Nikon

ECLIPSE Ti

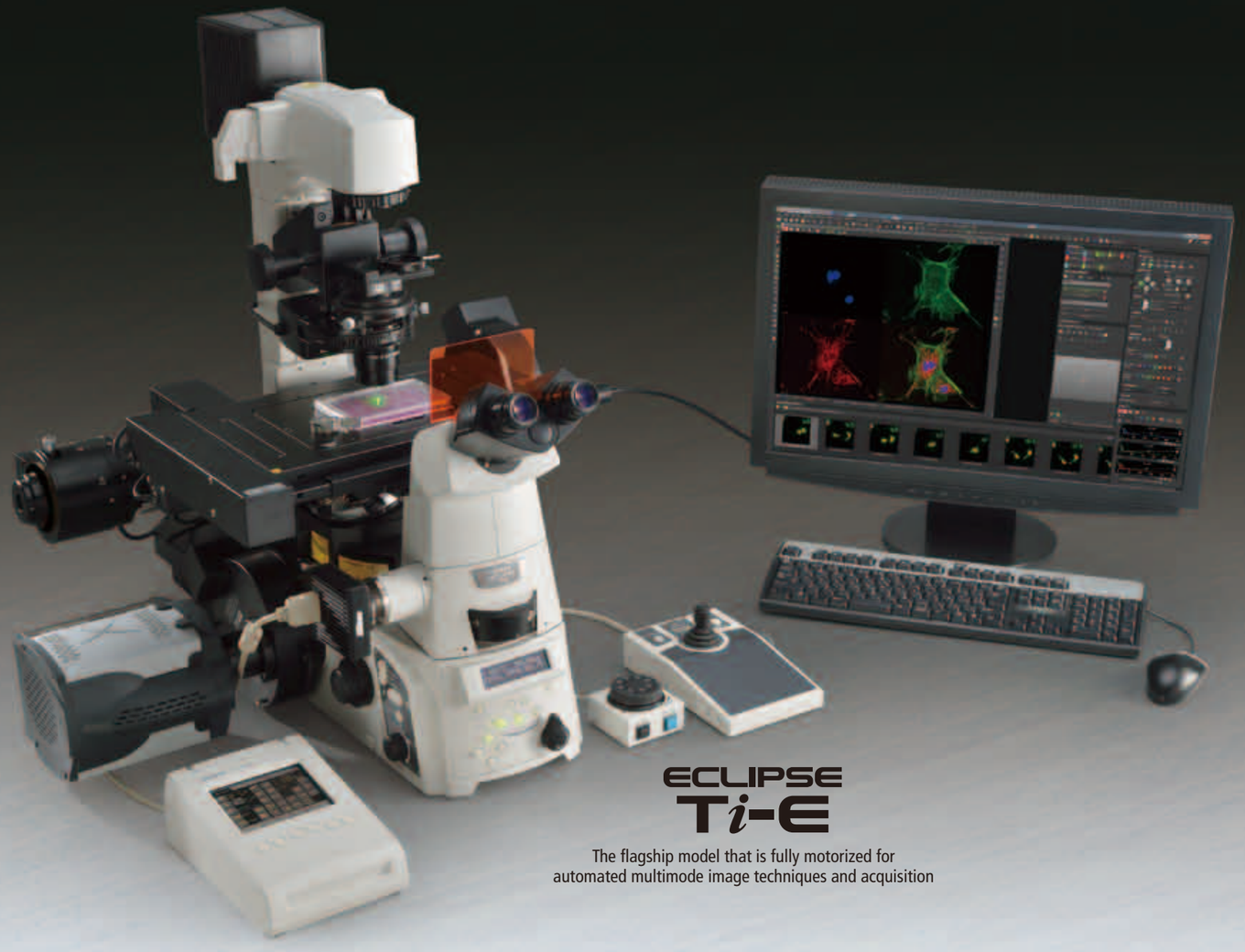
Inverted Research Microscope

ECLIPSE Ti

At the Center of Your Research Discoveries

Nikon's third-generation Perfect Focus System (PFS) further expands the capability of the world's most dynamic focusing system

Microscopes are critical tools for cutting-edge research in biology, medical and pharmaceutical sciences. To satisfy the demands of today's high-end research, Nikon has developed the Ti series of microscopes. Combined with NIS-Elements imaging software, the Ti supports diverse image acquisition and analysis methods such as multi-dimensional time-lapse imaging to acquire temporal, spatial and spectral information of fast, dynamic live cell processes. Intelligently designed automation and further expansion of Nikon's powerful modular approach make the Ti ideal for applications such as confocal, FRET and photobleaching/photoactivation to study the interaction of fluorescence protein molecules in living cells and tissues.
Nikon's exclusive Perfect Focus System (PFS) for Ti-E has been significantly improved to provide more powerful and versatile performance.
By providing the best dynamic focusing system on the market, Nikon's newest PFS continues to extend research capabilities.



ECLIPSE Ti-E

The flagship model that is fully motorized for automated multimode image techniques and acquisition

Advanced functions of Ti-E dramatically expand research imaging possibilities

Advanced Time-lapse Imaging
Advanced built-in Perfect Focus System (PFS) for improved automatic focus correction *P4*

Fast and Automated
High-speed motorized components allow fast, coordinated and seamless image acquisition *P6*

Screening
Multimode scanning of well plate at an unprecedented speed

High-quality Phase Contrast Observation
"Full intensity" optical components enable phase contrast with high NA non-phase-contrast objectives *P7*

Multiple Cameras
Image acquisition and analysis with multiple side ports and back port cameras *P8*

Motorized Laser TIRF (Total Internal Reflection Fluorescence) Observation
Alternate time-lapse observation between widefield fluorescence and TIRF (NA 1.49) images by fast illumination switching and motorized control of laser incident angle *P10*

Photoactivation
The photoactivation unit allows cell marking and dynamic analysis using photoactivatable and photoswitchable proteins such as PA-GFP and Kaede *P11*

Muliphoton, confocal, super-resolution imaging
Flexible configuration that enables system building for cutting-edge research applications *P20*

ECLIPSE Ti-U

The universal model that can be configured for use with motorized components

ECLIPSE Ti-S

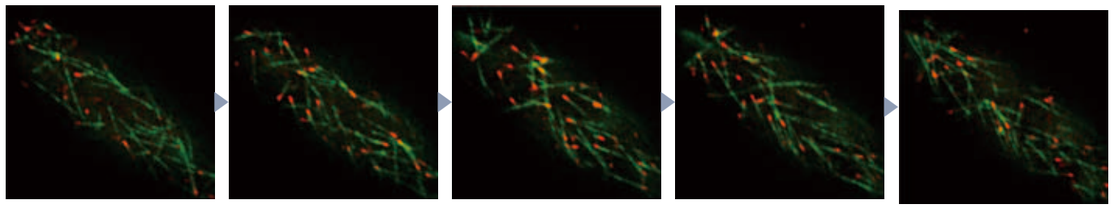
The basic model with two built-in imaging ports that can be dedicated to specific tasks

Remarkably stable and reliable time-lapse imaging of living cells

NEW

Nikon's Perfect Focus System (PFS) provides real-time focus correction that overcomes microscope focus drift caused by thermal and mechanical effects. The use of PFS dramatically improves the quality of long-term time-lapse image data.

Nikon's Perfect Focus System (PFS) automatically corrects focus drift caused by thermal and mechanical changes that occur during long-term observations and when reagents are added. Images remain in focus even when using higher magnification and higher resolution techniques such as TIRF imaging. The latest generation of PFS offers significant enhancements, setting a new standard for live cell imaging. Its streamlined design enables easier access to objective lenses and correction collars. Two models are available: one for UV-visible imaging and another for Visible-IR imaging for multiphoton microscopy.

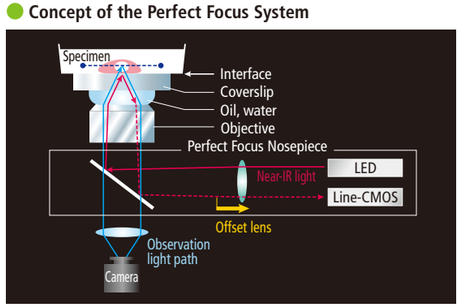


EB1 and tubulin in the cortex of Physcomitrella patens moss
Images were acquired on a spinning disk confocal with a Plan Apochromat VC 100x 1.4 NA lens at the Marine Biological Laboratory.
Photos courtesy of: Drs. Jeroen de Keijzer and Marcel Janson, Wageningen University, and Dr. Gohta Goshima, Nagoya University.

Optical offset technology

Nikon's proprietary technology allows focusing at a desired height above the coverslip while simultaneously detecting the coverslip interface. PFS immediately corrects focus drift resulting from stage movement during multi-point imaging or temperature drops when reagents are added. PFS eliminates the need to capture extra images of different planes in anticipation of focus drift, resulting in minimized light exposure and photobleaching.

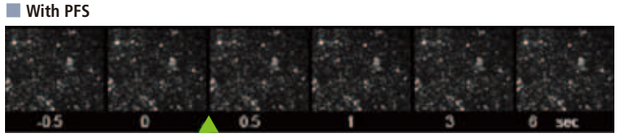
Concept of the Perfect Focus System



The diagram shows the case when an immersion type objective is used.
A dry type objective is also available.

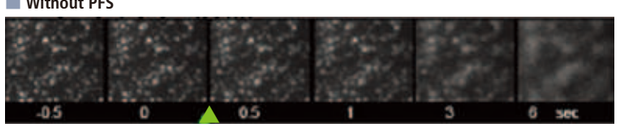
Correction to focus drift when reagents are added

With PFS



Adding reagent

Without PFS

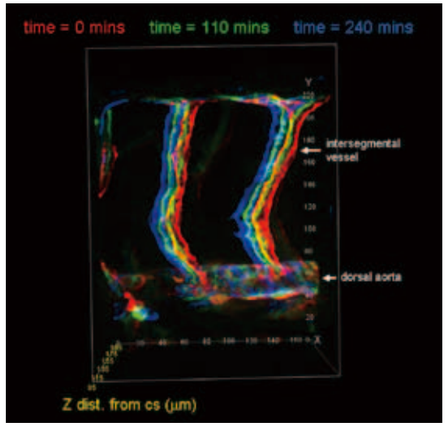


Adding reagent

The change in temperature caused by adding media (indicated by the arrow) causes the focus to drift if PFS is not used. Engaging PFS eliminates this problem entirely.

Maintaining focus at greater depths

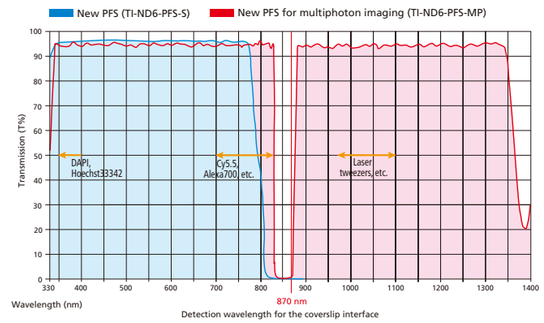
Due to its improved optics and sensitivity, PFS allows for correction of focus drift at significantly greater distances from the objective lens and at greater depths within the specimen than before.
This capability is ideal for developmental biology and applications that require studying the dynamics of cells in thick samples such as tissues or organs.
This broadened focus drift correction range results in more reliable data.

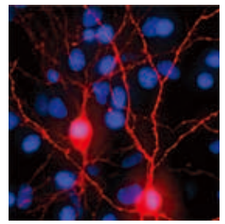


3D time-lapse image of the developing vasculature of a zebrafish embryo (Z-series is imaged at 95-186 μm away from the coverslip).
Because PFS can maintain focus at greater depths within the specimen, whole images of intersegmental vessels sprouting upward from the dorsal aorta are clearly captured.
Shown in the three channels are three different timepoint volumes.
Objective: CFI Apochromat LWD 40x WI λ S, NA 1.15
Photo courtesy of: Dr. Robert Fischer, Marine Biological Laboratory

Compatible with diverse fluorescence dyes with improved performance in broader wavelength range

PFS utilizes an 870nm wavelength LED for detection of the coverslip interface, enabling imaging of near-infrared fluorescence dyes such as Cy5.5 without interference. The overall wavelength range has increased, allowing researchers to acquire focused-data sets in applications that require a broad spectrum of imaging wavelengths, including Ca2+ imaging in the UV range and laser tweezer applications in the IR range.
The multiphoton model can correct for focus drift even when imaging with wavelengths ranging from 880-1300 nm.





Live imaging of primary rat cortical neurons stained with Hoechst33342 and DiR
Photo courtesy of: Drs. Ippei Kotera, Shinya Hosaka and Prof. Takeharu Nagai, Research Institute for Electronic Science, Hokkaido University

Compatible with plastic dishes and well plates

In addition to glass bottom dishes, plastic dishes, which are less expensive but suitable for cell culture, can be used with PFS. This plastic-compatibility feature enables a cost-effective means for focused imaging in high-throughput screening applications that involve multi-well plates.

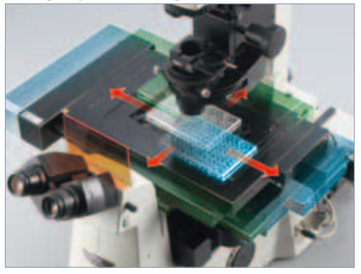
High-speed Motorized Control and Acquisition

The synchronized control of motorized components allows researchers to use the microscope for a wide range of automated multi-dimensional experiments. Faster device movements and image acquisition minimizes unnecessary light exposure to the specimen and subsequent photo-toxicity, resulting in more accurate and reliable data.

Enhanced speed of individual motorized components

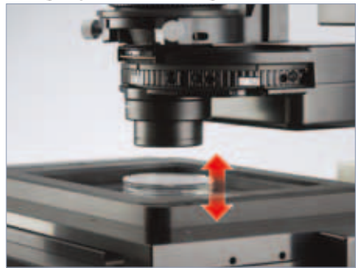
Operation and/or changeover speed of objectives, filter cubes, XY stage, and excitation/barrier filters have been greatly enhanced, enabling a stress-free operational environment that allows researchers to focus on the acquired data and analysis. The controller memorizes and accurately reproduces acquisition parameters and the joystick easily allows control of the stage in XY and Z, making the microscope feel like a natural extension of the eyes and hands.

High-speed XY stage movement



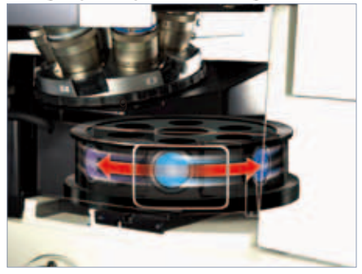
Nikon-exclusive high-speed encoded stage

High-speed Piezo Z stage movement



Nikon-specified Piezo Z specimen stage

High-speed epi-fl filter changeover

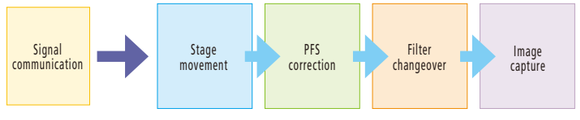


Nikon filter dichroic cube turret

The digital Controller Hub significantly increases motorized accessory speed by reducing the communication overhead time between components, boosting total operation speed.

PC control and automation of the Ti's motorized components are optimized to reduce the respective communication time between action commands and movements producing high-speed total control. By adding firmware intelligence to the microscope, total operation time of the motorized components is reduced. For example, the total time for continuous image acquisition in three modes (two-channel fluorescence and phase contrast) with illumination shutter control is greatly reduced enhancing cell viability.

Control process



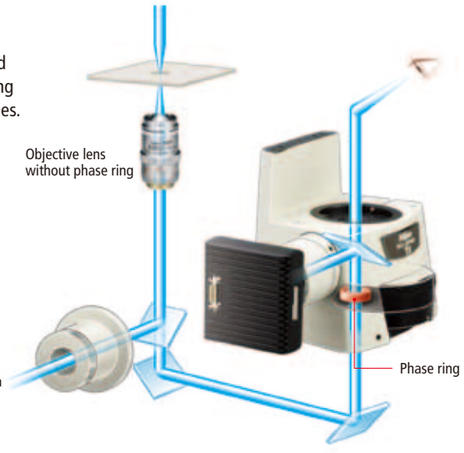
Once it receives command signals from a PC, the Ti controller takes over control of each motorized component, allowing the communication time between PC and each motorized component to be eliminated, minimizing overall operation time.

High-quality Phase Contrast Images with High NA Lens

With Nikon's unique "full intensity" external phase contrast unit, a phase ring is incorporated in the microscope body instead of the objective lens enables the acquisition of uncompromised, full-intensity fluorescence images as well as phase-contrast images with high-NA objectives that do not contain phase rings.

Phase ring is incorporated in the microscope body

Incorporating a phase ring—that was normally positioned within the phase contrast objective lens—into the external phase contrast unit optically allows use of specified high NA objectives to produce high-resolution phase contrast images. Moreover, using the objectives without a phase ring enables "full intensity" bright fluorescence images. Five types of phase contrast rings are available according to the objectives used. (common for Ti-E/U/S)



Changing the conventional concept of phase contrast

Unprecedented high resolution

Nikon's high-performance objective lenses, including the 60x and 100x TIRF objectives with the world's highest numerical aperture of 1.49 incorporating spherical aberration correction collars, deliver high-resolution phase contrast images that can not be captured with any standard phase contrast objective.

Bright fluorescence image using same objective

Because there is no light loss due to a phase ring, bright "full intensity" fluorescence, confocal and TIRF images can be captured using the same objective as well as providing phase contrast observation.

NG108 cell: Growth cone stained with EGFP-fascin

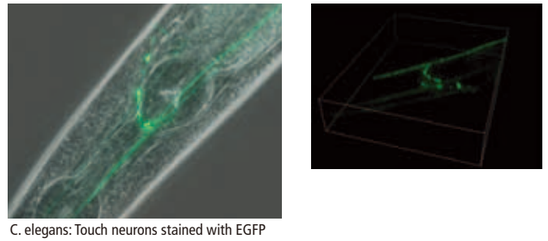
Photos courtesy of: Drs. Satoe Ebihara, Kaoru Katoh, The National Institute of Advanced Industrial Science and Technology (AIST)

Use of laser tweezers without changing lens

Because an objective without a phase ring can be used for phase contrast observation, use of laser tweezers is possible without changing the objective lens.

Phase contrast observation with water immersion objective

It is now possible to use a water immersion objective for phase contrast observation. Clear, high-resolution—refractive index matched—phase contrast images with minimal aberration of deep specimen areas can be captured.



C. elegans: Touch neurons stained with EGFP

Photos courtesy of: Drs. Motomichi Doi and Kaoru Katoh, The National Institute of Advanced Industrial Science and Technology (AIST)

High resolution effective for image analysis

Because phase contrast observation is also possible with the same objective used for TIRF observation as well as DIC observation, phase contrast images with less oblique background shading than that of DIC observation are captured, allowing high-precision data processing and image analysis such as cell contour definition of TIRF image specimen.

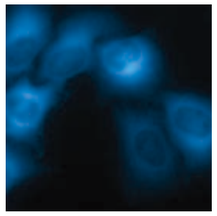
Multiport and Stratum Structure Support Advanced Research

Multiple image port design with left, right, and bottom* ports for optical output enables a camera or detector to be attached to each port. Furthermore, the expanded space stratum structure enables addition of an optional back port. These features allow simultaneous image capture with multiple cameras using two-tier dichroic fluorescence filter turrets.

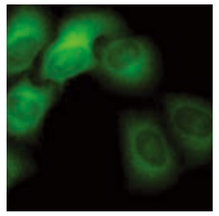
*Available with Ti-E/B and Ti-U/B models with bottom port

Back port enables multiple camera imaging

Use of an optional back port expands the image capture capability. Used in combination with the side port it allows simultaneous image acquisition for two wavelengths with two cameras. For example, when observing interaction between fluorescence proteins with FRET (Förster Resonance Energy Transfer) and intensity difference between CFP and YFP is great, individual camera sensitivity adjustment allows comparison of high S/N ratio images.



ECFP image from YC3.60



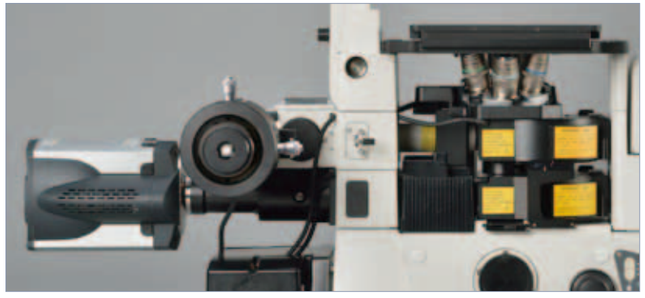
cp173Venus image from YC3.60

Photos courtesy of: Dr. Kenta Saito and Prof. Takeharu Nagai, Research Institute for Electronic Science, Hokkaido University

Back port can be attached as an option.

Stratum structure enables flexible extendibility

The Ti employs the stratum structure that takes advantage of infinity optics. In addition, the PFS is incorporated in the nosepiece unit, allowing two optical component levels in addition to the PFS to be attached by using the "stage up position set." Simultaneous mounting of laser tweezers and the photoactivation unit, as well as multiple stacked epi-fluorescence filter turrets, is possible. Each of the tiered motorized filter cube turrets can be controlled individually.

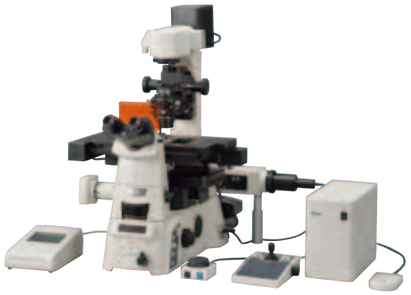


Example: In addition to the PFS, a photoactivation module (upper tier) and a back port (lower tier) are mounted.

Epi-Fl LED Illuminator for long periods of fluorescence time-lapse imaging

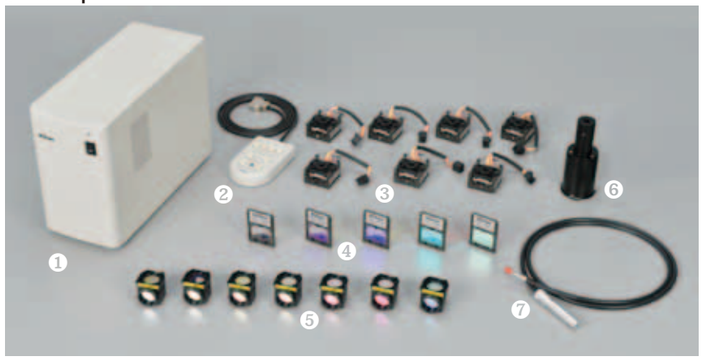
NEW

A newly developed epi-fluorescence illuminator equipped with an LED light ensures more stable and quantitative brightness of illumination. It is also easier to operate than a mercury illuminator.



❶ Epi-FL LED Illuminator main unit
❷ Simple remote control pad
❸ LED unit
❹ Dichroic mirror unit
❺ Epi-Fl Filter Cube
❻ HG100W Adapter R
❼ Fiber (1.5 m/3.0 m)

C-LEDFI Epi-Fl LED Illuminator



Stable light intensity

Stable illumination brightness ensures quantitative and reliable fluorescence intensity measurement.
The LED illuminator ensures minimal output fluctuation of less than 0.1% in 100 Hz (10 ms.). In addition, it maintains output fluctuation at below 3% even when the illuminator is switched on and off intermittently over 72 hours of time-lapse observation.

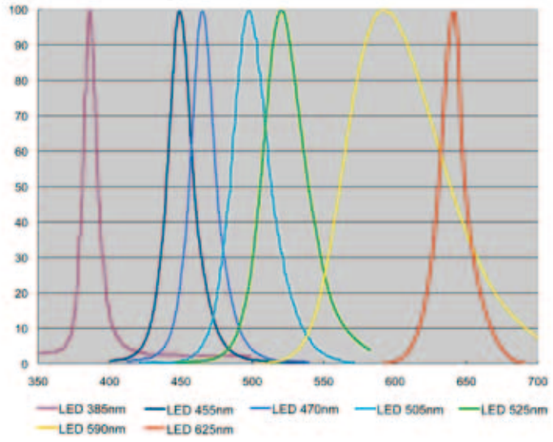
Zero warm-up time

The illuminator requires zero warm-up time and enables observation immediately after it is switched on. Thus it can even be employed only when capturing images during time-lapse imaging, thereby eliminating the need for fluorescence shutters.

Wavelength intensity control

The illuminator allows for a flexible combination of LED units, enabling simultaneous lighting with multiple wavelengths for multi-color observation. The intensity of the excitation LED light for each wavelength can be consecutively controlled, thereby eliminating the need for ND filters.

Wavelength characteristics of each LED unit



Control with NIS-Elements software

Turning the illuminator on and off and changing wavelengths in synchronization with image acquisition is possible with NIS-Elements imaging software.

Maintenance free

An LED has a minimum lifespan of 10,000 hours, eliminating the need for frequent lamp replacement.

Alignment free

The LED and dichroic units do not need to be aligned each time they are changed over. Furthermore, the Epi-Fl LED Illuminator is connected to the microscope fluorescent attachment using a dedicated optical fiber cable, eliminating the need to center the light source.

Specifications

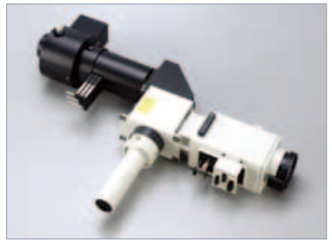
LED unit		7 types; up to 4 units can be assembled 385/455/470/505/525/590/625 nm
Dichroic mirror unit		5 types, up to 3 units can be assembled 425/455/470/565/610 nm
Fiber		Two types (1.5 m or 3.0 m)
LED control	Simple remote control pad	Selection and ON/OFF of LED unit is possible. (Simultaneous lighting of multiple LEDs and light intensity control for each LED unit is possible.) Light intensity control step: 7 steps (0, 10, 20, 40, 60, 80, 100%)
	NIS-Elements software	Selection and ON/OFF of LED unit is possible. (Simultaneous lighting of multiple LEDs is possible.) Light intensity control step: Minimum 0.5% linear control Intensity control of multiple LED units while retaining intensity ratios is possible. LED excitation in synchronization with image acquisition using CCD camera (time-lapse imaging) Recipe function available (Ti-E only) Trigger Acquisition function available
ON/OFF switching speed		Less than 100 μs
LED auto detection		Automatic detection and display of LED unit (using NIS-Elements)
LED lifetime		Over 10,000 hours
External dimensions		135 (W) x 227 (H) x 303 (D) mm
Weight		Approx. 5.4 kg

Advanced Fluorescence Illumination Functions Respond to Leading Bio-imaging from Live Cell to Single Molecule

The Ti series provides a diverse choice of fluorescence illuminators to support cutting-edge research of cell biology, molecular biology and biophysics using the new imaging and photo activation technologies.

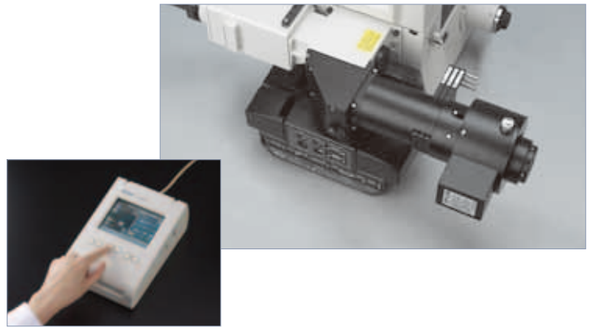
Laser TIRF (Motorized/Manual)

For observation of cell membrane dynamics and single molecules



Motorized TIRF illumination unit

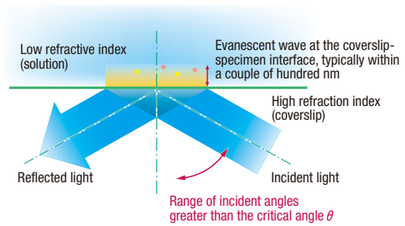
This unit allows total internal reflection fluorescence observation of specimens such as cell focal adhesions or single molecules in-vitro using laser illumination. When used with a high-sensitivity camera, images with extraordinarily high S/N ratios that allow observation of single molecules can be captured.
The motorized laser TIRF illumination unit allows laser incident angle adjustment, shutter control and switchover to widefield fluorescence excitation using the control pad or NIS-Elements software. Laser incident angles can be saved with a single touch of the control pad button and can be easily retrieved, enabling alternate time-lapse recording between fluorescence and multi-wavelength TIRF images.



Remote control pad

Principle of TIRF (Total Internal Reflection Fluorescence)

When light is incident to the coverslip at an angle greater than the critical angle (θ) for Total Internal Reflection, the light no longer propagates through the specimen, but sets up an evanescent field at the coverslip/specimen interface that can excite fluorescence in the specimen in an optical section less than 100nm. By exciting such a thin section within the specimen, extremely high S/N data can be acquired.

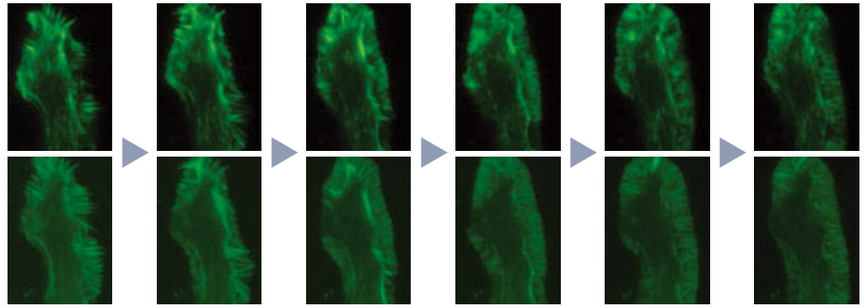


Overview of TIRF

TIRF objectives feature a high NA of 1.49—very close to the theoretical limit for standard oil immersion—and can capture even single-molecule images.

CFI Apochromat TIRF 60x Oil (left)
CFI Apochromat TIRF 100x Oil (right)

Time-lapse imaging by switching TIRF and epi-fluorescence observation



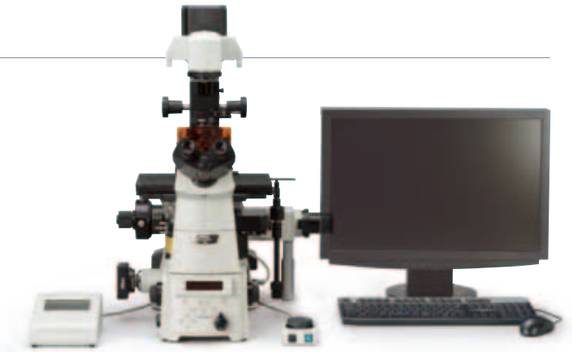
NG108 cell: Growth cone stained with EGFP-fascin

Photos courtesy of: Drs. Satoe Ebihara, Kaoru Katoh, The National Institute of Advanced Industrial Science and Technology (AIST)

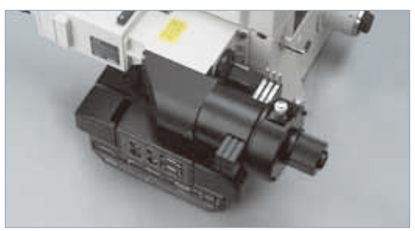
Photoactivation

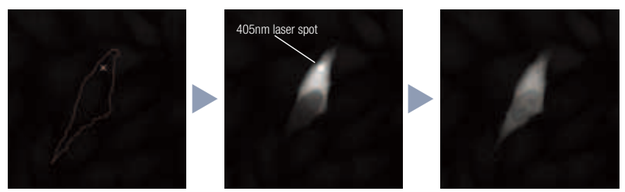
For observation of photoactivatable and photoconvertible fluorescent proteins

Photoactivation illuminator unit



When fluorescence proteins such as Kaede and PA-GFP are exposed to 405nm illumination, fluorescence characteristics change. For example, Kaede changes fluorescence colors from green to red, and PA-GFP increases fluorescence intensity 100 times. Kaede and PA-GFP are used, respectively, for selectively highlighting cells and proteins of interest within live specimens and studying their dynamics. The photoactivation illuminator utilizes lasers ranging from 405nm to 647nm to produce target spots of varying diameters, allowing time-lapse observation of dynamic events in living cells.





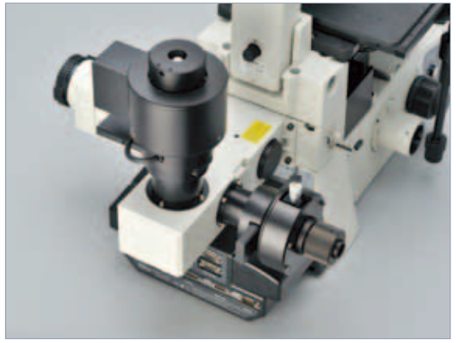
Photoactivation of PA-GFP in a living mammalian cell by 405nm laser irradiation

Photos courtesy of: Dr. Tomoki Matsuda and Prof. Takeharu Nagai, Research Institute for Electronic Science, Hokkaido University

TIRF-photoactivation

With the integration of the laser TIRF illuminator and photoactivation unit, both functions are now combined on one microscope. The user can switch between the two functions with ease.

TIRF-PAU illuminator unit



White light TIRF

This unit allows high-performance yet cost-effective total internal reflection fluorescence microscopy as well as oblique and standard widefield fluorescence techniques using mercury illumination.
The wide wavelength band of mercury illumination makes multiple wavelength TIRF observation possible by simply changing filter cubes.

Epi-fl illuminator unit with white light TIRF

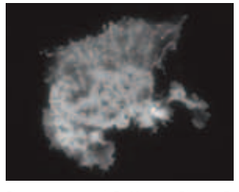


Photo courtesy of: Dr. Yasushi Okada, Cell Biology, Graduate School Medical Department, The University of Tokyo

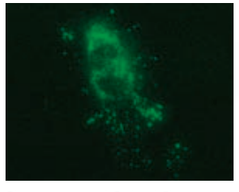
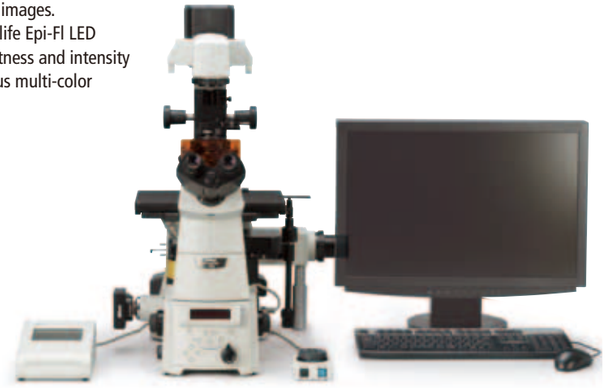


Photo courtesy of: Richard Cheney Ph.D., UNC Chapel Hill

Epi-fluorescence

With the Epi-fl illluminator unit, chromatic aberration has been significantly improved over a broad wavelength range to provide sharper and brighter fluorescence images.
In addition to the conventional HG Fiber Illuminator Intensilight, a long-life Epi-Fl LED Fiber illuminator is now available. With immediate light-on, stable brightness and intensity control of each wavelength, it is suitable for time-lapse and simultaneous multi-color fluorescent imaging.

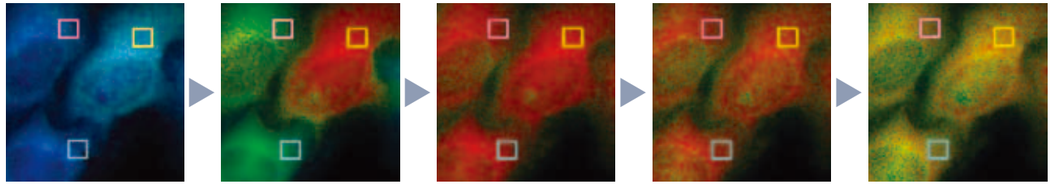
Epi-fl illuminator unit

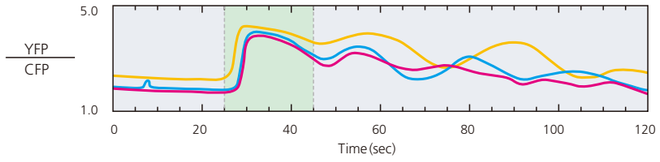


FRET

For analysis of intracellular Ca^{2+} concentration

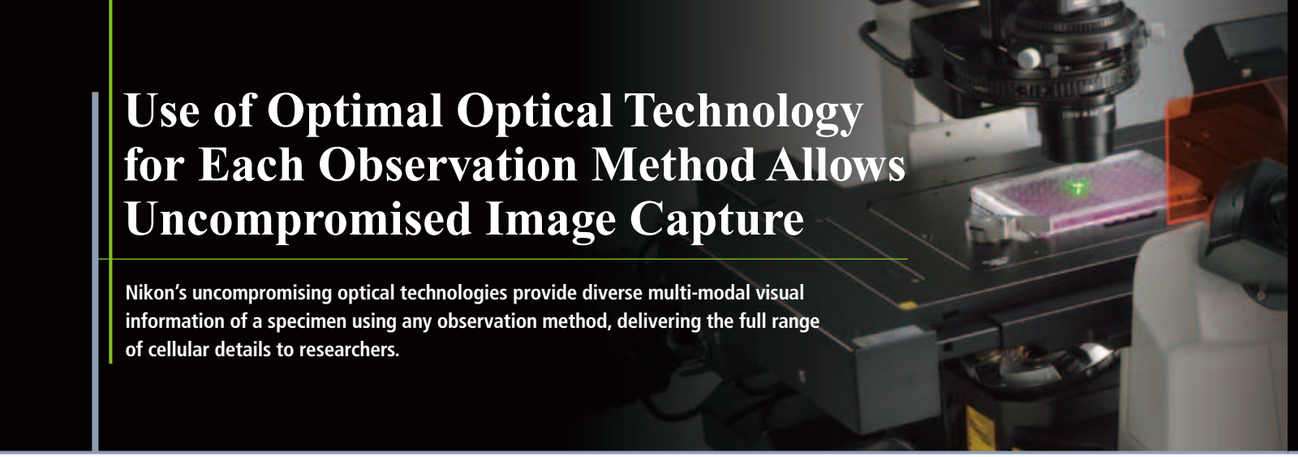
Using FRET (Förster Resonance Energy Transfer) technique, intermolecular interactions between molecules within close proximity of one another can be detected and measured. Using the optional back port, each FRET channel can be separated by wavelength and sent to separate cameras simultaneously. This enables the capture of high-resolution images in the entire frame for each wavelength. Even when intensity difference between wavelengths is large, a high-quality FRET image can be captured by adjusting camera sensitivity for each wavelength.





Imaging histamine-evoked Ca^{2+} release in mammalian cells reported by a FRET-based Ca^{2+} indicator, YC3.60
The images show the YFP/CFP fluorescence intensity ratio through colors. The graph shows the YFP/CFP intensity ratio within three ROIs indicated in the images. (The images were taken during a 25 to 45 second interval – the green shaded area in the graph.)

Photos courtesy of: Dr. Kenta Saito and Prof. Takeharu Nagai, Research Institute for Electronic Science, Hokkaido University



Use of Optimal Optical Technology for Each Observation Method Allows Uncompromised Image Capture

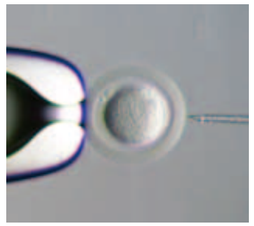
Nikon's uncompromising optical technologies provide diverse multi-modal visual information of a specimen using any observation method, delivering the full range of cellular details to researchers.

Nikon Advanced Modulation Contrast

Nikon has developed dedicated objectives for advanced modulation contrast. Colorless and transparent samples can be observed in high relief with a plastic dish, which is not possible in DIC observation. The direction of contrast can be matched to S Plan Fluor ELWD NAMC objectives, thereby allowing optimal contrast selection for techniques like microinjection and ICSI.

CFI S Plan Fluor ELWD NAMC series

CFI Achromat NAMC series



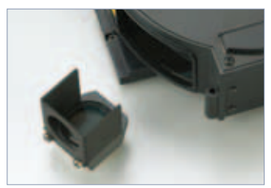
Photos courtesy of: Gianpiero D. Palermo, M.D., Ph.D., Cornell University

Nomarski DIC

The perfect balance of high contrast and high resolution is imperative for the observation of smaller structures. Nikon's unique DIC system is designed to achieve uniform high-resolution images even at low magnifications. The DIC sliders (dry types) include high-resolution and high-contrast choices.

Motorized analyzer cube

A filter cube style DIC analyzer can be mounted on the motorized filter turret to minimize switching time between DIC observation and fluorescence observation.



Filter cube style DIC analyzer

Darkfield

Use of high NA condenser allows darkfield observation. Long-term observation of nanoparticles without photobleaching is possible.

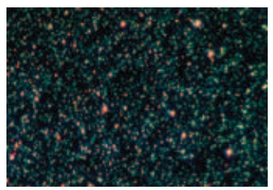


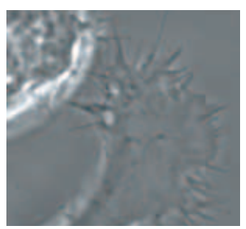
Photo courtesy of: Dr. Jan Liphardt, University of California Berkeley

Highly parallel single-molecule DNA bending assay using darkfield microscopy. Each bright green spot is a single plasmon ruler, composed of a pair of DNA-linked gold nanoparticles. Enzymatic DNA bending or cleavage can be monitored by following the intensity and color of the plasmon rulers. For more information see Reinhard et al, PNAS (2007).

Phase contrast

For critical phase contrast observation, the CFI Plan Fluor ADH 100x (Oil) objective is available. This objective reduces halos and doubles the contrast of minute cell detail compared to conventional phase contrast objectives. It enables phase contrast observation of specimens with low-contrast minute structures within the cell.

CFI Plan Fluor ADH 100x (Oil) objective



Viewed with an ADH objective

Viewed with a conventional phase contrast objective

Enhanced Operability Enables Comfortable Observation

All buttons and control switches for motorized operation are designed considering ease of operation, visibility and understandability. Users can concentrate on their research without being hindered by microscope operations.

Fast and comfortable operation with motorized components

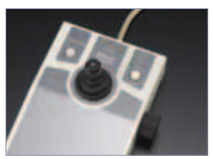
Operation buttons on both sides of microscope body

Fluorescence filter changeover, objective changeover, objective retraction, Z-axis coarse/fine changeover, PFS on/off control and offset storage, diascopic illumination on/off control can be operated quickly with easy-to-identify buttons on the microscope body.

High-speed position changing of the filter cubes in 0.25 second

Joystick and ergonomic controllers

High-speed motorized XY stage and Z-axis can be controlled using the joystick or ergo controller units. The joystick also allows a custom programmed speed adjustment with precise and natural operational feel.



Joystick unit

Ergonomic controller

Joystick and ergonomic controllers can not be used simultaneously; they are offered to provide a personal choice of control.

VFD screen and operation buttons on front of microscope body

Microscope status including attached objective information and on/off condition of the PFS can be confirmed on the display at a glance.

Visual conformation of the buttons can be clearly viewed in the dark

PFS offset controller

Can be placed outside an environmental enclosure, minimizing temperature and mechanical fluctuations to the system. Buttons for operating the dichroic mirror and coarse/fine Z-focus switching are available.

PFS offset controller

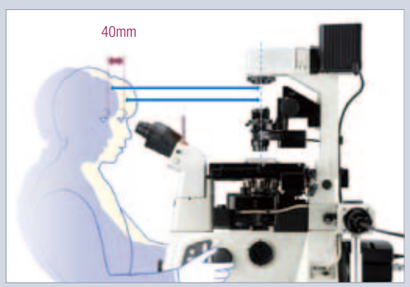
Remote control pad touch panel and preset buttons

The microscope can be operated and microscope status is confirmed with icons. Also, observation conditions can be memorized with preset buttons. This enables switching observations from phase contrast to fluorescence with a single touch of a button, allowing the user to concentrate on observation without stress or averting attention from the task.

Remote control pad

Sophisticated original slant design

By inclining the front part of the microscope's body slightly backward the distance between the operator's eyepoint and the specimen has been reduced by about 40mm, improving visibility and ergonomic design.



Fast, automatic operation by integrated control with NIS-Elements software

Microscopes have evolved from merely observation devices to software-controlled data acquisition devices. Nikon's Ti series not only features fast and comfortable motorized operation, but it also realizes acquisition of reliable data by controlling all motorized components for automatic imaging with the NIS-Elements imaging software.

Motorized XY stage

Fast and precise positioning is possible. Suitable for multipoint time-lapse observation. (Available as encoded or non-encoded versions)

Piezo Z stage

High-speed, precise Z-axis control is possible. (Manufactured by Mad City Labs, Inc.)

Motorized nosepiece

Six objective positions can be changed. (Photo shows motorized PFS nosepiece)

Motorized filter rotating turret

Position of fluorescence filter cubes can be changed in 0.3 sec. per position. (Photo shows high-performance type)

Motorized condenser turret

Motorized condenser changeover is possible.

Motorized barrier filter wheel

Fluorescence barrier filter positions (8 positions—using 25mm filters) can be changed at a high speed of 0.15 sec. between adjacent positions.

Remote control pad

Microscope status can be confirmed with icons. The microscope can be operated via the touch panel.

PFS offset controller

Real-time offset amount of Z-axis depth can be controlled after PFS setting.

Ti-E can be fully motorized with the HUB-A

Communication speed is dramatically increased through proprietary motorization algorithms, innovatively accelerating the sequence of operation. The Ti-E assures more reliable and efficient data acquisition in the research field.

Ti-U/S can be motorized with HUB-A-U

Motorized accessories can be controlled by the HUB-A-U when it is attached to the Ti-U/S.

Joystick unit

Flexible positioning of the motorized stage is possible.

Ergonomic controller

Enables ergonomic manual control of a microscope at a distance.

C-LEDFI Epi-FI LED Illuminator

Ensures stable and quantitative brightness of illumination and easier operation.

Motorized HG precentered fiber illuminator "Intensilight"

Controls shutter on/off and intensity of fluorescence excitation light.

Motorized laser TIRF illumination unit

Motorized control of laser incident angle and repositioning by memory settings are possible.

Motorized shutter

High-speed shutter compatible with both diascopic and episcopic illuminations

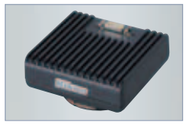
Motorized excitation filter wheel

Fluorescence excitation filters (8 positions—using 25mm filters) can be changed at a high speed of 0.15 sec. between adjacent positions.

Digital Sight series digital cameras for microscopes

These camera systems allow for smooth integration with a microscope and other products. Different combinations of camera head and control unit meet the requirements for any microscopic image acquisition.

Camera heads

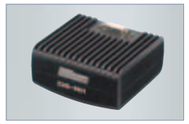


High-sensitivity Cooled Monochrome Camera Head DS-Qi1

DS-Qi1 is the definitive camera for time-lapse fluorescence imaging. The high-sensitivity CCD, which has outstanding quantum efficiency, combined with the Peltier cooling mechanism allows images to be captured with low noise and a wide dynamic range. A high frame rate of up to 48 fps and high quantitative linearity within 2% are achieved.

High-speed Color Camera Head DS-Vi1

Features a high-frame-rate 2.0-magapixel CCD. Displays SXGA live images (1600 x 1200 pixels max.) at 15 fps (29 fps max.). The DS-Vi1 balances smooth live image movement and high spatial resolution.



Ultrahigh-definition Cooled Color Camera Head DS-Ri1

Using the pixel shift method, a high resolution of 12.7 megapixel output and 2200 TV lines are realized. Superior color reproduction allows faithful recording of specimen colors, while a smooth live image display makes focusing easy. The Peltier cooling mechanism reduces heat-induced noise during fluorescence imaging.

High-definition Cooled Color Camera Head DS-Fi1c

A Peltier cooling mechanism incorporated into the 5-megapixel CCD keeps the CCD at 20°C below ambient temperature to produce images with less heat-induced noise. It is ideal for imaging during fluorescence and darkfield microscopy.

High-definition Color Camera Head DS-Fi2

Video performance is greatly improved in combination with a high-definition 5-megapixel CCD. The unique CCD control circuit offers a fast frame rate of up to 21 fps, enabling stress-free focusing and comfortable searches for sample regions.

Control units

PC-use Control Unit DS-U3

Control unit that allows image capture, control of microscope and peripheral equipment, measurement, analysis and data management on a PC using Nikon's imaging software NIS-Elements. High-speed image transfer to a PC is possible via the IEEE1394b interface.

Stand-alone Control Unit DS-L3

The stand-alone controller and its large display monitor enable image capture without a computer. Touch-panel or mouse operation allows setting and control of a Digital Sight camera by simply choosing the observation technique using the "scene mode" icons. Simple measurement functions, such as distance measurement between two points, are also available.

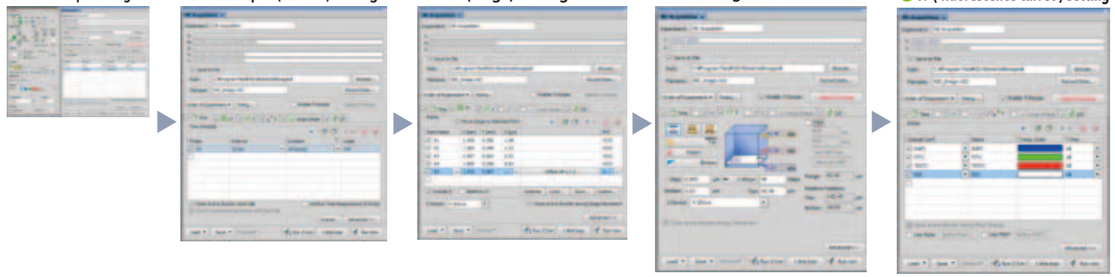
Imaging software NIS-Elements

Imaging software NIS-Elements provides seamlessly integrated control of the microscope, cameras, and peripherals. It allows for the programming of automated imaging sequences tailored to the user's imaging needs, further simplifying the imaging workflow. As a complete acquisition and analysis software, NIS-Elements offers many tools and controls to facilitate flexible and reliable data acquisition, paired with a diverse suite of analysis tools for measurement, documentation and data-management.

Control of multidimensional time-lapse imaging

Intuitive GUI and efficient workflow of NIS-Elements simplify 6D (X, Y, Z, t (time), Lambda (wavelength), multipoint) complex imaging experiments. The user simply selects the required parameters for each imaging dimension and images are automatically captured and presented as multi-dimensional ND2 files that can be seamlessly viewed, analyzed, and exported, all within NIS-Elements. Converting multi-dimensional ND2 files to standard image formats for external analysis is also easy to accomplish.

Microscope setting ▶ **Time-lapse (camera) setting** ▶ **XY (stage) setting** ▶ **Z setting** ▶ **λ (fluorescence turret) setting**



6D/4D packages selectable depending on purpose

Ar (advanced research) package that allows image acquisition up to 6D (X, Y, Z, time, Lambda (wavelength), multipoint) and analysis and Br (basic research) package that allows up to 4D image acquisition are available depending on research purposes and specimens. Upgrades are also possible by adding diverse optional modules.

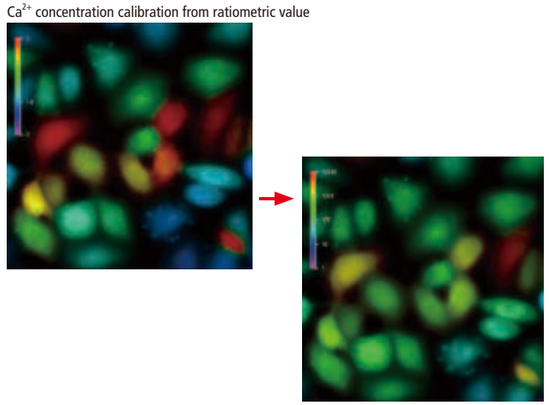
The economical yet powerful NIS-Elements D, designed for easy image acquisition, is also available.

Advanced image processing and analysis

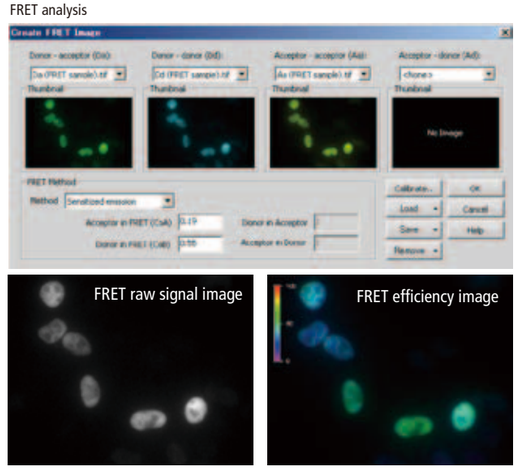
NIS-Elements allows advanced image processing and analysis, including Auto Measurement, Deconvolution, Object Counting, Object Tracking, Time Measurement and Calcium & FRET (depending on software type).

Calcium & FRET

Ca^{2+} concentration calibration from ratiometric value



FRET analysis



Advanced confocal laser microscopes optimally match the Ti-E

Confocal microscope

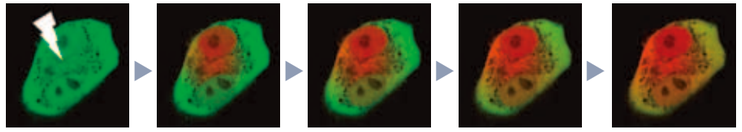
A1⁺/A1R⁺

The A1R⁺ with a revolutionary hybrid scanner realizes ultrafast and high-resolution imaging

- Hybrid scanner capable of high-speed imaging at 420 fps (512 x 32 pixels) allows simultaneous imaging and photoactivation (A1R⁺)
- High-resolution imaging up to 4096 x 4096 pixels
- With the VAAS pinhole unit, flare can be eliminated and image brightness retained; different sectioning can be simulated after image acquisition
- Dichroic mirror with 30% increased fluorescence efficiency provides high image quality

Simultaneous imaging and photoactivation (A1R⁺)

While imaging a HeLa cell expressing Kaede with green and red fluorescence using 488nm and 561nm lasers as excitation lights, Kaede in a ROI is continuously activated with the 405nm laser for photoconversion. The dispersion of Kaede red fluorescence produced by photoconversion can be observed.



Activation laser wavelength: 405nm, Imaging laser wavelength: 488nm/561nm, Image size: 512 x 512 pixels, 1 fps
Photos courtesy of: Dr. Tomoki Matsuda and Prof. Takeharu Nagai, Research Institute for Electronic Science, Hokkaido University

True spectral imaging confocal microscope

A1si⁺/A1Rsi⁺

High-performance spectral detector supports simultaneous excitation of multiple wavelengths

- Acquisition of 32 channels (512 x 32 pixels) at 24 fps in a single scan
- Accurate, real-time spectral unmixing
- Simultaneous excitation of four lasers
- V-filtering function adjusts individual sensitivity of up to four spectral ranges, allowing production of customized filters that are optimal for various fluorescence probes

A1Rsi⁺

Multiphoton confocal microscope

A1 MP⁺/A1R MP⁺

High-speed imaging of deep area in a living specimen

- A1R MP⁺ resonant scanner enables imaging up to 420 fps (512x32 pixels)
- Deep imaging with high-sensitivity NDD (non-descanned detector)
- Sharper, brighter imaging with high NA objectives deposited with Nano Crystal Coat
- High-speed, high-precision unmixing with NDD
- Multiphoton laser beam can be automatically aligned with a single click

A1R MP⁺

Confocal microscope

C2⁺

Personal confocal microscope now supports FRAP

- 1000x optical zoom of ROI
- ROI scanning is possible with an optional AOM/AOTF
- Accommodates a greater variety of lasers with wavelengths ranging from 405 to 640nm
- 4-channel simultaneous acquisition such as 3-channel confocal plus DIC
- Image acquisition up to 100 fps is possible

True spectral imaging confocal microscope

C2si⁺

Spectra across a wide 320nm range captured with a single scan

- High-speed, low-invasive imaging by a single scan acquisition
- Unmixing of spectral images without crosstalk
- Nikon's proprietary DEES and DISP technology for bright images
- Accuracy of spectra is maintained with diverse correction technologies

Super resolution imaging of the nanoscopic world beyond the diffraction limit

The amazingly high resolution of Nikon's Super Resolution Microscopes enables elucidation of the structures and functions of nanoscopic machinery within living cells. N-SIM and N-STORM, as well as a confocal laser microscope system, can be simultaneously mounted on the Ti-E, allowing multilateral imaging of a single live-cell specimen.

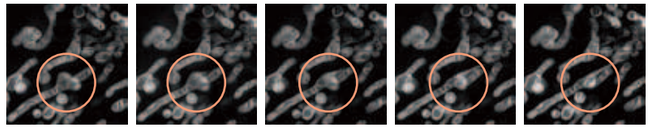
Super Resolution Microscope

N-SIM

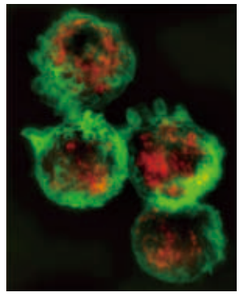
Live-cell imaging at double the resolution of conventional optical microscopes

- Offering nearly twice (up to approx. 85nm*) the resolution of conventional optical microscopes
- Ultrahigh temporal resolution of up to 0.6 sec/frame** enables super-resolution time-lapse imaging of dynamic molecular interactions in living cells
- High-speed TIRF-SIM/2D-SIM mode, TIRF-SIM mode for super-resolution TIRF imaging and 3D-SIM mode for axial super resolution imaging
- 5-laser multi-spectral super-resolution imaging

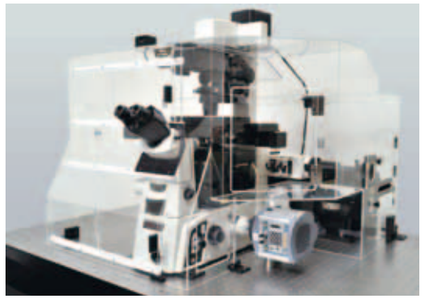
* Excited with 488 nm laser, in TIRF-SIM mode
** With TIRF-SIM/2D-SIM mode



Live-cell N-SIM imaging of mitochondria labeled with Mito-Tracker red.
Live-cell imaging with N-SIM reveals dynamics of mitochondria at twice the spatial resolution. Cristae in mitochondria are also clearly observed.
Mode: 3D-SIM
Objective: CFI Apo TIRF 100x oil (NA 1.49)
Image capturing interval: approx. 1 sec. (movie)



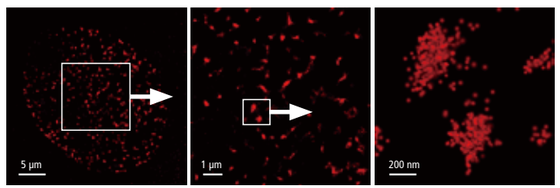
Macrophages (J774 cells expressing mVenus-SNAP23) phagocytosing opsonized beads that were incubated with Alexa555 labeled secondary antibodies after fixation. The beads without red signals are in phagosomes containing mVenus-SNAP23.
Photographed with the cooperation of: Drs. Chie Sakurai, Kiyotaka Hatsuzawa and Ikuo Wada, Fukushima Medical University School of Medicine.



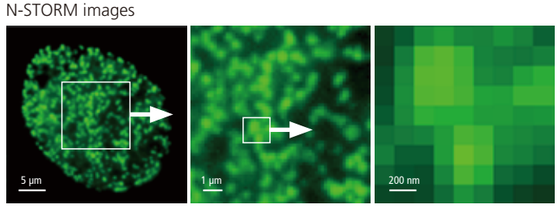
N-STORM

Resolution 10 times that of conventional optical microscopes enables molecular-level observations

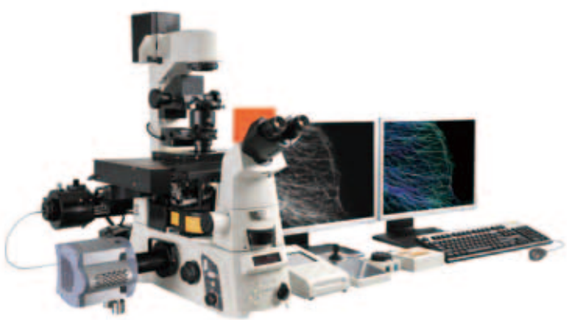
- Ultrahigh spatial resolution 10 times higher (approx. 20 nm) than that of conventional optical microscopes
- A tenfold enhancement in axial resolution (approx. 50 nm) provides 3D information at the nanoscopic scale
- Multicolor super-resolution imaging provides critical insights into the co-localization and interaction of multiple proteins at the molecular level



N-STORM images



Conventional widefield images



Sites of DNA synthesis in a pig kidney epithelial cell (LLC-PK1) visualized at super resolution with continuous activation imaging using Alexa647-labeled EdU.
Photos courtesy of: Dr. Michael W. Davidson, National High Magnetic Field Laboratory, Florida State University

Accessories

Incubator

The internal temperature of the case is maintained at 37ºC. However, temperature adjustment from room temperature to 50ºC is possible.
The incubator is compatible with both the rectangular stage and the motorized stage. Various dishes can be used, including a well plate, with different inside attachments.

Manufactured by Tokai Hit Co., Ltd.

Thermal plate warmer ThermoPlate TP series

A temperature-controllable stage ring with a glass-heating plate ensures more accurate and reliable thermal control of specimens.
The temperature can be set at between room temperature +5ºC and 50ºC in 0.1ºC increments. A sterilized sensor allows measurement of the actual temperature of dish contents. Management software and continuous current control provide solutions to a wide range of requirements.

Manufactured by Tokai Hit Co., Ltd.

For motorized stage

For manual stage

Stage incubation system INU series

It sustains the internal temperature at 37ºC with humidity of 90% and CO_2 of 5% to keep the specimen in a stable and precise condition for about three days. A special technique is employed to minimize focus drift caused by thermal expansion of a stage. The glass heater on top of the chamber prevents condensation and enables clear images.

Manufactured by Tokai Hit Co., Ltd.

NT-88-V3 micromanipulator system

A packaged set of compact instrumentation—about half the size of a conventional model—for cellular micromanipulation, the NT-88-V3 is ideal for IVF (in-vitro fertilization), ICSI (intracytoplasmic sperm injection), electrophysiology, or transgenic biotechnology applications. Hanging joystick design provides superior ergonomics and operability. Remote oil hydraulic operation minimizes pipette vibration. An index of the coarse manipulator enables easy position adjustment of the pipette.

Manufactured by Narishige Co., Ltd.

Ergonomic Tube

Eyepiece inclination is adjustable from 15° to 45°. Includes darkslide shutter and Bertrand lens.

Binocular Tube D

Observation of conoscope image with incorporated Bertrand lens (phase telescope) is possible and darkslide shutter is provided.

Binocular Tube S

Standard model

Tube Base Unit/Phase Contrast

High-resolution imaging with "full intensity" external phase contrast system is possible. TV port is incorporated.

Tube Base Unit/Side Port

TV port is incorporated.

Plain Tube Base Unit

Standard model

Eyelevel Riser

Eyepoint height can be raised 25 mm. Two 25mm emission filters can be installed.

Stage Up Position Set

Stage height can be raised by 70mm to mount multiple components utilizing expanded stratum structure.

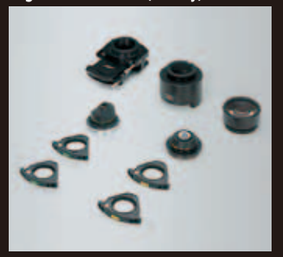
Stage Base

Stage base for configuration without diascopic illumination

Back Port Unit

Combined use with stage up riser allows a camera to be mounted on a back port.

High NA Condenser (Oil/Dry)



Perfect for observation with high NA objectives

CLWD Condenser

For high NA long working distance objectives

NAMC Condenser

For observation of Nikon Advanced Modulation Contrast

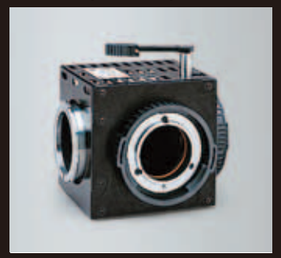
Stage Ring

Acrylic ring (left) features superior objective lens visibility and the glass ring (right) features less thermal expansion— ideal for time-lapse observation.

Epi-fluorescence Attachments

Light source and illumination optics for high S/N images

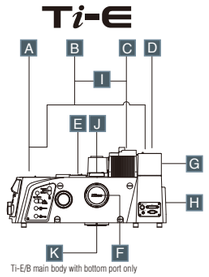
Double Lamphouse Adapter



For attaching two light sources

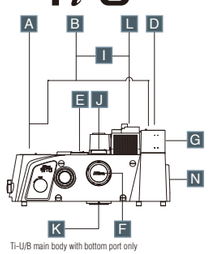
System Diagram

Ti-E



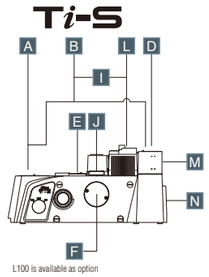
Ti-E/B main body with bottom port only

Ti-U



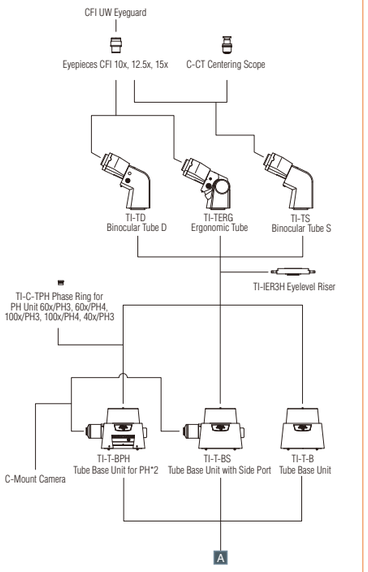
Ti-U/B main body with bottom port only

Ti-S

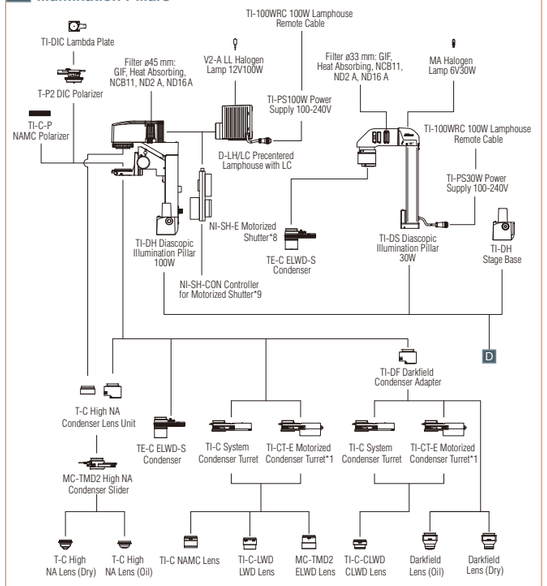


L100 is available as option

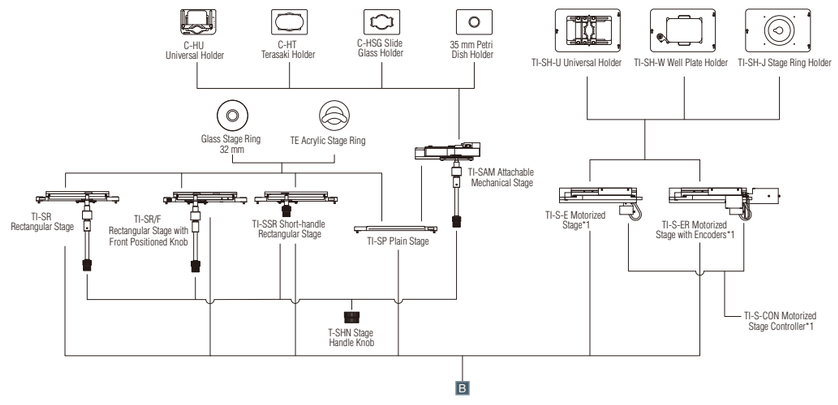
A Eyepieces/Tubes/Tube Base Units



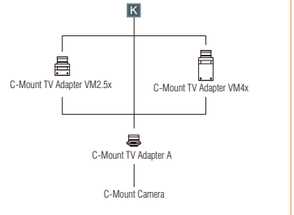
D Illumination Pillars



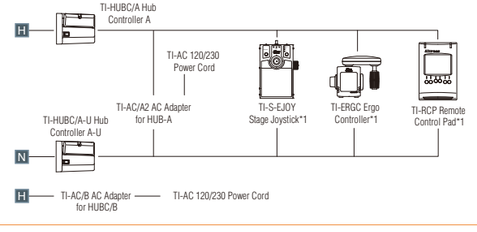
B Stages



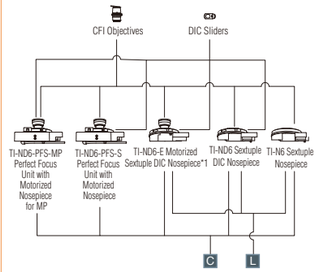
K Bottom Port



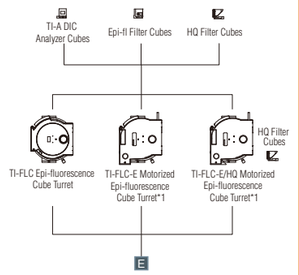
H N Communication Hub Units/Controllers



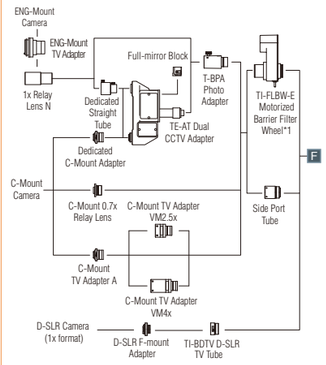
C L Nosepieces



E Epi-fluorescence Cube Turrets



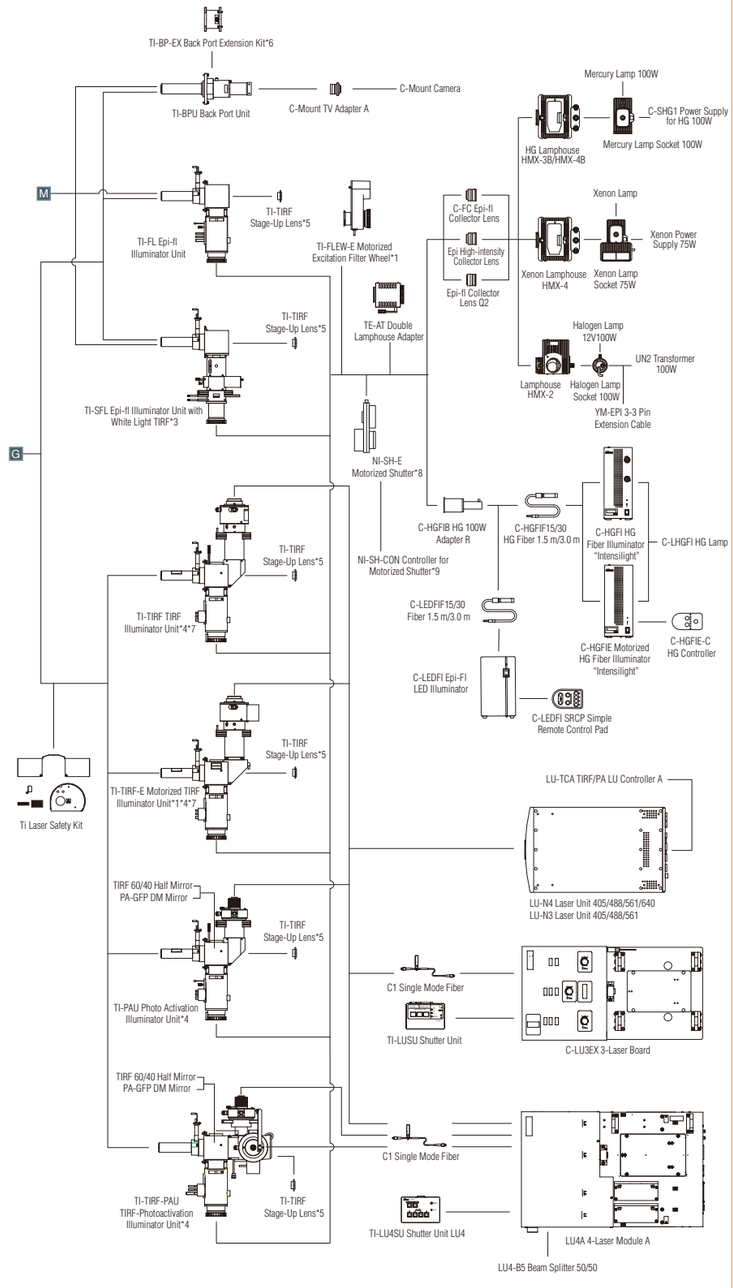
F Side Port



J Analyzer

I Stage Riser

G M Epi-fluorescence Illuminators



*1: Requires a Communication Hub Controller *2: When used with stage riser, TI-T-B Stage-up lens is required
*3: Combined use with C-HGFI/HGFIE Fiber Illuminator "Intensilight" or C-LEDFI Epi-Fl LED Illuminator is not recommended *4: Cannot be attached to Ti-S
*5: Necessary for incorporating an illuminator unit in lower tier of the stratum structure *6: Necessary for Back Port Unit when used with TIRF-Photoactivation Illuminator Unit
*7: TIRF 60/40 Half Mirror is included with the Illuminator Units *8: A dedicated adapter is required. Please contact Nikon for more details.
*9: Two NI-SH-E units can be connected. For each NI-SH-E connection, an NI-SHCL Motorized Shutter Cable Long is required.

Specifications

Ti-E

Ti-U

Ti-S

		Ti-E, Ti-E/B	Ti-U, Ti-U/B	Ti-S, Ti-S/L100
Main body	Port	Ti-E: 3 ports Eyepiece 100%, left 100%, right 100%*, eyepiece 20%/left 80%* Ti-E/B: 4 ports Eyepiece 100%, left 100%, right 100%**, bottom 100% Motorized optical path switching	Ti-U: 3 ports Eyepiece 100%, left 100%, right 100%, AUX** Ti-U/B: 4 ports, Eyepiece 100%, left 100%, right 100%**, bottom 100% Manual optical path switching	Ti-S: 2 ports Eyepiece 100%, eyepiece 20%/left 80%***, Ti-S/L100: 2 ports Eyepiece 100%, left 100%*** Manual optical path switching
		Two ports (tube base unit with side port, back port) can be added optionally.		
	Focusing	Via motorized nosepiece up/down movement Stroke (motorized): up 7.5 mm, down 2 mm Motorized (pulse motor) Minimum step: 0.025 µm Maximum speed: 2.5 mm/sec Motorized escape and refocus mechanism (coarse) Coarse/fine/exfine switchable	Via nosepiece up/down movement Stroke (manual): up 8 mm, down 3 mm Coarse stroke: 5.0 mm/rotation Fine stroke: 0.1 mm/rotation Minimum fine reading: 1 µm Coarse refocusing mechanism	—
	Intermediate magnification	1.5x		—
	Other	Light intensity control, Light on/off switch, VFD display on front of body, Operation with controller	—	
Tube	Tube body	TI-TD Binocular Tube D, TI-TS Binocular Tube S, TI-TERG Ergonomic Tube		
	Tube base unit	TI-T-B Eyepiece Tube Base Unit, TI-T-BPH Eyepiece Tube Base Unit for PH, TI-T-BS Eyepiece Tube Base Unit with Side Port		
	Eyepieces	CFI 10x, 12.5x, 15x		
Illumination pillar		TI-DS Diascopic Illumination Pillar 30W, TI-DH Diascopic Illumination Pillar 100W		
Condenser		ELWD condenser, LWD condenser, NAMC condenser, ELWD-S condenser, High NA condenser, Darkfield condenser, CLWD condenser		
Nosepiece		TI-ND6-PFS-S Perfect Focus Unit with Motorized Nosepiece, TI-ND6-PFS-MP Perfect Focus Unit with Motorized Nosepiece for MP	—	
		TI-ND6-E Motorized Sextuple DIC Nosepiece, TI-N6 Sextuple Nosepiece, TI-ND6 Sextuple DIC Nosepiece		
Objectives		CFI60 objectives		
Stage		TI-S-ER Motorized Stage with Encoders, TI-S-E Motorized Stage — Cross travel: X110 x Y75 mm, Size: W400 x D300 mm (except extrusions) TI-SR Rectangular Mechanical Stage, TI-SR/F Rectangular Stage with front positioned knob, TI-SSR Short-handle Rectangular Stage—Cross travel: X70 x Y50mm, Size: W310 x D300mm TI-SP Plain Stage — Size: W260 x D300 mm TI-SAM Attachable Mechanical Stage — Cross travel: X126 x Y84 mm when used with TI-SP Plain Stage		
Motorized functions		Focusing, Port switching	—	
Epi-fluorescence attachment		Sextuple fluorescence filter cube rotating turret, Filter cubes with noise terminator mechanism, Field diaphragm centerable, 33 mm ND4/ND8 filters, 25 mm heat absorbing filter Option: Motorized sextuple fluorescence filter cube rotating turret, Motorized excitation filter wheel, Motorized barrier filter wheel		
Nomarski DIC system		Contrast control: Senarmont method (by rotating polarizer) Objective side prism: for individual objectives (installed in nosepiece) Condenser side prism: LWD N1/N2/NR (Dry), HNA N2/NR (Dry/Oil) types		
Weight (approx.)		Phase contrast set: 41.5 kg Epi-fl set: 45.4 kg	Phase contrast set: 38.5 kg Epi-fl set: 42.3 kg	Phase contrast set: 29.6 kg Epi-fl set: 33.4 kg
Power consumption (max.)		Full set (with HUB-A and peripherals): approx. 95W	Full set (with HUB-A-U and peripherals): approx. 40W	

The following options are available at time of purchase;
Change * to eyepiece 20%/right 80%
Change ** to eyepiece 20%/right 80% or eyepiece 20%/left 80%
Change *** to right 100% or eyepiece 20%/right 80%

Nikon's Inverted Microscope Legacy and the History of Discovery

Eclipse Ti-E

Eclipse TE2000

Eclipse TE300

Diaphot 300

Diaphot TMD

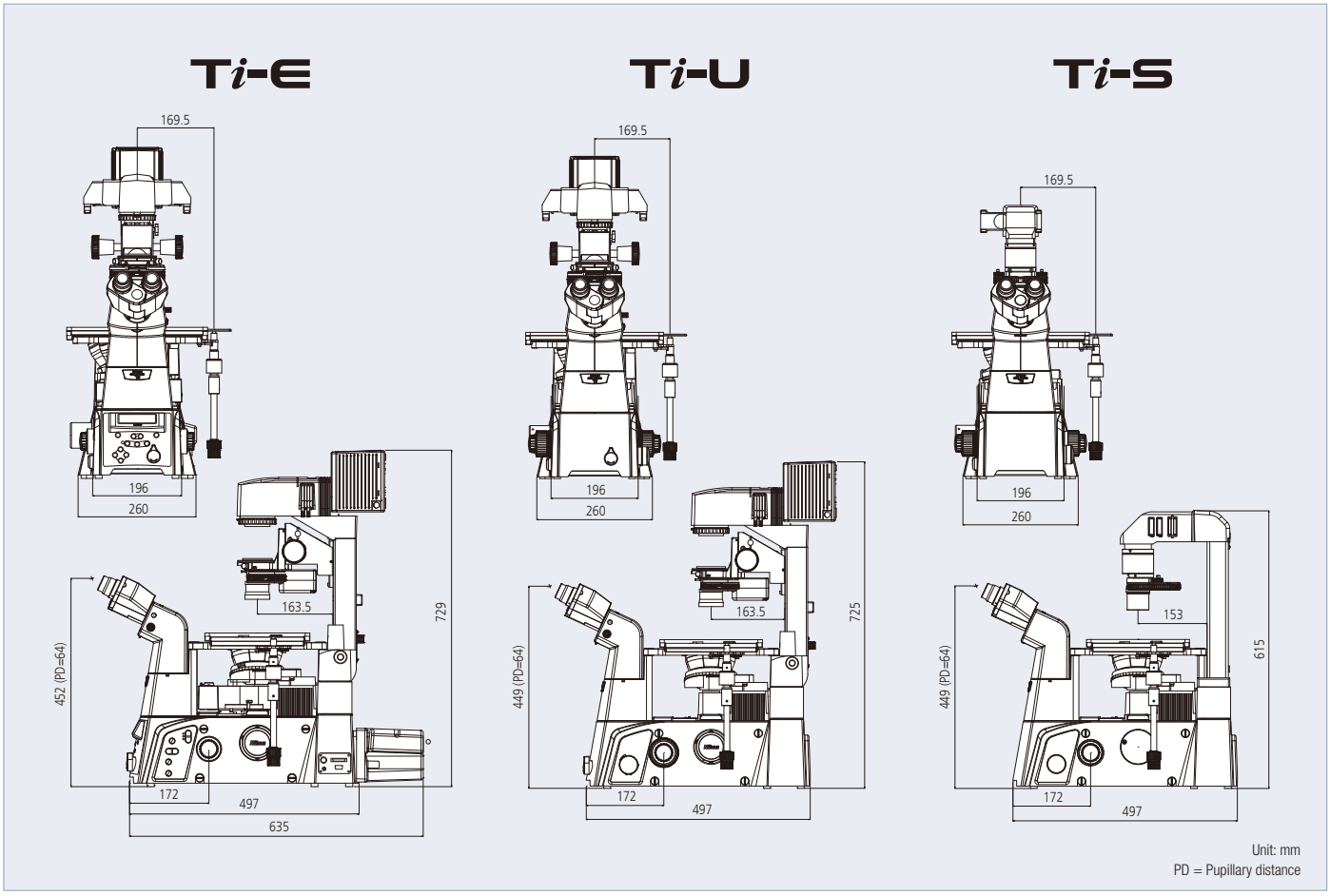
Model MSD

Model M

- 2012 Advanced PFS
- 2010 Super Resolution Microscopes N-SIM/N-STORM
- 2007 **Eclipse Ti-E, the next generation of discoveries begins today**
  - PFS (perfect focus system)
  - Laser TIRF
  - Simplified DNA sequencing on the TE2000
  - External phase contrast
- 2000 **Eclipse TE2000**
  - IR laser trapping
  - Special inverted model used in space
  - Cumulina the mouse cloned on the TE300
- 1996 **Eclipse TE300**
  - Breakthroughs: CFI 60 optics expanded infinity space
  - Dolly the sheep cloned on the Diaphot 300
  - First intracytoplasmic sperm injection (ICSI) on the Diaphot
- 1990 **Diaphot 300**
  - High NA DIC
  - Rectified DIC
  - Extra long working distance optics
  - The brightest fluorescence
  - World's first IVF baby on the Diaphot TMD
- 1980 **Diaphot TMD, a revolutionary market leader for inverted microscopy**
  - Beginning of Fura/Ca^{2+} imaging
- 1976 **First CF optics**
  - First Hoffman Modulation Contrast®
- 1966 **Model MSD, the first affordable tissue culture microscope**
- 1964 **Model M, the legacy begins**
  - Pioneering 16mm time-lapse live cells

Landmark achievements for Nikon
Nikon's unique technical innovations in inverted microscopy
Key scientific breakthroughs and Nikon's participation in some of these

Dimensional Diagram



Unit: mm
PD = Pupillary distance

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⚠ WARNING	TO ENSURE CORRECT USAGE, READ THE CORRESPONDING MANUALS CAREFULLY BEFORE USING YOUR EQUIPMENT.

Monitor images are simulated.

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Printed in Japan (1305-03)T
Code No. 2CE- MPFH-2
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