

OLYMPUS[®]

Your Vision, Our Future

CONFOCAL LASER SCANNING
BIOLOGICAL MICROSCOPE

FV1000

FLUOVIEW

Next Generation Live Cell Imaging System



Simultaneous Laser Light Stimulation and Imaging

The FV1000 incorporates 2 laser scanners in a single compact design for simultaneous confocal fluorescence observation and independent laser light stimulation.

Synchronization of these two functions ensures that cellular reactions that occur during or immediately following stimulation are not overlooked, and makes the FV1000 the most suitable microscope for FRAP, FLIP and photo activation.

SIM Scanner System Captures Reactions During Laser Stimulation

SIM SCANNER
FRAP



SIM SCANNER
Uncaging

SIM SCANNER
FLIP

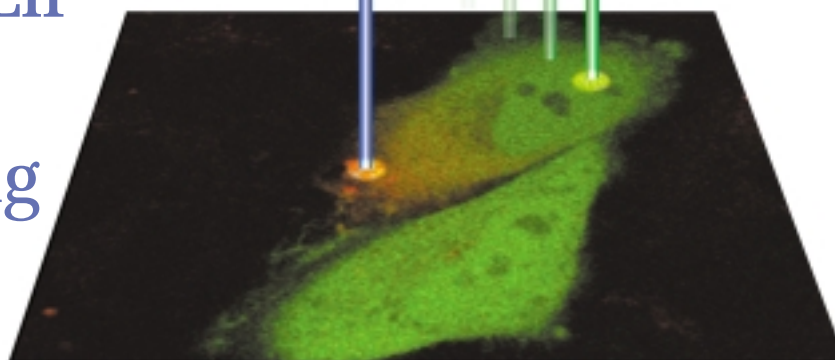
Laser for
stimulation

Laser for
imaging

SIM SCANNER
kaede

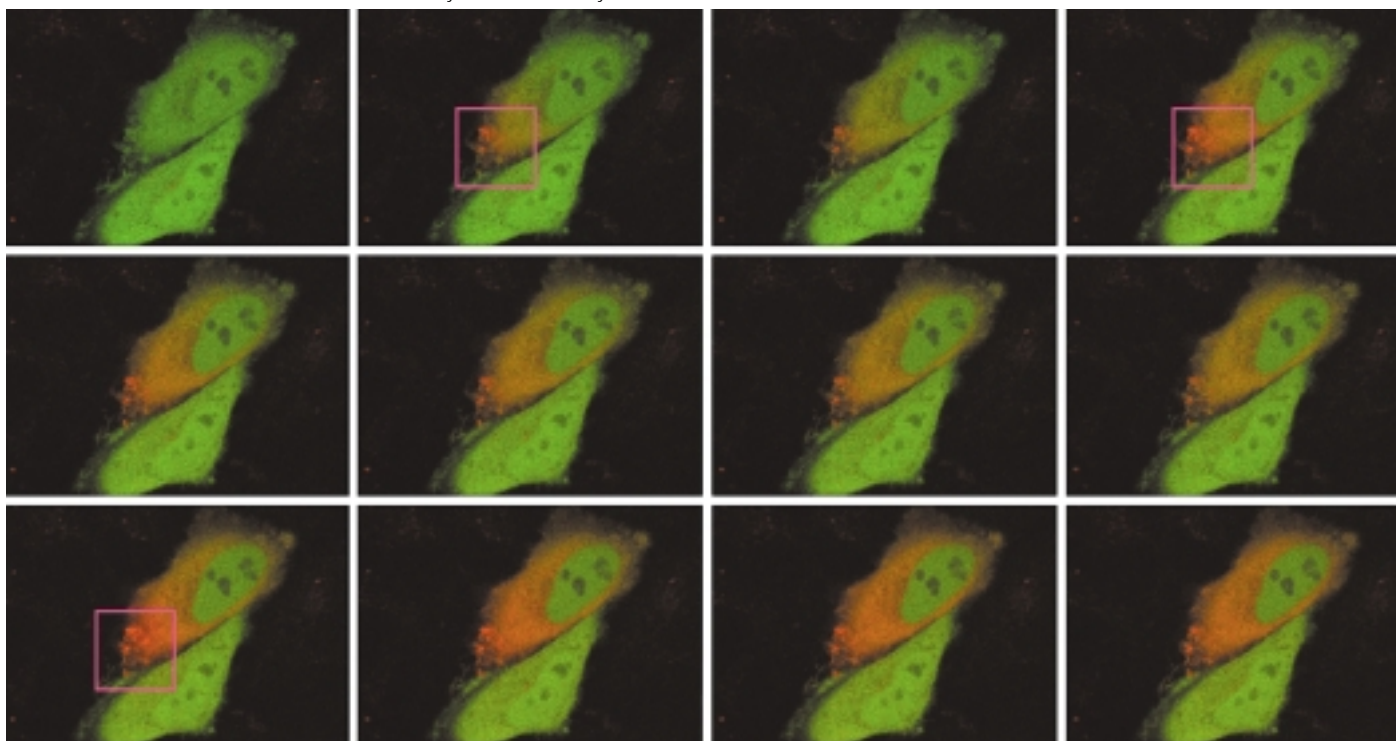
New Fluorescent
Protein
Applications

SIM SCANNER
PA-GFP



Protein diffusion in Kaede-expressing HeLa cells can be accurately monitored using the SIM Scanner System. During 405nm laser stimulation within a user-defined region (red box, frames 2, 4, and 9), the fluorescence emission peak of the Kaede protein shifts from green to red. Confocal fluorescence images recorded every 3 seconds using 488/543nm laser excitation demonstrate the spread of the activated Kaede protein (red) throughout the individual HeLa cell.

Data courtesy of: Ms. Ryoko Ando and Dr. Atsushi Miyawaki
RIKEN Brain Science Institute Laboratory for Cell Function Dynamics



Brighter, faster, more precise

The FV1000 delivers all the key performance functions required from a confocal laser scanning microscope, minimizes specimen damage during high-speed imaging of living organisms, and accurately captures a full range of related information.

Opening New Frontiers Live Cell Imaging System FV1000

High Sensitivity

- Efficient fluorescence detection via ion deposition filters
- Newly developed, high-sensitivity detection system

High Speed

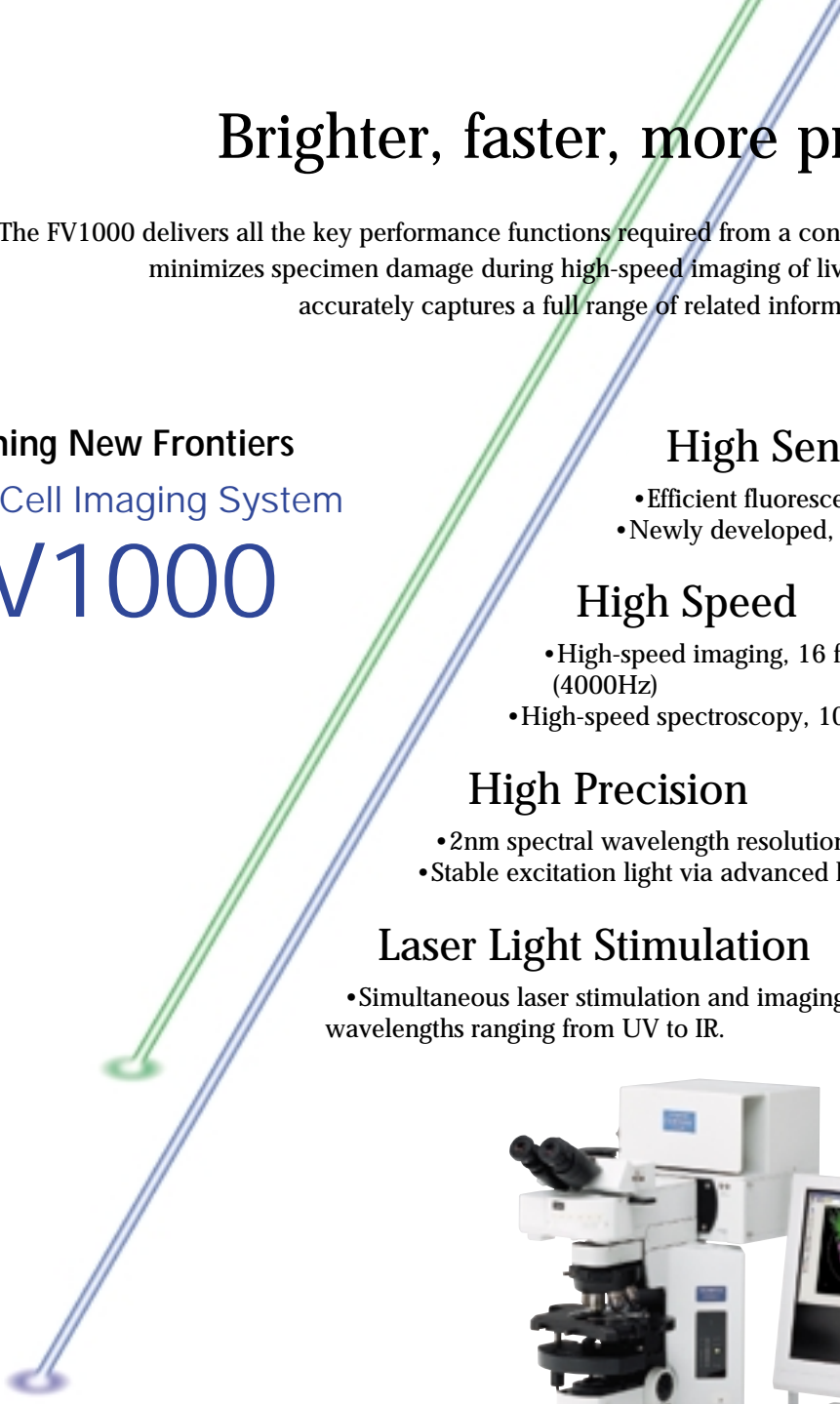
- High-speed imaging, 16 frames/sec at 256 x 256 image format (4000Hz)
- High-speed spectroscopy, 100 nm/msec

High Precision

- 2nm spectral wavelength resolution, linear spectral distribution
- Stable excitation light via advanced laser intensity feedback system

Laser Light Stimulation

- Simultaneous laser stimulation and imaging via SIM (SIMultaneous) Scanner, with wavelengths ranging from UV to IR.



FV1000 configuration with BX61 microscope



FV1000 configuration with IX81 microscope

Sensitivity, Speed and Precision that Redefine Basic Performance

A unique spectral system — sensitive, fast and accurate

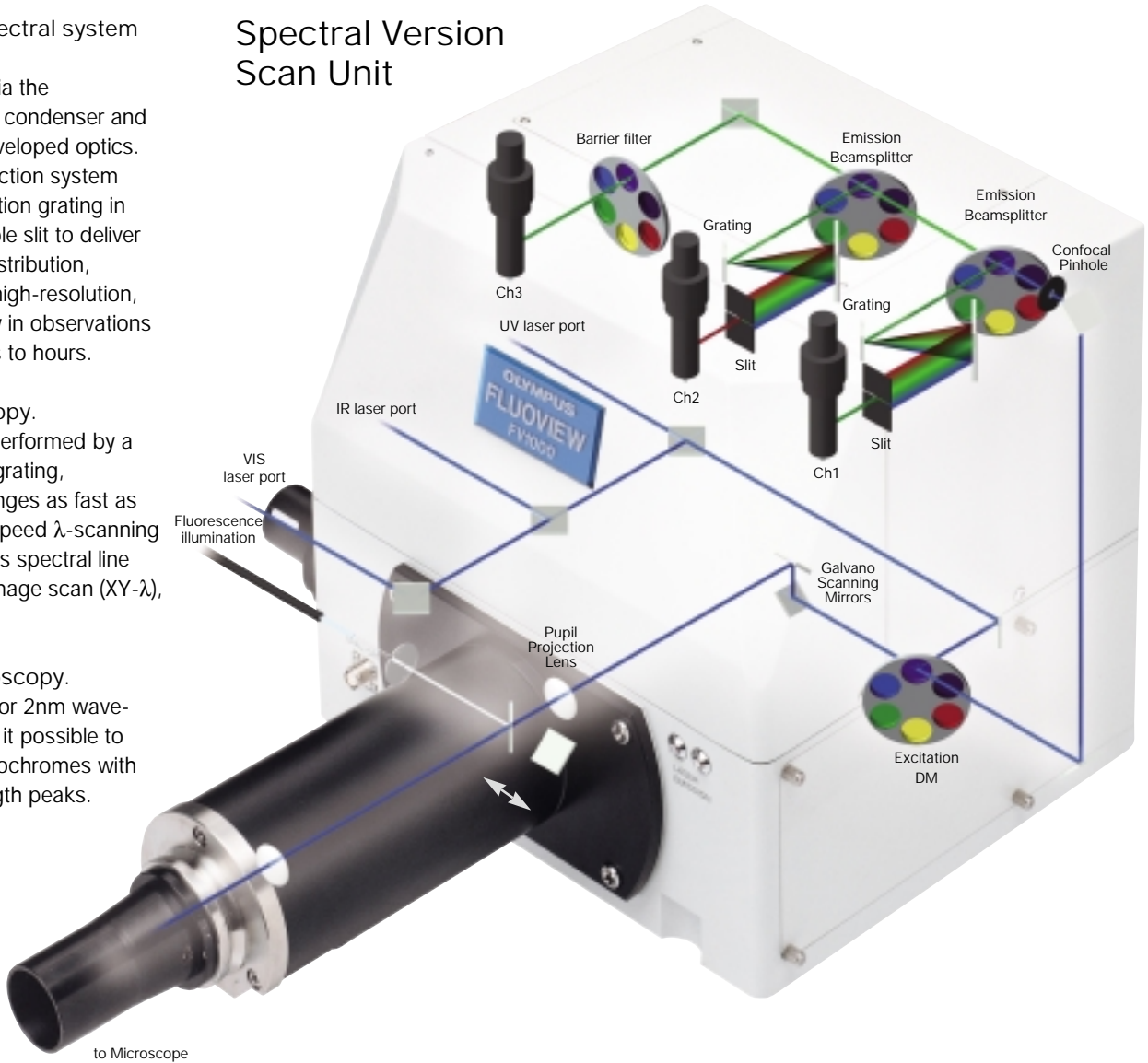
Original optical and spectral system design.

The FV1000 is adapted via the microscope fluorescence condenser and incorporates specially developed optics. The original spectral detection system uses a high speed diffraction grating in combination with a variable slit to deliver superior linear spectral distribution, enabling high-precision, high-resolution, high-speed spectroscopy in observations ranging from milliseconds to hours.

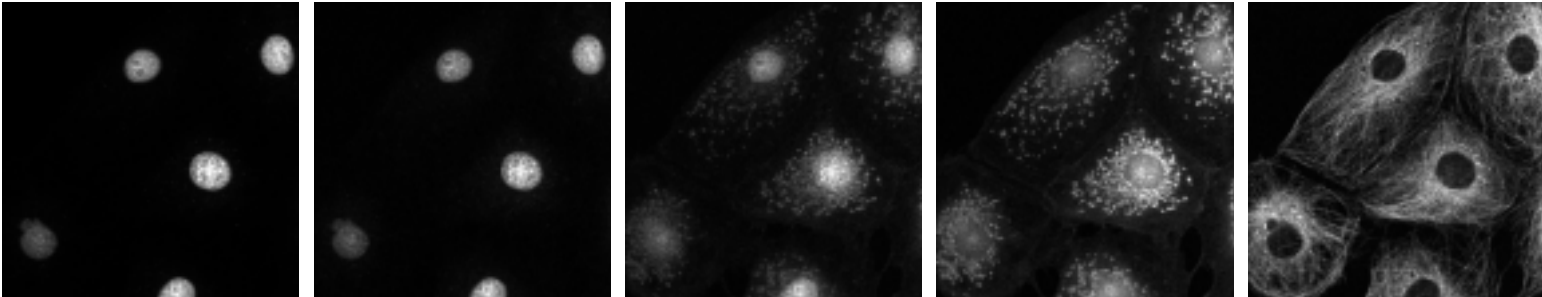
High-speed spectroscopy. Wavelength selection is performed by a galvanometer diffraction grating, enabling wavelength changes as fast as 100 nm/msec and high-speed λ -scanning image acquisition, such as spectral line scan (X- λ) and spectral image scan (XY- λ), with 1 nm step setting.

High-precision spectroscopy. The FV1000 offers superior 2nm wavelength resolution, making it possible to clearly separate two fluorochromes with similar emission wavelength peaks.

Spectral Version Scan Unit



Excitation DM488/543/633 comparison



495nm-515nm

565nm-585nm

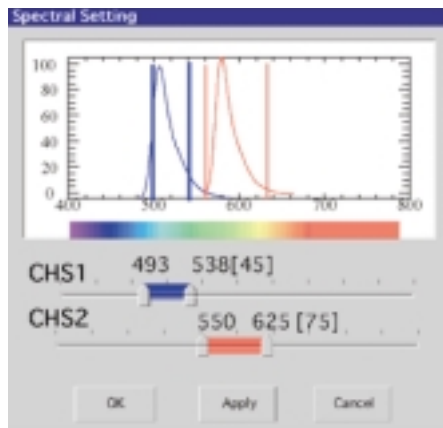
575nm-595nm

595nm-615nm

675nm-695nm

Variable wavelength setting.

The ideal emission bandwidth can be automatically set for each fluorochrome using the on-line dye database. In addition, an intuitive menu allows manual setting of the spectral detector's variable bandwidth, permitting the fluorescence detection bandwidth to be optimized for the emission characteristics of each fluorescent dye.



High Sensitivity Detection System.

The FV1000 features two user-selectable detection modes, a low noise analog integration mode and an original hybrid photon counting detection mode.

Highly-sensitive filter detection system minimizes cell damage

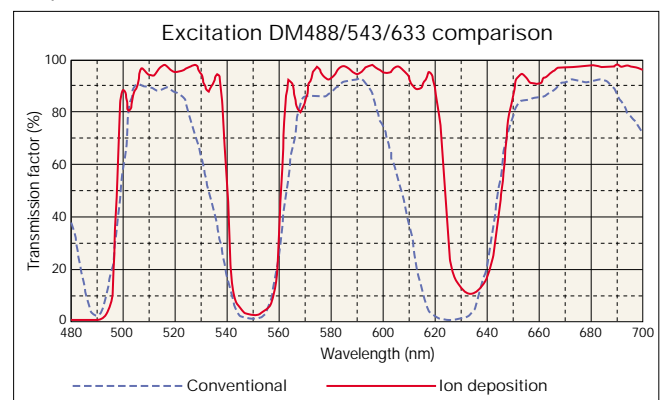
Ion deposition filters for increased sensitivity and full wavelength coverage.

All FV1000 filters feature an ion sputter coating applied by ion deposition technology. This original Olympus technology provides filters with superior curve steepness and wavelength band transmission compared to conventional vacuum deposition.

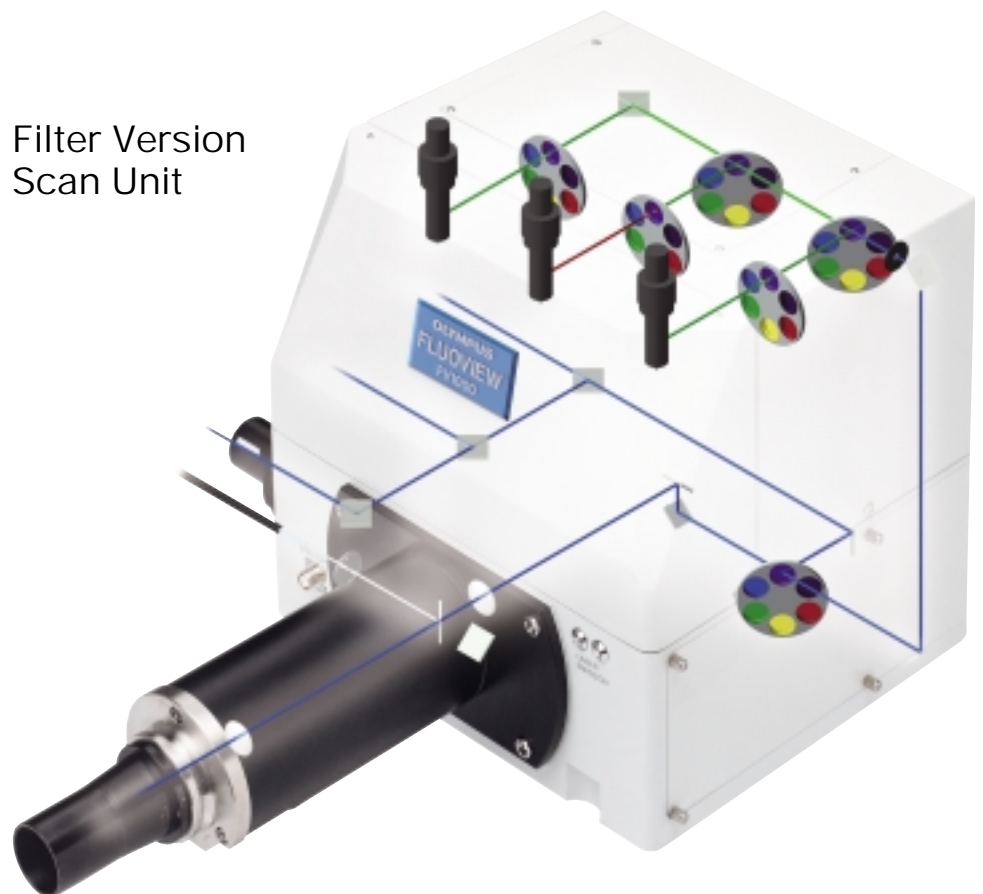
The resulting extended emission bandwidths and increased transmission efficiency enable observation with reduced excitation laser intensity, minimizing photo damage to living cells.

Highly-sensitive detection.

A pupil projection lens, highly sensitive photomultiplier and low-noise analog processing circuit are integrated within the optical system, providing enhanced performance sensitivity with a high S/N ratio.



Filter Version Scan Unit



XYλ series, selected images
XYλ image series of PtK2 cells, triple stained with YOYO-1 for nuclei, MitoTracker Red for mitochondria, and Cy5-conjugated anti-tubulin.
Spectral acquisition ranged from 495nm to 700nm, in 10nm increments with 20nm bandwidth.

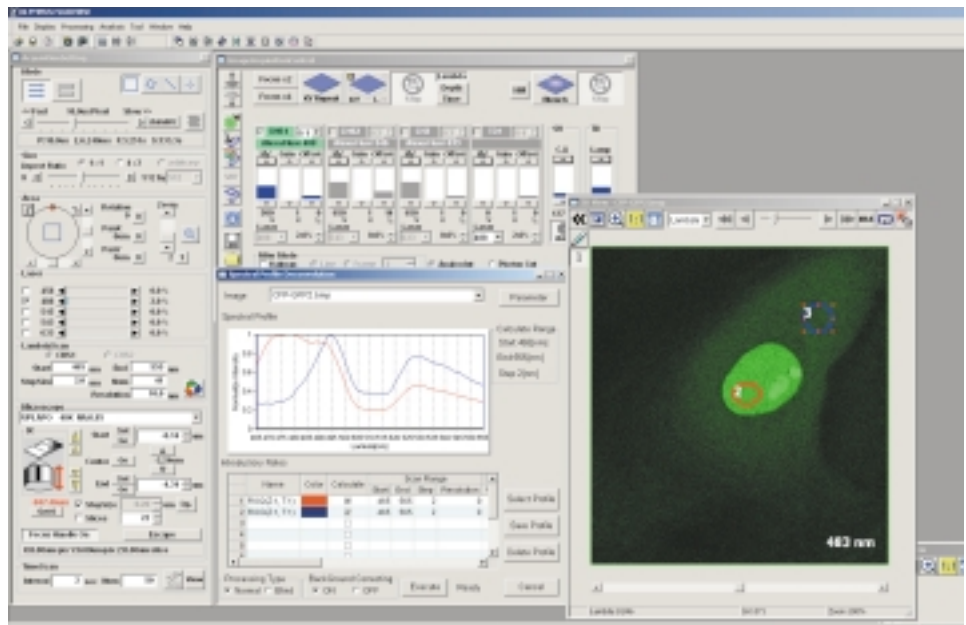
Intuitive Operation Makes Experiments Easy to Design, Easy to Execute

Intuitive software.

Spectral un-mixing for complete assurance.

Intuitive, easy-to-understand GUI. The operator can easily make on-line adjustments to the acquisition parameters (such as scan speed, optical zoom, scan area rotation, photomultiplier voltage, gain, and offset) while monitoring the image resolution. Automatic contrast mode makes image acquisition very easy.

Spectral Un-Mixing.
For separating fluorochromes with similar emission profiles, two modes are provided: Normal mode, which requires the input of the fluorochrome profile, and Blind mode, which automatically separates the emission profiles based on information derived from the specimen image alone. With superior 2 nm wavelength resolution, fast and accurate spectral un-mixing can be easily performed, even for fluorochromes without a known fluorescence profile, such as autofluorescence.



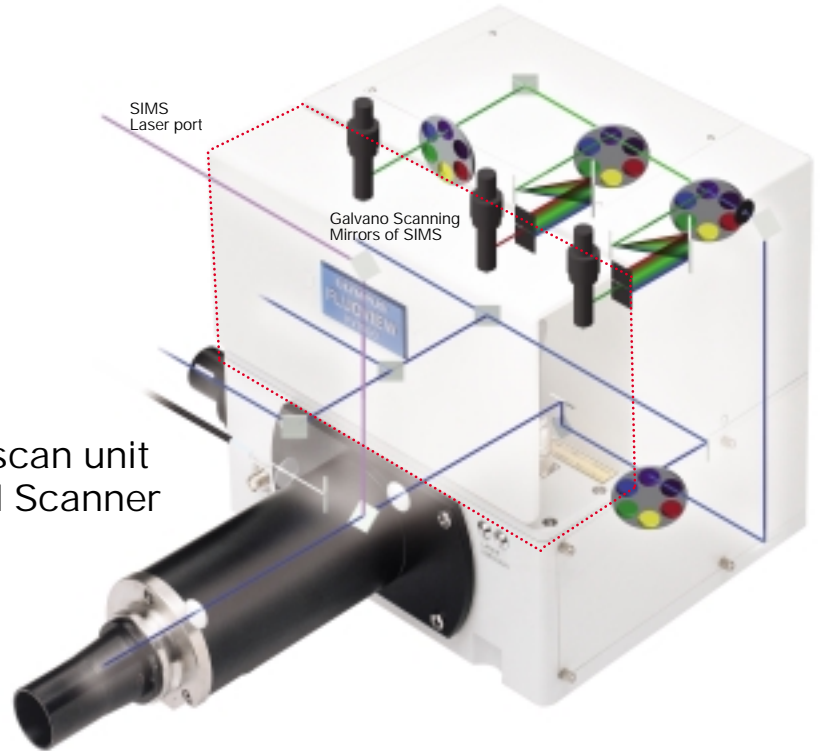
Spectral characteristics of CFP and GFP are measured using two regions of interest to designate the CFP profile (red) and the GFP profile (blue), and then used in the Normal mode for spectral un-mixing of the two fluorochromes.

Un-Mixing images

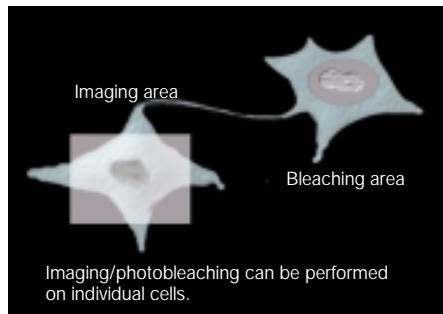
<p>CFP (nucleus) — GFP (tubulin) HeLa cell XYλ acquisition conditions Wavelength detection range: 465nm–565nm in 2nm steps Excitation wavelength: 457nm</p>	<p>MitoTracker (mitochondria) — POPO-3 (nucleus) XYλ acquisition conditions Wavelength detection range: 550nm–640nm in 2nm steps Excitation wavelength: 543nm</p>	<p>Rhodamine-Phalloidin (actin) — PI (nucleus) XYλ acquisition conditions Wavelength detection range: 560nm–630nm in 2nm steps Excitation wavelength: 543nm</p>

SIM (SIMultaneous) Scanner System Synchronizes laser light stimulat confocal imaging (option)

Sure capture of reactions immediately following light stimulation. In addition to the primary scanner for confocal observation, the FV1000 incorporates a compact 2nd scanner dedicated for laser light stimulation. With 2 synchronized scanners, confocal image observation is no longer interrupted during laser light stimulation or laser manipulation, and fluorescence changes that occur during or immediately following laser stimulation are no longer overlooked. This unique capability offers distinct advantages for a variety of applications, such as FLIP, FRAP, photo activation, photo conversion, uncaging, etc.

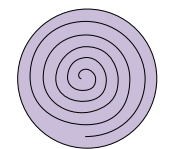


FV1000 scan unit with SIM Scanner



Tornado scanning for highly efficient bleaching.

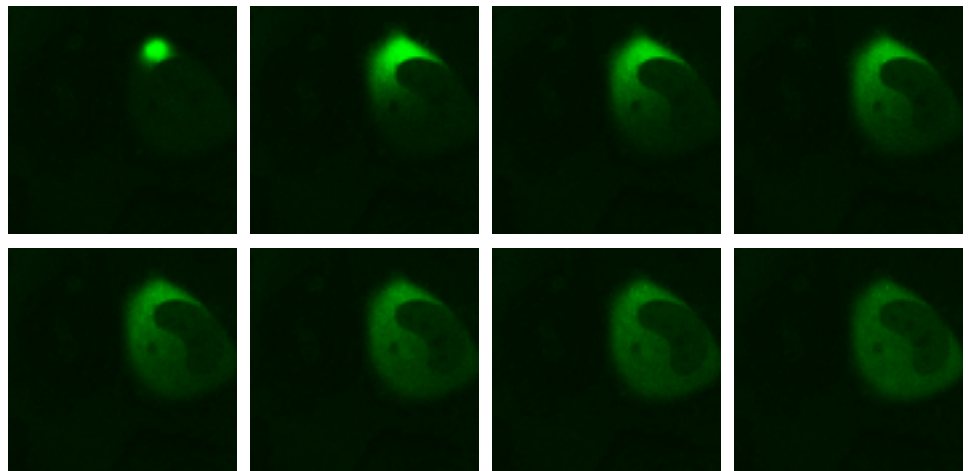
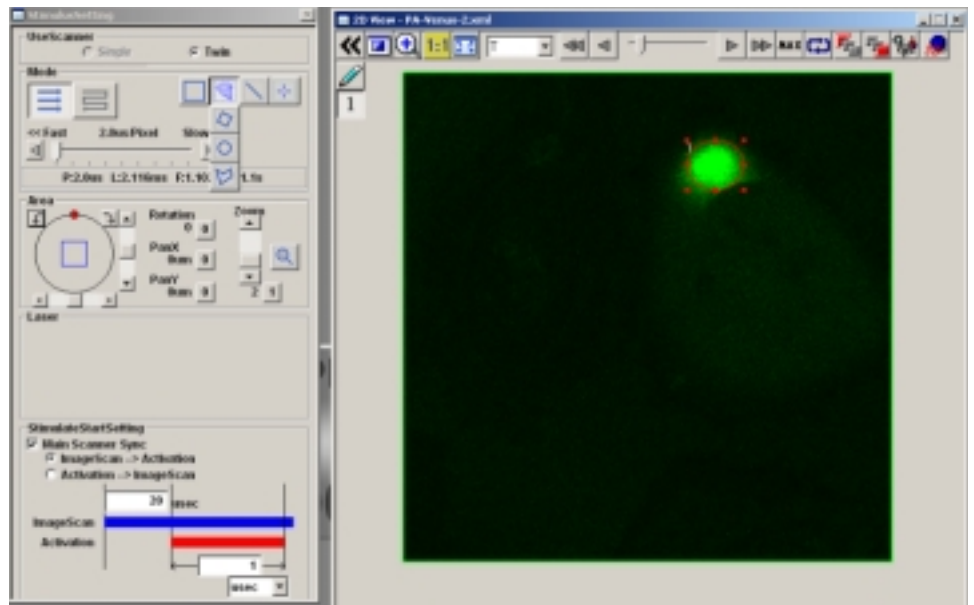
For photobleaching applications, conventional raster scanning tends to be slow and often results in inadequate bleaching. However, with the patent-pending Tornado Scan, fast and efficient bleaching is achieved by the SIM Scanner through a unique circular



Tornado scanning

scanning mode that significantly reduces the necessary laser exposure time.

Photo activation of PA-GFP expressing HeLa cells. SIMS stimulation (red ROI) using the 405nm diode laser, releasing GFP within the cell. GFP images were simultaneously acquired at 1 second intervals using the 488nm laser.



Data courtesy of Dr. Atsushi Miyawaki, Dr. Takeharu Nagai, Dr. Takayuki Miyauchi
RIKEN Brain Science Institute Laboratory for Cell Function Dynamics

High-speed, high-precision detection with time-lapse experiments

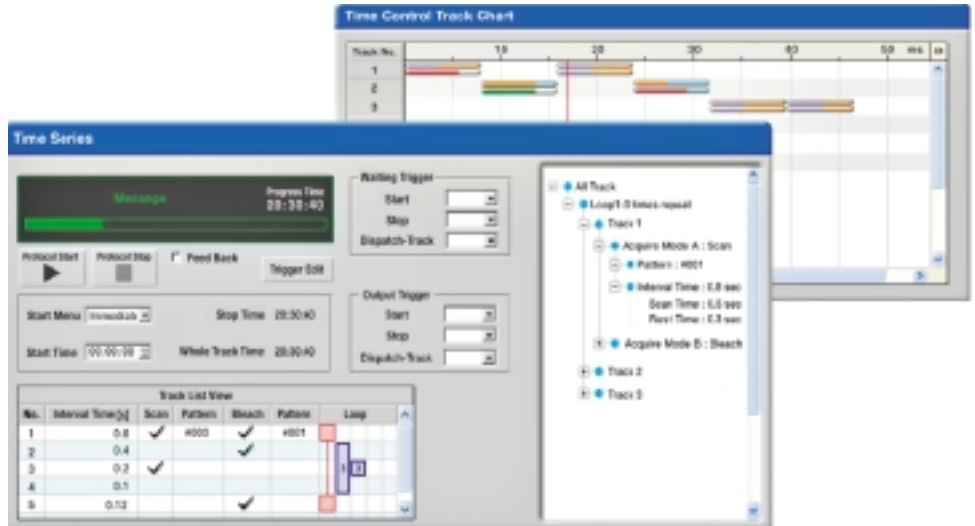
16 frames/sec. 4000 lines/sec.

The incorporation of highly stable galvano-meter scanning mirrors and an Olympus original acceleration circuit enables high-speed imaging (16 frames per second at 256x256 image format). Observation of rapid changes within living cells is now possible with significantly increased time resolution.

High-precision time-lapse imaging. The FV1000 employs an external real time controller for high-precision time-lapse imaging of live cells. Data acquisition is controlled in microsecond increments, ensuring far more accurate and reliable timing.

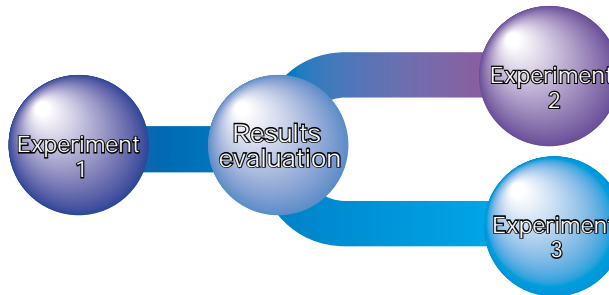
In addition, laser light intensity is monitored and fed back to the AOTF, helping to stabilize the excitation light during time-lapse imaging.

Intuitive change of experiment conditions, even while scanning. Pre-programmed image acquisition conditions (PMT sensitivity, laser intensity, time interval, channel settings, etc) can be changed while observation is in progress, making it possible to respond quickly to various cellular changes. On-line ROI plot data and real time ratio images can also be displayed.



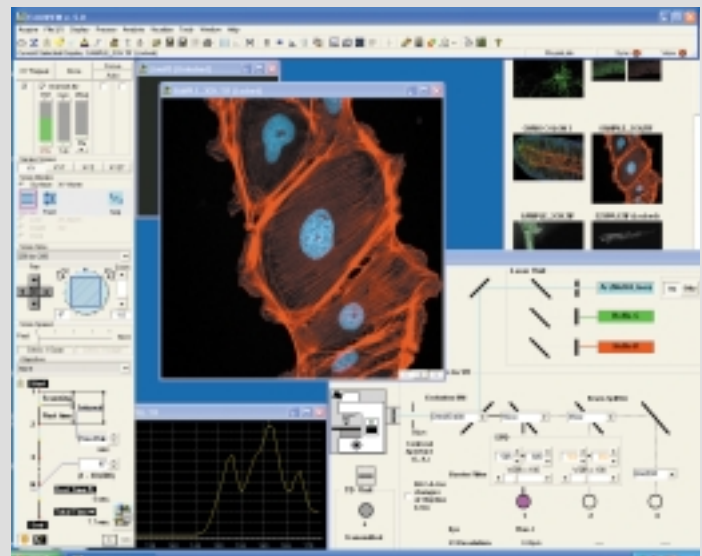
Independent designation of stimulation and scanning. Any region of interest can be specified for stimulation and scanning independently, with unrestricted control of variations in timing, duration and intensity.

Pre-programming of experiment flow. Experiments systematically programmed with a time series controller can be separated and freely combined, enabling the next set of experimental conditions to be selected after analysis of the prior experiment.



FV300/FV500/FV1000 SOFTWARE

Newly-developed FV300/FV500 Application Software may be used on FV1000 confocal microscope systems. Improving on the FV300/500 software platform, the Basic Software adopts the menu bar method as a new function to enhance ease of use. Functional panel and image windows are separately displayed to avoid image acquisition functions being hidden below the image display. Any image can be displayed freely, with each image shown in an independent window. The Basic Software is suitable for both the filter and spectral version of the FV1000, and includes support for a dual monitor display as well as the single monitor display used by the FV300/500 systems. Full functionality is available for the filter-based FV1000 detection system. However, advanced features such as the SIM Scanner, spectral λ -scanning and spectral un-mixing are not supported by the Basic software.



Single monitor image

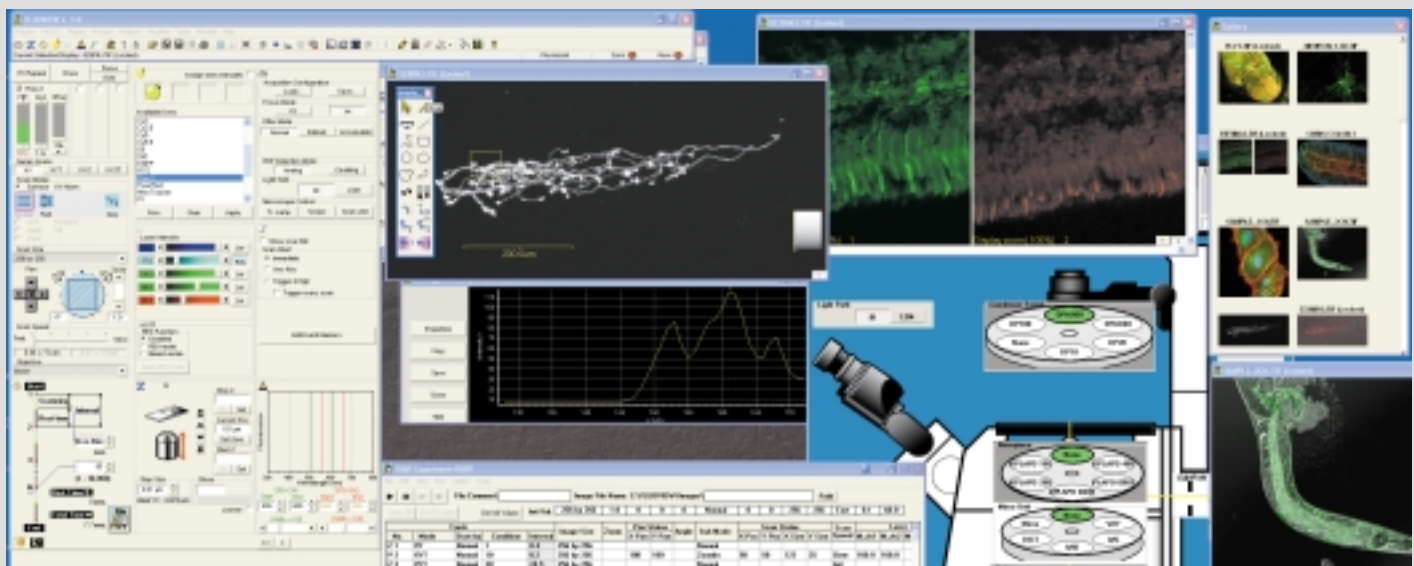
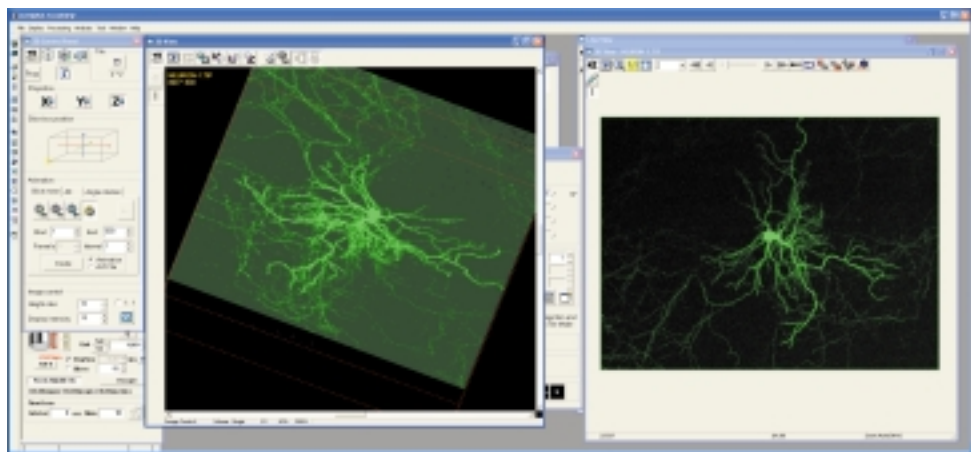
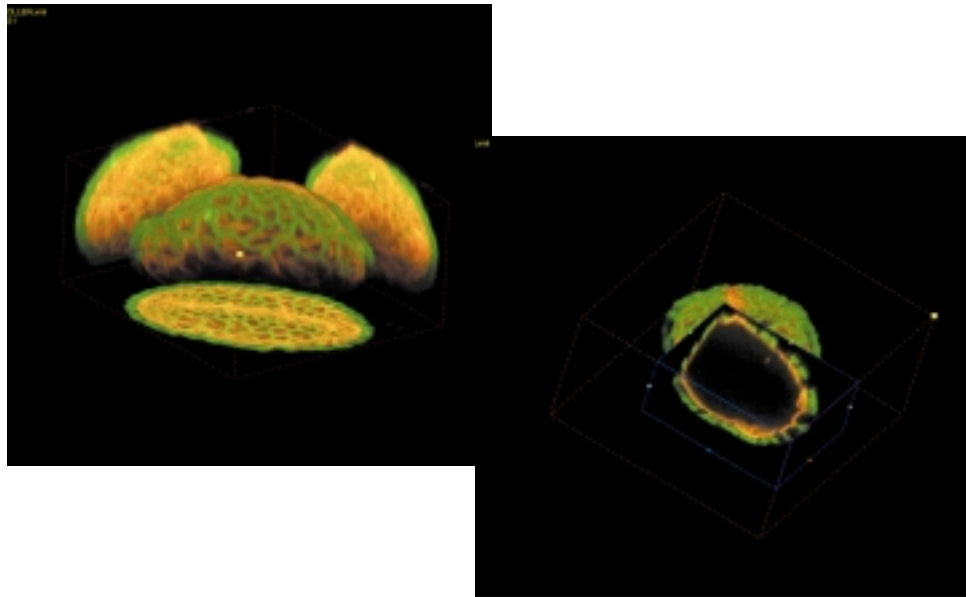
Intuitive on-line observation of desired region as a 2D or 3D image

3D-2D coupled display.

During 4-dimensional XYZT data acquisition or 3D rendering, a separate 2D image of any designated cross section can be obtained. This enables the scanning and image processing conditions to be changed in real time, i.e. while scanning. Any region can be freely observed by changing from 2D to 3D and from 3D to 2D dynamically.

Interactive volume rendering 3D.

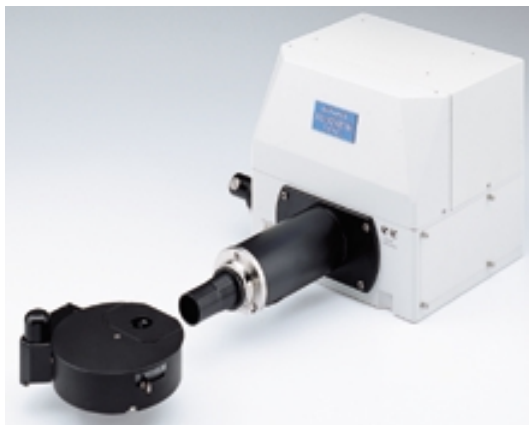
Images may be rotated in any direction to facilitate observation.



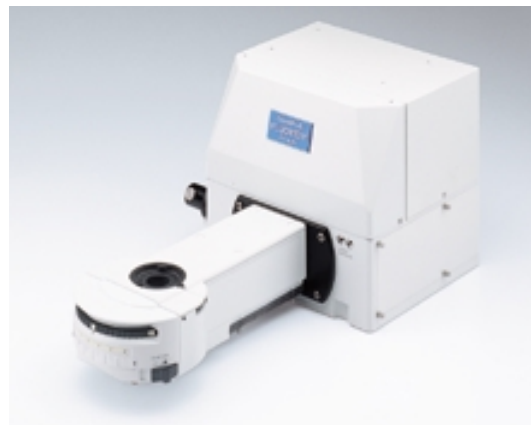
Dual monitor image

Scanning units

Two types of scanning units, filter-based and spectral detection, are provided. The design is all-in-one, integrating the scanning unit, tube lens and pupil projection lens. Use of the microscope fluorescence illuminator light path ensures that expandability of the microscope itself is not limited. Visible, UV and IR laser introduction ports as well as a laser power monitoring and feedback control system are implemented.



Scanning unit for IX81 inverted microscope
Dedicated mirror unit cassette is required.



Scanning unit for BX61/BX61WI upright microscopes
Fluorescence illuminator integrated with scanning unit.

Laser systems

A variety of laser systems are available. Ultra-fast and flexible laser intensity modulation is standard with FV1000. Use of a laser intensity monitoring and feedback control system in the scan unit ensures stable excitation intensity during long time-lapse observations.



Laser combiner (with mounted laser heads)
3 visible light lasers (multi-line Ar laser, HeNe-G and HeNe-R) can be mounted on the laser combiner with implemented AOTF module and driver.



LD405/LD440 laser
The Olympus-made 405nm and 440nm laser diodes feature a unique modulation function. High-speed shutter and laser intensity modulation are synchronized to the visible light AOTF system.

Illumination units

Conventional illumination modules are designed for long-duration time-lapse experiments. Since light is introduced through fiber delivery systems, no heat is transferred to the microscope.



Fluorescence illumination module
Stand with Mercury lamp house, motorized shutter, and fiber delivery system for conventional fluorescence observation. Light introduction via fiber optic port.



Transmitted light detection module
External transmitted light photomultiplier detector and 100W Halogen conventional illumination, integrated for both laser scanning and conventional transmitted light Nomarski DIC observation. Motorized exchange between transmitted light illumination and laser detection. Simultaneous multi-channel confocal fluorescence image and transmitted DIC acquisition enabled.

Optional upgrade modules for FV1000



4th channel detector unit
Attaches to the optional port of either the filter or spectral type scanning unit and is used as a 4th confocal fluorescence detection channel. This is a filter-based fluorescence detection unit.

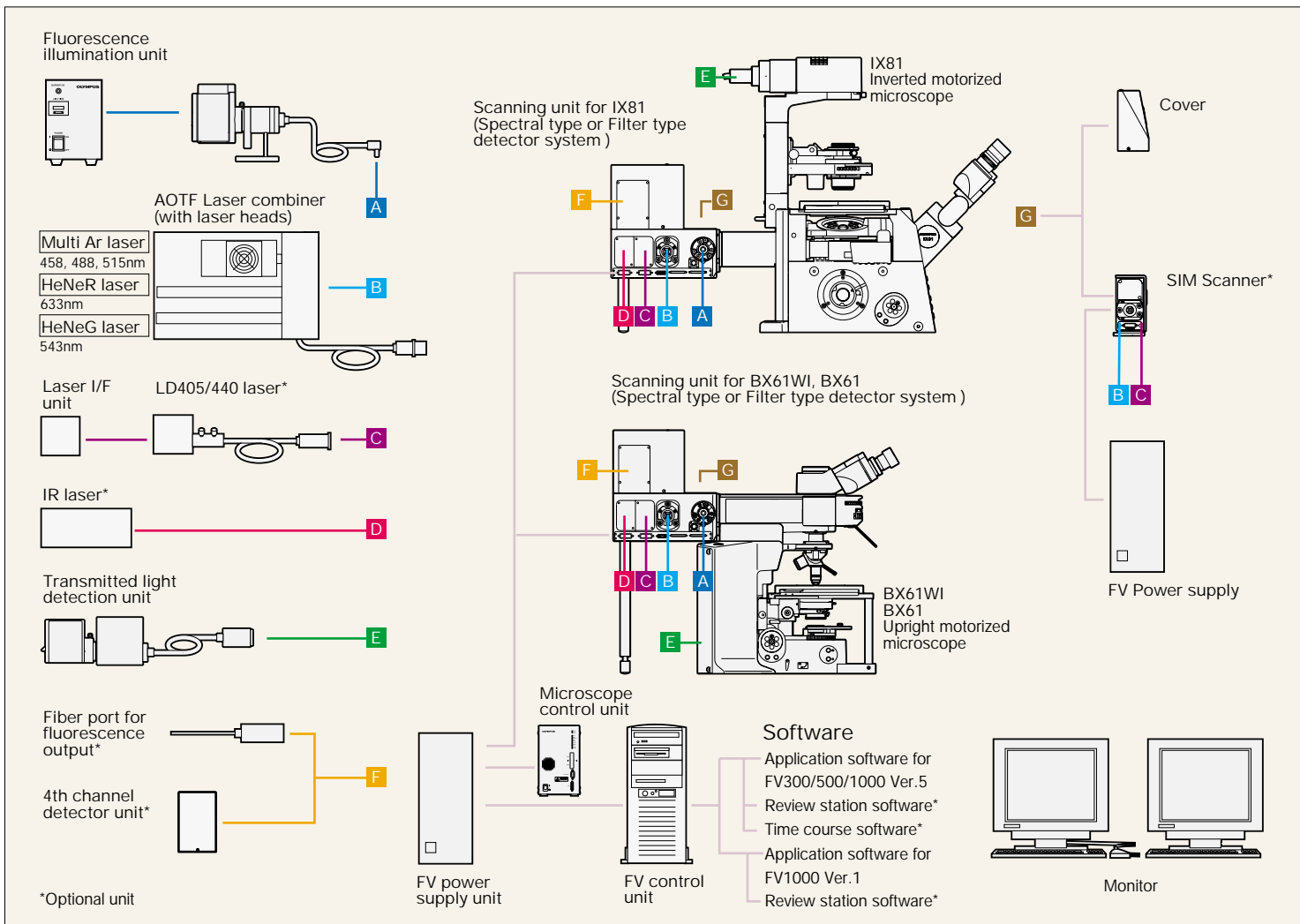


SIM Scanner
Second scanner dedicated for laser light stimulation, synchronized to the FV1000 main scanner for simultaneous laser stimulation and confocal image acquisition. Independent fiber optic laser introduction port. Dichromatic mirror within motorized optical port of the scan unit required for introduction of laser into main scanner.



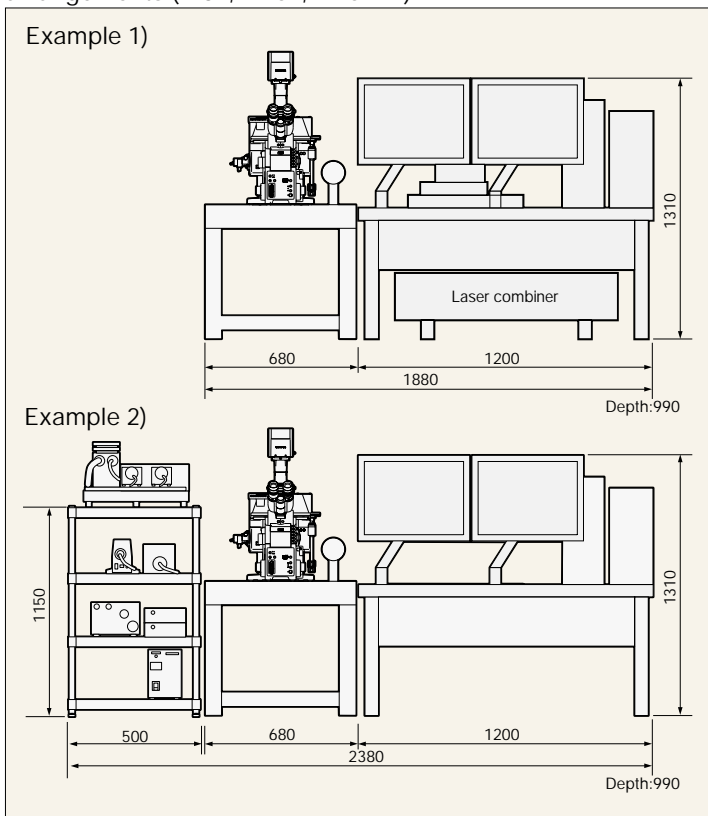
Fiber port for fluorescence output
Confocal fluorescence emission can be introduced via fiber delivery system into external device. Fiber port equipped with FC connector (fiber delivery system not included).

FV1000 SYSTEM DIAGRAM



Recommended FV1000 system setup arrangements (IX81, BX61, BX61WI)

(unit: mm)



Dimensions, weight and power consumption

	Dimensions (mm)	Weight (kg)	Power consumption
Microscope with Scan unit	BX system 320(W) x 580(D) x 565(H)	41	None
	IX system 350(W) x 750(D) x 640(H)	51	
Fluorescence illumination unit	Main unit 180(W) x 320(D) x 235(H)	6.7	100V/200V 260VA
	Power supply 150(W) x 295(D) x 200(H)	4.6	
Transmitted light detection unit	170(W) x 330(D) x 130(H)	5.9	Non (Microscope control unit)
Microscope control unit	125(W) x 330(D) x 215(H)	5.8	100-120/220-240V 350VA
FV Power Supply unit	180(W) x 328(D) x 424(H)	7.5	100-120/220-240V 400VA
FV Control unit (Computer)	180(W) x 420(D) x 360(H)	11.2	100-120/220-240V 300VA
Monitor	415(W) x 216(D) x 435(H)	6.6	100-120/220-240V 100VA
Laser combiner (with Laser heads)	483(W) x 800(D) x 279(H)	45	None
Multi Ar laser Power Supply	162(W) x 330(D) x 98(H)	3.2	100-120/220-240V 1500VA
HeNe G laser Power Supply	160(W) x 270(D) x 54(H)	1.4	100-120/220-240V 30VA
HeNe R laser Power Supply	160(W) x 270(D) x 54(H)	1.4	100-120/220-240V 30VA
LD405/440 laser	Laser head 70(W) x 70(D) x 70(H)	0.5	100-120/220-240V 100VA
	Power Supply 95(H) x 210(W) x 297(D)	2.7	

Mouse Hippocampal Neurons (cover page data)

Expression of the Kaede protein, a green fluorescing protein that transferred upon 405nm exposure, identifies mouse hippocampal neuronal dendrites derived from a single cell body. Kaede fluorescence in hippocampal neuron cells following 405nm exposure.

Left cell (red) 0.5 sec exposure, Middle cell (yellow) 0.25 sec exposure, Right cell (green) no exposure to the 405nm laser diode excitation.

Data courtesy of: Ms. Ryoko Ando, Dr. Atsushi Miyawaki
RIKEN Brain Science Institute Laboratory for Cell Function Dynamics

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