



High-resolution microscope DeltaVision™ Ultra

DeltaVision Ultra, the seventh-generation automated widefield microscope from GE Healthcare, delivers quality data in an easy-to-use and versatile system. Building on a legacy of imaging innovation to facilitate scientific discovery, DeltaVision Ultra is optimized for deconvolution to reveal the details in even the most challenging samples, including dim and live biology.

DeltaVision Ultra delivers:

- **High resolution:** Resolve detail in cellular and subcellular structures down to 250 nm.
- **Ease-of-use:** Get started quickly with an intuitive user interface that makes even complex experiments simple.
- **Flexibility:** Easily acquire complex data from a variety of sample types including multi-well plates, culture dishes, glass slides, or chambered cover glass.
- **Clear images:** DeltaVision Ultra's exclusive deconvolution method enhances image contrast, revealing previously unseen details.
- **Sensitivity:** Custom light path maximizes light efficiency and captures more signal from the sample, reducing photobleaching and phototoxicity.
- **Speed:** Integrated widefield system quickly acquires a single field of view without scanning or averaging, allowing fast dynamic events to be captured.



Fig 1. DeltaVision Ultra automated widefield microscope.

Deconvolution

In a widefield microscope, the entire sample is illuminated at once, and the images captured contain both in-focus and out-of-focus light. This out-of-focus light makes raw data look blurry and can mask small or dim structures, but is vitally important information that can be used to improve widefield data with deconvolution.

Deconvolution utilizes the point spread function (PSF), a model of how light spreads through microscope optics, to reassign blurred light back to its original point source. The proprietary algorithm used by DeltaVision Ultra is a quantitative process—no intensity values are added or subtracted—which results in image data with significantly improved contrast and slightly improved resolution (Fig 3). Small, fine, or dim structures that may have been masked by out-of-focus blur in raw data are suddenly detectable, and data at lower signal-to-background levels can be collected, preserving cell health. This thoughtful design and optimized algorithm ensure that users can focus on the biology and trust DeltaVision Ultra to do the rest.

Intuitive acquisition and analysis software

DeltaVision Ultra's user-friendly design and advanced software capabilities minimize the training burden and simplify user tasks, so time on the system is maximized for data collection. With smart experiment setup, the acquisition protocol is defined as the user explores the sample. Simple workflows for complex experiments empower even novice users to achieve expert results.

Multiple experiment types are critical to maximizing the data from your biological sample. Simple acquisition setup gives you the flexibility to image samples using a broad range of techniques. 2D or 3D imaging in multiple channels over time can easily be combined with point visiting, panel acquisition, and plate scanning. Automated acquisition with Acquire Ultra software (Fig 2) saves time by enabling you to do other things while the microscope captures data. In addition to GE's exclusive quantitative deconvolution algorithm, softWoRx™ analysis software features a variety of visualization and analysis tools for viewing acquired data and performing quantitative image processing.

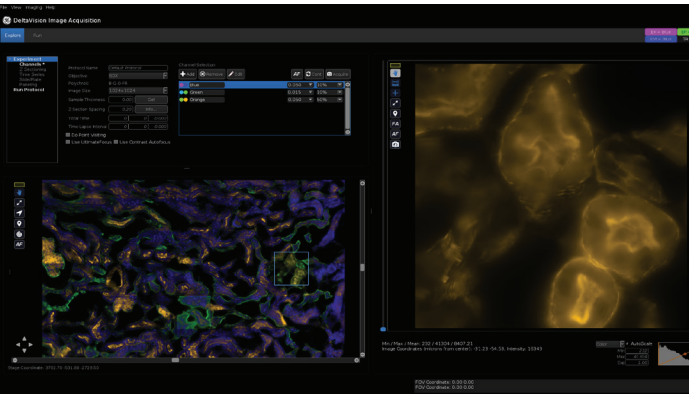


Fig 2. Acquire Ultra acquisition software interface for DeltaVision Ultra.

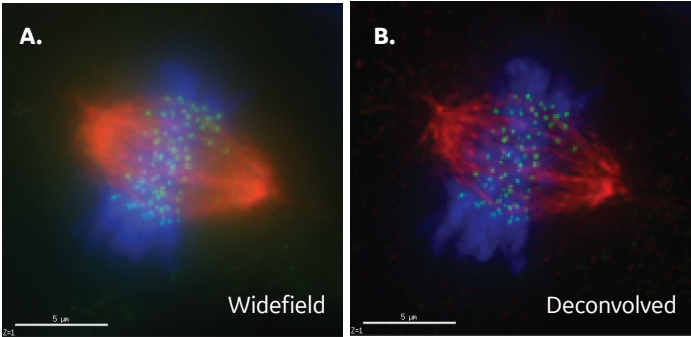


Fig 3. Mitotic spindle (red) with kinetochores (green) and DAPI. Comparison between raw widefield data (A) and deconvolved data (B). Scale bar represents 5 µm.

Item	Details
Sample location	<ul style="list-style-type: none">• Focus Assist easily locates the focal plane without using fluorescence or transmitted light• Spiral Mosaic quickly maps the sample to identify objects of interest or rare events• Preloaded and customizable plate maps
Setup protocol	<ul style="list-style-type: none">• Smart setup utilizes sample browsing settings to define automated acquisition routines• Mark thousands of points of interest to ensure robust data statistics• Collect data selectively with support for multiple image sizes, frame averaging, and binning
Flexible experiment design	<ul style="list-style-type: none">• Easily acquire 2D or 3D data• Time-lapse experiments monitor dynamic events as they occur• Collect overlapping images to capture a large field of view at high resolution• Readily combine any and all of these into a single experiment
Multi-well plate scanning	<ul style="list-style-type: none">• Automatically capture large amounts of data from a multi-well plate• Efficiently perform multiple experiments in a single multi-well plate• Increase statistical robustness of data by increasing data points and sampling• Reduce sampling bias through randomized field of view placement
Automatic post-acquisition processing	<ul style="list-style-type: none">• Deconvolution during time-lapse acquisition dramatically reduces processing time for long-term experiments• Task Builder yields results faster by automatically processing images according to user-defined routines• Tools such as line profile, polygon analysis, and intensity plots facilitate data analysis

Live cell imaging

Proper environmental control is critical for biologically-relevant live cell imaging. DeltaVision Ultra live cell options include an environmental chamber that encloses the stage and objective and is offered in both transparent and opaque versions (Fig 4, opaque chamber shown). A heater is used to warm the chamber to ensure temperature stability and preserve cell viability. Additionally, to control gas concentration, select between a CO₂ module for standard live cell support or a CO₂/O₂ module to enable advanced applications such as hypoxia experiments. Both options include a gas mixer, humidifier and sample lid to ensure delivery of precisely regulated humidified air to the sample to minimize evaporation and preserve cell health.



Fig 4. The DeltaVision Ultra environmental chamber comes in transparent or opaque versions to accommodate any microscope room. Built-in storage provides a place for commonly used accessories.

Table 1. Live Cell Module specifications

Parameter	Specification
Supported temperature range	Ambient + 7°C to 40°C
Temperature Fluctuation	+/- 0.1°C*
CO ₂ input requirement	100%
N ₂ input requirement**	100%
Background gas (air) input requirement	Clean, dry air
Supported CO ₂ range	0% to 20%
Supported O ₂ range	0% to 20%

*Average temperature over the sample area in any two minute window.

**N₂ only used for CO₂/O₂ Live Cell Module to control O₂ levels.

Microscope properties

DeltaVision Ultra is designed from the ground up to be a high-resolution widefield deconvolution microscope. Every hardware component and part of the imaging workflow has been optimized to provide the highest quality raw data to ensure outstanding deconvolution results. From the light source, to the light path, to the camera, nothing has escaped optimization, not even the immersion oil. When combined with GE's exclusive deconvolution algorithm and library of experimental optical transfer function (OTF) files, users can expect improved contrast and resolution in their images, enabling visualization of structures and processes that might otherwise have gone undetected.

Objective selection

Not all objective lenses are created equal with respect to aberration. To guarantee that every DeltaVision system yields excellent raw image quality and optimal deconvolution results, objectives are screened for five types of aberration prior to being paired with a system. This guarantees that every DeltaVision system yields excellent raw image quality and optimal deconvolution results. In addition, the instrument supports up to 6 objective lenses through an automated turret. A variety of objective lenses is available to support diverse data collection, from multi-well plate scanning, to imaging tissue on a slide, to long term live cell imaging, and everything in between.

Table 2. Selection of objectives suitable for use with DeltaVision Ultra

Magnification	NA	Optical corrections	WD (mm)	Immersion	Correction ring
4x	0.16	UPlanSapo	13	N/A	No
10x	0.40	UPlanSapo	3.10	N/A	No
20x	0.45	LUCPlanFLN	6.6-7.8	N/A	Yes
20x	0.75	UPlanSapo	0.60	N/A	No
40x	0.60	LUCPlanFLN	2.7-4.0	N/A	Yes
40x	1.30	UPlanFLN	0.20	Oil	No
60x	1.20	UPlanSapo	0.28	Water	Yes
60x	1.30	UPlanSapo	0.30	Silicone oil	Yes
60x*	1.42	PlanApoN	0.15	Oil	No
100x	1.40	UPlanSapo	0.13	Oil	No

*Primary objective lens supplied with DeltaVision Ultra system.

Key

- NA:** Numerical aperture
- WD:** Working distance
- U:** Universal objective for fluorescence and DIC
- Plan:** Flat field correction
- Sapo:** Super apochromat, indicating optimal color correction from violet to near IR
- L:** Long working distance
- C:** Tissue culture observations through bottles and dishes
- FLN:** Semi apochromat, indicating color correction in visible range
- Apo:** Apochromat, indicating optimal color correction in visible range (violet to red)
- N:** Denotes UIS2 objective

Fluorescence imaging

The DeltaVision Ultra light path features a custom-designed fluorescence illuminator incorporating seamless automation to switch between sample viewing (Köhler illumination) and image acquisition (optimized critical illumination). Combined with a bright and stable light source and a sensitive sCMOS camera, DeltaVision Ultra delivers outstanding signal-to-noise performance (Fig 5), enabling detection of small, dim objects such as organelles and microbial cells.

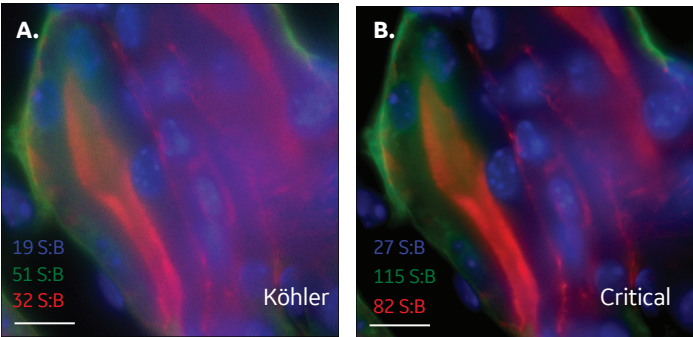


Fig 5. Mouse kidney section with Alexa Fluor™ 488 wheat germ agglutinin, Alexa Fluor 568 phalloidin and DAPI. Same field of view acquired with same exposure conditions in Köhler (A) and Critical (B) illumination modes. Critical illumination provides ~2-3 x increase in signal to background (S:B) when compared to Köhler illumination. Scale bar represents 10 µm. Images are scaled independently, not identically.

Transmitted light illumination

Brightfield imaging with DeltaVision Ultra uses a specially designed transilluminator arm assembly, incorporating a long life white light LED. An optional DIC accessory kit, including brightfield condenser, allows differential interference contrast imaging and other transmitted light modes.

Focus maintenance

The DeltaVision *UltimateFocus* system incorporates an exclusive patented design to automatically maintain the sample z-position regardless of mechanical or thermal changes. The system provides real-time compensation for stage drift, and focus control within 50 nm. *UltimateFocus* also enables *Focus Assist*, which allows the user to focus on their sample without using the eyepieces or camera. This feature is important for live cell imaging as it minimizes unnecessary illumination of the sample and reduces photobleaching.

Speed

DeltaVision Ultra system components have been carefully selected to work together to achieve excellence at high speed. The stage balances speed with accuracy and repeatability to facilitate fast and precise sectioning and point-visiting. By combining multi-band pass emission filters with the capability of the scientific CMOS detector to capture images at ultra-fast frame rates, DeltaVision Ultra excels at fast multi-channel imaging.

Table 3. Frame rate specifications

Image size	No. of channels	Frame rate (fps)*	
		Single bandpass EM	Multi-bandpass EM
2040 x 2040	1	65	N/A
2040 x 2040	2	8	27
1024 x 1024	1	186	N/A
1024 x 1024	2	11	64
512 x 512	1	401	N/A
512 x 512	2	11	129

*Frames per second (fps) based on 1 ms exposure, 0 sec. time lapse interval, no stage movement, no autofocus and excitation shutter open for entire scan.

Table 4. 10 µm Z stack imaging time

Image size	No. of channels	Imaging time (s)*	
		Wavelength then Z	Z then wavelength
1024 x 1024	1	N/A	2.0
1024 x 1024	2	10.7	4.3
1024 x 1024	3	16.8	6.5

*Imaging times based on 10µm Z thickness (0.2 µm section spacing, 50 sections), 1 ms exposure, no autofocus

Supports your evolving research needs

As research progresses, biological and experimental requirements often change. Fixed samples on coverslips are replaced by live cells in a 35 mm dish. Assays in chambered coverslips grow to populate 96-well plates. Today's *n* of 3 is tomorrow's *n* of 300. Whatever tomorrow's experiment demands, DeltaVision Ultra will keep up with your evolving research needs. With free access to new image acquisition software, DeltaVision Ultra is a sound investment that will continue to support the diverse experiments required to address your research questions.

DeltaVision Ultra includes advanced sample support as standard. With seven-channel SSI and three standard multi-bandpass polychroic sets, the DeltaVision Ultra can image a diverse array of fluorescent dyes and proteins across the visible spectrum. An advanced multi-format stage supports a wide variety of sample types including 75 x 25 mm slides, 35 mm dishes, multi-well chambered coverslips, and multi-well plates.

Vibration Isolation

DeltaVision Ultra is available with two options for vibration isolation. The first is a custom air table, with matching electronics cabinet (Fig 6), that provides superior isolation from vibration. For lab environments with limited space, the system may also be configured for benchtop placement. In the benchtop configuration, system electronics are mounted in a tabletop rack (Fig 7).



Fig 6. DeltaVision Ultra microscope with custom air table.

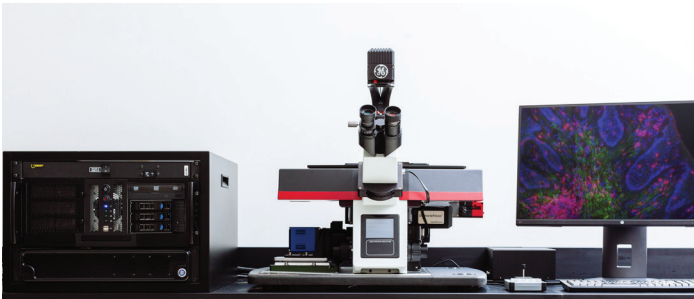


Fig 7. DeltaVision Ultra microscope configured for benchtop placement.

Technical features

Table 5. System specifications

Parameter	Specification
Illumination modalities	Widefield fluorescence
	Transmitted light
Standard supported dyes/fluorophores	Blue (DAPI, Hoechst, CF™405M)
	Cyan (CFP, mTurquoise)
	Green (GFP, Cy™2, Alexa Fluor™488, ATTO-488, CellTracker™ Green, Calcein AM)
	Yellow (YFP, Venus)
	Orange (Cy3, Alexa Fluor 546, TRITC, propidium iodide, CellTracker Orange, CellTracker CM-DIL, mOrange)
	Red (mCherry, mKate2, Alexa Fluor 568)
Standard objective lens	Far Red (Cy5, Alexa Fluor 647, To-Pro™-3, SiR)
	60x 1.42 NA PlanApoN
Camera	sCMOS detector
	2040 x 2040 imaging array
	6.5 µm x 6.5 µm pixels
	16-bit dynamic range
	272.3 MHz readout speed
Focusing range	0.9 (median) / 1.4 (rms) e ⁻ readout noise
	7 mm, automated
Stage travel	106 mm x 70 mm
Maximum stage speed	50 mm/sec in x/y
	20 mm/sec in z
Standard supported sample types	Microscope slides (75 mm x 25 mm)
	35 mm dishes
	2, 4, or 8-well chambered coverglass (24 x 60 mm)
	2, 4, or 8-well chambered microscope slides (75 x 25 mm)
	SBS footprint multi-well plates (6, 24, 96, 384-well)
Dimensions (W x H x D)	Air table: 192 x 142 x 100 cm (75.6 x 55.9 x 39.4 in)
	Benchtop: 222 x 63 x 66 cm (87 x 25 x 26 in)
Workstation	CentOS 7 or higher
	32 GB RAM
	256 GB SSD OS hard disk
	3 x 1 TB Onboard RAID5 Array
Operating conditions	Operating temperature: stable from 18-25°C (64-77°F)
	Fluctuation Rate: No more than ±2°C over four hours with an hourly variation of no more than 1°C
Humidity	Relative humidity 10% to 80%, noncondensing
Power requirements	100-120/200-240 VAC, 10/5 A, 50/60 Hz
Power consumption	1200 W
Heat output	1200 W
Manufacturing site	GE Healthcare, Issaquah, WA, USA



Product	Code number
DeltaVision Ultra with air table and cabinet	29254706
DeltaVision Ultra with benchtop platform	29206348
UltimateFocus laser module	29255129
Objectives:	
Air:	
4x0.16 NA UPLSAPO	34-100642-000
10x 0.4 NA UPLSAPO	34-100641-000
20x 0.45 NA LUCPLFLN	34-100640-000
20x 0.75NA UPLSAPO	34-018019-121
40x 0.6 NA LUCPLFLN	34-100639-000
Immersion:	
40x Oil 1.30NA UPLFLN	53-850009-122
60x Water 1.2NA UPLSAPO	53-850009-114
60x Silicone 1.3 UPLSAPO	52-852956-000
100x Oil 1.4NA UPLSAPO	53-850009-111
DIC:	
DIC Option DV Ultra	29294800
20x Nomarski prism	34-018019-135
40x Nomarski prism	34-018019-132
100x Nomarski prism	34-018019-134
Multi-band pass emission filters	53-852771-001
Live cell components:	
Common kit	29255617
Environmental chambers:	
Transparent	29255611
Opaque	29255612
Heaters:	
110 V	29255613
220 V	29255614
Gas Mixers:	
CO ₂ /O ₂ Module	29295616
CO ₂ Module	29255615
Standalone workstation with monitor	29255516



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