

MAICO™

MEMS CONFOCAL UNIT

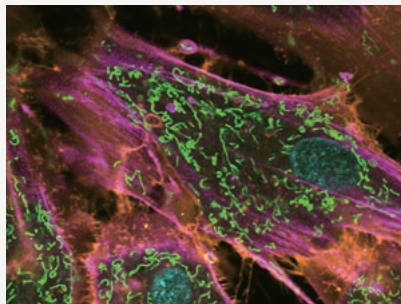
MAICO® MEMS confocal unit C15890 series



Making
confocal imaging
more accessible

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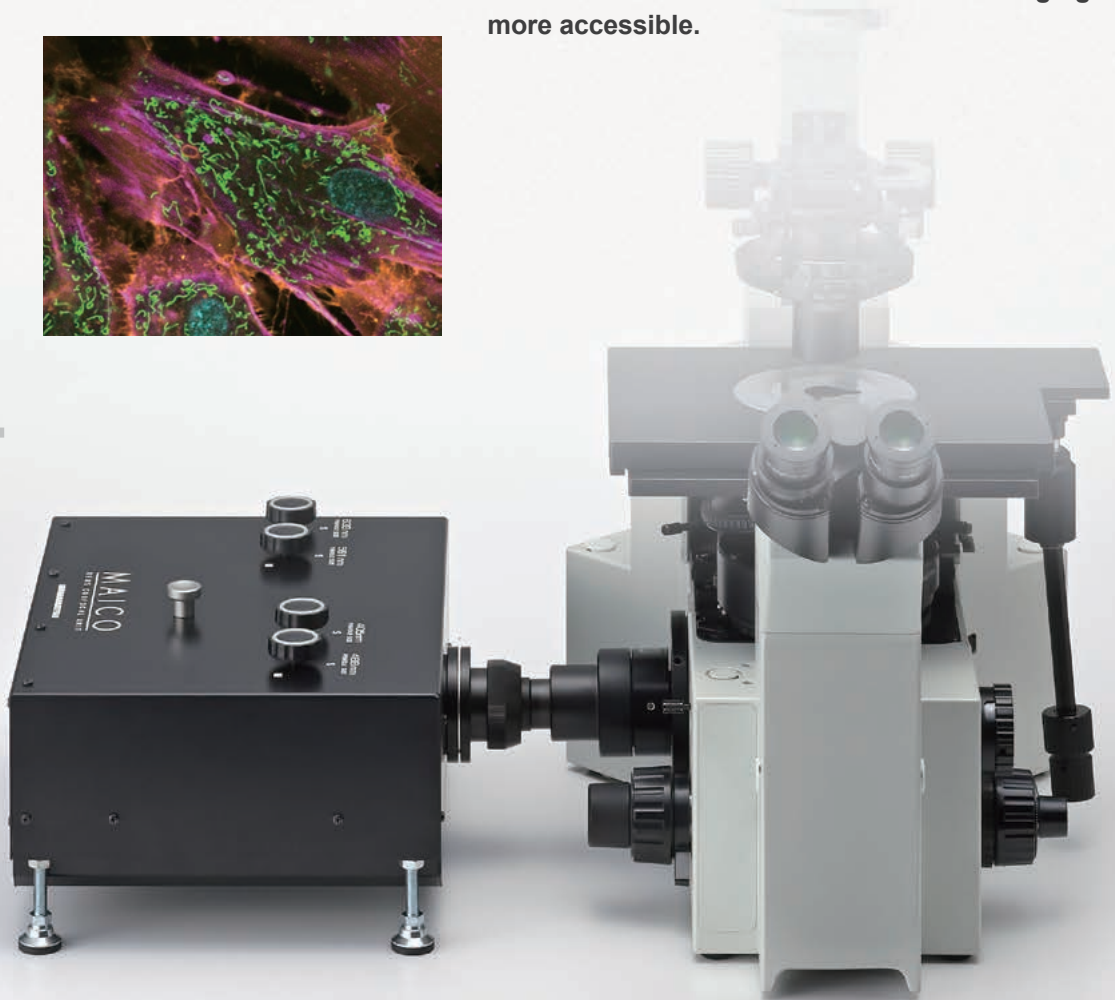
Confocal fluorescence unit installed in your own microscope



MAICO MEMS confocal unit is a confocal unit easily installed on your inverted microscope to achieve confocal fluorescence imaging.

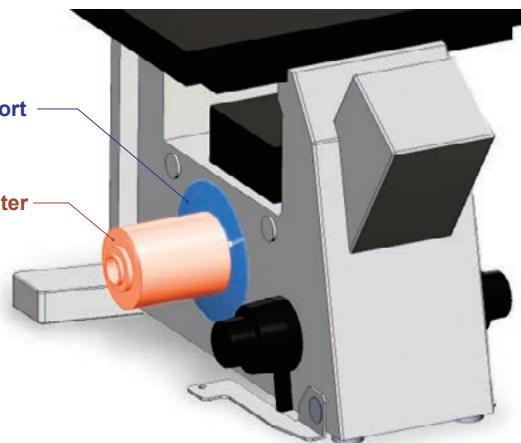
This compact, bench-top unit, does not require other devices such as cameras, filters or lasers.

As an entry-level model, or as a sub-model of a high-end confocal fluorescence microscope, MAICO makes confocal fluorescence imaging more accessible.



MAICO is mounted via a side port of the inverted microscope with a C-mount TV adapter.

Side port
C-mount TV adapter



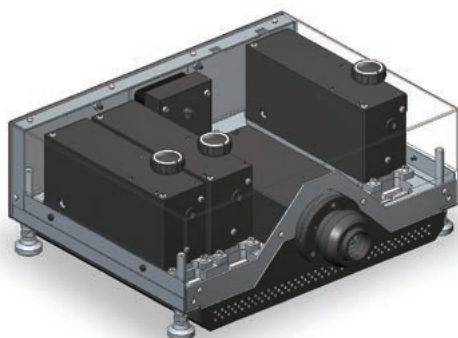
Our modular subunit structure makes adding extra channels easy

MAICO has a unique subunit structure which contains all the necessary components for each fluorescence band excitation and detection in a single unit.

By adopting the subunit structure you can, for example, select a single fluorescence band

when you purchase your first unit. You can then add more imaging channels as your research progresses.

MAICO supports single channel observation as well as up to four multi-channel (405 nm, 488 nm, 561 nm, and 638 nm) simultaneous excitation and observation.



Laser source
Dichroic mirror
Bandpass filter
Pinhole
Detector

The subunit contains all the necessary components for single band fluorescence excitation and detection, including a laser source, a pinhole, and a detector.

Selectable wavelength and detection sensitivity

Choose from 3 choices

Main unit



| Type number | Wavelength | Detector |
|-------------|------------|---|
| C15890-405N | 405 nm | Standard type |
| C15890-488N | 488 nm | |
| C15890-488S | 488 nm | High sensitivity type (Crystalline photocathode/ GaAsP) |

The A15892-01 mechanical shutter is available as a factory option.

Up to 4 imaging channels can be supported if you add

Subunit



| Type number | Wavelength | Detector |
|---------------------------------|-----------------------------------|---|
| Purchased with the main unit | Add or replace at a later date | |
| A15889-405N | A15891-405N | 405 nm |
| A15889-488N | A15891-488N | 488 nm |
| A15889-561N | A15891-561N | 561 nm |
| A15889-638N | A15891-638N | 638 nm |
| A15889-488S | A15891-488S | 488 nm |
| A15889-561S | A15891-561S | 561 nm |
| A15889-638S | A15891-638S | 638 nm |
| | | Standard type |
| | | High sensitivity type (Crystalline photocathode/ GaAsP) |

It is not possible to install two or more subunits with the same laser wavelength. Also, replacement of the detector alone is not possible.

Different laser lines and their detectors can be added or removed based on the subunit selection.

High-sensitivity detectors

Hamamatsu Photonics' detectors have a long track record in the field of fluorescence measurement. By adopting the world's most sensitive detector (photomultiplier tube) and applying our signal processing know-how, we were able to reduce the laser power to a Class 3R with sufficient fluorescence signals.

This has important implications for live cell imaging, such as long time-lapse imaging.

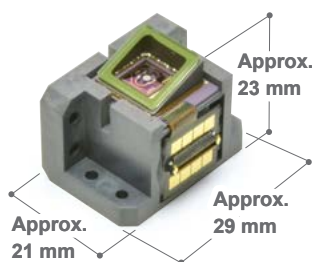


High-speed scanning with MEMS mirror

We adopted our 29 kHz resonant type high-speed MEMS* mirror as a spot scanning device. The MEMS mirror allows for a high-speed scan up to 76 frames/s and can be used for high-speed phenomena such as Ca^{2+} dynamics.

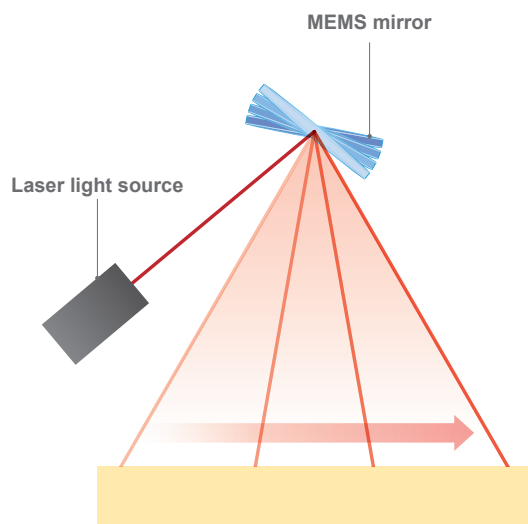
The high-speed resonant scanning system reduces laser irradiation time, which enables low phototoxicity, low photobleaching and high-efficiency observation of live cells as well as fixed samples.

High-speed scanning allows for comfortable observation at high resolution with minimal display delay when searching for and focusing on samples.



Our MEMS mirror developed for applications such as laser scanning microscopy.

* MEMS = Micro-Electro-Mechanical Systems



A light spot is scanned at 29 kHz resonant frequency.

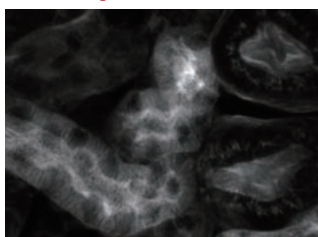
Conventional confocal optics

MAICO was designed to comply to the conventional confocal optics, which has a long history, using a spot scanning device and pinholes to acquire optical sectioning images.

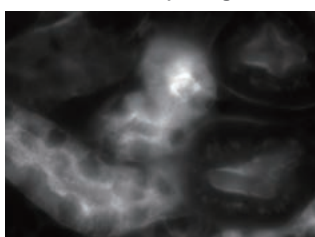
When imaging thick fluorescence samples, only the fluorescence emitted from the focal plane of the objective passes through the pinholes to the detector, while fluorescence emitted from further away from the focal plane is blocked.

It detects quantitative, reproducible and reliable signals. It also acquires high contrast images without the need for image processing techniques, such as deconvolution.

MAICO image

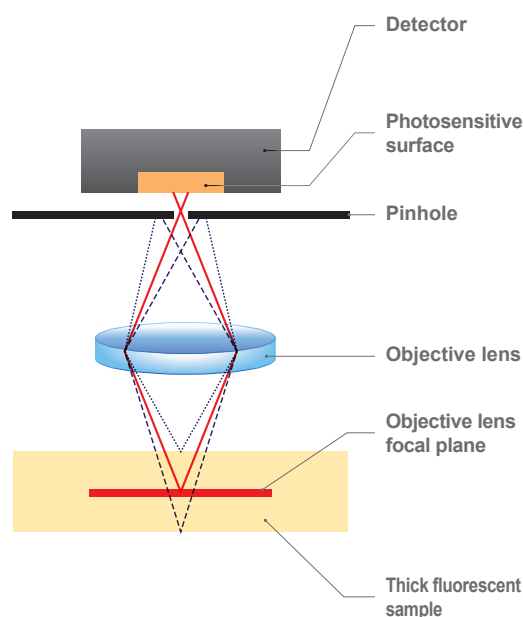


Widefield microscope image



Sample: Mouse kidney section

MAICO detects fluorescence in the objective focal plane only, so high contrast optical sectioning images can be acquired.



No laser control area required

As MAICO utilizes our most sensitive detectors and signal processing know-how, we were able to successfully reduce the laser power to a Class 3R. Therefore, you can use MAICO in a normal laboratory environment, without the need for a laser controlled area.

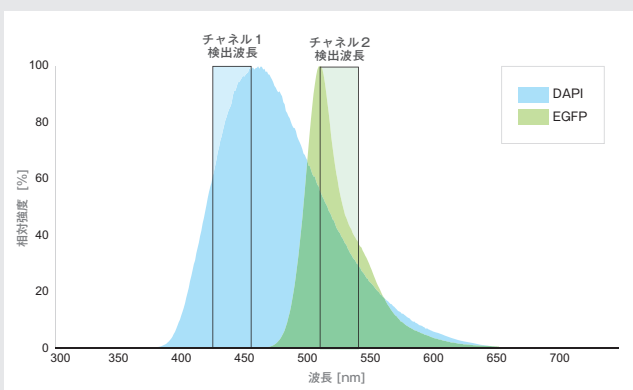
Software support

MAICO is compatible with DCAM-API®, a common camera library, and can be controlled by Hamamatsu's HCImage software. It is also possible to acquire images with DCAM-API compatible third party software.

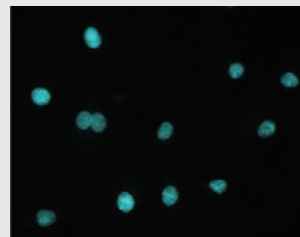
Enable simultaneous multiband confocal acquisition with minimum bleed-through (Patent pending)

Conventional simultaneous multiband observation

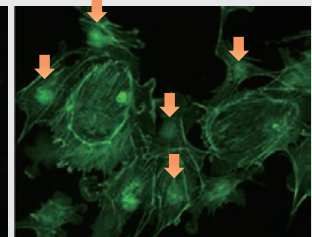
Fluorescent dyes emit a wide wavelength range of fluorescence, and if multiple fluorescent dyes are used, the fluorescence distributions are generally overlapped. When multiple dyes are excited simultaneously, an overlapping emission spectrum leaks into adjacent detection channels, causing an artifact of fluorescence imaging called bleed-through. The bleed-through cannot be prevented by simply using a dichroic mirror or a bandpass filter to select the wavelength, and this has been a problem.



DAPI (channel 1) image



EGFP (channel 2) image

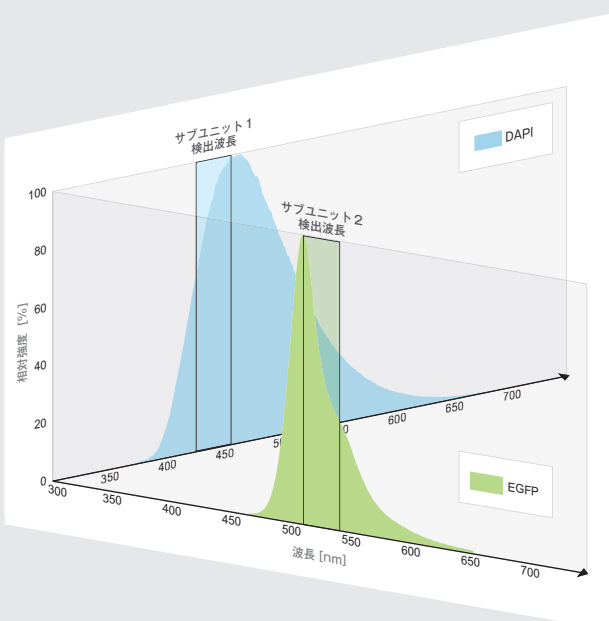


DAPI fluorescence leaks into the EGFP detection channel and causes artifact shapes of the nucleus in EGFP image. (Images are shown in pseudo-color.)

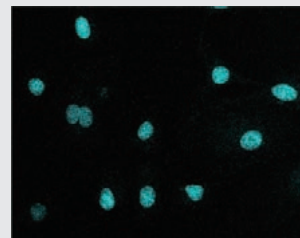
Newly developed

Simultaneous multiband observation with minimum bleed-through

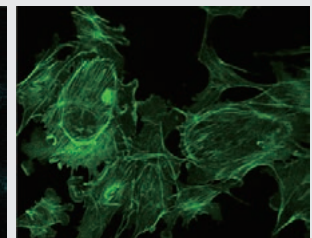
Since MAICO has a subunit structure, we can design the light path in each subunit independently. This minimizes the bleed-through to adjacent subunits and enables simultaneous multiband observation with high detection efficiency.



DAPI (subunit 1) image



EGFP (subunit 2) image

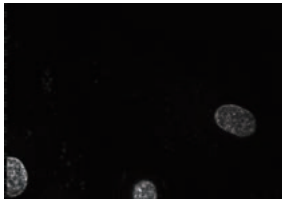


Simultaneous multiband excitation does not cause DAPI fluorescence bleed-through into the EGFP detection channel, and each fluorescent dye image is acquired accurately. (Images are shown in pseudo-color.)

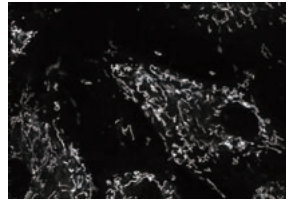
Live cell four-color imaging

Confocal imaging of cell nucleus, mitochondria, cell membrane, and actin filament with different dyes and channels. Each structure is clearly observed.

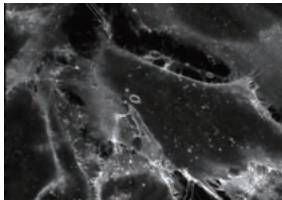
Sample: H9c2 cell line
Objective lens: 60×
Number of scan lines: 960
Laser wavelength: 405 nm, 488 nm, 561 nm, 638 nm



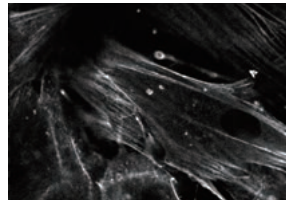
Wavelength 405 nm: Cell nucleus (HCS NuclearMask)



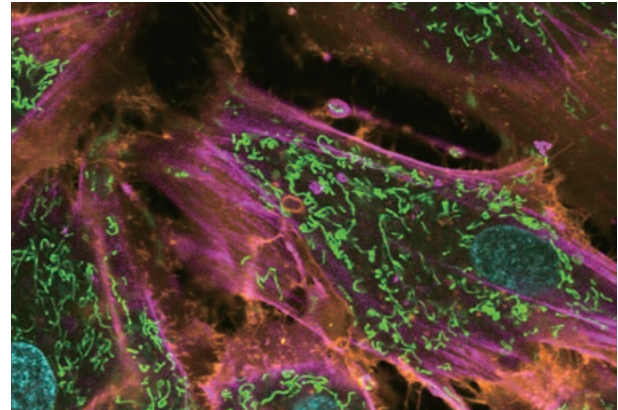
Wavelength 488 nm: Mitochondria (MitoTracker)



Wavelength 561 nm: Cell membrane (CellMask)



Wavelength 638 nm: Actin (SiR-Actin)

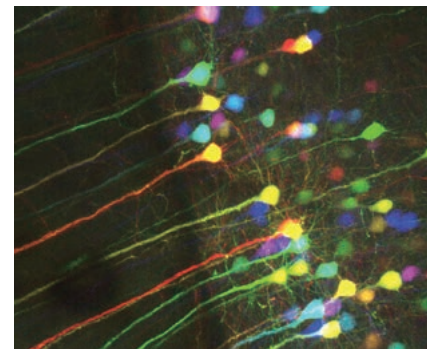
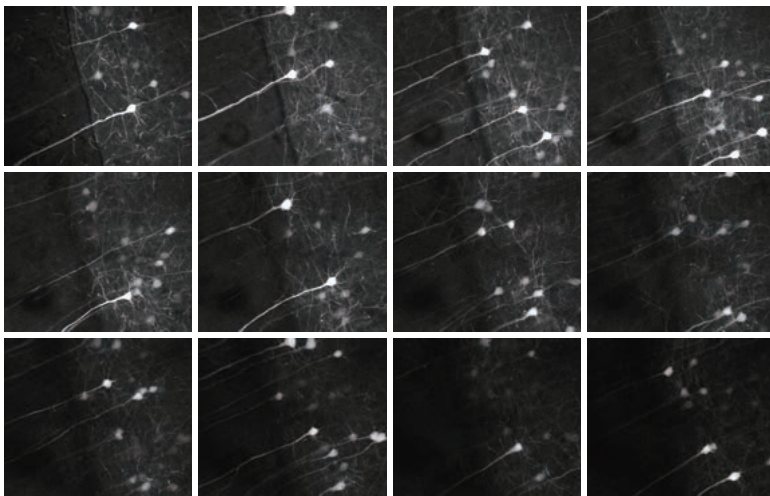


Superimposed four-color fluorescence image. (Image is shown in pseudo-color.)

Z-section imaging of mouse brain

These confocally sectioned images show that the structure of the cells and neurons in this thick section of mouse brain are pyramidal in volumetric shape.

Sample and images courtesy of Dr. Christian Jüngst and Dr. Astrid Schauss (CECAD Imaging Facility, University of Cologne)
Sample: Fixed sample of transgenic mouse brain (Thy1-eYFP)
Objective lens: 20× (NA: 0.40)
Laser wavelength: 488 nm



Superimposed image with different pseudo-colors for each Z position.

These images were acquired in 5 μm steps across a 200 μm thickness in tissue. Images shown in every 3 slices.

3D imaging of cultured neural cells in microfluidic devices

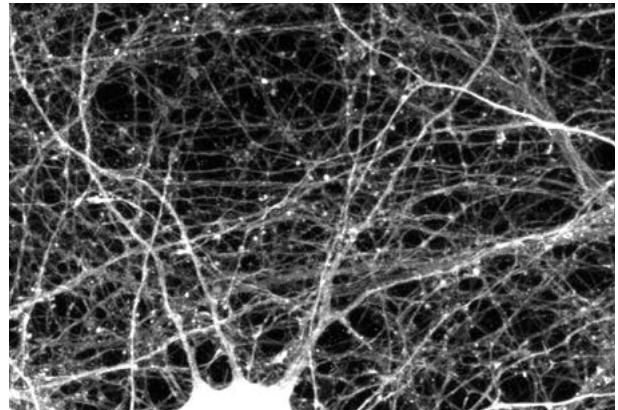
The Nano-Integration Devices and Systems Laboratory at the Research Institute of Electrical Communication (RIEC), Tohoku University, is developing a novel in vitro system that models the complex neural networks found in the brains of living organisms. The team observes the 3D structures formed by the aggregation of cultured nerve cells. To facilitate 3D imaging of these neuronal aggregates, they have introduced the MAICO MEMS confocal unit.

We interviewed Associate Professor Yamamoto and Mr. Murota, who is responsible for cell observation and analysis, to learn more about the reasons behind the adoption of the MAICO MEMS confocal unit and their future research.

Interviewee

Associate Professor Hideaki Yamamoto, Research Institute of Electrical Communication, Tohoku University

Mr. Hakuba Murota, Nano-Bio Integrated Molecular Device Laboratory, Research Institute of Electrical Communication, Tohoku University



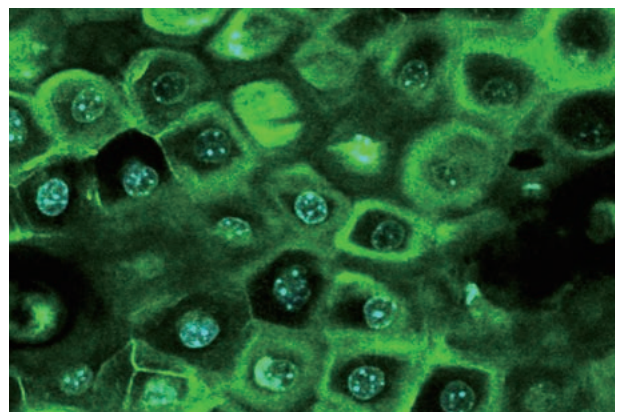
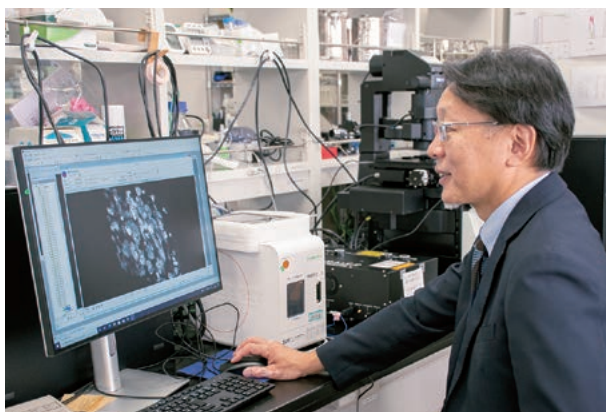
Data courtesy of Hideaki Yamamoto, Nano-Integrated Device and System Laboratory for Nanoelectronics and Spintronics, Research Institute of Electrical Communication, Tohoku University

3D live-cell imaging analysis of keratinocytes

The Laboratory of Skin Evolutionary Cell Biology, Cosmetic Course, Department of Applied Biological Sciences, Tokyo University of Technology, is conducting research on the mechanism of epidermal barrier formation. To elucidate the mechanism of epidermal barrier formation, it is necessary to image the epidermis in three dimensions. For this purpose, our company has introduced the MAICO MEMS Confocal Unit. We interviewed Mr. Takeshi Matsui of the same laboratory about the background of the introduction of the MAICO MEMS Confocal Unit, its usability, and future research prospects.

Interviewee

Professor Takeshi Matsui, Laboratory for Evolutionary Cell Biology of Skin, Cosmetic Course, School of Bioscience and Biotechnology, Tokyo University of Technology



Data courtesy of Takeshi Matsui, Laboratory for Evolutionary Cell Biology of the Skin, School of Bioscience and Biotechnology, Tokyo University of Technology

For more details about the interview, please refer to our website.

<https://www.hamamatsu.com/all/en/product/life-science-and-medical-systems/mems-confocal-unit/case-study.html>



Specifications

Specifications

| | | |
|---------------------------------|--|------------------|
| Type number | C15890 series | |
| Maximum effective field of view | 8.0 mm × 6.0 mm | |
| Maximum number of pixels | 1280 (H) × 960 (V) | |
| Image size | 1280 (H) × 960 (V) | |
| | 1280 (H) × 480 (V) | |
| | 1280 (H) × 240 (V) | |
| Frame rate (Typ.) | 960 scanning lines | 19 frames/s |
| | 480 scanning lines | 38 frames/s |
| | 240 scanning lines | 76 frames/s |
| Zoom function | 1×, 2× | |
| Excitation laser*1 | 405 nm, 488 nm, 561 nm, 638 nm | |
| Laser class | Class 3R | |
| Detection wavelength | at 405 nm excitation | 425 nm to 465 nm |
| | at 488 nm excitation | 510 nm to 540 nm |
| | at 561 nm excitation | 580 nm to 619 nm |
| | at 638 nm excitation | 660 nm to 730 nm |
| Detector*2 | PMT, high-sensitivity GaAsP PMT | |
| Digital output | 12 bit | |
| Image acquisition mode | Single channel measurement, multiple channel sequential measurement (frame by frame), multiple channel simultaneous measurement (up to 4 channels) | |
| Pinhole*3 | 3 manual selections (large/medium/small) for each wavelength | |
| Compatible objective lens*4 | Magnification 20× to 100× | |
| Interface | USB 3.0 | |
| Output trigger connector | SMA | |
| Lens mount | C-mount | |
| Power consumption | 90 VA | |
| Ambient operating temperature | +18 °C to +28 °C | |
| Ambient operating humidity | 30 % to 80 % (with no condensation) | |
| Ambient storage temperature | -10 °C to +50 °C | |
| Ambient storage humidity | 85 % (with no condensation) | |

*1 The C15890 series is provided with a single wavelength of 405 nm or 488 nm. Supports up to 4 wavelengths by addition of subunits.

*2 Equipped with the same number of lasers.

*3 The pinhole size can be read out as accessory information at the time of measurement.

*4 We recommend use of an objective lens with an image-side NA (objective lens NA/magnification) smaller than 0.0375.

Laser safety

MAICO MEMS Confocal Unit is a Class 3R laser product. Conforming to international laser safety standards (IEC 60825-1), which obligate manufacturers to provide preventive safety measures, Hamamatsu lasers are classified, and appropriate safety measures and labeling are provided. During operation, users must also use their preventive safety measures according to laser-related regulations.



▲ Description label (sample)

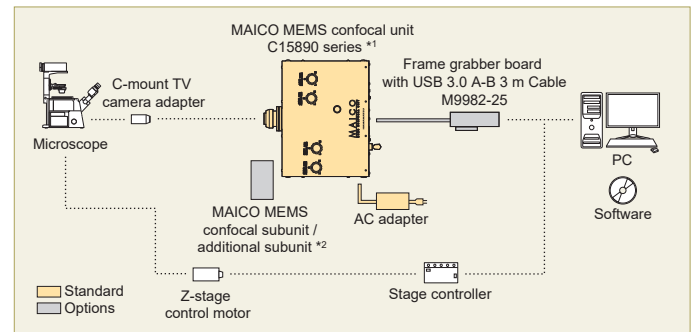


▲ Caution label

MAICO is equipped with a key switch and an interlock circuit. If necessary, connect to the safety device via the interlock connector (EIAJ RC5320A TYPE4, M04-390DJ Marushin electric mfg. Co).

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 - The product described in this brochure is designed to meet the written specifications, when used strictly in accordance with all instructions.
 - The university, institute, or company name of the researchers, whose measurement data is published in this brochure, is subject to change.
 - The measurement examples in this brochure are not guaranteed.
 - Specifications and external appearance are subject to change without notice.
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System configuration example



*1 C15890-405N, -488N, -488S

*2 For the details of the lineup, refer to page 3.

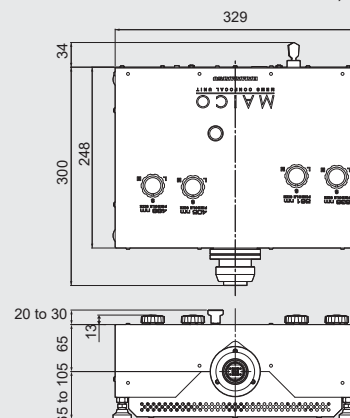
Option

| Type number | Product name |
|-------------|--|
| A15892-01 | MAICO MEMS confocal mechanical shutter |
| A15892-488 | MAICO MEMS confocal optical adjustment glass |
| A15892-638 | MAICO MEMS confocal optical adjustment glass |
| M9982-25 | Frame grabber board with USB 3.0 A-B 3 m Cable |
| U11158-02 | HCIImage Acquisition Software |
| U11158-08 | HCIImage Live Software |

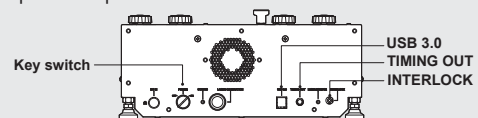
*You are able to add these options only at the time of purchase of the main unit. These can not be added after shipping.

Dimensional outlines (Unit: mm)

■ Weight: Approx. 8.7 kg
(with mechanical shutter and 4 subunits installed)



Back panel components



HAMAMATSU PHOTONICS K.K. www.hamamatsu.com

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