# CSU-W1

## General Specifications

| | | | | |
|---|---|---|---|---|
| Model | | 1 camera model（T1） | 2 camera model（T2） | Split-view model(T3) |
| Confocal scanning method | | Microlens-enhanced Nipkow disk scanning | | |
| Spinning speed | | 1,500rpm ～ 4,000rpm　Max200fps | | |
| External synchronization | | Scan-speed synchronization through pulse signals Input/output : TTL level 300Hz up to 800Hz | | |
| Disk unit | | Selectable up to 2 disks from 50µm and 25µm ： Motorized switching | | |
| Bright field | | Motorized exchange between confocal and brightfield | | |
| Effective FOV | | 17×16mm 【Optoin】Variable aperture | | 17×16mm |
| Excitation wavelength | | 405nm ～ 785nm | | |
| Laser introduction | | Yokogawa's standard fiber*1, Beam shaping optics　VIS port (405 ～ 647nm) 【Option】NIR port (685 ～ 785nm) | | |
| Excitation shutter | | Built-in shutter, Opening and shutting time : 30msec or less, Opening and shutting cycle : 10Hz or less | | |
| Observation wavelength | | 420nm ～ 850nm | | |
| Dichroic mirror switching | | Motorized 3CH (Dichroic mirror block can be exchanged) | | |
| Emission filter wheel | | 10-position filter wheel | | 6-position filter wheel |
| | Filter size | φ25mm | | φ25mm |
| | Switching speed | 100msec max.（Standard mode） 40msec max.（High speed mode） | | 100msec max. |
| External control | | RS-232C (CSU-X1 command upper compatible) | | |
| Microscope mount | | Yokogawa original mount adapter specific to each microscope | | |
| Camera adaptor | | C mount 1x （Variable magnification：0.5x, 0.83x ： Under development) | | |
| Light introduction port | | 【Option】External scanner such as for Photo activation can be connected to the External light path : Under development | | |
| Operating environment | | 15 ～ 35ºC , 20 ～ 75%　No condensation | | |
| Power consumption | | Input : 100 ～ 240 VAC ±10% 50 ～ 60Hz 250VAmax | | |
| External dimension | Main unit | 480(W)×327(L)×252(H)mm | 480(W)×476(L)×252(H)mm | 425(W)×374(L)×252(H)mm |
| | Power unit | 213(W)×438(L)×132(H)mm | | |
| Weight | Main unit | 14.3kg | 18.3kg | 15.8kg |
| | Power unit | 4.5kg | | |
| Attachable microscope | | Olympus IX series, Nikon ECLIPSE Ti , Zeiss Axio Observer, Leica (Under development)*2 | | |

*1 Each CSU-W1 head is optimized with its fiber at factory. Please inquire about fiber exchange if necessary.
*2 FN of some microscope could limit the FOV of CSU-W1, please inquire.




**Safety Precautions**

* Read the user's manual carefully in order to use the instrument correctly and safely.
* If used in combination with a laser light source, this product falls under the category of class 3B laser products. Do not look directly into the beam and avoid touching it or any other direct exposure to it.

YOKOGAWA

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**Represented by:**



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YOKOGAWA

Confocal Scanner Unit

# CSU-W1

**Wide and Clear** Confocal scanner unit CSU has evolved!

CSU-W1


Bulletin80C01D01-01E

http://www.yokogawa.com/scanner

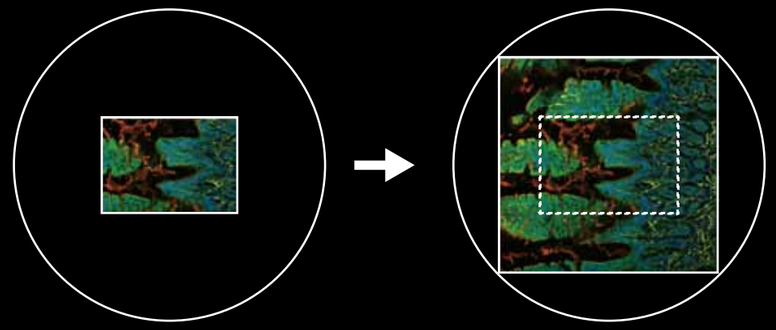
## Advantages of the Evolution

# Wide and Clear

Confocal Scanner Unit, CSU series, have been improved from the original CSU10 to the most recent CSU-X1, which are widely recognized as the de facto standard tool for live cell imaging, due to fast scanning and low photo-bleaching capability.
CSU-W1 is our answer to the researchers' request for "Wider FOV" and "Clearer Images".

## Wide

Widest FOV confocal! Provides 4 times wider FOV than the conventional model.

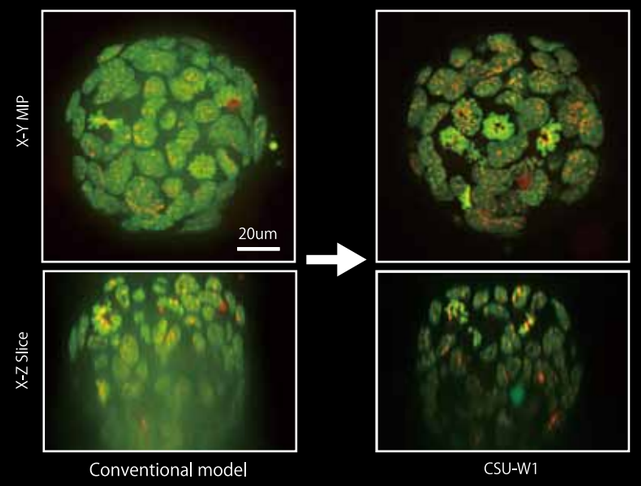


Conventional model　10mmx7mm　　CSU-W1　17mmx16mm

## Clear

Newly designed disk unit offers much improved image quality.

Due to significantly reduced pinhole crosstalk, CSU-W1 enables clear observation much deeper into thick samples.




Conventional model　　CSU-W1

Mouse ES cell colony
Fluorescent probe:
H2B-EGFP (Excitation:488nm)
mCherry-MBD-NLS (Excitation:561nm)
Objective lens:60x silicone
Z-sections/stack:100μm (0.4μm/251slices)

By courtesy of Jun Ueda, Ph.D. and Kazuo Yamagata, Ph.D.,
Center for Genetic Analysis of Biological Responses,
The Research Institute for Microbial Diseases, Osaka University





## Points of the Evolution

# Original and Flexible

## Original

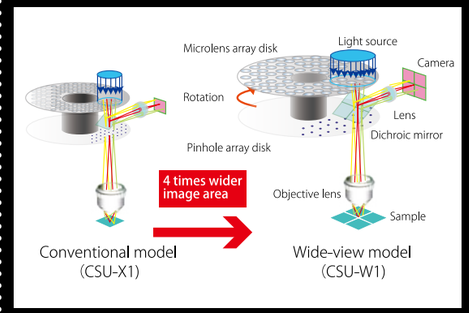
Newly designed disk unit to achieve wider FOV and much improved image quality

### Large diameter disks

The large diameter disks offer 4 times wider FOV to compare with our conventional model. This wide FOV matches with most advanced wide-field cameras.

### Newly designed pinhole (Nipkow) disk

Wider inter-pinhole distance for the CSU-W1 offers considerably reduced pinhole crosstalk and thus provides clearer images.




Microlens enhanced dual Nipkow disk scanning method

A Nipkow spinning disk containing many pinholes placed in the constant pitch helical pattern and a second disk containing the same number of micro-lens to focus excitation laser into each pinhole are mechanically fixed with a motor, and very rapidly raster scan the field of view with a large number of laser beams. The multi-beam scanning method offers not only high-speed imaging but also significantly reduced photo-toxicity and photo bleaching because of very reduced laser power of each beamlet.

## Flexible

Flexibly selectable functions to meet versatile applications

### New bright field path (Default)

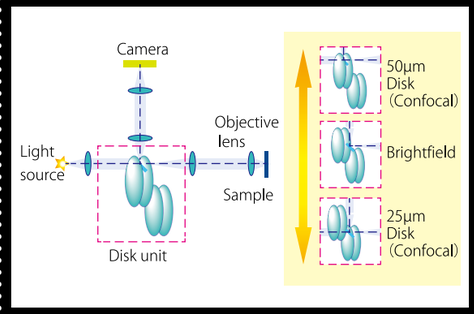
New mechanism to move the disks out of the light path allows much easier projection of confocal and non-confocal images such as phase contrast .

### High confocality pinhole (Optional Component)

In addition to our conventional 50μm pinhole size, 25μm pinhole size with higher confocality is available.
You can select either one or the both pinhole size, with easy-to-use motorized disk exchange mechanism.

### Simultaneous dual color imaging mechanisms (T2 and T3 Models)

CSU-W1 offers single camera split-view model, in addition to the dual camera model which are much improved from those for the CSU-X1. Thanks to the wide FOV, even the split-view offers 2 times wider image area than with older model.By using various dichroic mirrors, it is possible to select various dye-combinations for dual-color imaging*1 with both the two camera model and split-view model.




| | The standard of selection |
|---|---|
| 25μm pinhple | ・Low magnification (~40x)<br>・Low contrast (higher crosstalk) samples |
| 50μm pinhole | ・Hgh magnification (60x~)<br>・Low signal samples |

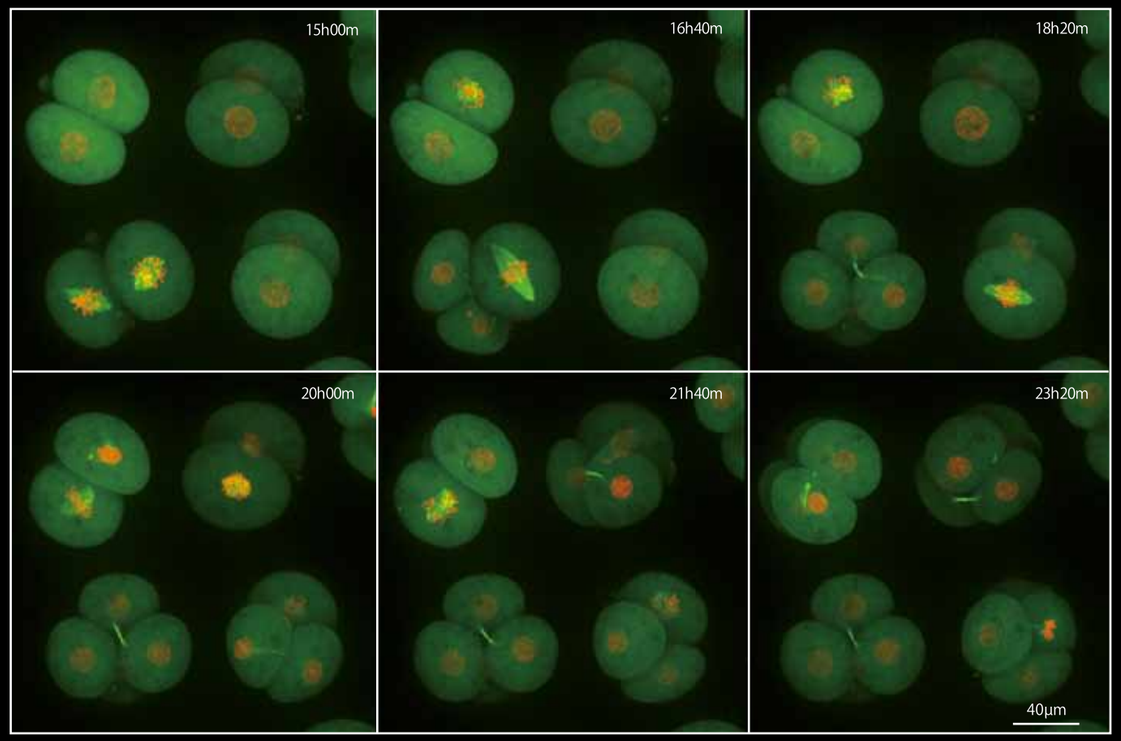
*1 Appropriate excitation lasers are necessary to utilize each dichroic mirror.

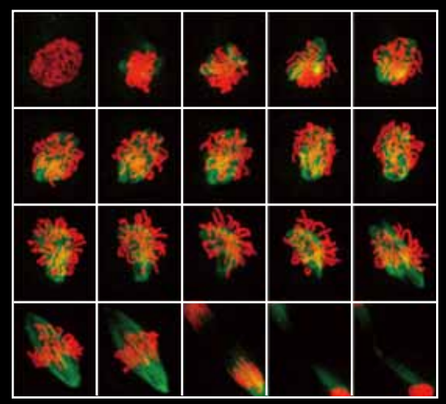
CSU-W1

# Image gallery -Wide-

Wide FOV without compromising the resolution offers most effective long-term observation of various biological events in a large tissue or many cells.

## Early stage mouse embryo



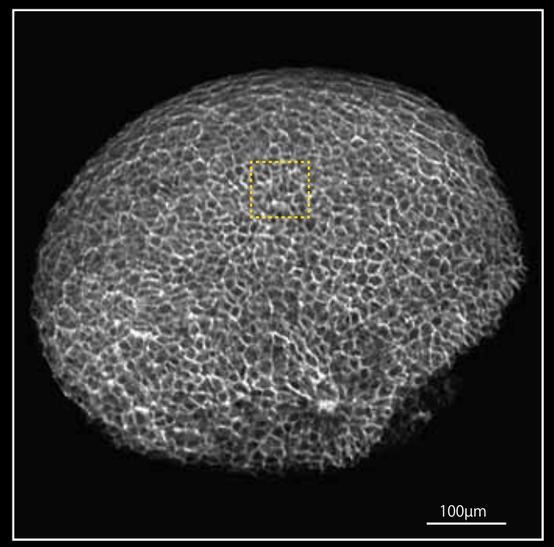



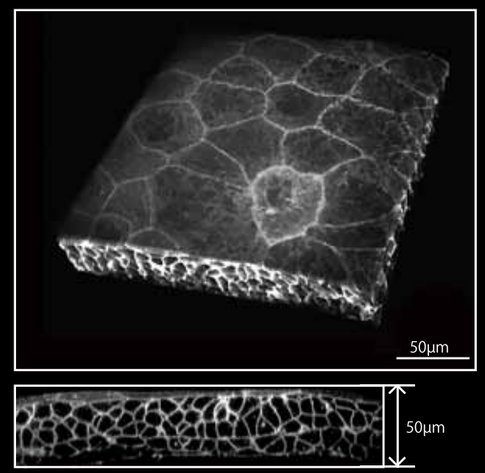
Upper ：Excerpts from time-lapse data（MIP）
Lower: Excerpts from time-lapse data (MIP of chromosome)
Fluorescent probe：H2B-EGFP (Excitation：488nm)，mCherry-MBD-NLS (Excitation：561nm)
Pinhole：50μm
Objective lens：60x silicone
Z-sections/stack：100μm (1μm/101slices)
Total time：48 hours (Interval ：10mins)

By courtesy of Kazuo Yamagata, Ph.D., Center for Genetic Analysis of Biological Responses, The Research Institute for Microbial Diseases, Osaka University

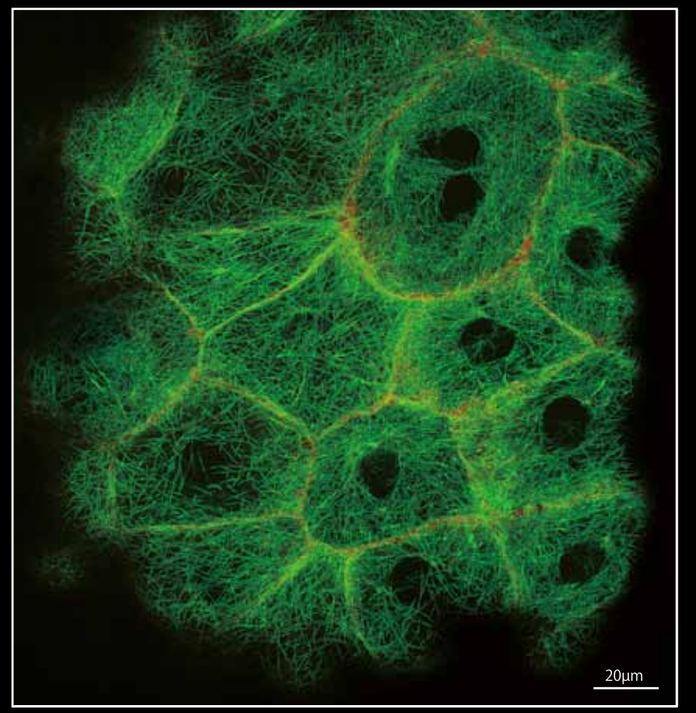


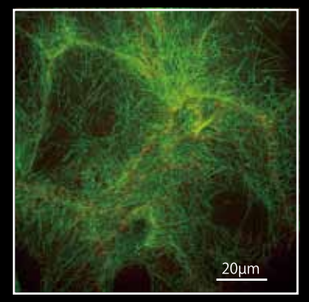
## Zebra fish embryo




Left：3D reconstructed image of whole embryo
Upper right：3D reconstructed embryo (partial, at high magnification)
Lower right：XZ image
Fluorescent probe: membrane RFP (Excitation：561nm)
Pinhole：50μm
Objective lens：20x dry(Left), 60x water(Upper right, Lower right)
Z-sections/stack：99μm (1μm/100slices)(Left)
50μm (0.5μm/101slices)(Upper right, Lower right)




Left：Time-line MIP of time-lapse images
Right：Image by our conventional model
(x1.25 Camera port)
Fluorescent probe:
EB3-GFP (Excitation：488nm)
membrane RFP (Excitation：561nm)
Pinhole：50μm
Objective lens： 60x water
Total time：200sec (Interval ：1sec)

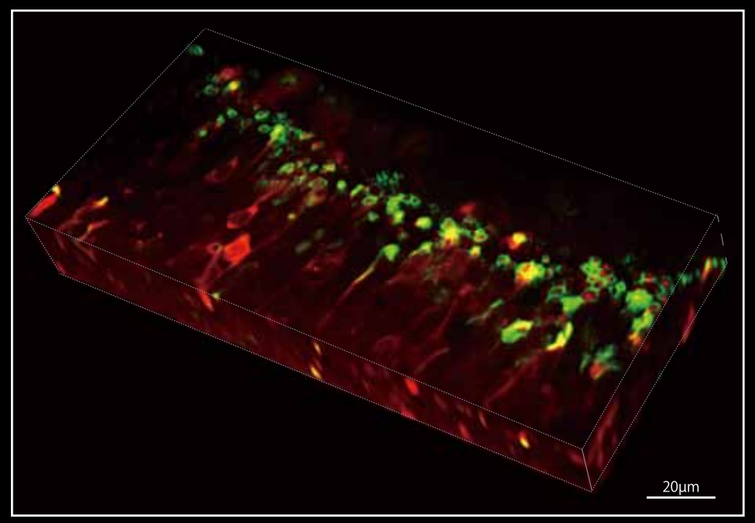
By courtesy of Makoto Suzuki, Ph.D. and Naoto Ueno, Ph.D.,Division of Morphogenesis, National Institute of Basic Biology

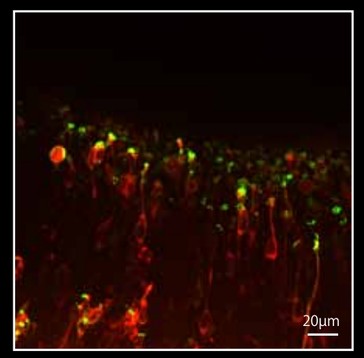
CSU-W1

# Image gallery -Clear-

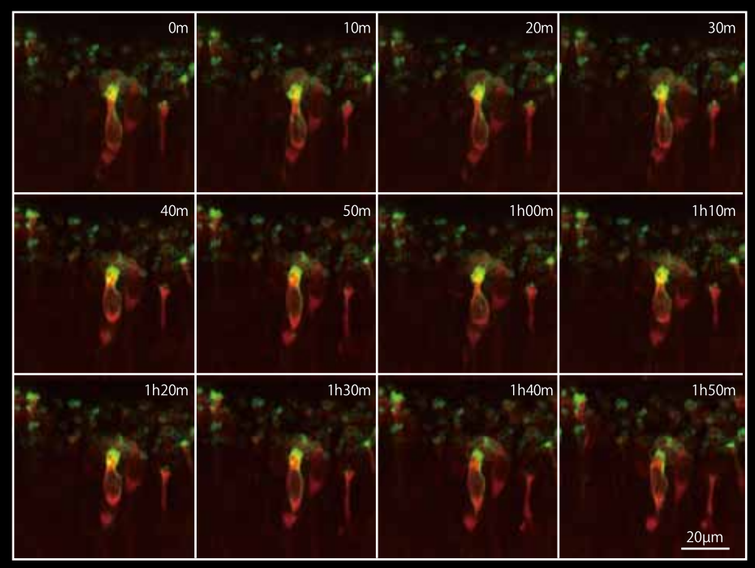
Most suitable for clear and thorough imaging of thick specimen, even tissues or small animal body, for a long time.
Selection of the optimal pinhole disk provides high level of confocality at both high and low magnification to give most detailed 3D reconstructions of live specimen.

## Brain slice of mouse fetus



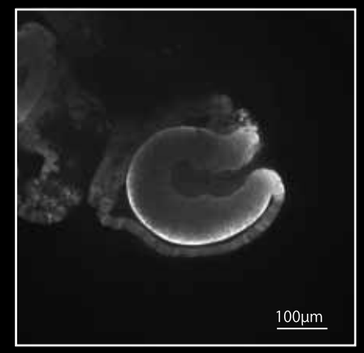

Left: 3D reconstructed slice (partial)
Right: 3D reconstructed image of whole slice
Fluorescent probe: GFP (Excitation: 488nm)
RFP (Excitation: 561nm)
Pinhole: 50μm
Objective lens: 60x water LWD
Z-sections/stack: 29.5μm (0.5μm/60slices)

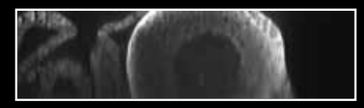



Excerpts (10 minuets' interval)
from Time lapse(MIP)
Fluorescent probe: GFP (Excitation: 488nm)
RFP (Excitation: 561nm)
Pinhole: 50μm
Objective lens: 60x water LWD
Z-sections/stack: 15μm (0.5μm/31slices)
Total time: 2hours (Interval : 1min)

By courtesy of Atsunori Shitamukai, Ph.D., Laboratory for Cell Asymmetry, Center for Developmental Biology, RIKEN

## Ocular cup organ regenerated from mouse ES cells

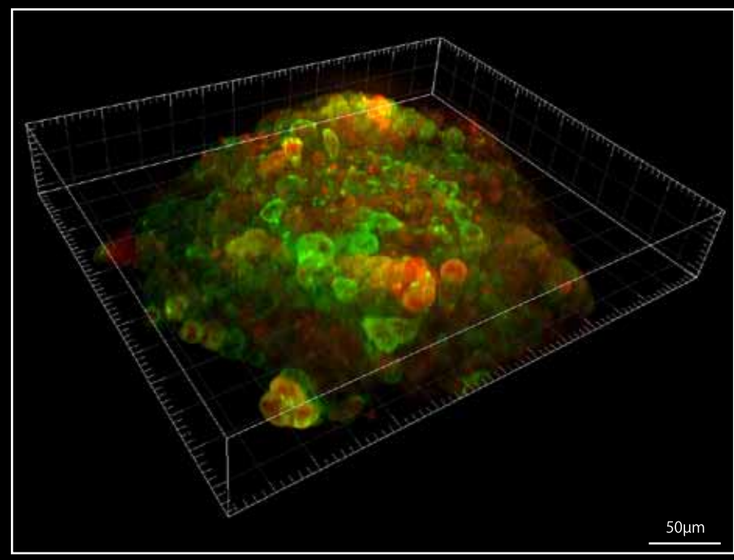



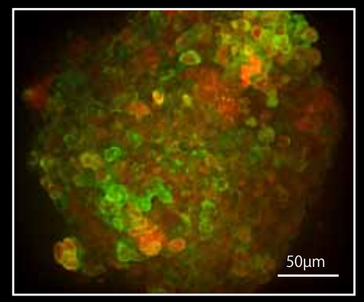



Left: 3D image
Upper right: MIP Lower right: YZ plane
Fluorescent probe: Cy5 (Excitation: 640nm)
Pinhole: 25μm
Objective lens: 20x dry
Z-sections/stack: 100μm (2μm/51slices)

By courtesy of Mototsugu Eiraku, Ph.D., and Yuiko Hasegawa, Ph.D., Sasai Lab., Organogenesis Neurogenesis group, Center for Developmental Biology, RIKEN

## ES cell colony




Left: 3D image Right: MIP
Fluorescent probe:
GFP (Excitation: 488nm)
mCherry (Excitation: 561nm)
Pinhole: 50μm
Objective lens: 60x oil
Z-sections/stack: 50μm (1μm/51slices)

By courtesy of Nozomu Takata, Ph.D., Sasai Lab.,Organogenesis Neurogenesis group, Center for Developmental Biology, RIKEN

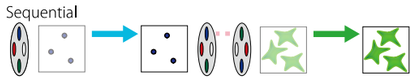
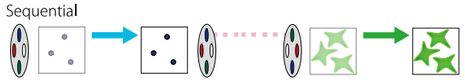
CSU-W1

# Basic Configurations and Option

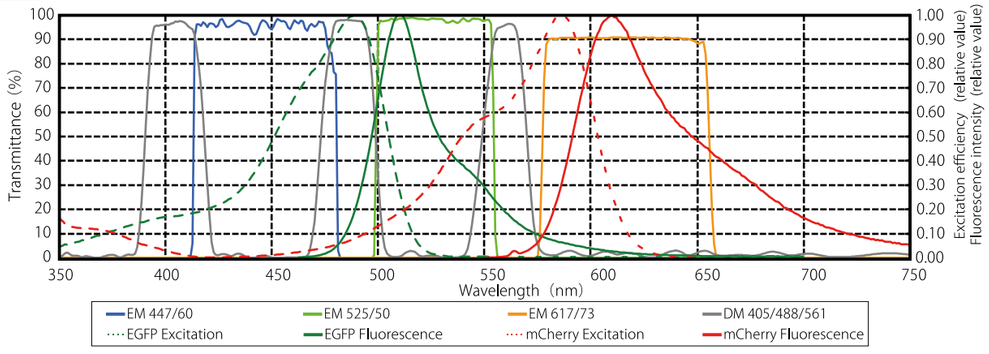
CSU-W1 offers selection from a total of three basic configurations, two pinhole sizes, options for near infrared observation and an external light path which is useful for versatile applications such as photo bleaching, while bright field light path is now a standard feature. All switching mechanisms in the CSU-W1 are fully motorized and thus ready for automated experiments.

## Basic Configurations

CSU-W1 provides a total of three basic configurations for multi-color imaging; 1) Sequential imaging with one camera and a filter wheel, 2) Simultaneous two-color imaging with two cameras, and 3) Split-view two color imaging with one camera shared by 2 optical paths. All features are upgradable after installation.

| | Comparison of 2 color imaging | Image |
|---|---|---|
| 1 Camera model | Sequential<br>  <br>Filter wheel |  |
| 2 Camera model | Simultaneous dual-color imaging<br> |  |
| Split-view model | Simultaneous dual-color imaging<br>  <br>Sequential<br>  <br>Filter wheel |  <br>  |

## Filter




Spectral curve example of filter combination

## Option

### ■ Near Infrared (NIR) Port

NIR port provides up to 785nm excitation capability to allow less-invasive deep imaging. The NIR laser is introduced via a dedicated optical fiber in the same way as visible lasers. It is possible to combine NIR and visible lasers within the CSU-W1 unit to allow simultaneous excitation.

### ■ External light path*1

External light path provides the direct path bypassing the disks to microscope. Versatile applications such as photo activation are available by introducing an external light scanner through this port.

### ■ Lens switcher*1

Newly designed motorized lens switcher between 2 relay lenses is useful for fitting CSU-W1 image size with various camera types, and also for easy magnification change without exchanging objective lenses.

### ■ Variable aperture*2

Variable aperture to change laser illumination area, and thus the imaging area by the CSU-W1, is useful to minimize laser damages in the specimen.

## Selectable option

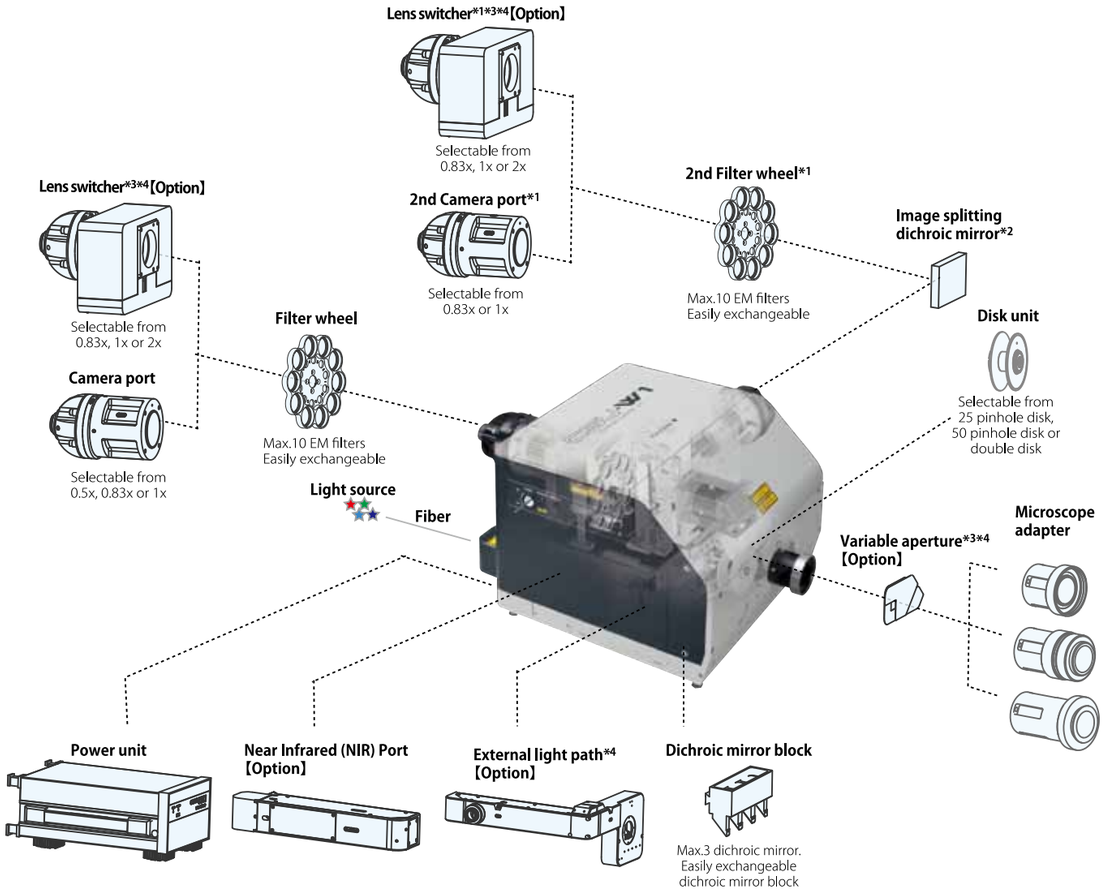
| Option | 1 Camera model | 2 Camera model | Split-view model |
|---|---|---|---|
| NIR port | ○ | ○ | ○ |
| External light path | ○ | ○ | ○ |
| Variable aperture | ○ | ○ | - |
| Camera port lens | Selectable from 0.5x, 0.83x, 1x | Selectable from 0.5x, 0.83x, 1x（1st camera）<br>0.83x, 1x（2nd camera） | Selectable from 0.83x, 1x |
| Additional lens to Lens switcher | Selectable from 0.83x, 1x, 2x | Selectable from 0.83x, 1x, 2x | - |

*1 Under development *2 1 Camera model, 2 Camera model

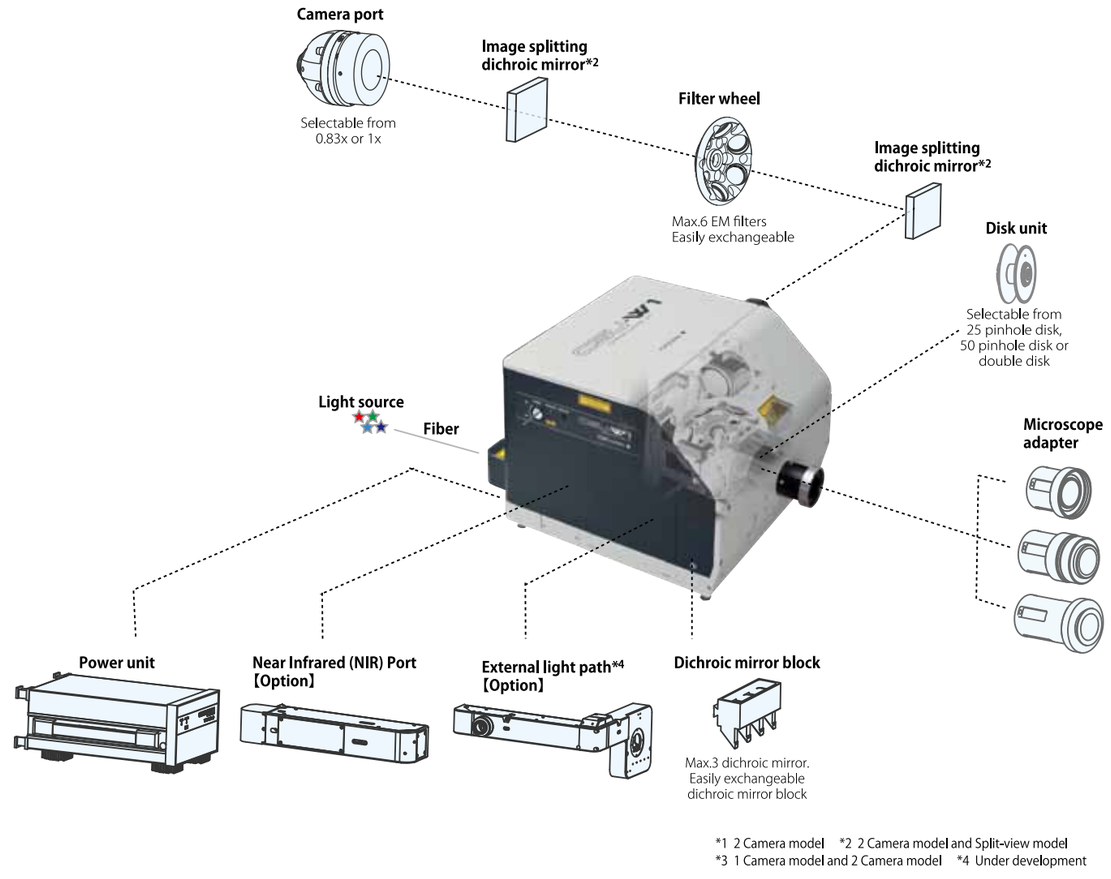
CSU-W1

# System configuration

## 2 Camera model, 1 Camera model



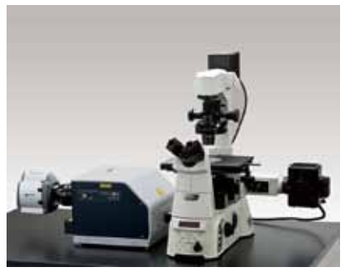

## Split-view model




*1 2 Camera model *2 2 Camera model and Split-view model
*3 1 Camera model and 2 Camera model *4 Under development

## Microscope-setup

Zeiss Axio Observer

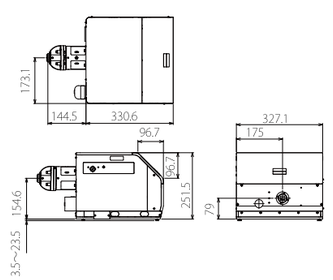


Nikon ECLIPSE Ti

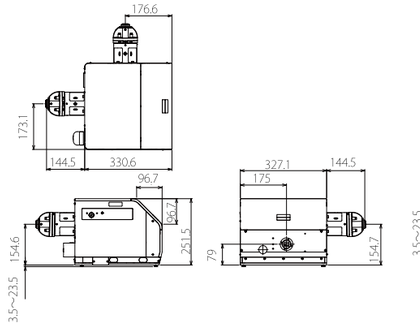
Olympus IX83

## External Dimensions

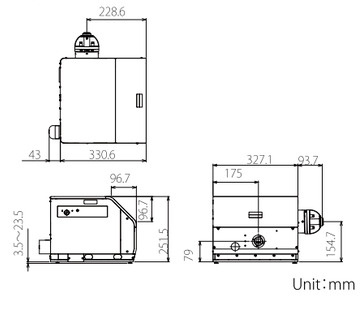
1 Camera model (T1)




2 Camera model (T2)




Split-view model (T3)




Unit:mm