-E Optional Software (Required for checking the inspection images.)

With a function converting images captured with a TAGLENS-enabled optical system into extended depth of focus images (EDOF images),
various EDOF image-related parameters can be set and images can be saved and uploaded. (I/O-enabled still image file types are .bmp, .tiff, .png, and .jpeg)
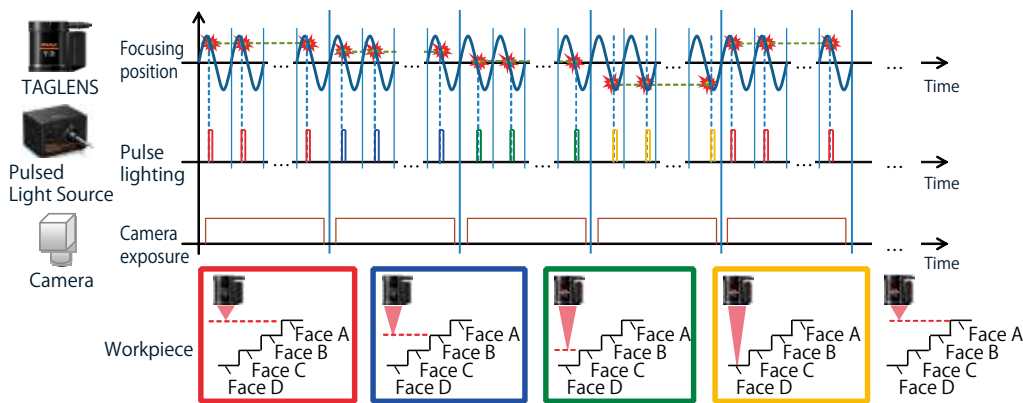*EDOF: Extended Depth of Focus
Viewer functions in available for the following modes:
EDOF, Multi Focus (up to 4 cross-sections), Mixed Image.
This software is included as standard in the TAGLENS-T1 E Set.
*Compatible camera interfaces: USB3 Vision, GigEVision
*To use the Multi Focus function, a separate camera trigger cable is required.

Items			System specifications
OS			Windows10 Pro 64bit
PC	CPU	Clock frequency	2.0 GHz or more
	Memory		8 GB or more
	Hard disk		25 GB or more
	Optical Drive		DVD-ROM Drive for installation software
	Communication port	For TAGLENS control	USB 2.0 × 1 port or RS-232C × 1 port
		For Pulsed Light Source control	USB 2.0 × 1 port
		For camera control	LAN (1000BASE-T) × 1 port (for GigE VISION camera)
			USB 3.0 × 1 port (for USB3 VISION camera)
		Dongle	USB 2.0 × 1 port
Monitor			SXGA(1024×768 Pixel) or more Note: TAGPAK does not support High DPI monitor.

Note 1: PC is not included.
Note 2: For TAGPAK-E, some functions are available as SDK (Software Development Kit), enabling their integration into your software.
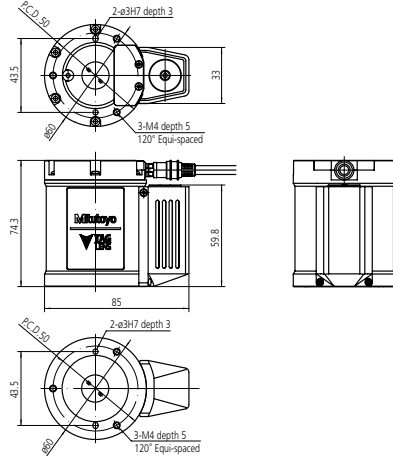*When using only TAGPAK-C, use a camera driver provided by the manufacturer to control the camera.
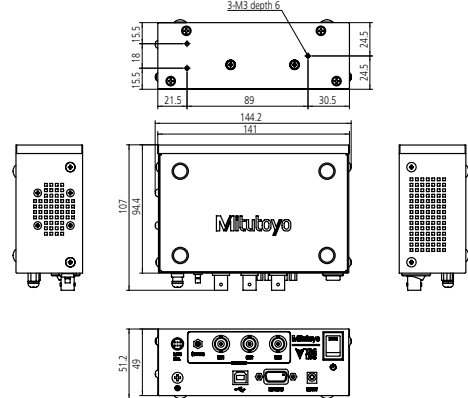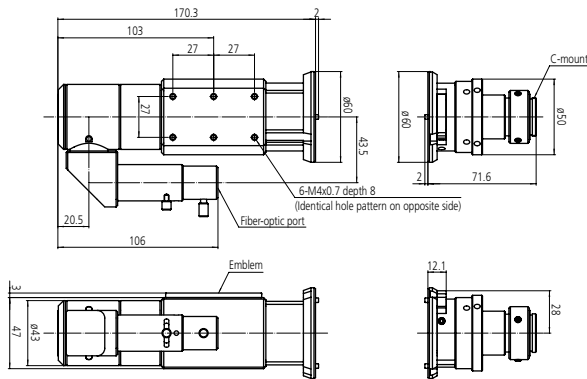
DIMENSIONS

TAGLENS-T1

＜Main unit＞

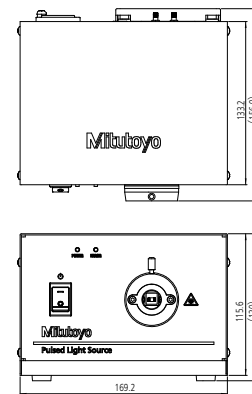＜Controller＞

VMU-T1

Pulsed Light Source　PLS

［ System diagram ］

TAGLENS-T1 379-010-1A		
TAGLENS-T1 E-SET*1 379-011-1A		

VMU-T1 379-110

Focus unit A 378-705 ／ Simple stand 378-730 ／ X-Y stage 378-020

USB3 Vision or GiGE Vision supported camera (C mount)
e.g. 1.3-megapixel USB color camera / Camera connecting cable C531-043 / C177-045

Objective
M Plan Apo Series

Manual turret 378-707 ／ Aligning motor revolver 378-713 ／ Revolver for VMU (aligning, parfocal) 378-717

Pulse lightning
Pulsed Light Source / Light guide*2 379-200A

Continuous lightning
LED light source / Light guide*2 Please contact Mitutoyo.
LED RING (for FS Objectives) Please contact Mitutoyo.
Halogen fiber-optic Illumination unit 100 W*3 378-700*4
Halogen fiber-optic Illumination unit 150 W*3 176-316*4

Polarized unit 378-710

Transmitted light unit 378-736

TAGLENS chart 1X Set *5 02AVB772 ／ TAGLENS chart 2X Set *5 02AVB773 ／ TAGLENS chart 5 to 10X Set *5 02AVB774

TAGLENS chart 1X 02AVB740 ／ TAGLENS chart 2X 02AVB769 ／ TAGLENS chart 5 to 10X 02AVB770

■ Optional TAGLENS
■ Optional peripheral equipment

*1 The standard accessory set supplied with software TAGPAK-E.
*2 Please prepare a light guide for the light sources separately.
　Following light guides are available for the "LED light source" and "Pulsed Light Source".
　1) Multi-component glass
　　C520-065 2m
　　C520-075 5m
　　C520-076 8m
　2) Plastic
　　C520-077 2m
　　C520-078 5m
　　C520-079 8m
　・Transmittance decreases if the light guide gets longer
　・Transmittance of plastic is lower than multi-component glass
*3 The light guide included in the halogen illumination unit can NOT be used for the "LED light source" and "Pulsed Light Source".
*4 Please contact Mitutoyo as power cable is different to each region.
*5 A flat base is included with the TAGLENS chart set.