# LIST OF SCHEDULES

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**Statements of Purchase and Services**

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**Schedule B**  
**Service Level**  
**Schedule C-1**  
FISHER-Proprietary Software (and Associated License Agreement)  
**Schedule C-2**  
Third Party Software (and Associated License Agreement)
Aquilos QUOTATION for
University of Missouri

Attn. Tommi White, PhD.

Quote Date: March 05, 2020
Quote Number: QUO-97331-M7Y4 R2
Expires: June 26, 2020

Prepared By
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ciceron.yanez@thermofisher.com
Solution Description

1136944 Aquilos

Aquilos is the first truly dedicated cryo-DualBeam microscope for preparing cryo-lamella samples for TEM tomography of frozen-hydrated biological materials. The instrument includes innovative electron and ion optics with state-of-the-art patterning controls. Proven technology from our Scios 2 DualBeam platform is combined with a dedicated cryo-stage, cooling, loading and transfer system, which allows for streamlined production of high quality cryo-lamellas for TEM tomography.

The key enabling technologies are all integrated onto a single platform and comprise:

- Complete cryo infrastructure: large capacity liquid nitrogen Dewar for extended runtimes, heat exchanger, flow controller, load-lock system, sample preparation station, controller and transfer device.
- Fully rotatable cryo-stage keeping samples at vitreous temperatures (<-170°C) at all times
- In-chamber retractable sputter coater for applying conductive coatings
- GIS-system for applying protective coatings
- Novel Field Emission Electron Optics optimized for all imaging needs
- Trinity detection system for fast imaging, and easy collection of all available signals
- High-resolution (field emission) Ion Optics with fast high-throughput milling capabilities
- Special Cryo-FIB AutoGrids (approved for use with Thermo Scientific autoloader systems) for shallow-angle milling of EM grids.
- Sample shuttle for AutoGrids: Cryo-FIB AutoGrid shuttle with integrated shutter system during cryo-transfers (with pre-tilted FIB- AutoGrid uptake).
- Large cryo-FIB consumables kit: tweezers, clipping and grid box tools, AutoGrid boxes, C-Clips and Cryo-FIB AutoGrids
- Windows 7, 4-quadrant “Beam per Quad” User Interface with User Guidance
- Maps correlation and targeting software

The core instrument includes:

- NICol UHR non-immersion field emission-SEM column
- Trinity Detection System (in-lens and in-column): (T1) segmented lower in-lens detector and (T2) upper in-lens detector
- Everhart-Thornley SE Detector (ETD)
- Sidewinder ion column
- Workstation with Windows 7 with two (2) 24” LCD monitors
- Support Computer with one (1) 24” LCD monitor
- Large table top with support
- Manual User Interface (MUI) for controlling magnification, contrast/brightness, beam shift and stigmators
- xT software
- 110 x 110 mm eucentric stage
- IR camera for viewing sample and chamber
- In-chamber Thermo Scientific Nav-Cam™ sample navigation camera
- Oil-free pumping system
- Integrated beam current measurement
- Automatic aperture system
The Cryo package included with the Aquilos core instrument contains a cryo-enabling infrastructure (CryoFIB Kit) and consumables and accessories (Cryo Starter Kit). More specifically, it includes:

- Rotatable SEM cryo-stage (Cooldown time: <30 min)
- Cryo-preparation station (including AutoGrid clipping insert)
- Controller for preparation station
- Sample transfer device (transfer rod)
- Cryo-loader (SEM load lock for transfer rod)
- Large capacity liquid nitrogen Dewar (runtime: >10 hrs.) with heat exchanger (delivering cooling gas)
- Extra rotary pump for heat exchanger
- Acoustic enclosure for heat exchanger rotary pump
- Nitrogen gas flow controller
- Dry diaphragm pump for cryo-preparation station
- Maps correlative workflow software for SEM
- Auxiliary gas kit
- Platinum Deposition gas injection system (GIS) for deposition of protective layers
- Integrated retractable sputter coater (target: platinum) for deposition of conductive layers
- Sample bake-out box for cleaning the shuttles and samples
- Safety wear kit for maintenance
- Temperature logger
- Cryo Starter Kit with 20 AutoGrid boxes, 100 Cryo-FIB AutoGrids, 100 C-Clips, 2 clipping tools, 2 cryo-FIB AutoGrid shuttles, 2 AutoGrid tweezers, 2 grid box openers, 2 soft grip tweezers, forceps, crossover, stub tweezers and 1 FIB Standard shuttle (for SEM alignment specimens and pin mount stubs)

Features and specifications:

Geometry:

On a 21-port specimen chamber the electron and ion column are mounted at an angle of 52 degrees to each other. The beam coincidence point is at 7 mm working distance, which is also the eucentric working distance of the stage and the analytical working distance using optitilt. The cryo loading system is located on the horizontal axis opposite the ion column. The retractable magnetron sputter coater sits below the ion column and allows for insertion of the coater when required for use. The platinum GIS is located on port 4, behind the ion column.

Vacuum

- Complete oil-free vacuum system in the microscope
- 1x turbomolecular pump (TMP) with turbo drag section, 240 l/s
- 1x Scroll pump
- 3x Ion Getter Pumps (IGPs), 25 l/s
- 1x Extra rotary pump for heat exchanger (providing vacuum on the isolated cooling gas lines)
- 1x Dry diaphragm pump for the cryo-preparation station, which is controlled by the station’s controller unit
- Chamber vacuum at room temperature: <4 * 10^{-4} Pa
- Chamber vacuum at cryo-conditions: <6 * 10^{-5} Pa
- Integrated battery backup for IGPs on the electron column, a FEG safety mechanism (for recoverability after an unplanned power outage)

Sample Navigation

All loading of sample carriers takes place via the cryo-loader, a SEM load lock system for the transfer rod. Two types of samples can be loaded and transferred with the transfer rod through the cryo-loader load lock system. The cryo-FIB AutoGrid shuttle and the FIB standard shuttle for SEM alignment specimens and pin mount stubs. The loading system works for cryo as well as for room temperature samples.

Cryostage

Aquilos is standardly equipped with a fixed fully rotatable cryo-stage. This proprietary cryo-stage accepts the cryo-FIB AutoGrid shuttle and FIB standard stub specimen shuttle. The combination of stage tilt and full rotation capabilities allows for maximum processing flexibility. The cryo-stage comes with the following specs:

- Rotation: 360° (endless)
- Compucentric rotation and tilt
- Cool down time: <30 min
- XY range: 110 mm
- Z range: 65 mm
- Tilt range at cryo (eucentric WD): -15° to +55°

Stage control software includes standard facilities for:
- Store and recall of sample position
- Multi-directional stage drive
- Image feature alignment to horizontal or vertical
- Navigation on image and navigation montage is supported with “Click-to-center” and “Drag-to-Zoom” functions
- External image import and registration for correlation.
- Y-Z correction for pre-tilted specimen translation at eucentric height

Electron Optics
Aquilos features a pre-aligned electron optical column – with continuous beam current control and optimized aperture angle – which is optimized for high resolution and for beam stability. The main elements of the electron optical system are:

Source: Field emission gun assembly with Schottky emitter source. The assembly is optimized for high brightness/high current, providing low-noise imaging. The pre-alignment of the FEG ensures no mechanical alignment is required. Easy gun installation and maintenance is provided with Auto bake-out and Auto Start capabilities. Minimum source lifetime: 12 months.

Objective Lens: Dual Objective combining field-free magnetic and electrostatic lenses, with a 60 degree geometry

Voltage: 200 eV to 30 kV (20 eV landing energy possible with optional Beam Deceleration)

Beam Current: 1 pA to 400 nA

Resolution: At Optimal working distance
- 6 nm* at 2 kV (* imaging conditions under cryo dependent on gas flow conditions)

Ion Optics
Sidewinder ion column. Field emission focused ion beam optics with liquid metal ion source (LMIS) emitting Gallium ions. Drift suppression mode as standard for non-conductive samples.

Source: Gallium LMIS. Source lifetime: 1,300 hrs

Voltage: 500 V to 30 kV

Beam Current: 1.5 pA – 65 nA in 15 steps

Resolution: Ion beam resolution

Room temperature resolution
- 3.0 nm at 30kV using selective edge method

Cryo temperature resolution
- 7.0 nm* at 30kV (*conditions subject to gas flow rates)

Image processor
High-resolution digital scanning and patterning engine controlled from the User Interface.

- Dwell time range from 25 ns – 25 ms/pixel
- Up to 6144 x 4096 pixels (up to 64k through Maps Software)
- File type: TIFF (8, 16, 24-bit), BMP or JPEG standard
- Electronic scanning rotation: 360° degrees
- Thermo Scientific SmartSCAN™ System (256 frame average or integration, line integration and averaging, interlaced scanning)
- DCFI (Drift Compensated Frame Integration)
- Patterns supported: rectangle, line, circle, cleaning, cross-section, regular cross-section, polygon, bitmap, stream file, exclusion zones, arrays
- Thermo Scientific SPI™ software (simultaneous FIB patterning and SEM imaging)
- Thermo Scientific iSPI™ software (intermittent SEM imaging and FIB patterning)
- Thermo Scientific iRTM™ software (integrated real time monitor) and FIB immersion modes for advanced, real-time SEM and FIB process monitoring and endpointing.

**Detection**
Aquilos features a secondary electron detector (Everhart-Thornley SED), optimized for use across the available kV and current range. The Trinity detection system is comprised of a segmented, lower in-lens detector (T1) and an upper in-lens detector (T2). An integrated IR-CCD camera is standard for in-chamber viewing and the included Nav-Cam+™ color optical camera can be used to take top-down images of samples (e.g. the cryo-FIB shuttle) for navigation. A secondary electron/secondary ion detector (ICE) is optional.

**The Nav-Cam+**
Is a color optical camera for Aquilos, mounted directly to the chamber for acquiring an image of samples mounted on the specimen stage. The Nav-Cam+ is optimized to capture images at the analytical working distance when the system is under vacuum so areas of interest can be found and investigated. The system incorporates sample lighting and a fully integrated, software-based capture control to ensure easy operation for high-quality images. The resulting image is acquired by moving the stage to a predefined location where approximately a 160 x 105 mm field-of-view is captured. The resulting image (with a resolution of 3072 by 2048 pixels or approximately 6 megapixels) can be digitally zoomed within the user interface to locate and move to specific sample locations. It is possible to save the Nav-Cam+ image file within the microscope control software with or without the current-location-marker-overlay (on the display) to document sample features or areas without the need of an additional external camera or annotation software.

**Imaging**
Images are displayed either in single-frame or four-quadrant display. Images can be viewed live, averaged or integrated. The Aquilos fully supports Thermo Scientific SmartSCAN™ advanced scanning strategies which allows line averaging and interlaced scanning in addition to Drift Corrected Frame Integration (DCFI). Still images can be saved in TIFF, BMP, JPEG file formats, and in 8-bit, 16-bit or 24-bit depth, to the hard disk or LAN from the graphical user interface. Image printing is also available from the user interface. In addition, the system supports recording of AVI movies. This can either be done on the fly or by capturing a series of TIFF images at user-specified intervals. These TIFF images can then be combined into AVI’s by using the included proprietary Thermo Scientific movie creator software.

The software includes a 4-quad mode, in which the quadrants can be used for live display of electron images (SE, BSE), mixing of signals and display of the image of the standard infrared (IR-CCD) camera.

Look-up tables allow image contrast, brightness or gamma to be enhanced. Flexible databar selection is also provided. User-definition of preferred imaging parameter sets is available. Imaging parameters are stored in the TIFF image file as private data. Finally, image measurements and annotations can be performed live on the image and the results can be stored together with the images.

**Current measurement**
A fully integrated Current Measurement option with sub-pA resolution and superior sensitivity, which makes it well suited for characterizing low current phenomena. With the electron beam/ion beam pointed at the Faraday cup, precise probe current measurements and current stability measurements can be performed. This device measures currents ranging from 1 pA up to 2 µA with up to 10 readings per second. The current read-out is displayed in the user interface.

**Milling**
Predefined mill patterns can be drawn in overlay in any of the four quadrants in the UI. Progress of the milling is monitored in the User Interface through a progress bar. End-point detection is available through an integrated real-time monitor. Simultaneous imaging and milling is a standard feature of Aquilos.

**Cold-Platinum Deposition GIS**

Gas chemistry solution for non-beam assisted deposition of Platinum onto frozen-hydrated samples using a proven cold deposition protocol. The GIS package includes the gas precursor, injection needle, gas injector system and controller.

Important note: the customer is responsible for making sure a fume hood is present for on-site service of this chemical by an Thermo Scientific engineer.

**System control**

Aquilos is controlled from an Windows 7 graphical user interface running at a 1920 x 1200 screen resolution. The microscope PC is based on an Intel Xeon W3520 Processor/ 2.66 GHz 8 MB cache, 12 GB system memory, one 500 GB hard drive, one 16x DVD +/- RW drive, integrated FireWire and USB ports and a 1 Gb LAN network card (computer specifications subject to change). The system includes two 24” LCD monitors, keyboard, optical mouse and a height-adjustable office desk. A USB manual user interface (for controlling magnification, contrast/brightness, beam shift and stigmators) is standard with the system. A Joystick (for control of stage movement) is optionally available.

The microscope PC is dedicated to its primary function controlling the Aquilos and has a possibility to connect directly to a LAN. A second support PC with a 24” LCD monitor is standard with the Aquilos and can be connected for additional PC-based functionality such as MS-Office software suite, firewall, anti-virus and other non-instrument software. The support PC is equipped with a Windows 7 operating system, 16 GB RAM, 3.50 GHz Intel Xeon E5-1620 v3 processor or higher, AMD FirePro W2100 2 GB graphics card or better model. The hard disk of the support PC has 2x 1 TB 7200 rpm HDD SATA or higher storage capacity (computer specifications subject to change).

The support PC enables the user to grow with the speed of computer peripheral innovations during the lifetime of the system, without affecting the microscope controller and endangering system uptime. The support computer is a second PC, which connects to the microscope controller with an Ethernet connection taking over the data management task from the microscope controller (which remains dedicated to microscope operation).

It is possible to use the support computer for hosting 3rd party software/hardware that is not part of the microscope (e.g. MsOffice, CorelDraw) or for gaining performance for the microscope controller. The support computer has a second Ethernet card to connect to the LAN or internet. Local IT departments have access to the support computer for (external) network configuration purposes. Internal networking (to the microscope controller) remains the responsibility of Thermo Scientific. The support computer may be loaded and/or upgraded with the user’s preferred anti-virus software, office-suite, printer drivers, email and Internet browser software.

**Maps 3 Correlative Workflow Software**

Maps 3 is a software enabling correlation of LM and EM data, tiling and stitching (import of 120+ image data formats, up to 64k x 64k). The software allows to define and store regions of interest (ROIs). In combination with the cryo-FIB AutoGrid shuttle pre-tilted sample holder, the software assists in the computation of eucentric positions for milling and fast retrieval of ROIs. Maps 3 enables the continuation of correlative microscopy experiments acquired on (cryo)-light microscopes, by allowing image and data import from external sources (light microscopes, other SEM, SDB or TEM systems). The external images can be used for fast navigation, stage control and for correlating the different image modalities with each other.

Maps 3 is a solution for automated large area acquisition and enables recording of images up to 64k x 64k (the maximum size depends on the instrument and server software) and stitches these images together to create a distortion-free, high-resolution overview of the sample area. In the acquisition mode the software controls SEM imaging and image acquisition is possible on all available detectors, e.g. in-lens detectors. Maps is optimized for minimal process overhead and offers instant feedback during the acquisition process.
Maps can import and handle image data in over 120 image formats, including: JPEG, BMP, TIFF and PNG. Maps image data can be saved in RAW format, TIFF format, or in the appropriate format for visualization with Microsoft HD View.

**Aquilos 4-day training course (mandatory)**
During this essential and mandatory four (4) days of On-Site Application Training (to be ordered separately), the user gets an in-depth introduction to the cryo-infrastructure of Aquilos and its operation. The user learns how to operate the heat exchanger, cool-down the cryo-stage, cool-down the preparation pot, operate the preparation station controller, load, clip and mount samples and shuttles in the preparation pot, perform the load-locking cycle using the transfer rod device, operate the cryo-stage, GIS system and sputter coater. Operation of XT and Maps software will be demonstrated with special focus on the cryo controls. The basics of how to perform in-situ cryo-lamella milling are shown using a standard cryo sample comprising of frozen-hydrated A9 cells on EM grids.

**System Acceptance Procedure**
After installation of the Aquilos at the customer’s site, the main microscope and cryo-specifications are proven and documented in a System Acceptance Test (SAT) report. The SAT is included as standard with the Aquilos and precedes the application training, which is also included as standard. The SAT secures that the full functionality of the Aquilos system (incl. cryo-functionality) is warranted and that the subsequent application training can take place.

**System Acceptance Test (SAT) Specification for Aquilos**

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<tr>
<th>Test</th>
<th>Specification</th>
<th>Comments</th>
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<tr>
<td><strong>Acceptance tests at room temperature</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnification accuracy</td>
<td>measured value for X,Y 4.63 μm +/- 3%</td>
<td></td>
</tr>
<tr>
<td>High resolution T1 at 2 kV in Hi-Vac</td>
<td>≤ 2.6 nm at 2 kV, 1.5 - 2 mm WD</td>
<td>Electron beam performance tests</td>
</tr>
<tr>
<td>High resolution ETD at 30 kV in Hi-Vac</td>
<td>≤ 1.6 nm at 30 kV, 2 - 3 mm WD</td>
<td></td>
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<tr>
<td>Beam coincidence point</td>
<td>5 μm</td>
<td></td>
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<tr>
<td>Magnification accuracy</td>
<td>≤ 3 μm in X,Y direction</td>
<td>Ion beam performance tests</td>
</tr>
<tr>
<td>High resolution at 30 kV</td>
<td>≤ 7 nm at 30 kV</td>
<td></td>
</tr>
<tr>
<td>Vacuum tests</td>
<td>Final Chamber pressure ≤ 4 * 10^-4 Pa (in Hi-Vac mode)</td>
<td>End pressure tests</td>
</tr>
<tr>
<td></td>
<td>Lower IGP1 pressure &lt; 1 * 10^6 Pa</td>
<td></td>
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<tr>
<td></td>
<td>Upper IGP2 pressure &lt; 1 * 10^7 Pa</td>
<td></td>
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<tr>
<td></td>
<td>Ion column IGP3 pressure &lt; 6.7 * 10^-5 Pa</td>
<td></td>
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<tr>
<td>Cryo loader loading time</td>
<td>Time to load a sample &lt; 100 s</td>
<td>Measuring the time required for loading a sample with the transfer system</td>
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<tr>
<td>Sputter coater</td>
<td>Demonstration of functionality Pt coating (1000 V, 30 mA, 10 s)</td>
<td>Non-conductive sample is made conductive</td>
</tr>
<tr>
<td>Gas Injection Systems</td>
<td>Deposition of a 20 x 5 μm Pt pattern.</td>
<td>Demonstrate GIS functionality</td>
</tr>
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### Test Specification Comments

#### Acceptance tests at cryo conditions

<table>
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<tr>
<th>Test</th>
<th>Specification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water deposition/ chamber cryo contamination test</td>
<td>Water deposition between 60 and 120 minutes after cooling down &lt; 50 nm/h</td>
<td>This test is specially developed for the Aquilos. It makes more time-consuming measurements in the TEM obsolete and the accuracy corresponds to TEM measurements.</td>
</tr>
<tr>
<td>Cryo stage and Cryo Shield cooling down</td>
<td>Terminal temperature at stage &lt; -180 °C&lt;br&gt;Time to reach terminal temperature at stage &lt; 30 min (without shuttle)&lt;br&gt;Terminal temperature at Cryo shield &lt; -180 °C&lt;br&gt;Time to reach terminal temperature at Cryo shield &lt; 20 min</td>
<td>Demonstration of performance of cryo hardware</td>
</tr>
<tr>
<td>Cryo stage drift</td>
<td>Drift in X direction &lt; 60 nm/min&lt;br&gt;Drift in Y direction &lt; 60 nm/min</td>
<td></td>
</tr>
<tr>
<td>Chamber pressure under cryo conditions</td>
<td>Chamber pressure 1 hour after cooling down the Cryo stage &lt; 8 * 10⁻⁵ Pa</td>
<td></td>
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</tbody>
</table>

**RAPID**

This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website.

**Installation requirements**

Please refer to the Aquilos pre-installation guide.

**Maps 3 Offline with Correlative Workflow**

Maps 3 Offline with Correlative Workflow is intended for running on dedicated image processing computers. The offline version of Maps 3 with Correlative Workflow requires at least 4 GB of RAM memory and can be connected to multiple Maps.

**NRTL Field Labeling**

Third party electrical safety assessment and field labeling by a Nationally Recognized Testing Laboratory (NRTL) at the Customer’s site.

**Acoustic Enclosure for Pre-vacuum Pump**

The acoustic enclosure is a cover that fits the pre-vacuum pump(s) of the microscope system. It provides noise dampening of the pump(s) for operator and microscope.

Please note that this part number (FP 3440/52) is not suitable for the Edwards XDS35i vacuum pump.
9432 909 96411  Compressor 120 V, 60 Hz with 4-liter Tank
The compressor is required when compressed air of 6 atm. is not available; compressed air is required for operating pneumatic valves and the microscope’s leveling system. The compressor is connected to the mains supply unit of the microscope.

1207794  Water-cooled Water Chiller 230 V, 50/60 Hz
The recirculating chiller delivers guaranteed, continuous cooling between 5 and 40 °C with a high temperature stability of 0.1 °C. This chiller is water-cooled and contains earth leakage breaker.
Cooling capacity: up to 1700/1900 W for 50/60 Hz, respectively
Dimensions: 61.5 x 37.7 x 50.0 cm (HxWxD)
Weight: 40 kg
Branch Circuit Reqs: 230 V, 50/60 Hz, 10 A

114064  ICE Detector
The ICE detector is an optional detector for secondary ion and electron detection. Its novel design is optimized for imaging with the ion column in both ion and electron collection mode. The patented ion detection schema provides revolutionary secondary ion imaging. Additionally, ICE has a high current and low current mode, increasing the useful beam current dynamic range. The ICE detector can be used in combination with the charge neutralizer enabling secondary ion imaging while the specimen is flooded with electrons to neutralize charge.

4022 404 41184  Installation Labor Aquilos NA
Standard Installation Labor coverage - see Terms and Conditions

4022 404 02184  Installation Material Aquilos
Standard Installation Material coverage - see Terms and Conditions

4022 404 43184  Warranty Labor Aquilos NA
Standard Warranty Labor coverage - see Terms and Conditions

4022 404 04184  Warranty Material Aquilos
Standard Warranty Material coverage - see Terms and Conditions

9425 061 69515  NA Installation Kit for Quanta (3D) FEG / Nova NanoSEM / Verios / Versa 3D / Scios / Teneo
Part Number  Qty  SSD Supplied items
25066  1  External 10-inch water filter kit
1001224  1  Specimen stubs (20)
1020166  2  NIPPLE,SS,3/8BSPP-NPT
1020167  2  BARB,BRASS,3/8NPT
1021406  1  Water Damper
4022 297 06181  5  8 mm Poly Tubing
4035 273 22521  1  Power strip, 6 out 220 IEC type
4035 273 43491  1  Chloramine-T algaeicide (250 gram jar)
9425 061 69458  1  Auto Transformer 208 V to 228 V 7 KVA
9425 061 69549  1  10 pack DVD+R x 10 - 4.7 GB Disks
9425 061 69585  2  50 ft. each - 3/8 inch Air Hose
9425 061 69586  8  Hose Clamps, Size 08
9425 061 69587  2  Brass Reducer ½”NPT – 3/8”NPT,
9425 061 69588  2  Brass Hose Barb5 3/8” NPT to 3/8” Hose
9425 061 69589  1  20 A, 250 V Twist Lock Plug, Hubbell
9425 061 69590  2  ½” KO Cable Clamp, Thomas & Betts
9425 061 69617  4  IEC Power cords, 6 ft.

Choose a Chiller Type – air or water cooled
1210057  Leica Cryo CLEM Kit
The Leica Cryo CLEM Kit contains one Aquilos FIB-shuttle compatible with the Leica Cartridge used in the Leica EM Cryo CLEM light microscope. Using this shuttle avoids manual manipulation of the AutoGrid during the Cryo-LM to Cryo-FIB transfer since the AutoGrid can remain inside the Leica Cartridge. This reduces the risk of Grid damage and contamination and maintains grid orientation between Cryo-LM and Cryo-FIB/SEM. The kit comes with all tools required for shuttle manipulation and transfer between the Leica EM Cryo CLEM light microscope and the Aquilos cryo-preparation station.

1136946  Spare Preparation Station including Preparation Pot
This option is a complete spare preparation set comprising of controller station, preparation pot with loading lid and diaphragm pump. It can serve as a second loading station, but the extra footprint (space on a separate desk and on the floor) needs to be considered.

1231399  Aquilos 2 package
The Upgrade Package Includes: A set of hardware enhancements of the Aquilos system for better productivity and ease-of-use is included. • Modifications to extended Dewar lifetime, increasing from 10 hours to over 15< hours enabling overnight runs. • An integrated Nitrogen digital flow controller keeps the temperature stable without user interaction; whilst minimizing the flow. • Optimization of the Navcam for a better view of the Aquilos stage and for improved cooling line lifetime. • Enhanced stage cooling body and cryo shield with fast cool down times and a higher cooling capacity. • A dry scroll pump replacement for the oil rotary pump which evacuates the heat exchanger line removing the need for monthly pump maintenance. The Windows 10 upgrade includes a New xT20 Aquilos software platform this includes: • New UI core features for enhanced ease of use. • GIS timer and deposition automation. • Sputter run automation. • Milling angle calculator. • UI integrated temperature and vacuum logger for real time temperature readout in the status bar as well as easily storing and viewing of logs. • Updated User guidance and new workflow support documentation. AutoTEM Cryo is dedicated lightweight version of AutoTEM 5 optimized for Aquilos for automated preparation of the S/TEM samples in Cryo Conditions enabling in Aquilos situ lamella preparation. It is now possible to create unattended batch milling jobs which can be configured with different steps Rough Milling, Fine Milling and Polishing. The processing can be carried out unattended overnight using multil pass or single pass. It also includes drift correction and user supervised modes for precision milling. Offering the highest level of automation and intuitive user interface with hints and instructive graphics significantly shortens the S/TEM lamella preparation process time for expert users and enables novice users. Auto Slice and View 4 software revolutionizes raw data collection from DualBeam™ instruments by automating the acquisition of high-resolution 3D images. It acquires data by milling serial sections (slices) and then imaging each slice of a user-defined volume of the sample. This software enables study of the 3D structure and composition of samples at the nanometer scale. Auto Slice and View software helps make 3D imaging faster, easier, more accurate, and cost effective. Ultimately, the results provide a better representation of all the information available from the sample volume, significantly improving laboratory productivity. Now this functionality is available for the Aquilos allowing for the recoding of 3D datasets from native frozen hydrated samples. Specifications under cryo conditions may vary from room temperature conditions. AutoScript 4 DB, a Python-based application programming interface (API) that offers control of SEM and DualBeam systems. AutoScript 4 API provides access to most of the microscope functions, including imaging, patterning, detector control, stage movement control and gas injection systems. Bringing advanced automation to Aquilos, the AutoScript 4 API researchers and scientists the tools to make their systems more productive. Offering experts precise control over the Aquilos for custom operations this complements AutoTEM offering the flexibility in developing new methods. EasyLift Cryo Lift-out is solution for the preparation of S/TEM lamella of frozen hydrated samples at cryogenic temperatures. • EasyLift needle can be cooled down to temperature below -165 degrees centigrade. • Lift out and Attachment is achieved with a combination of cold Platinum GIS welding and Redeposition Welding • This lift out solution is optimized for Autogrid workflows utilizing the standard Aquilos shuttle • Includes a starter pack with all the consumables you will need to get started (10 needles, 100 halfmoon grids and tweezers). • The Easy Lift module drives the positioning and fine control including 50nm step size, drift of <200nm/min, its integrated into the UI, automated needle alignment, quick release cooling braids for quick needle exchange, low drift and high temperature stability (+/-0.5C). • 2 Optional experimental shuttles for full angular flexibility, for 3mm HPF Planchettes and Autogrid Shuttle

1213452  NAS Data Storage Basic
NAS Data Storage Basic offers 16 TB of raw, external disk space, allowing large-volume datasets to be stored and accessed easily from the microscope computer or via a local Ethernet network (1 Gb/s). Please note, that NAS Data Storage Basic (1213452) cannot be combined with NAS Data Storage Extended (1130961).
1214207 Remote Control / Imaging
Remote Control / Imaging is a Remote Control package that enables full control of the microscope via another computer across a network. The imaging transfer speed and the remote system responsiveness is determined by the speed and quality of the network connection. 100 Mbps LAN connection is sufficient for most use cases.

The Remote Control / Imaging package contains a perpetual license for the Radmin Remote Control software, which is compatible with all Windows OS versions available on the Microscope and Support computers.

FP 3550/90 Uninterruptible Power Supply 230 V
The Uninterruptible Power Supply (UPS) will eliminate problems to the SEM, Small DualBeam (SDB) and V600/V400 Series of instruments caused by short power grid interruptions. For longer power outages (more than a few minutes, user adjustable) the UPS will switch the instrument to a power saving mode. When the UPS batteries are almost empty it will initiate a graceful shutdown of the system.

The autonomy time for the UPS batteries depends on the configuration of the system and the user adjustable time between the start of the power outage and the start of the power saving mode.

UPS characteristics:
- Model = LanPro LP8-11U
- Rating = 8 kVA / 6.4 kW
- Typical backup time of core instrument (i.e. at ca. 27% load) = 60 min.
- Input voltage = 172 - 285 Vac
- Input frequency = 40 - 70 Hz
- Output voltage = 230 Vac
- Output frequency = 50 / 60 Hz.

SC04 Year(s) Standard Service Contract including NSR's
Year(s) Standard Service Contract including NSR's

4022 400 44231 DDP Brno / Named place of destination; receiving dock in North America (T-3)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller's obligation is fulfilled when the goods have been made available at a specified point in the Buyer's country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination In accordance with Thermo Fisher Scientific's standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

1036171 C-Clip (100x) - Consumable
A set of 100 C-Clips

1205101 CryoFIB AutoGrid (100x)
A set of 100 AutoGrids, modified for low-angle CryoFIB milling with the Aquilos Small DualBeam. Suitable for standard, 3-mm specimen grids and compatible with the Autoloader. An additional, standard C-Clip is required to secure the Grid.

9425 060 99100 On-site Applications Training - Americas (1 day)
On-site applications training, per day, including all travel and expenses. For customers located in the Americas. Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3) consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not ordered as part of a microscope purchase).

 GENERIC - THUNDER Cryo CLEM microscope package - DM1029TF1 (incl. installation and training)
THUNDER Cryo CLEM microscope package:
Cryo CLEM DM6 FS microscope basic set with option to apply THUNDER to images collected with the CLEM software modul. To apply THUNDER live in the CLEM software module is not possible.

Set consisting of:

Cryo CLEM DM6 FS microscope
11888867 DM6 FS
11888874 CTR6 Halogen
11888425 Advanced XYZ-Module LX
11555089 Single objective slider
11525113 STP8000
11500845 Lamp housing 107/2, 12V 100W, 1-lens, 3m
11500974 Halogen lamp 12V 100W (Osram 64625)

Microscope stage
11501279 Cryo CLEM measurement stage 9x9

Documentation Port
11505297 Basic docu tube MBDT, mot., 19 CIP
11505161 Tube adapter incl. 1 docu. port
11507807 2 Eyepieces HC PLAN s 10x/22 Br. M

Image Acquisition and Analysis Software
11640581 LAS X CLEM Workflow Software

Computer Workstation
11533459 Monitor 32”
11640635 Thunder Station 3D DCV
11640639 32GB RAM Option for LAS X Workstation

Digital Documentation Camera
11547006 Leica DFC9000 GT
11640585 LAS X Driver DFC9000 GT/C Licence
11541551 HC CMount Adapter 1x for SCMOS

Accessory
10450288 Dust cover (80 x 50 x 50 cm), antistatic

EM Cryo CLEM Cartridge Set w 25l Dewar

consisting of:

Cryo stage
Cryo stage lid with objective port
Cryo CLEM transfer shuttle
Cryo objective
Parfocal adapter
25 liter LN2-Dewar
LN2-hose

Pump optimized for 25 liter Dewar
Pump controller
Special long forceps with insulation coating
Special long forceps, fine tip
Special forceps cartridge Autogrid

Please note:
The Leica EM Cryo CLEM Cartridge can only be used with Leica DM6 FS/CFS fix stage microscopes.

Cryo CLEM Transfer Shuttle Cartridge
consists of three functional parts:

Working platform
Rod with gripper for sample transfer
Removable transparent lid
Cartridge for bare grids

Loading aid for cartridge for bare grids

Cartridge for two Autogrids

Leica EM CTD - Cryo Tool Dryer
100 - 230V / 50 – 60 Hz Combination of ventilation heating and heating plate
reaches 45°C in 5 min (with 20°C environmental temperature)
max temperature 50 °C
Rubber Pad included, 1 pc.
Weight: 7.7 kg Dimensions W x D x H: 306 x 400 x 111mm

LED3
LED3 is a mercury-free, bright, and versatile solid-state light source offering white light in the 390-680nm range and is well suited for a range of fluorescence microscopy and stereo microscopy applications. LED3 is practically maintenance-free and offers better output stability and longer life time of the lamp than traditional metal-halide lamps. LED3 can be triggered to synchronize illumination with camera exposure and minimize photobleaching.
The LED3 Bundle contains:

LED
3 light source
3mm Liquid-Light-Guide
24V DC 220W Power Supply
2mm Hex Allen Wrench
1x BNC-to-SMB Cable
1x Adapter plug BNC-to-SMB
Lightguide coupler 1"
Liquide light guide coupler 1" for Leica microscopes, except DMI stands.

Reflector BFLP425, size k
Reflector BFLP425 for use with EL6000

Filter cube 405nm, k
Filter cube 405nm LED for Leica SFL4000/7000,
excitation filter: et405/60, emission filter: et470/40,
dichromatic mirror: 455

Filter system GFP ET, k
Filter system GFP ET, size K
Excitation: 470/40
Dichroic: 495
Emission: 525/50

Filter system YFP ET, k
Filter System YFP ET, size K
Excitation: 500/20
Dichroic: 515
Emission: 535/30
Filter system RHOD ET, k
Filter system RHOD ET, size "k"
Excitation: BP 546/10
Dichroic: LP 560
Emission: BP 585/40

Filter system TXR ET, k
Filter system TXR ET, size "k"
Excitation: BP 560/40
Dichroic: LP 585
Emission: BP 630/75

Trigger cable f. Andor Zyla sCMOS camera
High Speed Trigger cable for Andor Zyla 4.2 camera.

2TB SSD RAID option f. LAS X Workstation
2TB SSD RAID option for LAS X Workstation.

Keyboard US ;USB Hub
Keyboard US
USB Hub

System Integration LAS X
System integration for LAS X modular widefield systems
including LAS X final acceptance test. Can only be ordered along with an LAS X Workstation.

Air Table 30" X 36" #63533 with Casters. Include package of 8112184 ,,TMC cleanbench table637590M 8112042 ,,TMC OnTrak install f. 30x36 CleanBench (907590) 8111226 ,,TMC Caster kit 63500 series (8301401)

1 Day CM Application Training(Image/Dig)
Introduction to the LAS X software user interface • Data handling and management • Microscope control and camera settings • Single frame image acquisition • Advanced image acquisition workflows (e.g. XY stitching, extended depth of field imaging, XYZ imaging) if applicable • Image annotation • 2D and 3D measurements (if applicable) • Advanced image analysis configurations (e.g. image analysis, phase analysis, grain sizing, etc.) • Configuring and saving user settings
This Warranty Policy applies to goods and/or services sold by Leica Microsystems Inc. or its corporate affiliates (“Affiliate”). The selling entity hereinafter referred to as “Leica”. This Warranty Policy does not apply to goods or services sold by the Leica Biosystems division of Leica Microsystems Inc.

1. **Equipment Warranty.** Unless otherwise provided by Leica in writing, Leica warrants for the earlier of 13 months from delivery, or 12 months from date of completion of assembly and installation by Leica (if applicable), all new equipment and other hardware will conform to Leica’s published specifications and be free from manufacturing defects in material and workmanship. However, the warranty period for Leica authorized third party sellers is the earlier of one year from delivery to end user or 15 months from delivery third party seller. Leica will pass through transferable manufacturer’s warranties for any equipment not manufactured by Leica. Used or refurbished equipment is provided AS-IS unless otherwise provided by Leica in writing.

2. **Equipment Parts Warranty.** Leica warrants for 6 months from shipment that equipment parts will conform to Leica’s published specifications and be free from defects in workmanship and materials. Any product or part furnished without charge to Buyer during the warranty period to correct a warranty failure is warranted until the unexpired term of the warranty applicable to the repaired or replaced equipment. Leica may use refurbished material for all repairs of goods.

3. **Equipment Accessories Warranty.** Leica warrants that its equipment accessories, which includes syringes, probes, filters, tubing and other buyer replaceable peripheral items used with the equipment, will conform to Leica’s published specifications and will be free from defects in workmanship and materials at the time of shipment.

4. **Supplies/Consumables Warranty.** Leica warrants that its supplies and consumables, which includes reagents, controls, waxes, slides, cassettes and other similar consumable type products with a use by date, will conform to Leica’s published specifications and will be free from defects in workmanship and materials through the stated “use by date” appearing on the container.

5. **Software Warranty.** Leica warrants for 3 months from delivery, its software will perform substantially in accordance with Leica’s published specifications and any accompanying user documentation when used under normal operation and maintenance conditions. ANY THIRD-PARTY SOFTWARE, PROVIDED WITH THE SOFTWARE, AND DATA AND PRE-RELEASE VERSIONS OF THE SOFTWARE, ARE SUPPLIED ON AN “AS IS” BASIS WITHOUT CONDITION OR WARRANTY OF ANY KIND, INCLUDING ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT, EITHER EXPRESS OR IMPLIED. Any software warranty in any software license agreement between the parties will take precedence over this software warranty.

6. **Services Warranty.** Leica warrants for a period of ninety (90) days after performance that its services will be performed in a workmanlike manner.

7. **Third Party Goods.** Leica will flow down any transferable manufacturer’s warranties for any third party manufactured goods sold by Leica.

8. **Warranty Exclusions.** Warranty coverage does not include any defect or performance deficiency (including failure to conform to product descriptions or specifications) which results, in whole or in part, from (i) negligent storage or handling of the good by Buyer, its employees, agents, or contractors, or use that is inconsistent with normal operation and maintenance conditions, (ii) Buyer’s failure to prepare or maintain the site or provide power requirements or operating environmental conditions in compliance with any applicable instructions or recommendations of Leica, (iii) adverse power or environmental conditions such as erratic power, voltage spikes, RF or magnetic interference, HVAC failure or other causes beyond the reasonable control of the Leica, (iv) absence of any product, component, or accessory recommended by Leica but omitted or removed at Buyer’s direction, (v) any misuse, alteration or damage to the good by persons other than Leica, (vi) combining Leica’s goods with any product furnished by others, or incompatible with Leica goods, where such combination causes failure of or degradation to performance of Leica’s goods (including the substitution of any reagent not authorized by Leica), (vii) improper or extraordinary use, improper maintenance, failure to comply with any applicable instructions or user manuals; or (viii) if servicing, repair or movement/re-location of equipment was attempted by anyone other than Leica authorized providers. Leica is not responsible for and bears no liability for malfunction or inoperability of equipment, software, firmware, accessories or other hardware resulting from (i) changes to or de-commitment of operating systems or other applications by any original equipment manufacturer, (ii) introduction of a virus or other malware caused directly or indirectly by Buyer, or (iii) inoperability or incompatibility with any Buyer network or any attempted use of software or firmware on a workstation for which same is not expressly licensed or permitted, whether or not acquired from Leica.

9. **Warranty Services.** Should any failure to conform to the warranty appear within the applicable warranty period (or 30 days after shipment for equipment accessories), Buyer must promptly notify Leica in writing. Within a reasonable time thereafter and subject to the other provisions herein, Leica will make the necessary repairs at its expense after conformation that the non-conforming goods were stored, installed, maintained and used in accordance with its recommendations, accompanying documentation, published specifications and standard industry practice. Warranty services will be performed at the location of the goods if services cannot be provided remotely or equipment is not a depot repair product which must be shipped to Leica for repair. Buyer will ship the goods at Leica’s expense to Leica for repair and/or replacement after obtaining a valid Return Material Authorization number. Warranty services will be performed during Leica’s local business hours. After-hours service may be available upon request at an additional charge. While commercially reasonable efforts will be made to render services promptly, Leica makes no guarantees for response times or uptime.

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Rev. 4/21/15
Krios G4 QUOTATION for
University of Missouri

Attn. Ph.D. Tommi White

Quote Date: March 03, 2020
Quote Number: QUO-114196-L8B5 R1.1
Expires: June 26, 2020

Prepared By Ciceron Yanez, Sr Account Manager
ciceron.yanez@thermofisher.com
Solution Description

1156255  Krios G4
Krios G4 is a 300 kV FEG Cryo Transmission Electron Microscope (Cryo-TEM), optimized for both high-resolution 3D imaging of proteins and macromolecular assemblies through single particle analysis (SPA), and high-resolution cellular tomography, and can be also used for Micro Electron Diffraction (MicroED). Krios G4 contains important enhancements in automation and ease of use, including auto-alignment, and a simplified user interface, which make the system easier to use, with improved repeatability and reproducibility, and reduced time-to-results, relative to previous generations.

Krios G4 features a more compact design than its predecessors. Its default configuration fits in a microscope room with ceiling height of 3040 mm. In addition, the ergonomics of the microscope have been improved such that sample loading/unloading has been made easier.

Another main feature of the Krios G4 is its enhanced productivity. The powerful combination of aberration-free image shift (AFIS) in EPU and fringe-free imaging (FFI) contributes to a higher system throughput.

To ensure the best performance of the instrument, Krios G4 can assess the optical status of the microscope and can provide guidance on the alignment steps that need to be optimized. Via automated alignment routines, the microscope can subsequently be tuned to its optimal starting point for a Single Particle Analysis (SPA) or Tomography experiment.

For SPA experiments (including sample quality assessment and data acquisition), most alignment steps are embedded in EPU, which is the single user interface, providing extensive guidance for the set-up and execution of the workflow.

Krios G4 has a designed-in connectivity with the Glacios and Arctica Cryo-TEMs, as well as with other Krios generations, allowing the exchange of AutoGrid Cassettes and Capsules between all Autoloader equipped instruments. This way, samples can be pre-assessed and selected on other instruments and subsequently be transferred to Krios G4, ensuring an efficient use of the tool for the ultimate 3D structure analysis.

Features and specifications:

Microscope Column
The Krios G4 comes with a factory-aligned, High-Brightness X-FEG field emitter and a System Column that includes a five-lens condenser system (FEG gun lens, three condenser lenses and a mini-condenser lens), the C-TWIN objective lens with a computerized 4-axes eucentric goniometer, a diffraction lens, an intermediate lens and two projector lenses. The column is embedded in a support frame, allowing for extension with a Cs Image Corrector and/or post-column energy filter.

Some highlights of the Krios G4 column are:
- Cryo Autoloader for automated and contamination-free loading of Cassettes, containing up to 12 AutoGrids.
- Integrated cryo box, fixed to the objective lens, providing temperature stability and preserving cryo specimen quality.
- Temperature management software, including liquid nitrogen autofill, and scheduling of cool-down parameters after a cryo cycle.
- Extremely stable, 300-mm diameter column (Titan platform).
- Compact base frame and enclosure, requiring a ceiling height of only 3.04 meter (for non-Cs image corrected systems only).
- Automatic Condenser C1, C2, C3, Objective and SA apertures.
- Symmetric, Constant-Power™ C-TWIN objective lens, combining excellent resolution with high tilt and cryo capabilities (local length = 3.5 mm, Cs = 2.7 mm, Cc = 2.7 mm).
- Optics electronics that enable rotation-free imaging, and allow for fast switching of modes, magnifications, conditions and techniques, all with minimized stabilization time. This is crucial for full automation of Single Particle Analysis and high-resolution Tomography.
- Parallel illumination over a wide and variable field of view, crucial for both Tomography and high-resolution Single Particle Analysis.
- Low-hysteresis design with minimized crosstalk, which allows much better predictability of the electron beam position. This is essential for the implementation of automated alignments and applications software, and makes the operation of the system much more reproducible, which is extremely important for high throughput applications.
- Computerized, 4-axes specimen stage with ±70 degree alpha tilt.
- High-speed, digital search-and-view camera (FluCam).
- Linear distortion < 0.5% between magnifications of 18 kx and 155 kx in TEM microprobe and nanoprobe modes.
- Aberration-free image shift (AFIS - part of EPU) for imaging neighboring grid holes without mechanical stage movements, resulting in shorter acquisition times.
- Fringe-free imaging (FFI) for multiple image acquisitions per grid hole, resulting in shorter acquisition times.
- The microscope is fully aligned at 300 kV in the factory. At this pre-aligned acceleration voltage, critical microscope characteristics are optimized, ensuring ultimate performance in imaging and analysis.

Sample Handling System - Autoloader
Samples are put into AutoGrid Rings, which are robust sample carriers, protecting the grids that contain the sample against deformation and/or damage. Up to twelve AutoGrids can be put into a Cassette, which can be placed into a Capsule containing liquid nitrogen. The Capsule can be docked onto the Autoloader, which is part of the microscope column.

The Autoloader is a robotic sample handler, capable of transferring the AutoGrids automatically into and out of the microscope. Within the Autoloader, the AutoGrids are kept at low temperature, protected from their environment by cryo shielding at all times. Connectivity with other Autoloader-equipped microscopes is guaranteed.

FluCam Digital Search and View Camera
The FluCam has the following capabilities:
- High frame rate: up to 40 frames per second.
- Automatically adaptable gain and large magnification range allow the user to undertake diverse tasks such as locating a lost beam at low magnification and imaging a focused beam at high magnification.
- High Dynamic Range Mode allowing alternating short and long exposures.
- Ultra-robust scintillator design, insensitive to beam damage.
- Observation of focused high intensity beams.
- Live Fourier Transforms.
- False color imaging.
- All microscope alignments can be carried out using the camera.

Vacuum
Krios G4 makes use of an oil-free vacuum system. Differential pumping on the electron column, in combination with excellent cryo shielding, ensures a clean environment for the sample. Specimens can be used in the column for high-resolution data acquisition for at least three days (72 hours) without visible contamination or degradation. The Autoloader is pumped separately, and contains additional cryo shielding to protect the samples stored in the
Cassette, allowing storage of AutoGrids in the Autoloader for at least 5 days. The sample lifetime in the column and Autoloader is tested and documented on each system as part of the standard factory test.

**Electronics**

The completely customized, high-stability electronics of Krios G4 are driven by the microscope controller computer. The noise suppressing, self-regulating power supplies ensure both short- and long-term stability. Every board is equipped with accurate, auto-diagnostic electronics guaranteeing optimal performance of the system and fast fault finding.

**Control of the Microscope**

Control of the microscope and all its accessories is through one common graphical user interface operating under Windows 10. For complete control of all microscope functionality, logical combinations of controls are grouped on two movable control panels. Some of these controls are user-definable in order to enhance throughput and usability. In addition, for the single particle workflow, EPU software acts as single application user interface, containing all required setup and alignment steps, guiding the operator through the entire process.

The microscope workstation (two hand panels, two 30” monitors, keyboard, mouse) is placed within 15 meters away from the microscope, but this distance can be increased up to 300 meters by means of an optional KVM extender.

**EPU Software**

The EPU software is a single user interface for setting up and executing the Single-Particle Analysis workflow on the microscope. This workflow includes the required (auto) alignment routines, and setup parameters for screening or high-resolution data acquisition. The user is guided through all the required steps in the right order.

Screening of samples is automated, allowing the batch acquisition of grid atlas overviews of selected grids that are stored in the Autoloader. EPU can also automatically categorize the properties of the ice films in the grid squares, providing guidance for specimen quality assessment.

**Velox Imaging Software**

Velox Imaging Software provides the new ergonomic approach for multi-signal acquisition and analysis for Thermo Scientific Scanning/Transmission Electron Microscopes (S/TEM). The software runs on a 64-bit Windows 10 operating system.

The Velox™ user interface with its integrated design combines access to the microscope and detector parameters to provide superior experimental control to deliver the most reproducible, traceable, well documented, quantitative S/TEM investigations at the highest yields. Features include:

- TEM/STEM operation.
- Integrated Ceta camera, optionally to be expanded with high speed recording possibilities using Ceta Speed Enhancement. Unique TEM image rotation with automatic stage direction adjustment.
- Integrated Falcon 3EC and Falcon 4, including Integration and Counting mode, dose measurement and automatic fractionation. Principles of camera operation unified with EPU.
- Acquisition of up to four STEM signals.
- Recording of STEM images with flexible dwell times up to 2k x 2k (standard) or 4k x 4k (optional).
- Single and continuous acquisition capabilities that allow to record Ceta and STEM images and movies. Image series acquisition supports manual stop, stop at predefined number of frames or circular buffer modes.
- A new acquisition strategy with drift-corrected frame imaging (DCFI) to acquire high-quality TEM (with Ceta camera) or STEM data. The exceptional quality of the resulting image is enabled by high-speed drift correction and by merging multiple frames during acquisition. Support of camera-based image alignment for Falcon 3EC and Falcon 4.
- A new layout of the graphical detector interface which allows for overseeing the status of the detectors in one glance. STEM detector collection angles are indicated. Also, the interface enables easy adjustment of conditions for optimal imaging, and documentation of the experimental conditions required for quantitative analysis later.
An interactive beam diagram giving the operator a clear status overview of the experimental set-up in TEM and STEM mode to control exposure of the sample by the electron beam and to be able to choose the right detector with the right conditions for the experiment at hand.

- Automatic beam blanker function allowing for minimizing the total electron dose for a maximum lifetime of the sample.
- Sample navigation with mouse control.
- An extended Metadata storage for complete documentation of the experiment is part of the new data storage philosophy.

**Scanning system**

Krios G4 can be equipped with a high-resolution digital scanning engine controlled from the user interface (option).

- Resolution: up to 4kx4k pixels
- Minimum dwell time: 50 ns/pixel
- Electronic scan rotation

**Included in Delivery**
The following items are standard included in Krios G4:

- High-Stability High-Tension Generator
- Automatic Aperture System, with:
  - C1 condenser apertures 30 µm, 50 µm, 70 µm, 2000 µm
  - C2 condenser apertures 20 µm, 50 µm, 70 µm, 150 µm
  - Objective apertures 30, 70, 100 µm on systems without Phase Plate Solution (option)
  - Objective apertures 70, 100 µm on systems with Phase Plate Solution (option)
  - Selected area apertures 10 µm, 40 µm, 100 µm, 200 µm
- C-TWIN Lens
- Autoloader
- CompuStage with Krios Single-Axis Holder
- FluCam
- Workstation with 2x 30” LCD Monitor
- 300 kV Alignment
- Linear Distortion Correction
- EPU Software and License
- TEM Scripting
- Advanced TEM Scripting Academic License
- Velox imaging software
- 2x Capsules
- 4x Cassettes
- 1x C-Clip Ring (100x)
- 1x C-Clip (100x)
- 4x C-Clip Insertion Tools
- 1x Loading Station
- 1x AutoGrid Alignment Tool
- 1x AutoGrid Tweezers
- 1x AutoGrid Container (20x)
- 1x Cassette Tweezers
- 1x AutoGrid Assembly Workstation
- 1x Grid Container Tool

**System Acceptance Procedure**

Krios G4 is fully aligned in the Thermo Fisher Scientific factory at 300 kV. All important microscope specifications are tested, verified and the results are documented in the so-called ‘blue book’.

A two-day Customer Witnessed Acceptance Test (CWAT) can optionally be ordered together with the microscope. During this test, which is carried out in the factory, the test results in the ‘blue book’ are discussed, and a set of
important performance specifications is demonstrated in the presence of the customer. The functionality of major accessories of the customer’s configuration such as Tomography, EPU, Phase Plate, etc. will be demonstrated during the CWAT as well.

After installation of the microscope at the customer’s site, the main microscope and accessory specifications are proven again and documented in a System Acceptance Test (SAT) report. The SAT is standard included with Krios G4.

The CWAT (optional) and SAT (standard) are performed at 300 kV according to clearly defined protocols and using reference samples. See the following paragraph for the SAT specification.

System Acceptance Test (SAT) Specification for Krios G4

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-Ray Safety</td>
<td>X-ray radiation ≤ 0.5 μSv/hr at 0.1 m distance (X-FEG)</td>
<td>Safety test performed with X-ray sensor. Test can be performed at room temperature.</td>
</tr>
<tr>
<td>Spot Drift</td>
<td>Average spot drift during 10 minutes ≤ 0.5 nm/min</td>
<td>Spot drift is measured by direct observation, without recording any images.</td>
</tr>
<tr>
<td>X-FEG Brightness</td>
<td>≥ 7.5 (10^7) A/m²srV</td>
<td>The brightness is determined by measuring the semi-angle, spot size and spot current of the beam.</td>
</tr>
<tr>
<td>Information Limit</td>
<td>≤ 0.12 nm at zero specimen tilt ≤ 0.23 nm at -70° and +70° specimen tilt</td>
<td>Young's fringe images showing TEM information limit.</td>
</tr>
<tr>
<td>Thon Rings</td>
<td>Thon rings visible beyond a spatial frequency of 3 nm⁻¹ (corresponding to 0.33 nm resolution) in the rotationally averaged power spectrum of an image taken at -1 μm defocus at a total dose of 40 electrons/Å². If there is no direct electron detector on the configuration, a high dose test will be performed.</td>
<td>Thon rings demonstrate the transfer of contrast by the microscope column in combination with the detector. This test will be performed on all direct electron detectors present on the configuration. If a Phase Plate is present, an additional test result in combination with the Phase Plate will be provided.</td>
</tr>
<tr>
<td>Equilibrium Specimen Drift</td>
<td>Average specimen drift during 5 minutes ≤ 0.5 nm/min</td>
<td>Drift measurement performed after complete stabilization of the microscope, demonstrating the intrinsic system stability.</td>
</tr>
<tr>
<td>Drift after Specimen Exchange</td>
<td>Maximum drift values after exchange 2 min: 1.2 nm/s (Grid Atlas) 5 min: 0.45 nm/s (Target Areas) 10 min: 0.25 nm/s (Start Tomo) 20 min: 0.12 nm/s (Start EPU) 40 min: 0.035 nm/s (Drift Settling)</td>
<td>Drift measurement performed immediately after specimen exchange, demonstrating the behavior under normal use conditions. The drift values correspond to typical use-case requirements.</td>
</tr>
<tr>
<td>Test</td>
<td>Specification</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ice Growth</td>
<td>Transmission loss ≤ 1% per 24 hr</td>
<td>The effect of ice growth is quantified by the decrease of measured intensity of the specimen in the images. The measurements are performed for at least 8 hours and fitted to an exponential model and the result is reported as transmission loss per 24 hr.</td>
</tr>
<tr>
<td>Autoloader Performance</td>
<td>The following procedure should run without errors on each of the cassettes: the cassette is filled with 6 AutoGrids and docked. Next, an inventory is made and each AutoGrid is loaded into the column once.</td>
<td>Performance test, demonstrating the full load/unload cycle and proving the compatibility of the autoloader parts delivered with the system. Slot positions 1 to 12 of the cassettes are alternately filled and empty.</td>
</tr>
<tr>
<td>EPU</td>
<td>Sample data set of 15 images, demonstrating that the proper target areas were imaged.</td>
<td>EPU is set up to acquire 3 images of the edges of 5 different foil holes. The orientation of the edges in the acquired data set demonstrates that the target areas were imaged properly.</td>
</tr>
<tr>
<td>Eucentricity</td>
<td>Eucentricity X, Y ≤ 1 µm during Alpha tilt from -70° to +70° Eucentricity defocus ≤ 3 µm during Alpha tilt from -70° to +70°</td>
<td>Maximum mechanical movement that is observed over the entire tile range is reported. Either manual observation or Tomography holder calibration curves may be used.</td>
</tr>
<tr>
<td>Tomography (Option)</td>
<td>Calibrations required for Tomography are performed.</td>
<td>Calibrations including auto-functions, holder calibration, and Tomography specific calibrations.</td>
</tr>
<tr>
<td>Phase Plate (Option)</td>
<td>Film quality: 5 windows undamaged and clean Auto phase plate activation measurement Phase shift at 40 nC dose: &gt; 0.2 and &lt; 0.8 π Rad Phase shift between 40-80 nC dose: &gt; 0.2 π Rad</td>
<td>Images of amorphous carbon are collected while the Phase Plate is being conditioned.</td>
</tr>
<tr>
<td>STEM resolution (Option)</td>
<td>STEM Resolution &lt; 0.24 nm</td>
<td>Lattice reflections visible in power spectra of images acquired in STEM mode on a gold on carbon specimen.</td>
</tr>
</tbody>
</table>
This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific's service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific's overall quality of service. Thermo Fisher Scientific's service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website.

**Installation requirements**

Please refer to the Krios G4 pre-installation guide for specific installation requirements.

**FP 5703/67  Alignment at 200 kV**

This alignment for high-end transmission electron microscopes ensures that the microscope is aligned in the factory at 200 kV. It is carried out on the full system configuration that has been selected by the customer. This alignment can be ordered in addition to FP 5703/72 (Alignment at 60 kV and 300 kV), FP 5703/62 (Alignment at 80 kV and 300 kV) and FP 5703/63 (Alignment at 120 kV and 300 kV).

**1174688  Remote Monitoring Station**

The Remote Monitoring Station allows operators to monitor the microscope performance from a remote location and perform basic microscope operations. The option contains both software and hardware, including the remote computer, a 24” LCD monitor, and two microscope panels (with trackball, knobs and buttons). The software is structured in such a way that only one operator (either local or remote) can operate the microscope panels at the time.

The connection between the remote computer and the microscope system is made through TCP/IP connections. Any firewalls on the route between the remote computer and microscope system need to be opened for a limited number of ports.

The intended use of this solution is monitoring and basic operation. This solution is not suitable for operations requiring high levels of interaction (e.g. alignments, stage movements) and/or streaming of data. For such 'real-time' operation of the microscope, other solutions are available.

The Remote Monitoring Station can be installed on all TEM systems.

**1161499  Ceta-D Camera 300 kV**

The Ceta-D camera is the latest Thermo Scientific CMOS camera. It has been optimized for low dose diffraction experiments such as Micro Electron Diffraction (MicroED) on dose sensitive materials (e.g. proteins, pharmaceutical molecules and organic materials). The camera is fully embedded in the Thermo Scientific architecture and can also be used for imaging.

For low-dose diffraction work, the optimized scintillator of Ceta-D provides two important advantages compared to standard Ceta:

- Peak detection is more sensitive: weak peaks that are a factor of 2 below the detection limit of a standard Ceta can still be detected
- Peak detection is more precise: DQE(0) is improved by a factor of 1.4, which allows more accurate determination of the intensities of strong peaks

**Specifications:**

- Sensor: 4,096 x 4,096, 14 μm pixel CMOS
- Camera architecture: Fiber optic coupled scintillator (1:1)
- Frame rate
  - Standard: 4k x 4k, 2 fps; 2k x 2k, 8 fps; 1k x 1k, 18 fps
Noise reduction: 4k × 4k, 2 fps; 2k × 2k, 6 fps; 1k × 1k, 6 fps
- Imaging performance in 4k × 4k mode:
  DQE @ 0.1 Nyquist > 26% @300 kV
- Duty cycle in movie mode: 100% in rolling shutter mode
- Conversion efficiency:
  >22 counts/primary electron @300 kV
- Mounting position: On-axis, bottom mounted, retractable

9432 909 96281  Compressor 115 V, 50 / 60 Hz
Silent, automatic Junair model 6X/MAXI compressor with start relay and capacitor, thermal protection and intake filter. Provides clean, oil-free and water-free compressed air at 6 Bar (max. 37 Liter/minute), with a noise level of 40 dB(A) at one meter.

Direct-drive 0.34 kW motor mounted on a 25-liter reservoir. Complete with manometer, control valve, pressure switch, air admittance valve and safety valve.
Dimensions 375 x 375 x 540 mm (l x w x h)
Weight 30.5 kg
Power consumption 0.34 kW

1148375  S2 Compliant Chiller (Water Enhanced)
The S2 Compliant Chiller (Water Enhanced) provides the necessary cooling water for Thermo Fisher Scientific Themis microscopes. The cooling unit transfers the heat generated by the system to the source of the condenser water. The heat transfer to the air in the room is negligible. The unit must be installed in an adjoining room. This is a SEMI S2 compliant chiller.

Dimensions (W x D x H):  26” x 34” x 34” or 66cm x 86cm x 86cm
Shipping weight: 152 kg
Manufacturer and model: Haskris, model LX3-W5-CAXXX3-3

1149153  Standard Krios CWAT for 2 Days
The standard Krios Customer Witnessed Acceptance Test (CWAT) for two days is carried out in the cleanroom of the Thermo Fisher Scientific factory in Eindhoven, The Netherlands. An Application Specialist will provide a general introduction to the common features of the Krios microscope, and demonstrate its performance by repeating a selection of standard factory acceptance tests “live” in the presence of the customer. In addition, an overnight data acquisition experiment on a standard, vitreous, frozen sample will be set up, executed and evaluated.

The table below outlines the default agenda of the two-day visit. Slight deviations from this agenda, depending on microscope configuration and/or customer experience level, are possible, and should be discussed prior to the CWAT. Microscope configuration-dependent tests are labelled as “Option” in the table. Tests labelled as “Standard” are always carried out. The Estimated Time is a rough indication of the time required for each agenda item.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Included</th>
<th>Estimated Time (min)</th>
</tr>
</thead>
</table>
| Day 1
Welcome and agenda review.                                              | Standard | 15                   |
Presentation of factory results (Blue Book).                             | Standard | 60                   |
General introduction to the microscope in the cleanroom.                 | Standard | 20                   |
Demonstration of basic microscope operation, including FluCam and Ceta detectors. | Standard | 30                   |
Falcon direct electron detector demonstration, including counting mode and dose fractionation. | Option   | 45                   |
Gatan BioQuantum demonstration, including counting mode and dose fractionation. | Option   | 45                   |
| Information Limit at zero tilt (carbon/gold cross grating specimen) | Standard | 60 |
| Eucentricity, including demonstration of field of view at -70° and +70° specimen tilt (carbon/gold cross grating specimen). | Standard | 45 |
| Thon Rings (Ptr sample). | Standard | 30 |
| Phase Plate operation, including demonstration of activation curve/phase shift development (carbon/gold cross grating specimen). | Option | 45 |
| Cassette loading and screening of several vitreous, frozen samples. | Standard | 30 |
| Set up of EPU or Batch Tomography data acquisition experiment with detector of choice,* start of overnight run (vitreous, frozen sample).** | Standard | 90 |

**Day 2**

| Review of overnight data acquisition results | Standard | 60 |
| Time reserved for postponed or unfinished tests | Standard | 180 |
| Wrap-up meeting: review test results and document any issues, customer sign-off, further planning | Standard | 60 |

* Choice of detector for overnight data acquisition depends on the system configuration and customer preference, which will be discussed prior to the CWAT.

** Phase Plate is not included in the standard EPU or Batch Tomography data acquisition experiment, as that would require extensive low-dose characterization of Phase Plate behavior, which does not fit in the 2-day program.

Notes:
- The Standard Krios CWAT for 2 days can only be ordered as part of a new Krios configuration and cannot be ordered for systems already installed in the field.
- All tests are carried out at 300 kV.
- The test procedures in the CWAT are conducted according to standard factory practice, using standard reference samples, test protocols and specifications.
- It is not possible to conduct customer-specified tests and/or use customer samples. Deviations from this standard program are only possible upon special request and must be ordered together with the microscope in the form of an approved non-standard request (NSR). For more details, please contact your Thermo Fisher Scientific representative.

**1091845 BioQuantum Embedding**

BioQuantum Embedding allows the BioQuantum to be operated from within Thermo Scientific (application) software. Summed images are transferred to the Thermo Scientific software for display and to enable automated procedures in application software (e.g. to enable cross correlation based autofocus and automatic hole finding procedures). Individual frames/dose fractions will be stored on/via the Gatan PC directly to ensure throughput. Functionality to operate the BioQuantum through Gatan’s GMS on the Gatan PC will also remain.

**1156792 K3-BioQuantum**

K3-BioQuantum is a post-column, Quantum-based (Gatan Quantum 1967) energy filter from Gatan with a K3 direct electron detection camera for low-dose, zero-loss filtered imaging (no EELS support).

Selected specifications for K3-BioQuantum (all valid at 200 and 300 kV)

- Slit width minimum (eV): 3.0
- Slit width maximum (eV): 100
- Distortion - RMS (%): < 0.25
- Distortion - Maximum (%): < 0.50
- Chromatic distortion – RMS (%): < 0.25
- Chromatic distortion – Maximum (%): < 0.50
- Non-isochromaticity – RMS (%): < 0.69
- Non-isochromaticity – Maximum (%): < 2.75

The K3-BioQuantum energy filter includes an accessory cabinet for the filter electronics. Note that this accessory cabinet is not an acoustic enclosure for the Gatan server.
K3-BioQuantum (1156792) on Krios requires the presence of “BioQuantum Embedding” (1091845)

Notes
- K3-BioQuantum will be aligned in the factory at 200 kV and 300 kV only.
- A pre-GIF system camera is required.
- K3-BioQuantum comes with a Gatan PC which is used for (temporary) data storage.
- This Thermo Fisher Scientific part number contains the following Gatan order codes: 1967.3k, and 1967.TFIELD.
- Filter-specific, on-site operator training is done by Gatan at the time of installation.

1156693 System Enclosure
The System Enclosure is a casing specially designed to dampen acoustic and temperature variations from the environment. It completely covers the microscope, including the base of the microscope, the column and the Field Emission Gun. It provides easy front door access for Cassette loading/unloading, and includes an On-Screen Display (OSD) near the specimen loading area for convenient access to system information and Cassette loading/unloading controls.

The System Enclosure with part number 1156693 is suitable for uncorrected Krios G4 microscopes.

4022 404 41218 Installation Labor Krios G4 NA
Standard Installation Labor coverage - see Terms and Conditions

4022 404 02218 Installation Material Krios G4
Standard Installation Material coverage - see Terms and Conditions

4022 404 43218 Warranty Labor Krios G4 NA
Standard Warranty Labor coverage - see Terms and Conditions

4022 404 04218 Warranty Material Krios G4
Standard Warranty Material coverage - see Terms and Conditions

1157630 Global Installation Kit TEM FEG
The Global Installation Kit TEM FEG is a uniform install kit for making the installation of all Thermo Scientific TEM's with an FEG electron source more efficient. It provides a standard set of gas fittings and a water filtration panel, allowing for a consistent and smooth installation process.

The kit contains SF₆ and N₂ regulators, gas fittings, an SF₆ leak detector, electrical connection adapters for all local markets, and a water filtration panel.

1094695 Deflector/Stigmator Unit
The Deflector/Stigmator unit is used to correct image and diffraction astigmatism. The unit also shifts the image or diffraction pattern back to the optical axis of the microscope. This option is installed below the objective lens. It is required when a Lorentz lens is not included in the configuration.

1167144 MED Application Package
The MicroED Application Package contains all components required to collect diffraction data on small, dose sensitive crystals: a modified beam stop, a special diffraction lens series with optimized camera lengths, optimized C2 and SA aperture sets, and MicroED data acquisition software (EPU-D). The software takes care of continuous stage tilting while acquiring the images in diffraction mode. Please note: - For optimal performance, it is highly recommended to order a Ceta-D camera in combination with the MicroED Application Package. - Server software versions 2.15 (Krios) or 1.15 (Glacios, Talos Arctica) or higher are required. Any required server software upgrade is not included in this special offering. - No training is included in this special offering, but it is recommended to add 2 days of application training separately. - Image processing software to calculate the 3D structure of the crystals from the diffraction data is not included in the package.
1148381 KVM Extender with EFTEM
The KVM Extender kit consists of a transmitter and receiver that enables connecting a remote PC to a configuration that includes BioQuantum energy filter at up to a distance of 300 meters through an optical fiber connection.

Notes:
For connecting to the remote and microscope PC the following local fiber infrastructure is required (but not part of this package):
- Multimode 50/125um OM3 multimode cable 2x LC duplex per PC extension.

1174279 Network Computer
The network computer is a second PC, which connects to the microscope controller with an Ethernet connection taking over the data management task from the microscope controller (which remains dedicated to microscope operation). The network computer enables the user to grow with the speed of computer peripheral innovations during the lifetime of the basic microscope system, without affecting the TEM Microscope Controller and endangering system uptime.

The configuration of the computer supports:
- A second Ethernet card to connect to the LAN or WWW is available. Local IT departments have access to the network computer for (external) network configuration purposes. Internal networking (to the microscope controller) remains the responsibility of Thermo Fisher Scientific
- The network computer may be loaded and/or upgraded with the user’s preferred anti-virus software, office-suite, printer drivers, email and Internet browser software

Specifications:
- Windows 10 operating system
- Includes one 24” Widescreen LCD monitor.

Thermo Fisher Scientific’s warranty and service responsibilities for the network computer are restricted to the delivered configuration, with service arrangements comparable to service arrangements offered by regular PC vendors.

1160703 Phase Plate Solution
The Phase Plate Solution consists of a Phase Plate and the complete infrastructure required to operate it. The Phase Plate induces a phase difference between the unscattered and scattered parts of the electron wave function, resulting in an improved in-focus phase contrast in the image plane. This improvement is particularly beneficial for the imaging of weak phase objects, such as frozen hydrated organic specimens.

The Phase Plate is positioned in a holder, which also contains two regular objective apertures of 70 and 100 μm, and is installed in the automated objective aperture mechanism. The part at the tip of this assembly, containing the Phase Plate, a heater, and the two apertures, is a consumable and can be re-ordered through the Thermo Fisher Scientific Service organization. Electronics and software are provided to set up and operate the Phase Plate under optimal conditions.

Specifications:
- Phase Plate film quality: at least five (5) windows (slots) are undamaged and clean
- During an automated Phase Plate activation measurement, the phase shift shall be between 0.2 and 0.8 pi radians after applying a 40 nC dose, and shall still be higher than 0.2 pi radians after applying a 80 nC dose.
- The Phase Plate consumable average lifetime is nine months under normal TEM operating conditions

This part number (1160703) is suitable for Krios G4.
1094703  X-FEG Unit 300 kV
The ultimate performance of a TEM and STEM system depends highly on the properties and characteristics of the electron source, the gun. High brightness, high temporal coherence as well as high spatial coherence are vital for ultra-high resolution performance. In STEM, high brightness is a mandatory requirement for ultimate results in atomic resolution imaging and analytical applications. In TEM, a higher spatial coherence results in an improved information transfer or higher resolving power in imaging and holography applications.

Typically, Cold FEG (CFEG) guns have been acknowledged as high-brightness sources, especially finding applications in (dedicated) STEM systems. However, at the same time, these sources typically suffer from instabilities, asymmetry in energy distribution and significantly reduced current when compared to standard Schottky FEG technology. These characteristics hamper ultimate performance in applications for (EF)TEM, for low energy loss spectroscopy and extended analytical mapping experiments.

In comparison to the standard Schottky-FEG, the X-FEG delivers a dramatically increased brightness, comparable to CFEG emission, but delivers a significantly higher total current, which ensures descent illumination intensities at midrange magnifications. The X-FEG supports the Thermo Fisher Scientific strategy to not compromise TEM or STEM performance but to maximize the performance of both modes of operation.

The unique X-FEG makes use of optimized Schottky field emission technology. The advantage of this technology is that the electron source is robust and reliable. The illumination current does not fluctuate over time (constant emission) and the emission tip does not require flashing or resetting.

Two easy to switch operation modes are provided to run the X-FEG in high current and high energy resolution mode depending on the application requirements.

FP 6345/56  3-Phase Transformer
The 15 kVA 3-phase transformer provides conversion of a large number of local mains voltages to the 3-phase 400 V input voltage for Titan systems. This 3-phase transformer features an input for emergency switch-off (EMO) and provides galvanic isolation between input and output. It is suitable for both 50 and 60 Hz and takes the following mains voltage inputs: 190 / 200 / 208 / 220 / 230 / 360 / 380 / 400 / 415 / 440 / 480 V.

SC04  Year(s) Standard Service Contract including NSR's
Year(s) Standard Service Contract including NSR's

1139909  Accelerate SPA TEM Life Science North America
The base Accelerate offering provides targeted support for users that are already familiar with Thermo Fisher Scientific technology. The services provided in this contract will be carried out by the North America support team. This one-year service agreement includes:
- Workflow validation using a real biological sample
- Fifty (50) hours of remote support that can be used at any time
- Ten (10) days of on-site application support that can be scheduled in blocks of one week minimum
- Regular monitoring of system health using a proprietary technology
- Quarterly Reviews to discuss system trends and status
- Access to the iOS Workflow Assistant App, including automatic updates and upgrades. The Workflow Assistant app runs on most Apple and Android devices.

4022 400 44291  DDP Eindhoven / Named place of destination; receiving dock in North America (T-9)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination In accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.
1152410  Site Preparation Support for To-Be Built Facility
As the specifications of high-performance microscopes ("Systems") are constantly being improved, the demands on
the location where the System is installed have become more critical. Environmental factors, such as, acoustics, floor
vibration and AC/DC electromagnetic interference (EMI) can have a negative impact on the overall System
performance. In order to meet the specifications of these high-performance Systems for optimal performance, the
environment in which the System is installed should be evaluated for such environmental factors whether it is an
existing facility or building a new one.

With Site Preparation Support for a To-be-Built Facility ("Green Field"), Thermo Fisher Scientific offers its experience
and expertise to provide guidance for your consideration and selection of the most suitable location for a new facility.
In addition, recommendations shall be provided which may optimize the new building for installation and performance
of the System.

More specifically, the service “Site Preparation Support for To-Be Built Facility” includes:
- Green field site survey and evaluation of both EMI and data in an open area, or in the operating facilities and
  buildings where a new room will be constructed
- Discussions with the customer's design team on System requirements with respect to the facility and other relevant
  information
- Review of architectural and construction drawings focused on System installation and performance requirements
  (Walls, HVAC, floor, Cabling and lighting)
- Inspections and survey measurements (up to three measurements) conducted in Green Field, and interim and
  final evaluation (room commissioning) of pre-installation environmental specifications for Noise, Vibration and EMI
  Criterion,
- Follow up support: A dedicated Project Leader shall be assigned to facilitate the communication and track specific
  information regarding guidance and considerations for the System installation for the room readiness project. This
  Project Leader shall be the primary point of contact for the service execution.
- Site Preparation CAD Drawing
- Report delivered with survey results and suggested recommendations

1084591  AutoGrid Container (20x) - Consumable
Set of twenty AutoGrid containers, including lids. Each container can store up to four AutoGrids in a vertical position.
The shape and size of the four parking positions are optimized for placing and picking up AutoGrids with AutoGrid
Tweezers (to be ordered separately). The outer diameter and shape of the container is compatible with all
conventional grid box handling systems.

1036171  C-Clip (100x) - Consumable
A set of 100 C-Clips

1036173  C-Clip Ring (100x) - Consumable
A set of 100 C-Clip Rings

1156683  System Column
System column and mandatory ancillary components required to drive column optics.

1046231  Inspect3D Xpress
Inspect3D Xpress comprises all hardware and software required for carrying out alignment of tomography data and
subsequent ultra-fast tomographic reconstruction of the resulting aligned tilt series.

Software
Inspect3D involves an x-y alignment, which can be based on either bead tracking or image cross-correlations. These
cross-correlations can be improved by a multitude of filter options. Fine-tuning of the tilt axis position can be carried
out interactively. Bead tracking traces multiple round particles on the specimen throughout the tilt series. Apart from
x-y alignment, bead tracking can also correct rotation and magnification changes for each image. Beads used for the
alignment can be removed from the data sets prior to reconstruction by means of a unique “bead cloaking” algorithm.
This prevents nasty streaking artifacts from gold beads in the reconstructed volume. By partly executing these algorithms on the GPU and by a minimum of user interaction, these alignment algorithms execute very efficiently and quickly.

Reconstruction of the tilt series into a 3D volume of arbitrary size can be carried out by two different algorithms: weighted back projection (WBP) and simultaneous iterative reconstruction technique (SIRT), which are both executed on the GPU.

Inspect3D also supports ‘Dual Axis Tomography’. In this case, two data sets of the same area are taken, but they are rotated in-plane by about 90 degree with respect to each other. Inspect3D then determines the transformation parameters between the two sets and adds them, either in Fourier space or in real space.

The resulting reconstructed volumes can directly be read into the software packages Amira or Avizo for further advanced visualization and analysis.

Please note that Inspect3D Xpress does not include Amira/Avizo.

Added Key features
- Inspect3D is scriptable through any COM aware language (e.g. JavaScript, MATLAB, and Python)
- GPU acceleration of e.g. cross correlation alignment step, general feature tracking, and reconstruction
- New user interface guides the user more seamlessly through the workflow
- Fully 64-bit: arbitrarily large data volumes can be handled

Hardware
Inspect3D Xpress includes a preconfigured PC, optimized for Inspect3D, which is equipped with a dedicated, high-end graphics card (GPU) and Microsoft Windows 8.1. A 23” widescreen monitor, keyboard and mouse are also included.

1115604 TEM Tomography 4.x Data Acquisition Software
TEM Tomography Data Acquisition Software provides a user-friendly and fast way for the acquisition of tilt series for three-dimensional (3D) reconstruction. In brief, a specimen is tilted along a single axis over a large angular range (typically +/- 70°) with small angular tilt increments (typically 1°), and an image is recorded at every tilt angle.

The software includes the possibility to generate a grid overview, providing an easy way to identify the regions of interest. Predefined acquisition parameters help with the navigation on the specimen across different magnification levels, and several auto-functions are provided (focus, eucentric height, drift). Tilt series can be acquired one by one, but regions of interest can also be stored for later, unattended, data acquisition, also known as “Batch Tomography”.

Setting up tomography data acquisition in low-dose mode, by defining separate focus, tracking, and exposure positions for each tilt angle, can be done intuitively by placing areas onto an overview image.

Several features are available to minimize the lateral shifts and focus changes between the subsequent images of the acquired tilt series. First of all, the software automatically determines the position of the mechanical tilt axis and then aligns the microscope to center it in the field of view. Additional features are:
- Holder calibration (storing and compensating for reproducible specimen movements as a function of tilt angle)
- Tracking after (correction on the basis of the latest acquired image)
- Tracking before (acquiring an intermediate image and correcting for the movement before the real image is acquired)
- Automatic focusing

The tomography acquisition parameters can be tuned to the specific instrument type, specimen holder, specimen type (flat or rod-shaped), and application requirements.
Reconstruction and visualization SW, Inspect 3D and Amira/Avizo are not included in the package and can be purchased separately.

System requirements:
- Microscope manufactured in 2004 or later
- Latest released microscope platform software version
- A Thermo Fisher Scientific-embedded camera or fully embedded energy filter
- Tomography approved holder: Tomography Holder FP 5341/00, Tomography Holder (High Field-of-View) 9432 909 97191, Talos Arctica or Titan Krios
- Magnification Calibration Package FP 5458/50

9425 060 99100  On-site Applications Training - Americas (1 day)
On-site applications training, per day, including all travel and expenses. For customers located in the Americas. Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3) consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not ordered as part of a microscope purchase).

1060156  Amira for EM Systems (Life Sciences) - Floating, 1-user License
Amira for EM Systems is a software package for advanced visualization and analysis of reconstructed tomography data, acquired using electron and correlative microscopy systems. Amira for EM Systems consists of the base Amira package, augmented with various additional packages. A license is included for 1 (one) concurrent user on a local network (LAN) and includes 12 (twelve) months of maintenance service (hotline and product upgrades).

Amira is a software package for rapid exploration and analysis of 3D-image data, as well as for generation of numerical 3D models for advanced analysis and simulation. Amira for EM Systems is a tailored version of the Amira software, solely distributed by Thermo Fisher Scientific, currently published by Thermo Fisher Scientific's Visualization Sciences Group; more information can be found at www.amira.com.

Amira for EM Systems includes dedicated data import filters for loading EM data obtained from Thermo Scientific instruments into the software. The software also supports image to image alignment with pixel accuracy. Visualization modules include orthographic and oblique sections, efficient surface, mesh and volume rendering, iso-surfacing and iso-lines, simultaneous display of multiple datasets, virtual 3D navigation, movie clip generation, animation generation tools, and more. Thanks to the embedded ‘Very Large Data’ module, Amira for EM Systems can display even very large datasets (up to hundreds of GB) at interactive speed on regular desktop or laptop computers.

Amira for EM Systems supports a variety of semi-automatic and interactive tools for segmentation, providing the ability to construct 3D models of structures present in the image data, and defining complex regions of interest for analysis purposes. It comes with numerous tools for data analysis, including data probing, measurement of distances, regions, and volumes, and statistical analysis tools on multiple regions of interest. Amira for EM Systems also provides unique specific tools for cryo electron microscopy segmentation workflows such as microtubule/actin detection.

Amira for EM Systems offers support for presentations, by providing the capability of making snapshots, exporting movie files and single images, as well as 3D representations by exploiting advanced stereoscopic display technology.

The Amira for EM Systems provides a comprehensive digital lab for advanced 2D and 3D life sciences data analysis, especially aimed at scientists and researchers in cellular or structural biology, who want to get more insight in complex data and systems.

The license for Amira for EM Systems includes one year of Maintenance Service (which features on-line help via the World Wide Web and free-of-charge updates, both for the duration of one year). Upgrades and/or updates to Amira for EM Systems after the initial year of Maintenance Service will require the payment of software maintenance fees. The Maintenance Service for Amira for EM Systems (including help, updates, and ongoing software maintenance)
will be provided directly by Thermo Fisher Scientific Visualization Sciences Group. Details and Terms & Conditions of the Amira Maintenance Service can be found on the Thermo Fisher Scientific website.

The warranty period for Amira is started six months after the software is shipped from the Visualization Sciences Group, which might result in a reduced warranty period on-site, in case of long microscope installation times.

Amira software yearly maintenance service is not part of the Thermo Fisher Scientific system support service. Thermo Scientific system customers will receive a separate maintenance renewal offer for the Amira software.

**Platform requirements**

- Amira for EM Systems runs on:
  - Microsoft Windows 64-bit
  - Linux x86_64 (64-bit)
  - Mac OS X (64-bit)
- A 2 GHz minimum CPU processor is required. Multi-core CPUs recommended. 16 GB RAM minimum is required; 32 GB recommended
- A graphic board which supports a complete implementation of OpenGL is required. Recent graphic board supporting OpenGL 3D texturing and programmable shaders is recommended
- A CUDA-enabled graphic board (list on [https://developer.nvidia.com/cuda-gpus](https://developer.nvidia.com/cuda-gpus)) is a plus, especially to benefit from the Amira’s GPU-accelerated algorithms

For detailed information on supported and recommended hardware and operating systems for Amira for EM Systems please read the Amira-Avizo System Requirements on the Thermo Fisher Scientific website.

**Riggers for Inside Delivery**

Riggers for Inside Delivery. $18,000.00 is an estimate of rigging costs. A more accurate cost will be obtained when the rigging company is allowed onsite to assess the delivery pathways, equipment necessary for movement, manpower necessary for movement, and room dimensions for delivery. If, after assessment, the costs are greater than $18,000.00, the customer will be required to reissue their PO to cover additional costs. If the costs are less than $18,000.00, Thermo Fisher Scientific will credit back the difference. Actual costs are not known until the work is finished and Thermo Fisher Scientific receives an invoice from the rigging company.
Phenom Pro QUOTATION for
University of Missouri

Attn. Tommi White, Ph.D.

Quote Date: March 06, 2020
Quote Number: QUO-119187-T2S8 R0
Expires: June 26, 2020

Prepared By
Ciceron Yanez, Sr Account Manager
ciceron.yanez@thermofisher.com
Solution Description

4022 400 44341  DDP Brno / Named place of destination; receiving dock in North America (Upgrade T-14)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination In accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

1198267   Generic - Phenom ProX bundle with accessories -PW-230-002 +PW-100-517+PW-600-002
Price includes the Phenom ProX (G5) and all standard peripherals, including a standard 19” monitor. Including fully integrated energy-dispersive X-ray spectroscopy (EDS) for elemental analysis of samples. Price includes ProSuite, pre vacuum pump, power supply, one standard sample holder (manual height adjustable) and one Sample Preparation Starter Kit. Magnification range: 20 – 150,000x. Acceleration voltages: adjustable range from 4.8kV to 15kV, with presets at 5kV, 10 kV and 15kV. Upgradable with 20kV, SE Detector.
Elemental Mapping & Line Scan is (optional) part of the Elemental Identification software and can be enabled by entering an activation code.
Charge reduction holder for 3.5mm pin stubs (not required for Phenom Pharos).
VolumeScope QUOTATION for
University of Missouri

Attn. Tommi White, Ph.D.

Quote Date: March 05, 2020
Quote Number: QUO-117817-R1N8 R0
Expires: June 26, 2020

Prepared By Ciceron Yanez, Sr Account Manager
ciceron.yanez@thermofisher.com
Solution Description

1201485  VolumeScope
VolumeScope is a Serial Block-face Imaging (SBFI) solution for automated acquisition of large volumes, fully integrated with Thermo Fisher Scientific's latest high-performance SEM platform.

The key enabling technologies, hardware and software, are integrated into a single platform and are comprised of:

- Novel Field Emission Electron Optics optimized for both high resolution and exceptional contrast with the Trinity detection system, meeting all imaging needs at low beam currents.
- Fully integrated, compact, stage-mounted ultra-microtome for in-situ sectioning.
- Single integrating software interface, MAPS, enables direct correlation of images from any light microscope covering large volumes with automated multi-tile set runs followed by stitching.

Features and specifications:

Vacuum:
VolumeScope uses an entirely oil-free vacuum system, featuring:
- 1x 240 l/s turbomolecular drag pump
- 1x Scroll pumps
- 2x Ion Getter Pumps
- Integrated battery backup for IGPs on the electron column, a FEG safety mechanism (for recoverability after an unplanned power outage)
- Auto bake-out and Auto-start enable fast and easy maintenance of the FEG source
- Low vacuum mode up to 500 Pa for charge compensation of non-conductive samples, 50 Pa available in SBFI use case

Sample Navigation:
VolumeScope is standardly equipped with a 5-axes, motorized x-y-z-tilt-rotate stage, providing movements:
- X and Y range: 110 mm (motorized); Z range: 65 mm (motorized)
- Tilt: -15 to +90 degrees (motorized)
- Eucentric tilt
- A unique standard specimen holder with labeled positions and unique stage mounting, allowing simultaneous loading of 18 standard samples (Ø 12 mm), three 45° pre-tilted samples, two row bars (vertical, and 52° pre-tilted), and a spring-loaded clamp holder for mounting cross-sections.

A selection of additional sample holder kits is optionally available (including stub holders, additional TEM sample holders and vise specimen holders).

Joystick stage control is available as an option.

Stage control software includes standard facilities for:
- Store and recall of sample position
- Double-click-to-center and drag-to-zoom feature select functions
- Multi-directional stage drive
- Compucentric rotation
- Compucentric tilt
- Image feature alignment to horizontal or vertical
- Navigation on image and navigation montage is supported with “Click-to-center” and “Drag-to-Zoom” functions
- External image import and registration for correlation.

Intuitive, photo-based sample navigation is provided by the Nav-Cam™. The Nav-Cam is a color optical camera, mounted directly to the chamber for acquiring an image of samples mounted on the specimen stage. Fully integrated in the user interface, the Nav-Cam allows for quick point-and-click navigation to the region of interest. Nav-Cam features:
- Automatic image acquisition with sample lighting
- 160 x 105 mm field of view
- 3072 x 2048 pixels or approximately 6 megapixels
- Digital zoom
- Image annotation
- Image save

In-situ Ultramicrotome for SBFI
- Compact, stage-mounted microtome, allowing for easy exchange by the customer for simple switch between normal SEM use and SBFI
- Cutting speed range 0.1 – 1.2 mm/s, typical 0.5 – 1 mm/s
- Diamond knife
- Knife travel distance 1.2 mm
- Sample size 600 µm x 600 µm

Electron Optics
VolumeScope features a pre-aligned electron optical column, which is optimized for high resolution and for beam stability. The main elements of the electron optical system are:

Source: Field emission gun assembly with Schottky emitter source. The assembly is optimized for high brightness at low currents, providing low-noise imaging with minimal sample charging. The pre-alignment of the FEG ensures no mechanical alignment is required. Easy gun installation and maintenance is provided with Auto bake-out and Auto Start capabilities.

Final Lens: Dual Objective combining field-free magnetic and electrostatic lenses, that can be extended to a triple-mode compound electrostatic-magnetic final lens by the optional Immersion Lens. The pole piece has a 60° design.

Beam deceleration: Can be activated for getting higher surface sensitivity and contrast using low and very low landing energies. Beam deceleration is implemented as an additional degree of freedom to optimize contrast and surface sensitivity while improving the optical performance of the electron column

Voltage range: 200 eV to 30 keV (20 eV landing energy with optional Beam Deceleration)
Beam Current: 1 pA to 400 nA
Resolution (optimal working distance):

0.8 nm at 30 kV (STEM)
1.0 nm at 15 kV
1.3 nm at 1 kV

With optional Immersion Lens
0.8 nm at 15 kV
1.0 nm at 1 kV

With optional Immersion Lens, beam deceleration on and optional T3 detector
0.8 nm at 1 kV
0.9 nm at 500 V
1.8 nm at 100 V

Low vacuum imaging, field-free mode
1.2 nm at 15 kV
1.8 nm at 3 kV
Scanning system

High-resolution digital scanning engine controlled from the User Interface.
- Pixel density 768 x 512, 1536 x 1024, 3072 x 2048, 6144 x 4096, selectable
- Minimum dwell time 25 ns/pixel; maximum 25 ms/pixel
- Electronic scan rotation by n x 360 degrees

Detection

VolumeScope features a high-vacuum secondary electron detector (Everhart-Thornley SED) and low-vacuum SED (LVD), optimized for use across the available kV, current and pressure range. The Trinity detection system is comprised of a segmented, lower in-lens detector (T1), an upper in-lens detector (T2) and an optional in-column detector (T3). VolumeScope also includes a dedicated Low Vacuum secondary electron detector (VS-DBS) to provide charge-free topographic contrast imaging of non-conductive samples. An integrated IR-CCD camera is standard for in-chamber viewing and the Nav-Cam color optical camera is used to take top-down images of samples for navigation. Optionally available are a retractable Directional Backscatter (DBS) detector and a STEM detector for imaging thin sections, powders or FIB-prepared specimen.

Imaging

Images are displayed in an area of 1536 x 1024 pixels, configurable for either single-frame or four-view display. Images can be viewed live, averaged or integrated. VolumeScope fully supports the Thermo Scientific SmartSCAN™ advanced scanning strategies which allow line averaging and interlaced scanning in addition to Drift Corrected Frame Integration (DCFI). Still images can be saved in TIFF, BMP, JPEG file formats, and in 8-bit, 16-bit or 24-bit depth, to the hard disk or LAN from the graphical user interface. Image printing is also available from the user interface. In addition, the system supports recording of AVI movies. This can either be done on the fly or by capturing a series of TIFF images at user-specified intervals. These TIFF images can then be combined into AVI’s by using the included proprietary Thermo Scientific movie creator software.

The software includes a 4-view mode, in which the displays can be used for live display of electron images (SE, BSE), mixing of signals and display of the image of the standard infrared (IR-CCD) camera.

Look-up tables allow image contrast, brightness or gamma to be enhanced. Flexible databar selection is also provided. User-definition of preferred imaging parameter sets is available. Imaging parameters are stored in the TIFF image file as private data. Finally, image measurements and annotations can be performed live on the image and the results can be stored together with the images.

MAPS- Modular Automated Processing System

Single integrating software interface, MAPS, enables large volume coverage with automated multi-tile set runs. It enables:
- Identification of regions of interest by correlative light and electron microscopy (CLEM) approaches. Image correlation from different imaging modalities, in particular light microscopy techniques.
- Automated recording of a series of tiled images followed by stitching for large area acquisitions
- Individual tile image size up to 8k x 8k
- Final stitched images may be exported in Microsoft’s HD View image pyramid for easy pan and zoom over the entire field of view

System control

VolumeScope is controlled from an MS-Windows 7 graphical user interface running at a 1920 x 1200 screen resolution. The PC workstation is based on an Intel Xeon W3520 Processor (2.66 GHz 8 MB cache), 12 GB system memory, one 500 GB hard drive, one 16x DVD+/-RW drive, integrated FireWire and USB ports and a 1 Gb LAN network card (computer specifications subject to change). The system includes two 24” LCD monitors, WUXGA 1920 x 1200, keyboard, optical mouse and a height-adjustable office desk. A USB manual user interface (for controlling magnification, contrast/brightness, beam shift and stigmators) and/or a Joystick (for control of stage movement) is optionally available.
Optionally, an Advanced Support computer may be used for connectivity to a LAN and for additional PC-based functionality such as MS-Office software suite, firewall, anti-virus and other non-instrument software.

**RAPID**
This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website.

**Warranty and Training**
- One (1) year warranty
- Choice of service maintenance contracts
- Choice of operation/application training contracts

**Consumables (Partial List)**
- Replacement Schottky electron source module, diamond knife (Diatome)

**Installation requirements**
See VolumeScope pre-installation guide

**1129199 ThruSight Multi-energy DCV**
The integration of ThruSight, Thermo Fisher Scientific’s proprietary multi-energy deconvolution method, allows for virtual slicing of isotropic 3D data sets without removing sample material. An isotropic resolution of 10 x 10 x 10 nm can be achieved. In combination with physical slicing, the final axial resolution is independent of the physical slice thickness. Push-button, automatic functionality for coordinate selection and image acquisition provides automated 3D volume imaging. Achieve 3D imaging of large volumes readily when used in conjunction with a physical slicing method.

**1133682 Maps 3 for SEM/SDB with Correlative Workflow**
Thermo Scientific Maps is the system automation and correlative microscopy software suite for SEM and DualBeam systems. Maps provides automated acquisition of image mosaics via easy set up and offers complete control on location, resolution and imaging parameters. Maps makes it easy to set up multiple mosaic acquisitions on a single sample, or on multiple samples loaded in the chamber. Maps also makes it easy to re-align and collect data over multiple imaging sessions.

**Specifications:**
- The maximum pixel resolution is 40k x 40k per tile (depends on microscope type).
- Maps corrects for non-linear stage behavior to increase navigation accuracy.
- Maps supports batch acquisition, allowing the user to schedule acquisition of multiple areas in one job, saving supervised time.
- Microscope real-time stitching of tiled images can be carried out concurrent with image acquisition.
- Export of stitched tile sets or user defined areas to TIFF or HD View compatible formats.
- Maps image data can be saved in RAW formator TIFF format.

**Maps Correlative Workflow**
Maps Correlative Workflow serves as a powerful addition to the Maps correlative microscopy suite. Users can input images from any source via a wide range of standard image formats. Maps provides guided workflows to import, align and visualize all sample imagery. Users have control over visualized layers, transparency of each layer and native histogram controls for SEM images. Users can also easily share results using the optional offline
version. Annotations including text, linear and angular measurements can be made by multiple users and shared in a single project for a collaborative interpretation experience.

**Key Features:**
- Import of 2D images of any common image file format
- Import of 3D data in the form of 3D Tiff format
- Import of Leica CLEM data format including all overviews and local zStacks
- Guided Correlation Workflow
- Image layer controls

**1133684  Maps 3 Offline with Correlative Workflow**
Maps 3 Offline with Correlative Workflow is intended for running on dedicated image processing computers. The offline version of Maps 3 with Correlative Workflow requires at least 4 GB of RAM memory and can be connected to multiple Maps.

**9432 909 96411  Compressor 120 V, 60 Hz with 4-liter Tank**
The compressor is required when compressed air of 6 atm. is not available; compressed air is required for operating pneumatic valves and the microscope’s leveling system. The compressor is connected to the mains supply unit of the microscope.

**1092273  Directional, Lens-mounted GAD**
The Directional, Lens-mounted Gaseous Analytical Detector (GAD) is an ultra-sensitive, Solid-State (SS) detector which is sensitive to emitted electrons from 500 V onwards. Using Beam Deceleration (sample bias to reduce the landing energy), images with beam landing energies down to 20 V are possible. The detector contains a conical aperture with a diameter of 500 µm which is designed for low vacuum imaging. It allows a low vacuum mode of up to 500 Pa. The detector features four concentric ring segments that enable separate detection of electrons emitted at different angles. All four segments may be acquired simultaneously and mixing based on adding / subtracting individual segments is possible. This way it is possible to select multiple contrasts (material and topographical) that can be optimized per application. This detector is mounted manually on the lower pole piece by the user and allows simultaneous EDS spectra acquisition for WD ≥ 10 mm.

This Gaseous Analytical Detector is available for Apreo and VolumeScope. It requires the presence of the Solid-State Detector Integration Kit (1077075)

**1113152  Retractable DBS**
The Directional Back-scattered (DBS) detector is an ultra-sensitive, Solid State (SS) detector which is sensitive to emitted electrons from 500 V onwards. Using beam deceleration (sample bias to reduce the landing energy), images with beam landing energies down to 20 V are possible.

The retractable DBS detector features a flexible segmentation: either concentric (CBS mode) or in angular sectors (ABS mode). The active segmentation (CBS/ABS) is selected in the user interface.

In the concentric ring segmentation mode (CBS), separate detection of electrons emitted at different take-off angles is enabled. There are four concentric segments that may be acquired simultaneously and mixing based on adding / subtracting individual segments is possible. This way it is possible to select multiple contrasts (material and topographical) that can be optimized per application.

The second segmentation (ABS) offers three outer sectors plus a concentric central element. These three outer sectors are used to highlight topographical features through shadowing, while the inner concentric segment maintains pure materials contrast. As in the CBS mode, simultaneous acquisition as well as mixing is possible.

This detector is mounted on a software-controlled retractable arm and allows simultaneous EDS spectra acquisition for WD ≥ 10 mm.
This Retractable DBS detector (1113152) is available for Apreo and VolumeScope. It requires the presence of the Solid-State Detector Integration Kit (1120429) and Advanced Signal Selection (1050312).

1091077  Retractable STEM 3+ Detector
The Retractable STEM 3+ Detector enables scanning transmission imaging in bright-field, dark-field and high-angle dark-field modes. This STEM 3+ detector has eleven individual channels: a bright-field segment, four concentric dark-field segments, and six high-angle, dark-field (HADF) segments. With the Retractable STEM 3+ Detector there is no need to vent the chamber for inserting or removing the detector. The detector includes a row holder that can hold up to six TEM grids and that is compatible with the standard system holder. It also includes the load base.

This Retractable STEM 3+ Detector is suitable for Apreo and VolumeScope. It requires the presence of the Solid-State Detector Integration Kit (1077075) and Advanced Signal Selection (1050312). With support of signals from up to twelve channels, it is possible to sum the available signals from the bright-field segment, selectable dark-fields and selectable high-angle, annular dark-fields segments.

1120429  Solid-state Detector Integration Kit
The Solid-state Detector Integration Kit is required to enable interfacing with one or more solid-state detectors such as the STEM, DBS and GAD detectors. It allows having all three solid-state detectors connected simultaneously and provides support for up to twelve signal channels. This allows access to all solid-state detector segments.

1213454  T3 Detector
The T3 detector is a scintillation-based in-column detector which is especially suited for low-kV, low-energy, secondary electron detection giving advanced surface sensitivity.

4022 404 41211  Installation Labor VolumeScope NA
Standard Installation Labor coverage - see Terms and Conditions

4022 404 02211  Installation Material VolumeScope
Standard Installation Material coverage - see Terms and Conditions

4022 404 43211  Warranty Labor VolumeScope NA
Standard Warranty Labor coverage - see Terms and Conditions

4022 404 04211  Warranty Material VolumeScope
Standard Warranty Material coverage - see Terms and Conditions

9425 061 69515  NA Installation Kit for Quanta (3D) FEG / Nova NanoSEM / Verios / Versa 3D / Scios / Teneo
Part Number  Qty  SSD Supplied items
25066      1  External 10-inch water filter kit
1001224    1  Specimen stubs (20)
1020166    2  NIPPLE,SS,3/8BSPP-NPT
1020167    2  BARB,BRASS,3/8NPT
1021406    1  Water Damper
4022 297 06181  5  8 mm Poly Tubing
4035 273 22521  1  Power strip, 6 out 220 IEC type
4035 273 43491  1  Chloramine-T algaecide (250 gram jar)
9425 061 69458  1  Auto Transformer 208 V to 228 V 7 KVA
9425 061 69549  1  10 pack DVD+R x 10 - 4.7 GB Disks
9425 061 69585  2  50 ft. each - 3/8 inch Air Hose
9425 061 69586  8  Hose Clamps, Size 08
9425 061 69587  2  Brass Reducer ½"NPT – 3/8"NPT,
9425 061 69588  2  Brass Hose Barb 3/8" NPT to 3/8" Hose
9425 061 69589  1  20 A, 250 V Twist Lock Plug, Hubbell
9425 061 69590  2  ½" KO Cable Clamp, Thomas & Betts
9425 061 69617 4  IEC Power cords, 6 ft.

Choose a Chiller Type – air or water cooled
9425 031 90501 1  Haskris RO33 Air Cooled Water Chiller
OR
9425 031 90511 1  Haskris RO33 Water Cooled Water Chiller

1130957  Advanced Support Computer

The support computer enables the user to grow with the speed of computer peripheral innovations during the lifetime of the system, without affecting the microscope controller and endangering system uptime. The support computer is a second computer, which connects to the microscope controller with an Ethernet connection taking over the data management task from the microscope controller (which remains dedicated to microscope operation).

The Advanced Support Computer can be used for calculations on GPU because it is equipped with an nVidia graphical card which allows running CUDA code. It also supports two (2) powerful graphical cards running in parallel e.g. for advanced 3D visualizations in Amira software on the first graphical card and processing using GPU on the second graphical card.

The sample data management solutions enabled by the Advanced Support Computer are:
- It is possible to use the support computer for hosting 3rd-party software/hardware that is not part of the microscope or for gaining performance for the microscope controller.
- The support computer has a video adapter to connect two monitors for having multiple applications visible that makes it easier to work with.
- The Support Computer has a second Ethernet card to connect to the LAN or WWW. Local IT departments have access to the support computer for (external) network configuration purposes. Internal networking (to the microscope controller) remains the responsibility of Thermo Fisher Scientific.
- The Support Computer is equipped with a DVD+/R/RW (including software).
- The Support Computer may be loaded and/or upgraded with the user’s preferred anti-virus software, office-suite, printer drivers, email and Internet browser software.
- The Support Computer is delivered with a 24” widescreen LCD monitor and a software-controlled switchbox; this enables controlling the microscope controller and support computer by only one mouse and one keyboard. Switching between computers and monitors is fully controlled by the switchbox software.

Additional features of the Advanced Support computer are:
- Equipped with the Microsoft Windows 7 operating system
- 64 GB RAM, 3.50 GHz Intel Xeon E5-1620 4C processor or higher
- Powerful graphic card nVidia TRX 2070 or higher
- The hard disk of the support computer has 2x 1 TB 7200 rpm HDD SATA or higher storage capacity
- Standard Midi-tower model

Thermo Fisher Scientific’s warranty and service responsibilities for the support computer are restricted to the delivered configuration, with service arrangements comparable to service arrangements offered by regular computer vendors.

1120471  Manual User Interface

Manual User Interface (MUI) is a supplementary control console providing direct manual control of microscope parameters such as focus, magnification, contrast, brightness, beam shift and stigmator.

1130961  NAS Data Storage Extended

NAS Data Storage Extended offers 96 TB of raw, external disk space, allowing large-volume datasets to be stored and accessed easily from the microscope computer or via a local Ethernet network (1 Gb/s). Please note, that NAS Data Storage Extended (1130961) cannot be combined with NAS Data Storage Basic (1213452).
1214207  **Remote Control / Imaging**
Remote Control / Imaging is a Remote Control package that enables full control of the microscope via another
computer across a network. The imaging transfer speed and the remote system responsiveness is determined by the
speed and quality of the network connection. 100 Mbps LAN connection is sufficient for most use cases.

The Remote Control / Imaging package contains a perpetual license for the Radmin Remote Control software, which
is compatible with all Windows OS versions available on the Microscope and Support computers.

1094684  **Triple Monitor Stand**
Sturdy, high quality, ergonomic stand for holding three 24” LCD monitors. The adjustable design allows the operator
to position the monitors at eye level, improving the ergonomics of the workspace.

This item (1094684) is mandatory when an additional 24” LCD monitor (1016773) is selected.

**FP 3550/90 Uninterruptible Power Supply 230 V**
The Uninterruptible Power Supply (UPS) will eliminate problems to the SEM, Small DualBeam (SDB) and V600/V400
Series of instruments caused by short power grid interruptions. For longer power outages (more than a few minutes,
user adjustable) the UPS will switch the instrument to a power saving mode. When the UPS batteries are almost
empty it will initiate a graceful shutdown of the system.

The autonomy time for the UPS batteries depends on the configuration of the system and the user adjustable time
between the start of the power outage and the start of the power saving mode.

UPS characteristics:
- Model = LanPro LP8-11U
- Rating = 8 kVA / 6.4 kW
- Typical backup time of core instrument (i.e. at ca. 27% load) = 60 min.
- Input voltage = 172 - 285 Vac
- Input frequency = 40 - 70 Hz
- Output voltage = 230 Vac
- Output frequency = 50 / 60 Hz.

**SC01 Year(s) Standard Service Contract**
Year(s) Standard Service Contract

**4022 400 44231 DDP Brno / Named place of destination; receiving dock in North America (T-3)**
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled
when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also
responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to
the Buyer at the moment the goods have been delivered to the named destination In accordance with Thermo Fisher
Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price
indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

**9425 060 99100 On-site Applications Training - Americas (1 day)**
On-site applications training, per day, including all travel and expenses. For customers located in the Americas.
Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3)
consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled
within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not
ordered as part of a microscope purchase).

**1060158 Amira for EM Systems (Life Sciences) - Floating, 2-users License**
Amira for EM Systems is a software package for advanced visualization and analysis of reconstructed tomography
data, acquired using electron and correlative microscopy systems. Amira for EM Systems consists of the base Amira
package, augmented with various additional packages. A license is included for 2 (two) concurrent users on a local network (LAN) and includes 12 (twelve) months of maintenance service (hotline and product upgrades).

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Amira for EM Systems offers support for presentations, by providing the capability of making snapshots, exporting movie files and single images, as well as 3D representations by exploiting advanced stereoscopic display technology.

The Amira for EM Systems provides a comprehensive digital lab for advanced 2D and 3D life sciences data analysis, especially aimed at scientists and researchers in cellular or structural biology, who want to get more insight in complex data and systems.

The license for Amira for EM Systems includes one year of Maintenance Service (which features on-line help via the World Wide Web and free-of-charge updates, both for the duration of one year). Upgrades and/or updates to Amira for EM Systems after the initial year of Maintenance Service will require the payment of software maintenance fees. The Maintenance Service for Amira for EM Systems (including help, updates, and ongoing software maintenance) will be provided directly by Thermo Fisher Scientific Visualization Sciences Group. Details and Terms & Conditions of the Amira Maintenance Service can be found on the Thermo Fisher Scientific website.

The warranty period for Amira is started six months after the software is shipped from the Visualization Sciences Group, which might result in a reduced warranty period on-site, in case of long microscope installation times.

Amira software yearly maintenance service is not part of the Thermo Fisher Scientific system support service. Thermo Scientific system customers will receive a separate maintenance renewal offer for the Amira software.

Platform requirements
- Amira for EM Systems runs on:
  o Microsoft Windows 64-bit
  o Linux x86_64 (64-bit)
  o Mac OS X (64-bit)
- A 2 GHz minimum CPU processor is required. Multi-core CPUs recommended. 16 GB RAM minimum is required; 32 GB recommended
- A graphic board which supports a complete implementation of OpenGL is required. Recent graphic board supporting OpenGL 3D texturing and programmable shaders is recommended
- A CUDA-enabled graphic board (list on https://developer.nvidia.com/cuda-gpus) is a plus, especially to benefit from the Amira’s GPU-accelerated algorithms
For detailed information on supported and recommended hardware and operating systems for Amira for EM Systems please read the [Amira-Avizo System Requirements](#) on the Thermo Fisher Scientific website.

**1129197 Visualization Upgrade Kit**
The Visualization Upgrade Kit is required to enable full functionality of Amira visualization software. This option requires Advanced Support Computer (1130957) onto which it should be installed.
Apreo C HiVac FESEM

QUOTATION for
University of Missouri - St. Louis Campus

Attn: Prof. Keith Stine

Quote Date: March 02, 2020
Quote Number: QUO-113307-R0R5 R0
Expires: June 26, 2020

Prepared By Jim Smith, Sr Account Manager
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Mobile: +1 260.579.1302
jim.smith@thermofisher.com
Solution Description

1091065  Apreo C HiVac
Apreo C HiVac is a Schottky Field Emission Scanning Electron Microscope (FESEM) that combines high- and low-voltage ultra-high resolution capabilities with an electrostatic lens design. The instrument features beam deceleration and unique in-lens detection offering unprecedented contrast and versatility to researchers working with a variety of materials and devices.

The key enabling technologies are all integrated onto a single platform and comprise:

- Novel Field Emission Electron Optics optimized for both high current and high resolution meeting all imaging and analysis needs
- Trinity detection system for fast imaging, and easy collection of all available signals
- High-precision specimen goniometer with 110 mm travel along the x and y axes
- A Windows 7, 4-view “Beam per View” User Interface with User Guidance
- System architecture is optimized for automation, which is optionally available (e.g. MAPSTM)

Features and specifications:

Vacuum
Apreo C HiVac uses an entirely oil-free vacuum system, featuring:

- 1x 240 l/s turbomolecular drag pump
- 1x Scroll pumps
- 2x Ion Getter Pumps
- Integrated battery backup for IGPs on the electron column, a FEG safety mechanism (for recoverability after an unplanned power outage)
- Auto bake-out and Auto-start enable fast and easy maintenance of the FEG source

Sample Navigation
Apreo C HiVac is standardly equipped with a 5-axes motorized x-y-z-tilt-rotate stage, providing movements:

- X and Y range: 110 mm (motorized); Z range: 65 mm (motorized)
- Tilt: -15 to +90 degrees (motorized)
- Eucentric tilt
- A unique standard specimen holder with labeled positions and unique stage mounting, allowing simultaneous loading of 18 standard samples (Ø 12 mm), three 45˚ pre-tilted samples, two row bars (vertical, and 52˚ pre-tilted), and a spring-loaded clamp holder for mounting cross-sections.

A selection of additional sample holder kits is optionally available (including stub holders, additional TEM sample holders and vise specimen holders).

Joystick stage control is available as an option.

Stage control software includes standard facilities for:

- Store and recall of sample position
- Double-click-to-center and drag-to-zoom feature select functions
- Multi-directional stage drive
- Compucentric rotation
- Compucentric tilt
- Image feature alignment to horizontal or vertical
- Navigation on image and navigation montage is supported with “Click-to-center” and “Drag-to-Zoom” functions
- External image import and registration for correlation.

Intuitive, photo-based sample navigation is provided by the Nav-Cam™. The Nav-Cam is a color optical camera, mounted directly to the chamber for acquiring an image of samples mounted on the specimen stage. Fully integrated in the user interface, the Nav-Cam allows for quick point-and-click navigation to the region of interest.

Nav-Cam features:
- Automatic image acquisition with sample lighting
- 160 x 105 mm field of view
- 3072 x 2048 pixels or approximately 6 megapixels
- Digital zoom
- Image annotation
- Image save

**Electron Optics**

Apreo C HiVac features a pre-aligned electron optical column, which is optimized for high resolution and for beam stability. The main elements of the electron optical system are:

**Source:** Field emission gun assembly with Schottky emitter source. The assembly is optimized for high brightness/high current, providing low-noise imaging. The pre-alignment of the FEG ensures no mechanical alignment is required. Easy gun installation and maintenance is provided with Auto bake-out and Auto Start capabilities.

**Final Lens:** Dual Objective combining field-free magnetic and electrostatic lenses, with a 60° geometry.

**Beam deceleration:** Can be activated for getting higher surface sensitivity and contrast using low and very low landing energies. Beam deceleration is implemented as an additional degree of freedom to optimize contrast and surface sensitivity while improving the optical performance of the electron column

**Voltage:** 200 eV to 30 keV (20 eV landing energy possible with Beam Deceleration)

**Beam Current:** 1 pA to 400 nA

**Resolution (optimal working distance):**
- 0.8 nm at 30 kV (STEM)
- 1.0 nm at 15 kV
- 1.3 nm at 1 kV
- 1.0 nm at 1 kV (with beam deceleration)

**Scanning system**

- High-resolution digital scanning engine controlled from the User Interface.
  - Pixel density 768 x 512, 1536 x 1024, 3072 x 2048, 6144 x 4096, selectable
  - Minimum dwell time 25 ns/pixel; maximum 25 ms/pixel
  - Electronic scan rotation by n x 360 degrees

**Detection**

Apreo C HiVac features a secondary electron detector (Everhart-Thornley SED), optimized for use across the available kV and current range. The Trinity detection system is comprised of a segmented, lower in-lens detector (T1), an upper in-lens detector (T2) and an optional in-column detector (T3). An integrated IR-CCD camera is standard for in-chamber viewing and the Nav-Cam color optical camera is used to take top-down images of samples for navigation. Optionally available are a retractable Directional Backscatter (DBS) detector and a STEM detector for imaging thin sections, powders or FIB-prepared specimen.

**Imaging**
Images are displayed in an area of 1536 x 1024 pixels, configurable for either single-frame or four-view display. Images can be viewed live, averaged or integrated. Apreo C HiVac fully supports the SmartSCAN™ advanced scanning strategies which allow line averaging and interlaced scanning in addition to Drift Corrected Frame Integration (DCFI). Still images can be saved in TIFF, BMP, JPEG file formats, and in 8-bit, 16-bit or 24-bit depth, to the hard disk or LAN from the graphical user interface. Image printing is also available from the user interface. In addition, the system supports recording of AVI movies. This can either be done on the fly or by capturing a series of TIFF images at user-specified intervals. These TIFF images can then be combined into AVI’s by using the included proprietary movie creator software.

The software includes a 4-view mode, in which the displays can be used for live display of electron images (SE, BSE), mixing of signals and display of the image of the standard infrared (IR-CCD) camera.

Look-up tables allow image contrast, brightness or gamma to be enhanced. Flexible databar selection is also provided. User-definition of preferred imaging parameter sets is available. Imaging parameters are stored in the TIFF image file as private data. Finally, image measurements and annotations can be performed live on the image and the results can be stored together with the images.

System control
Apreo C HiVac is controlled from an MS-Windows 7 graphical user interface running at a 1920 x 1200 screen resolution. The PC workstation is based on an Intel Xeon W3520 Processor/ 2.66 GHz 8 MB cache, 12 GB system memory, one 500 GB hard drive, one 16x DVD+/-RW drive, integrated FireWire and USB ports and a 1 GB LAN network card (computer specifications subject to change). The system includes a 24” LCD monitor, keyboard, optical mouse and a height-adjustable office desk. A USB manual user interface (for controlling magnification, contrast/brightness, beam shift and stigmators) and/or a Joystick (for control of stage movement) is optionally available.

The microscope controller is dedicated to its primary function, includes a DVD/RW and has a possibility to connect directly to a LAN. Optionally, a support computer can be connected for additional PC-based functionality such as MS-Office software suite, firewall, anti-virus and other non-instrument software.

RAPID
This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website

Installation requirements
Please refer to Apreo pre-installation guide.

1133679
Maps 3 for SEM/SDB
Thermo Scientific Maps is the system automation and correlative microscopy software suite for SEM and DualBeam systems. Maps provides automated acquisition of image mosaics via easy set up and offers complete control on location, resolution and imaging parameters. Maps makes it easy to set up multiple mosaic acquisitions on a single sample, or on multiple samples loaded in the chamber. Maps also makes it easy to re-align and collect data over multiple imaging sessions.

Specifications:
- The maximum pixel resolution is 40k x 40k per tile (depends on microscope type).
- Maps corrects for non-linear stage behavior to increase navigation accuracy.
- Maps supports batch acquisition, allowing the user to schedule acquisition of multiple areas in one job, saving supervised time.
- Microscope real-time stitching of tiled images can be carried out concurrent with image acquisition.
- Export of stitched tile sets or user defined areas to TIFF or HD View compatible formats.
- Maps image data can be saved in RAW formatter TIFF format.

9432 909 96411  Compressor 120 V, 60 Hz with 4-liter Tank
The compressor is required when compressed air of 6 atm. is not available; compressed air is required for operating pneumatic valves and the microscope’s leveling system. The compressor is connected to the mains supply unit of the microscope.

1050312  Advanced Signal Selection
The option Advanced Signal Selection includes a multiplexer that permits the simultaneous detection of signals from all detectors, and all segments of all detectors. It is automatically selected when the detector configuration requires it.

1026861  EDS Installation by Thermo Fisher Scientific (EM)
Installation of EDS detector by a Thermo Fisher Scientific Service Engineer.

1137496  Thermo Scientific Pathfinder EDS UltraDry 30M (129 eV)
- UltraDry Premium EDS detector for analytical chamber SEM, Apreo, VolumeScope, Quattro, Prisma E
- Active area of 30 mm² and 129 eV energy resolution at Mn k-alpha
- Norvar window with proprietary evacuated tube design for detection sensitivity to Be
- Analyzer electronics with up to 1,000,000 x-ray input counts per second and 400,000 x-ray output counts per second.
- Motorized slide for software controllable insertion / retraction.

Pathfinder Alpine level software features
- Standardless quantitative analysis with ZAF, Proza, and Cliff Lorimer matrix corrections.
- Point and Shoot acquisition with electron image overlay
- Linescan acquisition with electron image overlay
- Spectral Imaging up to 1024 pixels with spectral extractions of user defined shapes and line scans.
- Ultra high resolution EDS element mapping with electron image overlay.
- EXTREME Element mapping with background subtraction, peak deconvolution and quantitative analysis in each pixel both during live time and in post-processing.
- EXTREME Elemental line scan acquisition and display with background subtraction, peak deconvolution and quantitative analysis at each point.
- Full Standards-based quantitative analysis.
- Automatic drift compensation
- Spectral Match capability with Spectral library
- Includes Microscope Column Communication Software with read/write of selected parameters.
- Requires customer-provided Microsoft Word® for report generation.

4022 404 41156  Installation Labor Apreo C HiVac NA
Standard Installation Labor coverage - see Terms and Conditions

4022 404 02156  Installation Material Apreo C HiVac
Standard Installation Material coverage - see Terms and Conditions

4022 404 43156  Warranty Labor Apreo C HiVac NA
Standard Warranty Labor coverage - see Terms and Conditions

4022 404 04156  Warranty Material Apreo C HiVac
Standard Warranty Material coverage - see Terms and Conditions
9425 061 69515  NA Installation Kit for Quanta (3D) FEG / Nova NanoSEM / Verios / Versa 3D / Scios / Teneo

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<tbody>
<tr>
<td>25066</td>
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<td>External 10-inch water filter kit</td>
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<td>1001224</td>
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<td>8 mm Poly Tubing</td>
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<td>Power strip, 6 out 220 IEC type</td>
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<td>20 A, 250 V Twist Lock Plug, Hubbell</td>
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<tr>
<td>9425 061 69590</td>
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<td>½” KO Cable Clamp, Thomas &amp; Betts</td>
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<td>9425 061 69617</td>
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<td>IEC Power cords, 6 ft.</td>
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</table>

Choose a Chiller Type – air or water cooled

9425 031 90501  1  Haskris RO33 Air Cooled Water Chiller
OR
9425 031 90511  1  Haskris RO33 Water Cooled Water Chiller

1120471  Manual User Interface

Manual User Interface (MUI) is a supplementary control console providing direct manual control of microscope parameters such as focus, magnification, contrast, brightness, beam shift and stigmator.

1218296  Windows 10 Support Computer

The support computer enables the user to grow with the speed of computer peripheral innovations during the lifetime of the system without affecting the microscope controller and endangering system uptime. The support computer is a second computer, connected to the microscope controller with an Ethernet connection, that takes over the data management task from the microscope controller (which remains dedicated to microscope operation).

The sample data management solutions enabled by the support computer are:
- It is possible to use the support computer for hosting 3rd party software/hardware that is not part of the microscope (e.g. MS Office, CorelDraw) or for gaining performance for the microscope controller.
- The support computer has a video adapter to connect two monitors for having multiple applications visible that makes it easier to work with.
- The support computer has a second Ethernet card to connect to the LAN or WWW. Local IT departments have access to the support computer for (external) network configuration purposes. Internal networking (to the microscope controller) remains the responsibility of Thermo Fisher Scientific.
- The support computer may be loaded and/or upgraded with the user’s preferred anti-virus software, office-suite, printer drivers, email and Internet browser software.
- The computer is delivered with a 24” widescreen LCD monitor and a software-controlled switchbox; this enables controlling the microscope controller and support computer by only one mouse and one keyboard. Switching between computers and monitors is fully controlled by the switchbox software.

Additional features of the support computer are:
- Equipped with the Microsoft Windows 10 operating system
- 16 GB RAM, 3.50 GHz Intel Xeon E5-1620 v3 processor or higher
- The hard disk of the support computer has 2x 1 TB 7200 rpm HDD SATA or higher storage capacity
- AMD FirePro W2100 2 GB graphics card or better

Thermo Fisher Scientific’s warranty and service responsibilities for the support computer are restricted to the delivered configuration, with service arrangements comparable to service arrangements offered by regular computer vendors.

4022 400 44231  DDP Brno / Named place of destination; receiving dock in North America (T-3)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination. In accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

9425 060 99100  On-site Applications Training - Americas (1 day)
On-site applications training, per day, including all travel and expenses. For customers located in the Americas. Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3) consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not ordered as part of a microscope purchase).
Helios Hydra CX

QUOTATION for
University of Missouri – Science & Technology

Attn: Dr. Scott Miller

Quote Date: March 02, 2020
Quote Number: QUO-114739-C1S3 R0
Expires: June 26, 2020

Prepared By
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Mobile: +1 260.579.1302
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Solution Description

1208516  Helios Hydra CX DualBeam System

The Helios Hydra Plasma Focused Ion Beam (PFIB) Workstation is the fourth generation fully digital, Extreme High Resolution (XHR) Field Emission Scanning Electron Microscope (FE SEM) equipped with a multiple ion species inductively coupled plasma (ICP) focused ion beam (PFIB). It enables in-situ large area sample preparation and high-resolution imaging and analysis of areas hundreds of microns across to ensure collection of relevant and representative results. It provides high performance site-specific, high-volume material removal for top-down deprocessing, cross-sectioning and fast characterization of nanometer details and analysis in 2D and 3D, high quality sample preparation for TEM analysis and in-situ materials testing.

The key enabling technologies are all integrated onto a single platform such as:
- XHR electron optics (magnetic immersion lens type) with electrostatic scanning, and advanced SE detection.
- An ultra-high brightness NG electron source equipped with UC+ technology to reduce the beam energy spread below 0.2 eV, which enables sub-nanometer resolution and high surface sensitivity at low landing energies.
- Electron Beam Deceleration (optional) for improved low-kV performance, access to ultra-low landing energies (down to 20 V) and balanced topographic and material contrasts.
- An optional high-sensitivity, retractable solid-state backscattered detector (DBS).
- Complete suite of standard high-sensitivity detectors for superior detection of SE and BSE signals even at low landing energies, with the ability to acquire simultaneous SE and BSE images. See Detection section for a complete list of detectors.
- ConstantPower™ design of electromagnetic lenses for ultimate stability, high controllability and reproducibility of the electron beam.
- Fast switchable multiple ion species PFIB Ion Column with outstanding performance in high volume material removal and precision milling for wide range of materials.
- An integrated CryoCleaner® with spare vessel and plasma cleaner (optional) to ensure a clean specimen surface. A clean specimen surface is especially of importance when working at low landing energies, where the deposition rate of hydrocarbons is highest and true sample information desired.
- Integrated control of the MultiChem Gas Delivery System to deliver precise, repeatable doses to the sample as well as mix gas precursors prior to injection. At least one metal deposition precursor must be selected with up to an additional five selectable precursors optionally available, including up to two external gases.
- A 5-axes motorized x-y-z-tilt-rotate eucentric stage. Travel along the x and y-axis is 110 mm, the z range is 65 mm.
- An integrated beam current measurement.
- A high-resolution, 16-bit digital patterning engine capable of Simultaneous Pattern and Imaging (SPI™).
- An integrated Real Time Monitor (iRTM).
- Selective Etch Software to enable contrast selective milling.
- A system architecture which is optimized for automation to support consistent Slice and View applications
- Windows User Interface optimized for three 24” widescreen LCD monitors, allowing for up to four independent live images and a large image window.
- Manual user interface and joystick for fast and intuitive microscope control.
Features and specifications:

Geometry
The electron and ion columns are mounted at 52 degrees to each other, on a 21-accessory port specimen chamber. The beam coincidence point is at 4 mm (e-beam) working distance, which is also the eucentric working distance of the stage and the analytical working distance. There are 5 ports available, grouped around the ion column, for installing Gas Injection Systems or the Thermo Scientific MultiChem Gas Delivery System.

Vacuum
The Helios Hydra DualBeam uses a vacuum system, which is entirely oil-free. Differential pumping on the electron column ensures tip operation at the ultra-high vacuum levels (10^-10 mbar) even with a controlled gas flow in the specimen chamber.

Sample navigation
The Helios Hydra CX is equipped with a 5-axes motorized x-y-z-tilt-rotate eucentric stage. Travel along the x and y-axis is 110 mm, the z range is 65 mm, the tilt range is -38 to +90 degrees. The stage repeatability is 3 μm at 0 degrees.

The stage comes with a unique standard specimen holder with labeled positions and unique stage mounting, allowing simultaneous loading of 18 standard samples (Ø 12 mm), three 45˚ pre-tilted samples, three row bars (vertical, horizontal and 52˚ pre-tilted).

A selection of sample holder kits is optionally available (including stub holders, TEM sample holders, vise specimen holders and wafer holders). Joystick stage control is available as an option. An optional in-chamber optical navigation camera (Nav-Cam+) can be included to facilitate low magnification sample navigation.

Ion optics
Differentially pumped, triple lens, focused ion beam optics
Source: Multiple Ion Species Inductively coupled Gas based plasma
Ion species: Xe, Ar, O, N
Switching time: <10 min
Source lifetime: >2 year
Landing Energies: Adjustable from 2 kV to 30 kV
Beam current: 1.5 pA to 2.5 μA in 20 steps
Resolution (Xe): <20 nm @ 30 kV using preferred statistical method
<10 nm @ 30 kV using selective edge method
Detection: ETD (secondary electron) and ICE detectors (secondary electron and ion detector)

Electron optics
Dual-mode magnetic immersion / field free lens electron optics with ultra-high brightness NG emitter and UC+ technology.
Source: Schottky field emitter mounted on the NG hot-swap gun module
Source lifetime: 1 year guaranteed
Acceleration Voltage: 350 V – 30 kV
Landing energies: adjustable from 20 V to 30 kV
Beam current: 0.8 pA – 100 nA (0.8 pA – 100 pA in UC+ mode)
Resolution @ optimum WD (the room needs to meet the installation requirements)
0.6 nm @ 2 – 15 keV landing energy
0.7 nm @ 1 keV (with optional Beam Deceleration)
1.0 nm @ 500 eV (with optional Beam Deceleration)
1.1 nm @ 350 eV (with optional Beam Deceleration)
Detection: See section below
**Scanning system**
High-resolution digital scanning engine controlled from the User Interface.
- Resolution: 768x512, 1536x1024, 3072x2048, 6144x4096, Legacy settings are still available 512x442, 1024x884, 2048x1768, 4096x3536 pixels
- Minimum Dwell Time: 25 ns/pixel
- Electronic scan rotation by n x 360 degrees

**Patterning system**
High-resolution digital patterning engine controlled from the User Interface
- Maximum resolution: 64k x 64k
- Maximum pattern size: 8M pixels
- Minimum Dwell Time: 25 ns/pixel
- Maximum Dwell Time: 25 ms/pixel
- Multiple pattern shapes
- Variable dwell time pattern to give 3D milling
- Complex milling patterns through Bitmap import

**Detection**
The Helios Hydra CX features, besides the traditional Everhart-Thornley detector for conventional SE detection, a suite of in-column and below-the-lens detectors to collect and discriminate as precisely as possible all the signal available.

Inside the Elstar FESEM column, the through-the-lens detector (TLD), collecting SE and high-loss BSE, is specially designed for high-resolution imaging at both high and low energies. It supports the SE energy range selection to access specific information such as voltage contrast.

Located above the TLD, an additional detector (optional):
- The In-Column Detector, detecting with high sensitivity no loss backscatter electrons, or when used with beam deceleration, enabling superb imaging at very low landing energies

Elstar’s immersion mode enables a high SE/BSE collection efficiency for the in-lens detection.

Below the Helios SEM objective lens, two detectors are available:
- The retractable DBS (Directional Back Scatter) detector (optional), a highly sensitive low voltage solid state detector optimized for low energy electron large solid angle detection. It can be used in combination with beam deceleration to optimize materials contrast and/or obtain mixed topographic and materials images
- The retractable STEM-III+ detector (optional), for bright-, dark- and high-angle dark-field imaging and for nano-analysis of thin samples

The ICE detector (included) is suitable for secondary ion and electron detection. Its novel design is optimized for imaging with the ion column in both ion and electron collection mode. The patented ion detection scheme provides revolutionary secondary ion imaging. Additionally, ICE has a high current and low current mode, increasing the useful beam current dynamic range. The ICE detector can be used in combination with charge neutralizer (optional), enabling secondary ion imaging while the specimen is flooded with electrons to neutralize charge.

Dual endpoint control monitor during milling, high sensitivity stage current and secondary electron plots (simultaneous), allows for very advanced monitoring of the milling process.

Two cameras are available:
- An integrated IR-CCD camera is standard for in-chamber viewing stage and sample position with respect to electron and ion columns and other in-chamber accessories
- The optional Nav-Cam+, a color optical camera that allows the acquisition of an in-situ, top down, 6 megapixel resolution image with a horizontal field width of approximately 70 mm. This image automatically registers with the SEM coordinates and is used both to document and easily navigate on the sample
Imaging
Images are displayed in an area of 1536 x 1024 pixels, configurable for single frame display or 4 quadrant display (768x512 pixels). Simultaneously, one of the 4-quad images can be displayed in full-screen mode on the 2nd LCD monitor. Images can be viewed live (up to 4 channels), averaged or integrated. Images can be saved in TIFF, BMP or JPEG file formats, and in 8-bit, 16-bit or 24-bit depth, to the hard disk or LAN from the graphical user interface. Image printing is also available from the user interface.

Patterning
Predefined patterns can be drawn in overlay in any of the four quadrants in the UI. Progress of the patterning is monitored in the User Interface through a progress bar. End-point detection is available through a specimen current graph and a software-integrated Real-Time Monitor. Simultaneous imaging and patterning is a standard feature of the Helios Hydra.

Integrated Real-Time Monitor (iRTM)
The integrated real-time monitor displays a live image within the patterning window during ion beam patterning (imaging, deposition or milling). The intensity (image brightness) is proportional to the level of the detector signal (amount of secondary particles being detected during patterning). As such, the real-time monitor can give instant feedback on the ion beam process. This is typically most useful when milling through a stack with different material layers. Since the yield of secondary particles changes when transitioning from one layer to the next, it is possible to follow the progress by monitoring the brightness changes on the real-time monitor. The real-time monitor is highly recommended for such tasks as device edit and micro-/ nano-machining.

System control
The Helios Hydra DualBeam is controlled from a Windows Graphical User Interface running at 1920 x 1200 screen resolution on a dedicated microscope controller. A support computer is standard on the system for software utilities that could interfere with the control software running on the controller (e.g., LAN connection). The system includes two 24-inch widescreen LCD monitors (a 3rd monitor for support or a 3rd party computer is optional) placed on optional Operator’s Table or height-adjustable office desk. The two computers are seamlessly sharing a single keyboard and mouse. In the two monitors configuration, one of the LCD monitors can be used both for the full-screen image and the support computer desktop displayed via Windows Remote Desktop technology. The two computers are controlled with a single keyboard and mouse. A manual user interface allows for hands-on control of focus, stigmation, magnification, XY fine position, and contrast/brightness in addition to standard mouse control. The stage can be controlled through the graphical user interface by the mouse, the keyboard or by the optional, specifically tailored joystick.

RAPID
This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website.

Installation requirements
Please refer to the Helios Hydra Pre-Installation Manual.

1111905 Auto Slice & View™ 4
Auto Slice and View 4 is the fourth generation of Thermo Fisher Scientific’s automation software for automated serial sectioning and imaging through a user-defined volume of a specimen. The sequence of images captured by Auto
Slice and View 4 can be compiled into a video or can be used as input for 3-dimensional reconstruction of the sliced volume.

Auto Slice and View 4 includes a number of key enhancements to improve automation success, increase reliability, provide feedback and facilitate setup and process monitoring/pausing and re-starting over the previous versions. Some notable key features include:

- Dedicated solution that unifies image acquisition and analytical mapping. Auto Slice and View 4 now enables you to acquire all the information on every slice.
- Dedicated user interface that guides the user with a step-by-step process.
- Acquisition of multiple images with independent settings (resolution, dwell, FOV, detector, kV) for each slice
- Acquisition of multiple regions of interests and the ability to define new regions on interests during the fulfillment of the slice and view.
- Enhanced repeatability of FIB cut placement.
- Image recognition of fiducials with confidence indication/limits to ensure accurate slice placement and/or pause automation
- Enhanced throughput with the ability to only image the regions of interest where there is relevant content in the sample
- Recoverability and continuation if an error condition is encountered
- Project/Job management to save, export and import project parameters for quicker setup of routine processes
- Low vacuum electron beam imaging and drift suppressed milling are supported for low vacuum enabled instruments to facilitate investigation of non-conductive sample volumes.

AutoTEM 4

AutoTEM 4 is a new generation of Thermo Fisher Scientific’s software for automated preparation of S/TEM samples and cross-sectioning with a DualBeam™. It is a unique solution with highly configurable workflow to enable preparation of a wide range of samples. AutoTEM 4 software includes:

- Complete in-situ sample preparation workflow, featuring
  - Fully unattended multi-site chunking
  - User guided lift-out
  - Automated final thinning with low-kV cleaning
- Fully unattended multi-site ex-situ lift-out sample preparation workflow
- Fully unattended multi-site cross-sectioning capability

Chunk Milling includes adding a protection layer and fiducial over an area of interest which can be customized and automated including both electron beam and ion beam deposition layers. It also contains milling of trenches, undercut and bulk cleanup steps. Chunk Milling can also be used to create an array of cross-sections or ex-situ lift-out samples. Lift-out automation uses guided steps to move the manipulator and stage to the correct places when the user follows simple on-screen instructions, minimizing the interaction time with microscope UI. Support of GIS-free attachment to the grid further simplifies and speeds up the lift-out process, resulting in an average time of 10 minutes for the whole lift-out step.

Final thinning of a lamella on the grid can be done automatically. Different strategies are available to thin the sample, including customizable windows, which helps to handle challenging samples. An automated low voltage final cleaning capability in AutoTEM 4 ensures creation of highest quality ultra-thin TEM lamellas. End-pointing during thinning of lamella is easy with precise patterning and imaging controls. It is also possible to use pre-tilted grid holder positions with the optional STEM detector for extremely precise thickness monitoring during final thinning of S/TEM lamella.

Highest level of automation and intuitive user interface with hints and instructive graphics significantly shortens the S/TEM lamella preparation process time for expert users and enables novice users to obtain routine, highest quality results in less than one hour.

Notes:

- AutoTEM 4 requires Single GIS with Platinum or Tungsten or Carbon deposition gas chemistry.
- In order to achieve the specified performance on Helios G4 PFIB and Helios Hydra, MultiChem with Platinum and Carbon precursors is required.
- EasyLift is required for the in-situ lift-out workflow.

1133682    Maps 3 for SEM/SDB with Correlative Workflow
Thermo Scientific Maps is the system automation and correlative microscopy software suite for SEM and DualBeam systems. Maps provides automated acquisition of image mosaics via easy set up and offers complete control on location, resolution and imaging parameters. Maps makes it easy to set up multiple mosaic acquisitions on a single sample, or on multiple samples loaded in the chamber. Maps also makes it easy to re-align and collect data over multiple imaging sessions.

Specifications:
- The maximum pixel resolution is 40k x 40k per tile (depends on microscope type).
- Maps corrects for non-linear stage behavior to increase navigation accuracy.
- Maps supports batch acquisition, allowing the user to schedule acquisition of multiple areas in one job, saving supervised time.
- Microscope real-time stitching of tiled images can be carried out concurrent with image acquisition.
- Export of stitched tile sets or user defined areas to TIFF or HD View compatible formats.
- Maps image data can be saved in RAW formator TIFF format.

Maps Correlative Workflow
Maps Correlative Workflow serves as a powerful addition to the Maps correlative microscopy suite. Users can input images from any source via a wide range of standard image formats. Maps provides guided workflows to import, align and visualize all sample imagery. Users have control over visualized layers, transparency of each layer and native histogram controls for SEM images. Users can also easily share results using the optional offline version. Annotations including text, linear and angular measurements can be made by multiple users and shared in a single project for a collaborative interpretation experience.

Key Features:
- Import of 2D images of any common image file format
- Import of 3D data in the form of 3D Tiff format
- Import of Leica CLEM data format including all overviews and local zStacks
- Guided Correlation Workflow
- Image layer controls

1133684    Maps 3 Offline with Correlative Workflow
Maps 3 Offline with Correlative Workflow is intended for running on dedicated image processing computers. The offline version of Maps 3 with Correlative Workflow requires at least 4 GB of RAM memory and can be connected to multiple Maps.

1081786    Electron Beam Deceleration
Electron Beam Deceleration enables:
- Improved resolution at landing energies of 2 kV and lower
- Landing energies 50 V – 30 kV
- Stage bias between -4 kV and -50 V

This part number (1081786) is available for Helios NanoLab G3 CX, Helios G4 / 5 CX, Helios G4 PFIB and Helios Hydra.

1136621    Compressor 230 V, 108 l/min, 230 V, 50/60 Hz
The oil-free compressor is needed if high-flow compressed air facilities are not available. Compressed air is required for air cooling of the plasma FIB source, operating pneumatic valves and the microscope’s leveling system. The compressor is connected to the mains supply unit of the microscope.
1117423  **Charge Neutralizer**
The Charge Neutralizer is an electron source and control system to minimize positive ion charge-up on glass and other highly insulating surfaces. The electron source produces a broad beam which floods the sample with up to 1 µA of low energy electrons (@200 eV), thus neutralizing any positive charge built up on the sample surface during ion beam use. The reduction of charge makes it possible to accurately mill and image with the ion beam even on completely non-conducting samples.

This option (1117423) is suitable for Helios G4 and 5, Helios PFIB and Centrios FIB systems. On Helios G4 / 5 UC and CX systems it requires presence of ICE Detector (1094663).

1201713  **Elstar In-Column Detector (ICD)**
The Elstar In-Column Detector, located in the Elstar SEM final lens above the TLD, is a high-sensitivity in-column detector with excellent direct detection of low loss backscatter electrons. When used with Electron Beam Deceleration (1081786), it enables superb imaging at very low landing energies.

This Elstar In-Column detector (1201713) is suitable for Helios G4 PFIB and Helios Hydra.

1128677  **Retractable DBS detector**
The annular, Back-scattered (BS) detector (called the DBS – Directional Back Scatter detector) is an ultra-sensitive, Solid State (SS) detector which is sensitive to emitted electrons from 500 V onwards. Using Beam deceleration (sample bias to reduce the landing energy), images with beam landing energies down to 50 V are possible. Especially when Beam Deceleration is applied in combination with immersion field, it is possible to detect all BS electrons emitted up to 90 degrees.

The retractable DBS detector features four annular and three azimuthal segments that enable separate detection of electrons emitted at different angles. User can switch between two detector modes:
- ABS – for distinguishing four ranges of annular angles
- CBS – for distinguishing two annular and 3 azimuthal angle ranges

In both modes, signal from four independent detector segments can be acquired simultaneously, and mixing based on adding / subtracting individual signals is possible. This way it is possible to select multiple contrasts (material and topographical) that can be optimized per application.

This detector is mounted on a software-controlled retractable arm and allows simultaneous EDS spectra acquisition for WD ≥ 5 mm. Fast imaging becomes possible with this detector.

This Retractable DBS detector (1128677) is suitable for Helios G4 / 5 HX, HP, UX, UC and CX, Verios G4 HP and UC, Helios G4 PFIB Cxe, Hxe, UXe and Helios Hydra. It requires the presence of the STEM/DBS integration kit (1128675). If a Retractable STEM 3+ detector is configured to the system, also the STEM/DBS Upgrade Kit (1128685) has to be included.

1128683  **Retractable STEM 3+ Detector**
The retractable STEM 3+ detector enables scanning transmission imaging on thin samples in SEM and DualBeam instruments. It consists of three concentric, ring-shaped sections:
- Inner section - for bright field imaging
- Intermediate section - sub-divided in 4 annular rings, for tunable dark-field imaging and enhanced compositional contrast.
- Outer section - sub-divided into six angular segments, for high angle dark field imaging.

The xT software supports easy switching between imaging modes and the display of up to 4 STEM signals simultaneously. With the retractable STEM 3+ detector there is no need to vent the chamber to insert or remove the detector. The detector includes a special sample holder that can hold up to six TEM grids and which is compatible with the UMB holder. It also includes the load base.
This Retractable STEM 3+ detector (1128683) is suitable for Helios G4 CX, Helios G4 PFIB CXe, and Helios Hydra CX. It requires the presence of a STEM/DBS integration kit (1128675). If the Retractable DBS detector (1128677) is also added to the system, the STEM/DBS Upgrade Kit (1128685) must be included as well.

1128675  STEM / DBS integration kit
Common infrastructure needed for Retractable DBS detector (1094680 or 1128677) and/or Retractable STEM 3+ detector (1128681 / 1128683 / 1211190 / 1213698 / 1213700) for Helios G4 / 5, Helios Hydra and Verios G4 systems.

1128685  STEM/DBS Upgrade Kit
Common infrastructure needed for the combination of Retractable DBS detector (1128677) and Retractable STEM 3+ detector (1128681 / 1128683 / 1211190 / 1213698 / 1213700) on the following systems: Helios G4 / 5 UX, UC and CX, Helios G4 PFIB CXe and UXe, Helios Hydra, and Verios G4 UC.

1026861  EDS Installation by Thermo Fisher Scientific (EM)
Installation of EDS detector by a Thermo Fisher Scientific Service Engineer.

1137506  Thermo Scientific Pathfinder EDS UltraDry 60M (129 eV)
- UltraDry Premium EDS detector for small dual beam chamber SEM
- Active area of 60 mm² and 129 eV energy resolution at Mn k-alpha
- Norvar window with proprietary evacuated tube design for detection sensitivity to Be
- Analyzer electronics with up to 1,000,000 x-ray input counts per second and 400,000 x-ray output counts per second.
- Motorized slide for software controllable insertion / retraction.

Pathfinder Alpine level software features
- Standardless quantitative analysis with ZAF, Proza, and Cliff Lorimer matrix corrections.
- Point and Shoot acquisition with electron image overlay
- Linescan acquisition with electron image overlay
- Spectral Imaging up to 1024 pixels with spectral extractions of user defined shapes and line scans.
- Ultra high resolution EDS element mapping with electron image overlay.
- EXTREME Element mapping with background subtraction, peak deconvolution and quantitative analysis in each pixel both during live time and in post-processing.
- EXTREME Elemental line scan acquisition and display with background subtraction, peak deconvolution and quantitative analysis at each point.
- Full Standards-based quantitative analysis.
- Automatic drift compensation
- Spectral Match capability with Spectral library
- Includes Microscope Column Communication Software with read/write of selected parameters.
- Requires customer-provided Microsoft Word® for report generation

1137518  Pathfinder Alpine Upgrade to Pinnacle
Pathfinder Alpine Upgrade to Pinnacle adds the following features to Pathfinder Alpine software:
- X-phase for EDS elemental map phase mapping
- Direct-to-Phase with Compass Principal Component Analysis for advanced, live-time Phase mapping with no need for elemental identification or quantification
- Analysis Automation for stage-controlled and templated acquisitions
- X-ray imaging filters for 29 unique smoothing, sharpening and edge-finding filters

Pathfinder Alpine Upgrade to Pinnacle on Prisma requires the presence of Pathfinder Alpine EDS System (1220198); on all other systems it requires the presence of an UltraDry EDS Detector.

1209246  System Covers
The System Covers are required to complement the main Helios Hydra instrument when no acoustic enclosure is ordered. This option includes covers for the column and the console of the instrument.
This option (1209246) is available for Helios Hydra CX / UX

**1100019  EasyLift EX NanoManipulator**
The EasyLift family of NanoManipulators is Thermo Fisher Scientific's advanced and preferred solution for in-situ sample manipulation and TEM lamella transfer. All EasyLift models are integrated with the microscope xT software to provide an easy, intuitive method for sample manipulation inside the DualBeam chamber. With motorized needle rotation included, EasyLift EX provides superior performance for TEM sample preparation. EasyLift EX includes increased precision, increased stability, and motorized needle rotation for easy preparation of traditional, plan view, and ultra-thin TEM samples.

*EasyLift EX Product Features:*
- Software control integrated into the DualBeam user interface
- Stable, consistent, and repeatable movement in any direction
- Closed-loop encoder feedback enabling easy restore/recall of probe positions
- Motorized, 360° control of needle rotation
- Comes with a supply of 10 replacement needles and 50 pcs of halfmoon molybdenum grids.

*EasyLift EX includes the following enhanced stability performance:*
- Smallest step size <50±30 nm
- Omni-directional repeatability <150 nm
- True 'Z' movement of 500 nm over a 5 µm Z stroke
- Drift <200 nm/min in first 3 minutes after insertion

The EasyLift EX NanoManipulator (1100019) is suitable for Helios G4 / 5 CX, Helios G4 PFIB CXe, Helios Hydra CX and Scios 2 systems.

**FP 3400/31  Platinum Deposition**
Gas chemistry solution for Ion or Electron beam deposition of Platinum-containing material. Platinum gas chemistry is the preferred metal deposition in case ease of use, high deposition rate and precision of the deposition is required. The package includes the gas precursor, injection needle, gas injector system and controller. This gas chemistry option is assembled, tested and shipped with the basic microscope or DualBeam.

Important note: the customer is responsible for making sure a fume hood is present for on-site service of this chemical by a Thermo Fisher Scientific engineer

**4022 404 41217  Installation Labor Helios Hydra CX NA**
Standard Installation Labor coverage - see Terms and Conditions

**4022 404 02217  Installation Material Helios Hydra CX**
Standard Installation Material coverage - see Terms and Conditions

**4022 404 43217  Warranty Labor Helios Hydra CX NA**
Standard Warranty Labor coverage - see Terms and Conditions

**4022 404 04217  Warranty Material Helios Hydra CX**
Standard Warranty Material coverage - see Terms and Conditions

**9425 061 69546  NA Installation Kit for Nova NanoLab / Strata / Helios / V600**
<table>
<thead>
<tr>
<th>Part Number</th>
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<th>Description</th>
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<tr>
<td>13289</td>
<td>25</td>
<td>PVP Hose</td>
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<tr>
<td>25066</td>
<td>1</td>
<td>External 10-inch water filter kit</td>
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<td>1001224</td>
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<td>Specimen stubs (20)</td>
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<td>1020166</td>
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1020171  1  CONNECTOR, 1/2IN STRT
1020172  4  CLAMP, HOSE, WORMDRIVE, 24
4022 293 39101  1  Damper assembly
4022 297 06181  5  8 mm Poly Tubing
4035 273 22521  1  Power strip, 6 out 220 IEC type
4035 273 43491  1  Chloramine-T algaeicide (250 gram jar)
9425 061 69458  1  Auto Transformer 208V to 228V 7KVA
9425 061 69549  1  10 pack DVD+R x 10 - 4.7 GB Disks
9425 061 69585  1  50 ft. each - 3/8 inch Air Hose
9425 061 69586  8  Hose Clamps, Size 08
9425 061 69587  2  Brass Reducer ½"NPT – 3/8"NPT,
9425 061 69588  2  Brass Hose Barb 3/8" NPT to 3/8" Hose
9425 061 69617  4  IEC Power cords, 6 ft.

Choose a Chiller Type – air or water cooled
9425 031 90501  1  Haskris RO33 Air Cooled Water Chiller
OR
9425 031 90511  1  Haskris RO33 Water Cooled Water Chiller

1111961  **In-Chamber Nav-Cam**
The In-Chamber Nav-Cam is a color optical camera for Helios G4 / 5 CX, Helios G4 PFIB CXe / UXe, and Helios Hydra. It is mounted directly to the chamber for acquiring an image of samples mounted on the specimen stage. The In-Chamber Nav-Cam is optimized to capture images at the analytical working distance when the system is under vacuum so areas of interest can be found and investigated.

Images of samples can be easily captured when the user starts the sequence. The system incorporates sample lighting and a fully integrated, software-based capture control to ensure easy operation for high-quality images. The resulting image is acquired by moving the stage to a predefined location where approximately a 160 mm horizontal field-of-view is captured. The resulting image (with a resolution of 3072 by 2048 pixels or approximately 6 megapixels) can be digitally zoomed within the user interface to locate and move to specific sample locations. It is possible to save the Nav-Cam image file within the microscope control software with or without the current-location-marker-overlay (on the display) to document sample features or areas without the need of an additional external camera or annotation software.

1085916  **PFIB Column Hoist Kit**
The PFIB column hoist kit is required for servicing the system ion column and work in combination with the SDB Service Crane. Thermo Fisher Scientific will not be able to provide service or maintenance on the system column unless the service crane and PFIB hoist kit are made available to the field service engineer at the time of servicing. If the crane and hoist kit are not available or not in a usable condition, Customer will be required to purchase or procure an additional unit prior to Thermo Fisher Scientific servicing the column. Customer may use the same crane and hoist kit for multiple tools at the same location.

Thermo Fisher Scientific’s failure to service the system column or related parts of the system due to the unavailability of the hoist shall not be a breach of Thermo Fisher Scientific’s warranty or any other contractual commitment including a service contract.

1074810  **Service Crane SDB**
The SDB service crane is needed both for the regular Elstar column maintenance (including replacement of the electron source) and troubleshooting by Thermo Fisher Scientific authorized service personnel. Therefore, it is mandatory that each customer site has at least one functional SDB service crane available.

On the other hand, the service crane is not supposed to be mounted on system during normal microscope operation, so it is usually sufficient to have just one crane in the laboratory equipped with multiple systems.
The SDB service crane is designed for all Helios, Aquilos and Scios SDBs, Centrios FIB and for Magellan and Verios SEMs.

1094682  **Standard Operator’s Table**
130 x 80 cm large, height-adjustable office desk, specifically designed as a workspace for a Helios SDB or Verios SEM system operator. It incorporates dedicated holders for the Microscope and Support computers as well for the cables between the computers and the microscope console. It can accommodate the two 24” LCD monitors that are standard part of the main instrument, but with an optional, special holder (1094684), it can support three 24” LCD monitors.

1016773  **24” Widescreen LCD Monitor**
Specifications of the 24” Widescreen LCD monitor:
- 16.77 million colors
- High performance IPS TFT 16:10 display
- On-screen user control via on-screen manager (OSM)
- Intelligent power manager

<table>
<thead>
<tr>
<th>Display</th>
<th>61.1 cm (24.1 inch)</th>
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<tbody>
<tr>
<td></td>
<td>0.270 mm dot pitch, 300 cd/m²</td>
</tr>
<tr>
<td></td>
<td>1000:1 contrast ratio</td>
</tr>
<tr>
<td></td>
<td>&lt;16 ms response time</td>
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</tbody>
</table>

| Resolution       | 1920 x 1200 at 60 Hz refresh rate (optimum) |

1120471  **Manual User Interface**
Manual User Interface (MUI) is a supplementary control console providing direct manual control of microscope parameters such as focus, magnification, contrast, brightness, beam shift and stigmator.

1214207  **Remote Control / Imaging**
Remote Control / Imaging is a Remote Control package that enables full control of the microscope via another computer across a network. The imaging transfer speed and the remote system responsiveness is determined by the speed and quality of the network connection. 100 Mbps LAN connection is sufficient for most use cases.

The Remote Control / Imaging package contains a perpetual license for the Radmin Remote Control software, which is compatible with all Windows OS versions available on the Microscope and Support computers.

1094684  **Triple Monitor Stand**
Sturdy, high quality, ergonomic stand for holding three 24” LCD monitors. The adjustable design allows the operator to position the monitors at eye level, improving the ergonomics of the workspace.

This item (1094684) is mandatory when an additional 24” LCD monitor (1016773) is selected.

4022 400 44231  **DDP Brno / Named place of destination; receiving dock in North America (T-3)**
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination In accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

9425 060 99100  **On-site Applications Training - Americas (1 day)**
On-site applications training, per day, including all travel and expenses. For customers located in the Americas. Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3) consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled.
within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not ordered as part of a microscope purchase).

1104086 Amira for EM Systems (Life Sciences) - Local, 1-user License

Amira for EM Systems is a software package for advanced visualization and analysis of reconstructed tomography data, acquired using electron and correlative microscopy systems. Amira for EM Systems consists of the base Amira package, augmented with various additional packages. A license is included for 1 (one) user that is restricted to a single designated workstation and includes 12 (twelve) months of maintenance service (hotline and product upgrades).

Amira is a software package for rapid exploration and analysis of 3D-image data, as well as for generation of numerical 3D models for advanced analysis and simulation. Amira for EM Systems is a tailored version of the Amira software, solely distributed by Thermo Fisher Scientific, currently published by Thermo Fisher Scientific's Visualization Sciences Group; more information can be found at www.amira.com.

Amira for EM Systems includes dedicated data import filters for loading EM data obtained from Thermo Scientific instruments into the software. The software also supports image to image alignment with pixel accuracy. Visualization modules include orthographic and oblique sections, efficient surface, mesh and volume rendering, iso-surfacing and iso-lines, simultaneous display of multiple datasets, virtual 3D navigation, movie clip generation, animation generation tools, and more. Thanks to the embedded ‘Very Large Data’ module, Amira for EM Systems can display even very large datasets (up to hundreds of GB) at interactive speed on regular desktop or laptop computers.

Amira for EM Systems supports a variety of semi-automatic and interactive tools for segmentation, providing the ability to construct 3D models of structures present in the image data, and defining complex regions of interest for analysis purposes. It comes with numerous tools for data analysis, including data probing, measurement of distances, regions, and volumes, and statistical analysis tools on multiple regions of interest. Amira for EM Systems also provides unique specific tools for cryo electron microscopy segmentation workflows such as microtubule/actin detection.

Amira for EM Systems offers support for presentations, by providing the capability of making snapshots, exporting movie files and single images, as well as 3D representations by exploiting advanced stereoscopic display technology.

The Amira for EM Systems provides a comprehensive digital lab for advanced 2D and 3D life sciences data analysis, especially aimed at scientists and researchers in cellular or structural biology, who want to get more insight in complex data and systems.

The license for Amira for EM Systems includes one year of Maintenance Service (which features on-line help via the World Wide Web and free-of-charge updates, both for the duration of one year). Upgrades and/or updates to Amira for Thermo Scientific Thermo Scientific Systems after the initial year of Maintenance Service will require the payment of software maintenance fees. The Maintenance Service for Amira for EM Systems (including help, updates, and ongoing software maintenance) will be provided directly by Thermo Fisher Scientific Visualization Sciences Group. Details and Terms & Conditions of the Amira Maintenance Service can be found on the Thermo Fisher Scientific website.

The warranty period for Amira is started six months after the software is shipped from the Visualization Sciences Group, which might result in a reduced warranty period on-site, in case of long microscope installation times.

Amira software yearly maintenance service is not part of the Thermo Fisher Scientific system support service. Thermo Scientific system customers will receive a separate maintenance renewal offer for the Amira software.

Platform requirements
- Amira for EM Systems runs on:
  - Microsoft Windows 64-bit
  - Linux x86_64 (64-bit)
  - Mac OS X (64-bit)
- A 2 GHz minimum CPU processor is required. Multi-core CPUs recommended. 16 GB RAM minimum is required; 32 GB recommended
- A graphic board which supports a complete implementation of OpenGL is required. Recent graphic board supporting OpenGL 3D texturing and programmable shaders is recommended
- A CUDA-enabled graphic board (list on https://developer.nvidia.com/cuda-gpus) is a plus, especially to benefit from the Amira’s GPU-accelerated algorithms

For detailed information on supported and recommended hardware and operating systems for Amira for EM Systems please read the Amira-Avizo System Requirements on the Thermo Fisher Scientific website.
Helios Hydra UX with ToF-SIMs

QUOTATION for
University of Missouri – Columbia Campus

Attn: Xiaoqing He

Quote Date: March 02, 2020
Quote Number: QUO-114736-J3X0 R0
Expires: June 26, 2020

Prepared By Jim Smith, Sr Account Manager
Phone: +1 260.387.6923
Mobile: +1 260.579.1302
jim.smith@thermofisher.com
Solution Description

The Helios Hydra Plasma Focused Ion Beam (PFIB) Workstation is the fourth generation fully digital, Extreme High Resolution (XHR) Field Emission Scanning Electron Microscope (FE SEM) equipped with a multiple ion species inductively coupled plasma (ICP) focused ion beam (PFIB). It enables in-situ large area sample preparation and high-resolution imaging and analysis of areas hundreds of microns across to ensure the collection of relevant and representative results. It provides highest performance site-specific, high-volume material removal for top-down deprocessing, cross-sectioning, chunking, fast characterization of nanometer details and analysis in 2D and 3D, best in class TEM sample preparation and precise micromachining in a laboratory environment. The key enabling technologies are all integrated onto a single platform such as:

- XHR electron optics (magnetic immersion lens type) with electrostatic scanning, and advanced SE detection.
- An ultra-high brightness NG electron source equipped with UC+ technology to reduce the beam energy spread below 0.2 eV, which enables sub-nanometer resolution and high surface sensitivity at low landing energies.
- Electron Beam Deceleration (optional) for improved low-kV performance, access to ultra-low landing energies (down to 20 V) and balanced topographic and material contrasts.
- An optional high-sensitivity, retractable solid-state backscattered detector (DBS).
- Complete suite of standard high-sensitivity detectors for superior detection of SE and BSE signals even at low landing energies, with the ability to acquire simultaneous SE and BSE images. See Detection section for a complete list of detectors.
- ConstantPower™ design of electromagnetic lenses for ultimate stability, high controllability and reproducibility of the electron beam.
- Fast switchable multiple ion species PFIB Ion Column with outstanding performance in high volume material removal and precision milling for wide range of materials.
- An integrated CryoCleanerEC (optional) with spare vessel and plasma cleaner (standard) to ensure a clean specimen surface. A clean specimen surface is especially of importance when working at low landing energies, where the deposition rate of hydrocarbons is highest and true sample information desired.
- Integrated control of the MultiChem Gas Delivery System to deliver precise, repeatable doses to the sample as well as mix gas precursors prior to injection. At least one metal deposition precursor must be selected with up to an additional five selectable precursors optionally available, including up to two external gases.
- A high-precision, 5-axes eucentric specimen stage with 150 mm travel along the x and y axes.
- An integrated beam current measurement.
- A high-resolution, 16-bit digital patterning engine capable of Simultaneous Pattern and Imaging (SPI™).
- An integrated Real Time Monitor (iRTM).
- Selective Etch Software to enable contrast selective milling.
- A system architecture which is optimized for automation to support consistent Slice and View applications.
- Windows User Interface optimized for two 24” widescreen LCD monitors, allowing for up to four independent live images and a large image window.
- Manual user interface and joystick for fast and intuitive microscope control.
Features and specifications:

**Geometry**
The electron and ion column are mounted at 52 degrees to each other, on a 21-accessory port specimen chamber. The beam coincidence point is at 4 mm (e-beam) working distance, which is also the eucentric working distance of the stage and the analytical working distance. There are 5 ports available, grouped around the ion column, for installing Gas Injection Systems or the Thermo Scientific MultiChem™ Gas Delivery System.

**Vacuum**
Helios Hydra DualBeam uses a vacuum system, which is entirely oil-free and which includes a scroll pump. Differential pumping on the column ensures source operation at the ultra-high vacuum levels ($10^{-10}$ mbar), even with a controlled gas flow in the specimen chamber.

**Sample navigation**
The Helios Hydra UX system is equipped with a 5-axes motorized x-y-z-rotate-tilt eucentric stage, of which x, y and rotation movements are piezo-controlled. Travel along the x and y-axis is 150 mm, the tilt range is -38 to 60 degrees. The motorized z-range is 10 mm. Minimum step size is 100 nm, repeatability at 0 and 52 degrees tilt is 1.5 μm. A high-resolution sample holder for five 0.5" specimen stubs is included.

A selection of sample holder kits is optionally available (including stub holders, TEM sample holders, vise specimen holders and wafer holders). Joystick stage control is available as an option. An in-chamber optical navigation camera (Nav-Cam+) facilitates low magnification sample navigation.

**Ion optics**
Differentially pumped, triple lens, focused ion beam optics

- **Source:** Multiple Ion Species Inductively coupled Gas-based plasma
- **Ion species:** Xe, Ar, O, N
- **Switching time:** <10 min
- **Source lifetime:** >2 year
- **Landing Energies:** Adjustable from 2 kV to 30 kV
- **Beam current:** 1.5 pA to 2.5 μA in 20 steps
- **Resolution (Xe):** <20 nm @ 30 kV using preferred statistical method
  - <10 nm @ 30 kV using selective edge method
- **Detection:** ETD (secondary electron) and ICE detectors (secondary electron and ion detector)

**Electron optics**
Dual-mode magnetic immersion / field free lens electron optics with ultra-high brightness NG emitter and UC+ technology.

- **Source:** Schottky field emitter mounted on the NG hot-swap gun module
- **Source lifetime:** 1 year guaranteed
- **Acceleration Voltage:** 350 V – 30 kV
- **Landing energies:** adjustable from 20 V to 30 kV
- **Beam current:** 0.8 pA – 100 nA (0.8 pA – 100 pA in UC+ mode)
- **Resolution @ optimum WD:** (the room needs to meet the installation requirements)
  - 0.6 nm @ 2 – 15 keV landing energy
  - 0.7 nm @ 1 keV (with optional Beam Deceleration)
  - 1.0 nm @ 500 eV (with optional Beam Deceleration)
  - 1.1 nm @ 350 eV (with optional Beam Deceleration)
- **Detection:** See section below

**Scanning system**
High-resolution digital scanning engine controlled from the User Interface.

- **Resolution:** 768x512, 1536x1024, 3072x2048, 6144x4096, Legacy settings are still available 512x442, 1024x884, 2048x1768, 4096x3536 pixels
- **Minimum Dwell Time:** 25 ns/pixel
Electronic scan rotation by n x 360 degrees

**Patterning system**
- High-resolution digital patterning engine controlled from the User Interface
  - Maximum resolution: 64k x 64k
  - Maximum pattern size: 8M pixels
  - Minimum Dwell Time: 25 ns/pixel
  - Maximum Dwell Time: 25 ms/pixel
- Multiple pattern shapes
- Variable dwell time pattern to give 3D milling
- Complex milling patterns through Bitmap import

**Detection**
The Helios Hydra UX features, besides the traditional Everhart-Thornley detector for conventional SE detection, a suite of in-column and below-the-lens detectors to collect and discriminate as precisely as possible all the signal available.

Inside the Elstar FESEM column, the through-the-lens detector (TLD), collecting SE and high-loss BSE, is specially designed for high-resolution imaging at both high and low energies. It supports the SE energy range selection to access specific information such as voltage contrast.

Located above the TLD, an additional detector (optional):
- The In-Column Detector, detecting with high sensitivity no loss backscatter electrons, or when used with beam deceleration, enabling superb imaging at very low landing energies

Elstar’s immersion mode enables a high SE/BSE collection efficiency for the in-lens detection.

Below the Helios SEM objective lens, two detectors are available:
- The retractable DBS (Directional Back Scatter) detector (optional), a highly sensitive low voltage solid state detector optimized for low energy electron large solid angle detection. It can be used in combination with beam deceleration to optimize materials contrast and/or obtain mixed topographic and materials images
- The retractable STEM-III+ detector (optional), for bright-, dark- and high-angle dark-field imaging and for nano-analysis of thin samples

The ICE detector (included) is suitable for secondary ion and electron detection. Its novel design is optimized for imaging with the ion column in both ion and electron collection mode. The patented ion detection scheme provides revolutionary secondary ion imaging. Additionally, ICE has a high current and low current mode, increasing the useful beam current dynamic range. The ICE detector can be used in combination with charge neutralizer (optional), enabling secondary ion imaging while the specimen is flooded with electrons to neutralize charge.

Dual endpoint control monitor during milling, high sensitivity stage current and secondary electron plots (simultaneous), allows for very advanced monitoring of the milling process.

Two cameras are available:
- An integrated IR-CCD camera is standard for in-chamber viewing stage and sample position with respect to electron and ion columns and other in-chamber accessories
- The optional Nav-Cam+, a color optical camera that allows the acquisition of an in-situ, top down, 6 megapixel resolution image with a horizontal field width of approximately 70 mm. This image automatically registers with the SEM coordinates and is used both to document and easily navigate on the sample

**Imaging**
Images are displayed in an area of 1536 x 1024 pixels, configurable for single frame display or 4 quadrant display (768x512 pixels). Simultaneously, one of the 4-quad images can be displayed in full-screen mode on the 2nd LCD
monitor. Images can be viewed live (up to 4 channels), averaged or integrated. Images can be saved in TIFF, BMP or JPEG file formats, and in 8-bit, 16-bit or 24-bit depth, to the hard disk or LAN from the graphical user interface. Image printing is also available from the user interface.

**Patterning**
Predefined patterns can be drawn in overlay in any of the four quadrants in the UI. Progress of the patterning is monitored in the User Interface through a progress bar. End-point detection is available through a specimen current graph and a software-integrated Real-Time Monitor. Simultaneous imaging and patterning is a standard feature of the Helios Hydra.

**Integrated Real-Time Monitor (iRTM)**
The integrated real-time monitor displays a live image within the patterning window during ion beam patterning (imaging, deposition or milling). The intensity (image brightness) is proportional to the level of the detector signal (amount of secondary particles being detected during patterning). As such, the real-time monitor can give instant feedback on the ion beam process. This is typically most useful when milling through a stack with different material layers. Since the yield of secondary particles changes when transitioning from one layer to the next, it is possible to follow the progress by monitoring the brightness changes on the real-time monitor. The real-time monitor is highly recommended for such tasks as device edit and micro-/nano-machining.

**System control**
The Helios Hydra DualBeam is controlled from a Windows Graphical User Interface running at 1920 x 1200 screen resolution on a dedicated microscope controller. A support computer is standard on the system for software utilities that could interfere with the control software running on the controller (e.g. LAN connection). The system includes two 24-inch widescreen LCD monitors (a 3rd monitor for support or a 3rd party computer is optional) placed on optional Operator's Table or height-adjustable office desk. The two computers are seamlessly sharing a single keyboard and mouse. In the two monitors configuration, one of the LCD monitors can be used both for the full-screen image and the support computer desktop displayed via Windows Remote Desktop technology. The two computers are controlled with a single keyboard and mouse. A manual user interface allows for hands-on control of focus, stigmation, magnification, XY fine position, and contrast/brightness in addition to standard mouse control. The stage can be controlled through the graphical user interface by the mouse, the keyboard or by the optional, specifically tailored joystick.

**RAPID**
This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (>5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website.

**Installation requirements**
Please refer to the Helios Hydra Pre-Installation Manual.

**1111905 Auto Slice & View™ 4**
Auto Slice and View 4 is the fourth generation of Thermo Fisher Scientific’s automation software for automated serial sectioning and imaging through a user-defined volume of a specimen. The sequence of images captured by Auto Slice and View 4 can be compiled into a video or can be used as input for 3-dimensional reconstruction of the sliced volume.
Auto Slice and View 4 includes a number of key enhancements to improve automation success, increase reliability, provide feedback and facilitate setup and process monitoring/pausing and re-starting over the previous versions. Some notable key features include:
- Dedicated solution that unifies image acquisition and analytical mapping. Auto Slice and View 4 now enables you to acquire all the information on every slice.
- Dedicated user interface that guides the user with a step-by-step process.
- Acquisition of multiple images with independent settings (resolution, dwell, FOV, detector, kV) for each slice
- Acquisition of multiple regions of interests and the ability to define new regions on interests during the fulfillment of the slice and view.
- Enhanced repeatability of FIB cut placement.
- Image recognition of fiducials with confidence indication/limits to ensure accurate slice placement and/or pause automation
- Enhanced throughput with the ability to only image the regions of interest where there is relevant content in the sample
- Recoverability and continuation if an error condition is encountered
- Project/Job management to save, export and import project parameters for quicker setup of routine processes
- Low vacuum electron beam imaging and drift suppressed milling are supported for low vacuum enabled instruments to facilitate investigation of non-conductive sample volumes.

1129201 AutoTEM 4
AutoTEM 4 is a new generation of Thermo Fisher Scientific’s software for automated preparation of S/TEM samples and cross-sectioning with a DualBeam™. It is a unique solution with highly configurable workflow to enable preparation of a wide range of samples. AutoTEM 4 software includes:
- Complete in-situ sample preparation workflow, featuring
  - Fully unattended multi-site chunking
  - User guided lift-out
  - Automated final thinning with low-kV cleaning
- Fully unattended multi-site ex-situ lift-out sample preparation workflow
- Fully unattended multi-site cross-sectioning capability

Chunk Milling includes adding a protection layer and fiducial over an area of interest which can be customized and automated including both electron beam and ion beam deposition layers. It also contains milling of trenches, undercut and bulk cleanup steps. Chunk Milling can also be used to create an array of cross-sections or ex-situ lift-out samples. Lift-out automation uses guided steps to move the manipulator and stage to the correct places when the user follows simple on-screen instructions, minimizing the interaction time with microscope UI. Support of GIS-free attachment to the grid further simplifies and speeds up the lift-out process, resulting in an average time of 10 minutes for the whole lift-out step.

Final thinning of a lamella on the grid can be done automatically. Different strategies are available to thin the sample, including customizable windows, which helps to handle challenging samples. An automated low voltage final cleaning capability in AutoTEM 4 ensures creation of highest quality ultra-thin TEM lamellas. End-pointing during thinning of lamella is easy with precise patterning and imaging controls. It is also possible to use pre-tilted grid holder positions with the optional STEM detector for extremely precise thickness monitoring during final thinning of S/TEM lamella.

Highest level of automation and intuitive user interface with hints and instructive graphics significantly shortens the S/TEM lamella preparation process time for expert users and enables novice users to obtain routine, highest quality results in less than one hour.

Notes:
- AutoTEM 4 requires Single GIS with Platinum or Tungsten or Carbon deposition gas chemistry.
- In order to achieve the specified performance on Helios G4 PFIB and Helios Hydra, MultiChem with Platinum and Carbon precursors is required.
- EasyLift is required for the in-situ lift-out workflow.
Maps 3 for SEM/SDB
Thermo Scientific Maps is the system automation and correlative microscopy software suite for SEM and DualBeam systems. Maps provides automated acquisition of image mosaics via easy set up and offers complete control on location, resolution and imaging parameters. Maps makes it easy to set up multiple mosaic acquisitions on a single sample, or on multiple samples loaded in the chamber. Maps also makes it easy to re-align and collect data over multiple imaging sessions.

Specifications:
- The maximum pixel resolution is 40k x 40k per tile (depends on microscope type).
- Maps corrects for non-linear stage behavior to increase navigation accuracy.
- Maps supports batch acquisition, allowing the user to schedule acquisition of multiple areas in one job, saving supervised time.
- Microscope real-time stitching of tiled images can be carried out concurrent with image acquisition.
- Export of stitched tile sets or user defined areas to TIFF or HD View compatible formats.
- Maps image data can be saved in RAW formator TIFF format.

Maps 3 Offline
Maps 3 Offline is intended for running on dedicated image processing computers. The main capabilities include:
- Access to Maps 2 and Maps 3 projects.
- Offline Stitching including batch processing of tile sets or subsets.
- Export stitched tile sets to TIFF or HDView compatible format.
- Maps 3 Offline can be connected to multiple Maps.

Electron Beam Deceleration
Electron Beam Deceleration enables:
- Improved resolution at landing energies of 2 kV and lower
- Landing energies 50 V – 30 kV
- Stage bias between -4 kV and -50 V

This part number (1081786) is available for Helios NanoLab G3 CX, Helios G4 / 5 CX, Helios G4 PFIB and Helios Hydra.

Compressor 230 V, 108 l/min, 230 V, 50/60 Hz
The oil-free compressor is needed if high-flow compressed air facilities are not available. Compressed air is required for air cooling of the plasma FIB source, operating pneumatic valves and the microscope’s leveling system. The compressor is connected to the mains supply unit of the microscope.

Charge Neutralizer
The Charge Neutralizer is an electron source and control system to minimize positive ion charge-up on glass and other highly insulating surfaces. The electron source produces a broad beam which floods the sample with up to 1 µA of low energy electrons (@200 eV), thus neutralizing any positive charge built up on the sample surface during ion beam use. The reduction of charge makes it possible to accurately mill and image with the ion beam even on completely non-conducting samples.

This option (1117423) is suitable for Helios G4 and 5, Helios PFIB and Centrios FIB systems. On Helios G4 / 5 UC and CX systems it requires presence of ICE Detector (1094663).

Estar In-Column Detector (ICD)
The Estar In-Column Detector, located in the Estar SEM final lens above the TLD, is a high-sensitivity in-column detector with excellent direct detection of low loss backscatter electrons. When used with Electron Beam Deceleration (1081786), it enables superb imaging at very low landing energies.

This Estar In-Column detector (1201713) is suitable for Helios G4 PFIB and Helios Hydra.
1128677 Retractable DBS detector
The annular, Back-scattered (BS) detector (called the DBS – Directional Back Scatter detector) is an ultra-sensitive, Solid State (SS) detector which is sensitive to emitted electrons from 500 V onwards. Using Beam deceleration (sample bias to reduce the landing energy), images with beam landing energies down to 50 V are possible. Especially when Beam Deceleration is applied in combination with immersion field, it is possible to detect all BS electrons emitted up to 90 degrees.

The retractable DBS detector features four annular and three azimuthal segments that enable separate detection of electrons emitted at different angles. User can switch between two detector modes:
ABS – for distinguishing four ranges of annular angles
CBS – for distinguishing two annular and 3 azimuthal angle ranges

In both modes, signal from four independent detector segments can be acquired simultaneously, and mixing based on adding / subtracting individual signals is possible. This way it is possible to select multiple contrasts (material and topographical) that can be optimized per application.

This detector is mounted on a software-controlled retractable arm and allows simultaneous EDS spectra acquisition for WD ≥ 5 mm. Fast imaging becomes possible with this detector.

This Retractable DBS detector (1128677) is suitable for Helios G4 / 5 HX, HP, UX, UC and CX, Verios G4 HP and UC, Helios G4 PFIB CXe, HXe, UXe and Helios Hydra. It requires the presence of the STEM/DBS integration kit (1128675). If a Retractable STEM 3+ detector is configured to the system, also the STEM/DBS Upgrade Kit (1128685) has to be included.

1128681 Retractable STEM 3+ Detector
The retractable STEM 3+ detector enables scanning transmission imaging on thin samples in SEM and DualBeam instruments. It consists of three concentric, ring-shaped sections:
- Inner section - for bright field imaging
- Intermediate section - sub-divided in 4 annular rings, for tunable dark-field imaging and enhanced compositional contrast.
- Outer section - sub-divided into six angular segments, for high angle dark field imaging.

The xT software supports easy switching between imaging modes and the display of up to 4 STEM signals simultaneously. With the retractable STEM 3+ detector there is no need to vent the chamber to insert or remove the detector. The detector includes a special sample holder that can hold up to six TEM grids and which is compatible with the UMB holder. It also includes the load base.

This Retractable STEM 3+ detector (1128681) is suitable for Helios G4 UX and UC, Helios G4 PFIB UXe, Helios Hydra UX and Verios G4 UC. It requires the presence of a STEM / DBS integration kit (1128675). If the Retractable DBS detector (1128677) is also added to the system, the STEM/DBS Upgrade Kit (1128685) must be included as well.

1128675 STEM / DBS integration kit
Common infrastructure needed for Retractable DBS detector (1094680 or 1128677) and/or Retractable STEM 3+ detector (1128681 / 1128683 / 1211190 / 1213698 / 1213700) for Helios G4 / 5, Helios Hydra and Verios G4 systems.

1128685 STEM/DBS Upgrade Kit
Common infrastructure needed for the combination of Retractable DBS detector (1128677) and Retractable STEM 3+ detector (1128681 / 1128683 / 1211190 / 1213698 / 1213700) on the following systems: Helios G4 / 5 UX, UC and CX, Helios G4 PFIB CXe and UXe, Helios Hydra, and Verios G4 UC.

1026861 EDS Installation by Thermo Fisher Scientific (EM)
Installation of EDS detector by a Thermo Fisher Scientific Service Engineer.
1137506 Thermo Scientific Pathfinder EDS UltraDry 60M (129 eV)
- UltraDry Premium EDS detector for small dual beam chamber SEM
- Active area of 60 mm² and 129 eV energy resolution at Mn k-alpha
- Norvar window with proprietary evacuated tube design for detection sensitivity to Be
- Analyzer electronics with up to 1,000,000 x-ray input counts per second and 400,000 x-ray output counts per second.
- Motorized slide for software controllable insertion / retraction.

Pathfinder Alpine level software features
- Standardless quantitative analysis with ZAF, Proza, and Cliff Lorimer matrix corrections.
- Point and Shoot acquisition with electron image overlay
- Linescan acquisition with electron image overlay
- Spectral Imaging up to 1024 pixels with spectral extractions of user defined shapes and line scans.
- Ultra high resolution EDS element mapping with electron image overlay.
- EXTREME Element mapping with background subtraction, peak deconvolution and quantitative analysis in each pixel both during live time and in post-processing.
- EXTREME Elemental line scan acquisition and display with background subtraction, peak deconvolution and quantitative analysis at each point.
- Full Standards-based quantitative analysis.
- Automatic drift compensation
- Spectral Match capability with Spectral library
- Includes Microscope Column Communication Software with read/write of selected parameters.
- Requires customer-provided Microsoft Word® for report generation

1137518 Pathfinder Alpine Upgrade to Pinnacle
Pathfinder Alpine Upgrade to Pinnacle adds the following features to Pathfinder Alpine software:
- X-phase for EDS elemental map phase mapping
- Direct-to-Phase with Compass Principal Component Analysis for advanced, live-time Phase mapping with no need for elemental identification or quantification
- Analysis Automation for stage-controlled and templated acquisitions
- X-ray imaging filters for 29 unique smoothing, sharpening and edge-finding filters

Pathfinder Alpine Upgrade to Pinnacle on Prisma requires the presence of Pathfinder Alpine EDS System (1220198); on all other systems it requires the presence of an UltraDry EDS Detector.

1209246 System Covers
The System Covers are required to complement the main Helios Hydra instrument when no acoustic enclosure is ordered. This option includes covers for the column and the console of the instrument.

This option (1209246) is available for Helios Hydra CX / UX

1112175 EasyLift EX NanoManipulator
The EasyLift family of NanoManipulators is Thermo Fisher Scientific’s advanced and preferred solution for in-situ sample manipulation and TEM lamella transfer. All EasyLift models are integrated with the microscope xT software to provide an easy, intuitive method for sample manipulation inside the DualBeam chamber. With motorized needle rotation included, EasyLift EX provides superior performance for TEM sample preparation. EasyLift EX includes increased precision, increased stability, and motorized needle rotation for easy preparation of traditional, plan view, and ultra-thin TEM samples.

EasyLift EX Product Features:
- Software control integrated into the DualBeam user interface
- Stable, consistent, and repeatable movement in any direction
- Closed-loop encoder feedback enabling easy restore/recall of probe positions
- Motorized, 360° control of needle rotation
- Comes with a supply of 10 replacement needles and 50 pcs of halfmoon molybdenum grids.

*EasyLift EX includes the following enhanced stability performance:*
- Smallest step size <50±30 nm
- Omni-directional repeatability <150 nm
- True Z’ movement of 500 nm over a 5 µm Z stroke
- Drift <200 nm/min in first 3 minutes after insertion

The EasyLift EX NanoManipulator (1112175) is suitable for Helios G4 / 5 UX, Helios G4 PFIB HXe / UXe and Helios Hydra UX.

**1127550 MultiChem Gas Delivery System**
Thermo Fisher Scientific’s MultiChem Gas Delivery System is a flexible gas delivery system used for precision gas assisted etching or deposition. MultiChem allows the operator to precisely control precursor flow rates and gas delivery location as well as mix two precursors prior to sample delivery. MultiChem can support up to 6 different chemistries. Simple and fast crucible replacement translates to less downtime. Application files for each available chemistry are included to optimize performance.

*Key Features*
- Gas delivery system with up to 6 chemistries
- Supports gaseous, liquid and solid precursors
- Only occupies one port of the vacuum chamber
- Capable of fine gas flow / pressure control.
- Able to mix gases
- Two injection lines with cooling capability to provide better gas flow control with high vapor pressure precursors
- Provides motorized X, Y motion suitable for gas needle alignment
- Gas crucible design does not require chamber vent or needle realignment after replacement
- Full integration in the main system user interface and applications

This option (1127550) is available for Helios G4 PFIB and Helios Hydra.

The MultiChem Gas Delivery System is installed on GIS port 4. A portable fume hood is required for crucible replacement and can either be supplied by the customer or be purchased from Thermo Fisher Scientific as a separate option.

**4022 404 41216 Installation Labor Helios Hydra UX NA**
Standard Installation Labor coverage - see Terms and Conditions

**4022 404 02216 Installation Material Helios Hydra UX**
Standard Installation Material coverage - see Terms and Conditions

**4022 404 43216 Warranty Labor Helios Hydra UX NA**
Standard Warranty Labor coverage - see Terms and Conditions

**4022 404 04216 Warranty Material Helios Hydra UX**
Standard Warranty Material coverage - see Terms and Conditions

**9425 061 69546 NA Installation Kit for Nova NanoLab / Strata / Helios / V600**
Part Number   Qty   Description
13289        25   PVP Hose
25066        1    External 10-inch water filter kit
1001224      1    Specimen stubs (20)
1020166      2    NIPPLE,SS,3/8BSPP-NPT
1020171      1    CONNECTOR,1/2IN STRT
1020172  4  CLAMP, HOSE, WORMDRIVE, 24
4022 293 39101  1  Damper assembly
4022 297 06181  5  8 mm Poly Tubing
4035 273 22521  1  Power strip, 6 out 220 IEC type
4035 273 43491  1  Chloramine-T algaecide (250 gram jar)
9425 061 69458  1  Auto Transformer 208V to 228V 7KVA
9425 061 69549  1  10 pack DVD+R x 10 - 4.7 GB Disks
9425 061 69585  1  50 ft. each - 3/8 inch Air Hose
9425 061 69586  8  Hose Clamps, Size 08
9425 061 69587  2  Brass Reducer ½”NPT – 3/8”NPT,
9425 061 69588  2  Brass Hose Barbs 3/8” NPT to 3/8” Hose
9425 061 69617  4  IEC Power cords, 6 ft.

Choose a Chiller Type – air or water cooled
9425 031 90501  1  Haskris RO33 Air Cooled Water Chiller
OR
9425 031 90511  1  Haskris RO33 Water Cooled Water Chiller

1094686  Height-adjustable Operator’s Table
130 x 80 cm large office desk with motorized height adjustment (from 67.5 to 132.5 cm), specifically designed as a workspace for Helios SDB or Verios SEM system operator. It incorporates dedicated holders for the Microscope and Support computers as well for the cables between the computers and the microscope console. It can accommodate the two 24” LCD monitors that are standard part of the main instrument, but with an optional, special holder (1094684), it can support three 24” LCD monitors.

This table is available as an alternative to the Standard Operator’s Table (1094682).

1111961  In-Chamber Nav-Cam
The In-Chamber Nav-Cam is a color optical camera for Helios G4 / 5 CX, Helios G4 PFIB CXe / UXe, and Helios Hydra. It is mounted directly to the chamber for acquiring an image of samples mounted on the specimen stage. The In-Chamber Nav-Cam is optimized to capture images at the analytical working distance when the system is under vacuum so areas of interest can be found and investigated.

Images of samples can be easily captured when the user starts the sequence. The system incorporates sample lighting and a fully integrated, software-based capture control to ensure easy operation for high-quality images. The resulting image is acquired by moving the stage to a predefined location where approximately a 160 mm horizontal field-of-view is captured. The resulting image (with a resolution of 3072 by 2048 pixels or approximately 6 megapixels) can be digitally zoomed within the user interface to locate and move to specific sample locations. It is possible to save the Nav-Cam image file within the microscope control software with or without the current-location-marker-overlay (on the display) to document sample features or areas without the need of an additional external camera or annotation software.

1085916  PFIB Column Hoist Kit
The PFIB column hoist kit is required for servicing the system ion column and work in combination with the SDB Service Crane. Thermo Fisher Scientific will not be able to provide service or maintenance on the system column unless the service crane and PFIB hoist kit are made available to the field service engineer at the time of servicing. If the crane and hoist kit are not available or not in a usable condition, Customer will be required to purchase or procure an additional unit prior to Thermo Fisher Scientific servicing the column. Customer may use the same crane and hoist kit for multiple tools at the same location.

Thermo Fisher Scientific’s failure to service the system column or related parts of the system due to the unavailability of the hoist shall not be a breach of Thermo Fisher Scientific’s warranty or any other contractual commitment including a service contract.
1074810 Service Crane SDB
The SDB service crane is needed both for the regular Elstar column maintenance (including replacement of the electron source) and troubleshooting by Thermo Fisher Scientific authorized service personnel. Therefore, it is mandatory that each customer site has at least one functional SDB service crane available.

On the other hand, the service crane is not supposed to be mounted on system during normal microscope operation, so it is usually sufficient to have just one crane in the laboratory equipped with multiple systems.

The SDB service crane is designed for all Helios, Aquilos and Scios SDBs, Centrios FIB and for Magellan and Verios SEMs.

1082739 Air Filtration System for MultiChem, 120 VAC
The Fumex FA1 is a portable, industrial indoor air cleaner utilizing a high-performance, three-stage hybrid air purification system to capture hazardous gases that may be released when replacing MultiChem crucibles. Easy to use digital controls and an integrated electronic gas sensor continuously monitor the system performance and displays operating parameters. A large-capacity prefilter protects the system’s large HEPA filter providing an extremely cost-effective, efficient air scrubbing system. This system has been tested with and is required to be used when replacing chemistry crucibles in the Thermo Scientific MultiChem Gas Delivery System. It is recommended to have at least one Fumex FA1 unit for each lab site where MultiChem units are installed and used. This version is designed specifically to work with a 120 VAC electrical supply.

1011761 Carbon Deposition Precursor for MultiChem
Gas chemistry solution (Naphthalene) for Ion or Electron beam deposition of Carbon-based material. The package includes the gas precursor crucible for the MultiChem Gas Delivery System and is shipped with the basic SEM/FIB/SDB/WDB system and is assembled on site.

1011759 Platinum Deposition Precursor for MultiChem
Gas chemistry solution for Ion or Electron beam deposition of Platinum-containing material. Platinum gas chemistry is the preferred metal deposition in applications where ease of use, high deposition rates and precision of the deposition are required. The package includes the gas precursor crucible for the MultiChem Gas Delivery System. This gas chemistry crucible is shipped with the basic SEM/FIB/SDB system and is assembled on site.

1011757 Tungsten Deposition Precursor for MultiChem
Gas chemistry solution for Ion or Electron beam deposition of Tungsten-containing material. Tungsten gas chemistry is the preferred metal deposition in case low electrical resistance of the deposited material is required. The package includes the gas precursor crucible for the MultiChem Gas Delivery System and is shipped with the basic SEM/FIB/SDB system and is assembled on site.

1244136 Flange G1 for UltraDry 60M
Flange for EDS Detector to port G1 of SDB chamber The flange is suitable for EDS Thermo Fisher Scientific: - UltraDry 60M - UltraDry 30M - UltraDry 10M Important: - The EDS detector in port G1 has longer detector to sample distance and consequently smaller solid angle and collection efficiency (20%) compared to the default port X for Dual Beam Systems. - Requires free port G1 (not compatible with the GIS, MultiChem or EasyLift in G1)

1218774 Modified column covers for EDS in G1
Modified column covers to accept EDS in port G1

1215047 Time of Flight (ToF) SIMS TOFwerk
"The Secondary ion mass spectroscope - Time of Flight detector (SIMS TOF) SIMS TOF includes: - CTOF from ToFWerks company integrated to X-port of SDB chamber (Not compatible with EDS in default position) - SDB system modification to fit TOF-SIMS unit TOF-SIMS has following expected features: - Detection limit: few ppm On bulk sample: actual value strongly dependent on sample matrix - Lateral resolution: < 50 nm Measured by integrated line profile on BAM test sample L200f - Depth resolution: < 20 nm For 5 kV Ga FIB. Lower at 5 kV - Maximum mass: 500-600 Th - Expected limit for Ga / Xe excitation - Mass resolution: 800 - M/ΔM at M around 120 - Minimum dwell time: 10 μs - Equal to 100 kHz sampling rate at mass 180 - Detector to sample distance: < 7 mm For optimum ion transmission - Isootope analysis - Retractable - Isolation valve with Getter NEG pump
TOF SIMS installation and training
Installation, system validation and application training of TOF SIMS device (non EU) - Installation will be done by engineer from Thermo Fisher Scientific Brno production site - Customer training by Business unit SIMS specialist Installation of TOF SIMS unit is done after standard SAT testing

24” Widescreen LCD Monitor
Specifications of the 24” Widescreen LCD monitor:
- 16.77 million colors
- High performance IPS TFT 16:10 display
- On-screen user control via on-screen manager (OSM)
- Intelligent power manager

Display: 61.1 cm (24.1 inch)
0.270 mm dot pitch, 300 cd/m²
1000:1 contrast ratio
<16 ms response time
Resolution: 1920 x 1200 at 60 Hz refresh rate (optimum)

Manual user interface with integrated keyboard
The Next Gen Manual User Interface (NG.MUI) is designed to reduce ergonomic strain by placing all of the system controls within the Zone of Convenient Reach. The NG.MUI combines a backlit keyboard and control dials for Magnification, Focus, Shift, and Stigmation into a single console. Programmable Hot keys with OLED display are also included to simplify system operation.

Remote Control / Imaging
Remote Control / Imaging is a Remote Control package that enables full control of the microscope via another computer across a network. The imaging transfer speed and the remote system responsiveness is determined by the speed and quality of the network connection. 100 Mbps LAN connection is sufficient for most use cases.

The Remote Control / Imaging package contains a perpetual license for the Radmin Remote Control software, which is compatible with all Windows OS versions available on the Microscope and Support computers.

Triple Monitor Stand
Sturdy, high quality, ergonomic stand for holding three 24” LCD monitors. The adjustable design allows the operator to position the monitors at eye level, improving the ergonomics of the workspace.

This item (1094684) is mandatory when an additional 24” LCD monitor (1016773) is selected.

Quick Loader
The Quick Loader is designed to load regular, 12.5 mm to 32 mm size sample stubs into the specimen chamber via a chamber port without breaking the working vacuum. This alone helps provide a cleaner environment for electron optical work to proceed. With an exchange time of less than one minute from sample to sample loading and unloading is invariably faster than system door entry, providing more time for observation and analysis.

The vacuum operation is totally integrated into the vacuum of the SDB or SEM it is loading and therefore utilizes all necessary internal safety interlocks. Operation is via indicating buttons for only Pump and Vent on the Quick Loader console, thus simplifying the loading and unloading cycles. Stage location is automatically set when either Pump or Vent buttons are pressed allowing immediate loading/unloading at the computed position to take place.
The Quick Loader can be upgraded at any time to cryogenic operation. With the addition of a CryoMAT kit (FP 3610/09), the Quick Loader transforms to a cryo-stage version for cooling non-hydrated samples. This proves to be very useful for FIB work or even just observing Polymers, composites and other beam or vacuum sensitive samples. The addition of CryoMAT does not compromise the operation of the Quick Loader as a room temperature loader.

**Key points**
- Fast pumping time of 25 seconds
- Image to image less than 1.5 minutes
- Integrated into microscope vacuum system
- Uses system safety interlocks
- Software automated control of stage positioning
- Upgradeable to CryoMAT

This part number (1095705) is suitable for Verios G4 UC, Helios G4 / 5 UX / UC / CX, Helios G4 PFIB CXe and UXe, Helios Hydra, and for Scios 2 systems. It cannot be combined with Cryo Interlock Kit (1099932).

**1031135 Quick Loader-compatible STEM Holder**

With this specimen holder, samples on a 3-mm S/TEM grid can be observed using the Retractable STEM-3(+) detector option and (un)loaded using the Quick Loader option. It will be possible to carry out STEM imaging directly after in-situ liftout without having to vent the chamber.

With the included pre-tilted shuttle it is also possible to do sample thinning at stage tilt 0° using the ion column in an Small DualBeam tool. A stage tilt of +38° with Retractable STEM detector inserted for imaging is supported with software release V3.8.6 (and up) for Helios NanoLab.

The pre-tilted shuttle can also be used without the Retractable STEM detector to enable low-background EDS on grids (@ stage tilt +38°) or to enable cross-section viewing (@ stage tilt +52° & rotation 180°).

The kit consists of:
- Stage adaptor for sample shuttles compatible with retractable STEM detector, allowing insertion of these shuttles with a Quick loader
- One (1) sample shuttle for one pre-tilted STEM row holder and one stub-based sample of 1” diameter or less
- One (1) sample shuttle for one horizontally mounted STEM row holder and one stub-based sample
- Two (2) STEM lamella row holders with 3 grid positions

**Notes:**
- Shuttles are not compatible with original Quick Loader adaptor base
- Quick Loader, Retractable STEM detector and Load base for STEM samples must be ordered separately
- This option is available for Apreo, Quattro, Verios G4 UC, Helios NanoLab G3 CX, G3 UC, 6X0, 600i, Helios G4 UX / CX, Helios 5 UX / CX, Helios G4 PFIB CXe and UXe, Helios Hydra, Scios, Nova NanoSEM x50, Quanta 3D FEG and Versa 3D
- This option can be used for non-STEM use cases on Inspect and Quanta SEM’s

**4022 400 44231 DDP Brno / Named place of destination; receiving dock in North America (T-3)**

Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination. In accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.
FP 3660/05  UMB FIB/TEM Specimen Holder Kit
TEM specimen holder kit containing 2 row holders for 6 TEM samples each. Also included are 2 row holder carriers, a storage box and a sample loading base. FP 3660/00 UMB Stub holder kit is required for this option.

FP 3660/00  UMB Stub holder kit
Specimen stub holder kit containing the following items:
- Universal mounting base (UMB)
- 2 stub modules each holding 3 ½ inch stubs or 2 1 inch stubs
- 2 clamp bars
- User guide
- Storage box
- System calibration sample

9425 060 99100  On-site Applications Training - Americas (1 day)
On-site applications training, per day, including all travel and expenses. For customers located in the Americas. Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3) consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not ordered as part of a microscope purchase).

1060166  Avizo for EM Systems (Materials Science) - Local, 1-user License
Avizo for EM Systems is a software package for advanced visualization and analysis of reconstructed tomography data, acquired using electron and correlative microscopy systems. Avizo for EM Systems consists of the base Avizo package, augmented with various additional packages. A license is included for 1 (one) user that is restricted to a single designated workstation and includes 12 (twelve) months of maintenance service (hotline and product upgrades).

Avizo is a software package for rapid exploration and analysis of 3D-image data, as well as for generation of numerical 3D models for advanced analysis and simulation. Avizo for EM Systems is a tailored version of the Avizo software, solely distributed by Thermo Fisher Scientific, currently published by the Thermo Fisher Scientific’s Visualization Sciences Group; more information can be found at http://www.avizo3d.com.

Avizo for EM Systems includes dedicated data import filters for loading EM data obtained from Thermo Scientific tools into the software. The software also supports image to image alignment with pixel accuracy. Visualization modules include orthographic and oblique sections, efficient surface, mesh and volume rendering, iso-surfacing and iso-lines, simultaneous display of multiple datasets, virtual 3D navigation, movie clip generation, animation generation tools, and more. Thanks to the embedded XLVolume module, Avizo for EM Systems can display even very large datasets (up to hundreds of GB) at interactive speed on regular desktop or laptop computers.

The dedicated DualBeam™ 3D Wizard provides a unique and efficient support for the FIB/SEM image data acquisition workflow. Avizo for EM Systems supports a variety of semi-automatic and interactive tools for segmentation, providing the ability to construct 3D models of structures present in the image data, and defining complex regions of interest for analysis purposes. It comes with numerous tools for data analysis, including data probing, measurement of distances, regions, and volumes, and advanced quantification and statistical analysis tools on multiple regions of interest.

Avizo for EM Systems offers support for presentations, by providing the capability of making snapshots, exporting movie files and single images, as well as 3D representations by exploiting advanced stereoscopic display technology.

The Avizo for EM Systems - Materials Science provides a comprehensive digital lab for advanced 2D and 3D materials characterization, especially aimed at scientists and engineers who require insight into the details of materials properties on full 3D structures in a wide range of materials science research areas and for many types of materials (porous materials, metals and alloys, fibrous materials, composites, food…).
The license for Avizo for EM Systems includes one year of Maintenance Service (which features on-line help via the World Wide Web and free-of-charge updates, both for the duration of one year). Upgrades and/or updates to Avizo for EM Systems after the initial year of Maintenance Service will require the payment of software maintenance fees. The Maintenance Service for Avizo for EM Systems (including help, updates, and ongoing software maintenance) will be provided directly by Thermo Fisher Scientific Visualization Sciences Group. Details and Terms & Conditions of the Avizo Maintenance Service can be found on the Thermo Fisher Scientific website.

The warranty period for Avizo is started six months after the software is shipped from the Visualization Sciences Group, which might result in a reduced warranty period on-site, in case of long microscope installation times.

Avizo software yearly maintenance service is not part of the Thermo Fisher Scientific system support service. Thermo Scientific system customers will receive a separate maintenance renewal offer for the Avizo software.

**Platform requirements**
- Avizo for EM Systems runs on:
  - Microsoft Windows 64-bit
  - Linux x86_64 (64-bit)
  - Mac OS X (64-bit)
- A 2 GHz minimum CPU processor is required. Multi-core CPUs recommended. 16 GB RAM minimum is required; 32 GB recommended.
- A graphic board which supports a complete implementation of OpenGL is required. Recent graphic board supporting OpenGL 3D texturing and programmable shaders is recommended.

For detailed information on supported and recommended hardware and operating systems for Avizo for EM Systems please read the [Amira-Avizo System Requirements](https://developer.nvidia.com/cuda-gpus) on the Thermo Fisher Scientific website.
NEXSA XPS

QUOTATION for
University of Missouri – Science & Technology

Attn: Dr. Scott Miller

Quote Date: March 02, 2020
Quote Number: QUO-115854-V3H8 R0
Expires: June 26, 2020

Prepared By Jim Smit, Sr. Account Manager
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jim.smith@thermofisher.com
Solution Description

1200502 Nexsa
The Thermo Scientific™ Nexsa™ XPS System offers fully automated multi-technique analysis, for high throughput, research grade results. A high specification micro-focused Al Kα X-ray source is complemented by patented features such as co-axial, dual-beam charge compensation for insulator analysis, and reflex optical viewing to allow rapid identification and analysis of small features. The XPS SnapMap feature further enhances analysis by enabling rapid mapping of sample chemistry over small areas, to identify and detect subtle differences which may not be detectable otherwise.

The option of adding further analytical techniques, including ISS, UPS, REELS and Raman, integrated onto the same platform allows users to conduct true correlative analysis. This capability unlocks the potential for analysis to drive advances in microelectronics, ultra-thin films, nanotechnology development and many other applications.

Features and specifications:

**Electron Energy Analyzer**
- Double-focusing hemispherical analyzer
- Multi-element input lens
- 125 mm mean radius, full 180° hemispherical analyzer
- 128 channel position sensitive detector
- Operating mode Constant Analyzer Energy (CAE)
- Scanned mode, snapshot mode and SnapMap mode

**Microfocused monochromated x-ray source**
- 0.25 m Rowland circle monochromator with micro-focused X-ray source
- 12 keV nominal operating voltage electron source
- Motorized, water-cooled aluminum-coated anode with >20 operating positions.
- Single toroidal quartz crystal, adjustable from the data system with three degrees of freedom
- X-ray spot sizes user selectable in 5 µm steps in the range 10 - 400 µm
- 72 W Maximum power (400 µm X-ray spot)
- High voltage, coolant, vacuum, and mechanical interlocks

**High performance color optical system for precise alignment of analysis position.**
- Three alignment views are always available
- Platter View: Automatically recorded image of the sample holder in the loadlock, used to navigate between the samples mounted on the holder.
- Reflex Optics View: Live, high-magnification view of the analysis position for alignment of features on the sample with the analysis position.
- Height Setting View: Live, high-magnification view of the analysis position, used to ensure that the sample is at the correct working distance from the photoelectron transfer lens.
Sample illumination
- Off-Axis: Used for samples having a rough surface.
- On-Axis: Used for smooth or highly reflective samples.

XPS SnapMap
- Rapid XPS imaging capability integrated into the optical view for feature identification and alignment.
- Four user-selectable areas for imaging are available, with full range of energy selection for the image.

4-Axis Specimen Stage
High precision, automated specimen stage with internal stepper motors
- Standard samples, apertures and knife edges built into the stage for calibration and alignment
- Calibration samples: Cu foil, Ag foil, Au foil
- Phosphorescent sample for X-ray spot alignment
- Cu knife edge and grid for X-ray spot size measurement
- Range of aperture sizes for ion beam alignment and focusing
- Stage controller interfaced to the Avantage software
- Two multi-specimen mounting plates
- Maximum specimen dimensions 60 x 60 x 20 mm
- One mounting plate for powder samples
- One mounting plate for fiber samples
- One set of three rotation holders (maximum specimen dimensions 30 mm diameter 15 mm thick)
- One mounting plate for use in combination with a rotation holder
- Sample plate carrier
(Additional sample holders are available on request)

Sample Transfer
Automated specimen transfer mechanism controlled from Avantage software

Integral Bakeout System
- Control of temperature and bakeout time
- Interlocked with ion gauge pressure
- No requirement to remove cables
- Integral bakeout covers

Vacuum System and Control
- Vacuum system controlled from Avantage software.
- 260 L/s-1 turbomolecular pump for analysis chamber
- 260 L/s-1 turbomolecular pump for loadlock chamber
- Data system controlled titanium sublimation pump in analysis chamber
- Combined Pirani and ion gauge head and controller for analysis chamber
- Combined Pirani and ion gauge head and controller for load-lock chamber
- Pirani gauge for backing pump

System Control Electronics
- Fully integrated into system enclosure
- Fully under the control of the Avantage software

Avantage Software
- Full control of all aspects of XPS data acquisition (including spectra, SAXPS, line scans, maps, depth profiles)
- Lighting and optical system
- Sample transfer and stage control
- Wide range of XPS data processing capabilities
- Report generation
- Calibration and alignment of sources, analyzer and detector
- All electronics
- Vacuum system
- One Avantage Acquisition and Processing License is supplied for the main instrument computer
- One Avantage Processing License is supplied for data processing on another computer (not supplied)

**System Performance and Acceptance**

Please refer to the Nexsa Technical Specifications document for details of the system performance specifications. After installation of the system at the customer’s site, all main specifications are proven again in a System Acceptance Test (tests proven are marked with an asterisk in the specifications document).

**Installation requirements**

Please refer to the Nexsa Site Preparation guide for specific installation requirements.

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### 1200529 Charge Compensation

Combined Low-energy Electron / Ion Flood Source for Charge Neutralization

- Patented dual-beam low energy electron / ion source
- Low energy-spread, high brightness electron source
- Electron beam energy 0 - 5 eV
- Electron beam emission up to 250 µA
- High precision gas inlet for inert gas admission
- Integral differential pumping
- Useable with Inert gases. Argon is recommended.

### 1200534 iXR Raman Spectrometer

iXR Raman spectrometer unit with optical integration to the analysis chamber and alignment to the XPS analysis position. 532 nm laser kit included (alternative laser kits available upon request). Omnic software for system operation installed on system PC, with control from Avantage enabled.

- Laser Classification (normal operation) Class 1
- Laser Center Wavelength 532 ± 1 nm
- Laser Type Diode-pumped, solid state (DPSS)
- Maximum Laser Power at Sample 10.0 mW
- Laser Power Resolution 0.1 mW
- Spot size at sample Typically less than 15 µm
- Spectrograph Design Triplet Spectrograph with no moving parts
- 4 software-selectable apertures 25 and 50 µm pinhole apertures
- 25 and 50 µm slit apertures
- Spectral Resolution Better than 5.0 cm⁻¹ FWHM
- Spectral Dispersion 2 cm⁻¹/CCD pixel element
- Upper Cutoff 3400 cm⁻¹
- Lower Cutoff 50 cm⁻¹

The system spectral resolution is measured using ASTM Method E2529-06 and a 100× objective prior to fitting the spectrometer.

### 1200521 XPS Analyzer Electronics

- Energy range (kinetic energy) 5 – 1500 eV
- Minimum energy step size 3 meV
- Pass energy 1 – 400 eV continuously selectable

### 1149066 Closed Circuit Water Chiller (110 V, 60 Hz)

- Water chiller unit with 1000 W @ 20 °C cooling capacity
- Water temperature regulator and flow control
1200536 Computer
PC with Microsoft Windows™
Avantage software installed and system operation parameters set-up during system testing
Minimum PC specifications:
- Core i3 3.7 GHz Processor
- 8 GB DDR3 RAM
- 1 TB hard drive
- DVD ReWriter
- 23” LCD Widescreen Monitor
- Mouse and keyboard
A desk for the PC is not supplied with the system

4022 404 41222 Installation Labor Nexsa NA
Standard Installation Labor coverage - see Terms and Conditions

4022 404 02222 Installation Material Nexsa
Standard Installation Material coverage - see Terms and Conditions

4022 404 43222 Warranty Labor Nexsa NA
Standard Warranty Labor coverage - see Terms and Conditions

4022 404 04222 Warranty Material Nexsa
Standard Warranty Material coverage - see Terms and Conditions

1200509 EX06 Ion Source
- EX06 series differentially pumped electron impact source with dual electrostatic lenses and floating flight tube
- High precision leak rate gas inlet
- Differential pumping
- Automated beam alignment and focusing
- Gases possible: Ar, He, Ne, Xe (argon recommended)
- Beam energy 200 eV to 4 keV
- Maximum Ar beam current ≥ 4 µA at 3 keV
- Spot size <500 µm @ 3.5 µA and 3 keV
- Steerable by electrostatic deflector plates and controlled by electronic scan unit.
- Chamber pressure typically better than 2 × 10⁻⁷ mbar

1200542 Mains Cable North America
Single phase input mains cable with US color coding for all system operation, including bakeout

1200507 Standard Entry Lock
- Pneumatically driven Entrylock door
- Automated operation from software
- Door open/close detection

1200589 On Site Training (per day)
Training on-site, charged per day

The price includes:
- Applications Engineer Travel costs
- Applications Engineer Hotel accommodation
- Training Materials
- The application scientist’s or engineer’s time
Courses should be a minimum of three days duration

This training course is provided at the customer site (recommended up to 6 attendees per course). This training is custom to the customer’s requirements, and a suitable timetable will be agreed either before or at the start of such a course. The timing of such training courses will normally be agreed between the customer and applications laboratory personnel for a mutually convenient time, typically a few months after the system has been accepted to allow for familiarization with the general operation of the instrument.

On-site training courses must be used within 2 years of the instrument being installed, unless prior agreement is made.

**4022 400 44211** DDP Brno / Named place of destination; receiving dock in North America (T-1)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination. In accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

**1200513** Oil Pumping for EX06 system
- Rotary backing pump for analysis chamber and Entrylock
Prisma ColorSEM

QUOTATION for
University of Missouri – Science & Technology
Attn: Dr. Scott Miller

Quote Date: March 02, 2020
Quote Number: QUO-98306-P0P6 R0
Expires: June 26, 2020

Prepared By
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Mobile: +1 260.579.1302
jim.smith@thermofisher.com
Solution Description

1200267 Prisma E
The Prisma E is a versatile, high-resolution scanning electron microscope with a thermionic electron source. It is well suited for routine materials characterization, industrial failure analysis and quality control. The Prisma E is capable of generating and collecting all available information from any type of sample material.

Features and Specifications

Vacuum
The Prisma E can be freely and simply switched between three vacuum modes, which enables investigation of conductive, non-conductive and high-vacuum incompatible materials:
- High-vacuum mode (<6*10^-4 Pa) for imaging and microanalysis of conductive and/or conventionally prepared specimens;
- Low-vacuum mode (10 to 130 Pa) for imaging and microanalysis of non-conductive specimens without preparation;
- ESEM™ mode (10 to 4000 Pa) for high-vacuum incompatible specimens which are impossible to investigate with traditional EM methods.

Features of the vacuum system include:
- Patented, through-the-lens (ESEM) differential pumping technology;
- 250 l/s turbomolecular drag pump;
- 1 rotary pump;
- Vacuum buffer to reduce energy consumption
- Seamless transition between the vacuum modes;
- Water vapor imaging gas is standard.

Key benefits of this design and technology are very short beam-gas path lengths for optimized beam brightness under gaseous conditions and the high chamber pressures that can be achieved in ESEM mode.

Sample Navigation
Prisma E equipped with a 5-axes motorized x-y-z-t-r stage, providing movements:
- X and Y range: 110 mm (motorized); Z range: 65 mm (motorized)
- Tilt: -15 to +90 degrees (motorized)
- Eucentric tilt
- A unique standard specimen holder with labeled positions and unique stage mounting, allowing simultaneous loading of 18 standard samples (Ø 12 mm) or 6 large samples (Ø 25 mm). Positions are predefined in the UI for easy navigation.

A selection of additional sample holder kits is optionally available (including stub holders, pre-tilted samples, row bars (vertical, and 52° pre-tilted), spring-loaded clamp holder for mounting cross-sections, additional TEM sample holders and vise specimen holders).

Convenient control of X & Y stage translation is activated by pressing the center mouse wheel button (operating like a joystick without additional hardware). Joystick stage control hardware is available as an option.

Stage control software includes standard facilities for:
- Store and recall of sample position
- Double-click-to-center and drag-to-zoom feature select functions
- Multi-directional stage drive
- Compucentric rotation
- Compucentric tilt
- Image feature alignment to horizontal or vertical
- Navigation Montage feature creates automatic images for easily finding an area of interest from stage moves and tiled images from an active imaging detector
- Navigation on image and navigation montage is supported with “Click-to-center” and “Drag-to-Zoom” functions
- External image import and registration for correlation.

**Electron Optics**

The Prisma E features a pre-aligned, 3-lens, air-cooled, electron optical column optimized for high-resolution and high beam current applications with a single, fixed-position, final lens aperture. This eliminates the need for objective aperture mechanical centering and makes the system easy to use. The main elements of the electron optical system are:

<table>
<thead>
<tr>
<th>Source</th>
<th>Tungsten hairpin filament. This is mounted within a tetrode gun assembly and has 256 gun bias positions. It is fully automatically switched to keep constant emission over the full high tension range.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>200 V to 30 kV</td>
</tr>
<tr>
<td>Beam Current</td>
<td>Up to 2 µA (optimal working distance)</td>
</tr>
</tbody>
</table>
| Resolution  | High-vacuum mode:  
  - 3.0 nm at 30 kV (SED)  
  - 8.0 nm at 3 kV (SED)  

  High-vacuum mode with Options:  
  - 4.0 nm at 30 kV (with optional BSED)  
  - 7.0 nm at 3 kV (requires optional Beam Deceleration Mode plus optional BSED)  

  Low-vacuum mode:  
  - 3.0 nm at 30 kV (SED)  
  - 10.0 nm at 3 kV (SED)  

  Low-vacuum mode with Options:  
  - 4.0 nm at 30 kV (with optional BSED)  

  Extended vacuum mode (ESEM):  
  - 3.0 nm at 30 kV (SED)  

<table>
<thead>
<tr>
<th>Focus Range</th>
<th>3 – 99 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnification</td>
<td>6x (at longest working distance) to better than 1,000,000x in single quadrant view of the Prisma E user interface on the standard 24” LCD monitor</td>
</tr>
</tbody>
</table>
| Field of View | Identical field of view in high- and low-vacuum modes (18 mm at the longest working distance)  
  500 µm with standard, axial, gaseous secondary electron (SE) detector |

**Scanning System**

The Prisma E provides a flexible scanning system controlled from the graphical user interface:

- Pixel density 768 x 512, 1536 x 1024, 3072 x 2048 or 6144 x 4096, selectable.
- Minimum dwell time 50 ns/pixel; maximum 25 ms/pixel.
- Electronic scan rotation by n x 360 degrees.
- SmartSCAN™ scan settings include frame averaging, line averaging and interlaced scanning to minimize noise.
- DCFI (drift compensated frame integration) is available to help compensate for charge drifting or instability.

**Detector Systems**

The Prisma E is equipped with all necessary detectors for detecting secondary electrons in all vacuum modes, namely:

- High-vacuum mode: conventional Everhart-Thornley detector with variable grid bias;
- Low-vacuum mode: 3rd generation, large-field, off-axis gaseous SE detector with an enhanced gain pre-amplifier, which is also suitable for use at low voltages;
- ESEM mode: standard gaseous SE detector, axially mounted, containing an integrated 500 µm pressure-limiting aperture for operation up to 4000 Pa;

Optionally, for backscatter imaging, the system can be equipped with a high-sensitivity, high-speed BSED detector or a Gaseous Analytical BSED detector for optimized BSE imaging and EDS analysis in low-vacuum mode. Other detectors are also available as options, such as the STEM detector for imaging of TEM prepared samples and the directional backscatter (DBS) detector for low voltage imaging in beam deceleration mode.

The system software integrates selection of the proper detector upon the vacuum mode selection and automatically displays the relevant SE detector and controls. Additionally, mounting or changing a gaseous SE detector configures the vacuum system accordingly to enter low vacuum mode. This hardware-software connectivity makes the system easy to use for imaging a large variety of sample types.

An IR-CCD camera is included as standard; when in operation, its output can be displayed simultaneously with electron images in both high- and low-vacuum modes.

**Imaging**

Images are displayed in an area of 1536 x 1024 pixels, configurable for either single-frame or four-quadrant display. Additionally, if a second monitor is present, the “Large Image Window” function can be configured to display a full screen image on the second monitor from any of the available 4 quadrant display signals. Images can be viewed live, averaged or integrated. The Prisma E fully supports the SmartSCAN™ advanced scanning behavior which allows line averaging and interlaced scanning in addition to Drift Corrected Frame Integration (DCFII). Still images can be saved in TIFF, BMP, JPEG file formats, and in 8-bit, 16-bit or 24-bit depth, to the hard disk or LAN from the graphical user interface. Image printing is also available from the user interface. In addition, the system supports recording of AVI movies. This can either be done on the fly or by capturing a series of TIFF images at user-specified intervals. These TIFF images can then be combined into AVI’s by using the included proprietary movie creator software which also allows creating movies with selected data bar information (as stored in the individual TIFF files).

The software includes a 4-quad mode, in which the quadrants can be used for live display of electron images (SE, optional BSE, etc.), mixing of signals and display of the image of the standard infrared (IR-CCD) camera, standard navigation montage or optional color Nav-Cam. Simultaneous on-the-fly capture and mixing of signals in grayscale or color is supported from 2 or 3 sources enabling comparison and identification of unique information during image acquisition.

Look-up tables allow image contrast, brightness or gamma to be enhanced. Flexible databar selection is also provided. User-definition of preferred imaging parameter sets is available. Imaging parameters are stored in the TIFF image file as private data. Finally, image measurements and annotations can be done live on the image and the results can be stored together with the images.

**System Control**

The Prisma E is controlled from an MS-Windows graphical user interface running at a 1920 x 1200 screen resolution. The user interface is fully customizable: toolbar icons can be added or removed, side panels can be configured, and custom shortcuts can be made. This way every user can have their own personalized interface.

The controller computer is based on an Intel Xeon W3520 Processor/ 2.66 GHz 8 MB cache, 12 GB system memory, one 500 GB hard drive, one 16x DVD+/-RW drive, integrated FireWire and USB ports and a 1 Gb LAN network card (computer specifications subject to change). The system includes a 24” LCD monitor, keyboard, optical mouse and a height-adjustable office desk. A USB manual user interface (for controlling magnification, contrast/brightness, beam shift and stigmators) and/or a Joystick (for control of stage movement) is optionally available.
The microscope controller is dedicated to its primary function, includes a DVD/RW and has a possibility to connect directly to a LAN. Optionally, a support computer can be connected for additional PC-type of functionality such as MS-Office software suite, firewall, anti-virus and other non-instrument software.

**RAPID**

This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the RAPID pages on the Thermo Fisher Scientific website.

**Installation Requirements**

Please refer to the Prisma E pre-installation guide.

**1133679**  **Maps 3 for SEM/SDB**

Thermo Scientific Maps is the system automation and correlative microscopy software suite for SEM and DualBeam systems. Maps provides automated acquisition of image mosaics via easy set up and offers complete control on location, resolution and imaging parameters. Maps makes it easy to set up multiple mosaic acquisitions on a single sample, or on multiple samples loaded in the chamber. Maps also makes it easy to re-align and collect data over multiple imaging sessions.

Specifications:
- The maximum pixel resolution is 40k x 40k per tile (depends on microscope type).
- Maps corrects for non-linear stage behavior to increase navigation accuracy.
- Maps supports batch acquisition, allowing the user to schedule acquisition of multiple areas in one job, saving supervised time.
- Microscope real-time stitching of tiled images can be carried out concurrent with image acquisition.
- Export of stitched tile sets or user defined areas to TIFF or HD View compatible formats.
- Maps image data can be saved in RAW format or TIFF format.

**1126924**  **Beam Deceleration**

The Beam Deceleration option enables adjustment of the landing energy of the electron beam on the sample for conductive and partially conductive samples. The option contains a sub stage adapter to be compatible with negative voltage of up to 4 kV in Beam Deceleration Mode (BDM) and required electronics (power supplies, wiring, software control, etc.). This option improves low-kV aberrations and thus the contrast can be increased at low kV for some samples.

**Note:**
- For BDM on FEG instruments, it is necessary to use a suitable detector, such as the In-column Detector, Lens-mounted DBS Detector or Retractable DBS Detector.

**9432 909 96411**  **Compressor 120 V, 60 Hz with 4-liter Tank**

The compressor is required when compressed air of 6 atm. is not available; compressed air is required for operating pneumatic valves and the microscope’s leveling system. The compressor is connected to the mains supply unit of the microscope.

**1091075**  **Retractable DBS Detector**

The Directional Back-scattered (DBS) detector is an ultra-sensitive, solid state detector which is sensitive to emitted electrons from 500 V onwards. Using beam deceleration (sample bias to reduce the landing energy), images with beam landing energies down to 20 V are possible. The retractable DBS detector features a flexible segmentation.
With the Solid-State Detector Integration Kit Basic (1088334), an inner (materials contrast) and an outer (topography) concentric segment are available.

With the Solid-State Detector Integration Kit (1120429), four concentric segments (CBS mode) or four angular sectors (ABS mode) are available. The active segmentation (CBS/ABS) can be selected in the user interface. In concentric ring segmentation mode (CBS), separate detection of electrons emitted at different take-off angles is enabled. There are four concentric segments that may be acquired simultaneously and mixing based on adding / subtracting individual segments is possible. This way it is possible to select multiple contrasts (material and topographical) that can be optimized per application.

The ABS segmentation offers three outer sectors plus a concentric central element. These three outer sectors are used to highlight topographical features through shadowing, while the inner concentric segment maintains pure materials contrast. As in the CBS mode, simultaneous acquisition as well as mixing is possible.

This detector is mounted on a software-controlled retractable arm and allows simultaneous EDS spectra acquisition for WD ≥ 10 mm.

This Retractable DBS detector (1091075) is available for Quattro systems and for Prisma E. It requires the presence of either the Solid-State Detector Integration Kit (1120429) or the Solid-State Detector Integration Kit Basic (1088334).

1200426 Retractable Detector Integration Kit
The Retractable Detector Integration Kit is required for incorporating a retractable detector to Prisma E.

1120429 Solid-state Detector Integration Kit
The Solid-state Detector Integration Kit is required to enable interfacing with one or more solid-state detectors such as the STEM, DBS and GAD detectors. It allows having all three solid-state detectors connected simultaneously and provides support for up to twelve signal channels. This allows access to all solid-state detector segments.

1220202 ColorSEM
ColorSEM brings elemental analysis to the xT User Interface. Using a combination of live color imaging and conventional EDS functions, the system allows to quickly determine the elemental composition of the sample.

Specifications:
- Live, composition-based image coloring with automatic element identification
- Smart image coloring, user selectable coloring, and flexible element selection to easily highlight the relevant features of the sample
- Standardless quantitative analysis with Proza matrix corrections.
- Quantification by point, multiple points, area and line scan
- Mapping – conventional EDS element maps are either directly collected or converted from the color image
- Session-based EDS data collection and storage
- Generation of analysis reports
- Export of spectral EDS data to EMSA format

ColorSEM requires the presence of an UltraDry EDS detector.

1026861 EDS Installation by Thermo Fisher Scientific (EM)
Installation of EDS detector by a Thermo Fisher Scientific Service Engineer.

1208174 EDS Integration Kit
Network PCIe card with instructions to install Pathfinder on the Microscope Control Computer. This item requires on Prisma E the presence of an additional LCD Monitor, either as standalone option (1016773), or as part of a Windows 10 Support Computer (available with part number 1202171)
1220194        EDS UltraDry 129 eV 60M
UltraDry Premium EDS detector for analytical chamber SEM, Apreo, Quattro, Prisma E
- Active area of 60 mm² and 129 eV energy resolution at Mn k-alpha
- Norvar window with proprietary evacuated tube design for detection sensitivity to Be
- Motorized slide for software controllable insertion / retraction.

1220198        Pathfinder Alpine EDS System
Analyzer electronics for Thermo Fisher Scientific UltraDry EDS detectors with processing bandwidth up to 1,000,000 input counts per second and 300,000 output counts per second.

Pathfinder Alpine level software features
- Standardless quantitative analysis with ZAF, Proza, and Cliff Lorimer matrix corrections.
- Point and Shoot acquisition with electron image overlay
- Linescan acquisition with electron image overlay
- Spectral Imaging up to 1024 pixels with spectral extractions of user defined shapes and line scans.
- Ultra high resolution EDS element mapping with electron image overlay.
- EXTREME Element mapping with background subtraction, peak deconvolution and quantitative analysis in each pixel both during live time and in post-processing.
- EXTREME Elemental line scan acquisition and display with background subtraction, peak deconvolution and quantitative analysis at each point.
- Full Standards-based quantitative analysis.
- Automatic drift compensation
- Spectral Match capability with Spectral library
- Includes Microscope Column Communication Software with read/write of selected parameters.
- Requires customer-provided Microsoft Word® for report generation

1220200        Pathfinder Alpine Upgrade to Mountaineer
The Pathfinder Alpine Upgrade to Mountaineer adds the following features to the Pathfinder Alpine software:
- X-phase for EDS elemental map phase mapping
- Direct-to-Phase with Compass Principal Component Analysis for advanced, live-time Phase mapping with no need for elemental identification or quantification

Pathfinder Alpine Upgrade to Mountaineer requires the presence of Pathfinder Alpine EDS System (1220198)

4022 404 41203  Installation Labor Prisma E NA
Standard Installation Labor coverage - see Terms and Conditions

4022 404 02203  Installation Material Prisma E
Standard Installation Material coverage - see Terms and Conditions

4022 404 43203  Warranty Labor Prisma E NA
Standard Warranty Labor coverage - see Terms and Conditions

4022 404 04203  Warranty Material Prisma E
Standard Warranty Material coverage - see Terms and Conditions

9425 061 69509  NA Installation Kit for Quanta / Quanta 3D / Inspect
Part Number       Qty     SSD Supplied items
1001224            1       Specimen stubs (20)
4022 297 06181     1       8 mm Poly Tubing
4035 273 22521     1       Power strip, 6 out 220 IEC type
9425 061 69458     1       Auto Transformer 208V to 228V 7KVA
9425 061 69549     1       10 pack DVD+R x 10 - 4.7 GB Disks
9425 061 69589     1       20A, 250 v Twist Lock Plug, Hubbell
9425 061 69590  2  ½" KO Cable Clamp, Thomas & Betts
9425 061 69617  4  IEC Power cords, 6 ft.

FP 6888/00  Additional Wehnelt
The additional Wehnelt cartridge may be used to minimize system downtime during filament replacement. Typical tungsten filament lifetimes are 100 hours of continuous operation or better at filament saturation conditions. The cartridges are pre-centered, and normally no column alignments are necessary after cartridge replacement.

1140650  In-chamber Nav-Cam
The in-chamber Nav-Cam™ provides intuitive, photo-based sample navigation. The Nav-Cam is a color optical camera, mounted directly to the chamber for acquiring an image of samples mounted on the specimen stage. Fully integrated in the user interface, the Nav-Cam allows for quick point-and-click navigation to the region of interest. Nav-Cam features:
- Automatic image acquisition with sample lighting
- 160 x 105 mm field of view
- 3072 x 2048 pixels or approximately 6 megapixels
- Digital zoom
- Image annotation
- Image save

This Nav-Cam (1140650) is suitable for Quattro and Prisma systems.

1126938  Integrated Current Measurement
A fully integrated Current Measurement option with sub-picoampere resolution and superior sensitivity, which makes it well-suited for characterizing low-current phenomena. With the electron beam/ion beam pointed at the Faraday cup, precise probe current measurements and current stability measurements can be performed.

This device measures currents ranging from 1 pA up to 2 µA with up to 1 reading per second. The current read-out is displayed in the user interface.

FP 5250/00  Set of 10 Tungsten Filaments
Set of 10 Tungsten Filaments

1016773  24” Widescreen LCD Monitor
Specifications of the 24” Widescreen LCD monitor:
- 16.77 million colors
- High performance IPS TFT 16:10 display
- On-screen user control via on-screen manager (OSM)
- Intelligent power manager

Display: 61.1 cm (24.1 inch)
0.270 mm dot pitch, 300 cd/m²
1000:1 contrast ratio
<16 ms response time
Resolution: 1920 x 1200 at 60 Hz refresh rate (optimum)

1120471  Manual User Interface
Manual User Interface (MUI) is a supplementary control console providing direct manual control of microscope parameters such as focus, magnification, contrast, brightness, beam shift and stigmator.

1094684  Triple Monitor Stand
Sturdy, high quality, ergonomic stand for holding three 24” LCD monitors. The adjustable design allows the operator to position the monitors at eye level, improving the ergonomics of the workspace.
This item (1094684) is mandatory when an additional 24” LCD monitor (1016773) is selected.

4022 400 44211 DDP Brno / Named place of destination; receiving dock in North America (T-1)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination in accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

9425 060 99100 On-site Applications Training - Americas (1 day)
On-site applications training, per day, including all travel and expenses. For customers located in the Americas. Training will be fully customized to the customer needs and is typically delivered in blocks of two (2) to three (3) consecutive days. This training will usually be provided by the USA-based NanoPort team and should be scheduled within one (1) year of microscope installation completion (or within one (1) year of purchase in case training is not ordered as part of a microscope purchase).

1173440 Accessories - Keithley Picoammeter - PF-215
Keithley Picoammeter for measuring beam current. Requires an electrical connection to the stage. Stage must contain a Faraday cup.

1155051 ACCESSORIES - MAGNARAY-MOB4C (can select maximum 2 from 4 available optional diffractors)
MOB4C Diffractor (can select maximum 2 from 4 optional diffractors)
65 eV – 255 eV (Optimal for Be analysis)

1135135 ACCESSORIES - MAGNARAY INTERFACE KIT ANALYTICAL CHAMBER - WDS-ANA
Magnaray interface kit for Analytical chamber

1160749 EBSD - Lumis EBSD system for Analytical Chamber incl PC/screen - EBSD-LUMIS-ANA-PC (EXCL INSTALLATION)
“Lumis EBSD System for analytical chamber SEM models (Prisma E, Quattro, Apreo)
Ultra-low noise, high DQE, large format CMOS camera with integrated motorized slide
High resolution custom optical assembly supporting both high resolution and high speed analysis
Integrated 5 diode (two top, three bottom) forescatter detector (FSD)
Includes calibration standards
Requires Pathfinder 2.0 or greater software platform
Requires UltraDry EDS detector/Pathfinder installed on same system
Includes all required interfacing cables
Includes personality interface for the Analytical SEM chamber
Integrated Pathfinder Software, seamless integration with EDS/ WDS in a single platform
Includes dedicated high performance Windows 10, 64 bit PC and 24” LCD monitor for data processing and display”

1182153 INSTALLATION - EBSD installation by Thermo Fisher Scientific (SPEC) - NA & Zone 1 - INST-EBSD-Z1
Installation of EBSD system by Thermo Fisher Scientific SPEC-ULS service engineer for Continental USA and Canada & European Union and Western Europe

1155064 Software - PATHFINDER Beam Current Interface Keithley picoammeter - PF-BEAM-KEITHLEY
Beam current measurement software interface for a Keithley picoammeter

1182151 TRAINING - On-site customer training for WDS or EBSD (2 days) – NA - TRAIN2-NA
2 days on-site customer training for WDS or EBSD, including travel & living costs for Continental USA and Canada
1137747    WDS - MagnaRay Extended Range WDS Spectrometer - MAGNARAY-ER-RC (Excl installation & interface kit)

"MagnaRay Extended Range WDS Spectrometer

Requires additional purchase of unique mounting kit per WDS-XXXX
~Includes LIF, PET, TAP and NiC80 diffractors as standard. Optional additional diffractors available with two open diffractor slots available. Ability to acquire WDS spectra across an energy range from 160 eV to 12.2 keV with standard diffractors. Ability to acquire WDS spectra across an energy range from 65 eV to 17.9 keV with MOB4C and LiF220 diffractors."


Spectra 300 with Continuum 1069/K3

QUOTATION for
University of Missouri – Columbia Campus

Attn: Xiaoqing He

Quote Date: March 02, 2020
Quote Number: QUO-114737-G8Z6 R0
Expires: June 26, 2020

Prepared By
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Mobile: +1 260.579.1302
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1156232 Spectra 300
Spectra 300 is a state-of-the-art FEG Scanning Transmission Electron Microscope (S/TEM) with a high-tension voltage range of 30-300 kV. It is completely enclosed in a casing, specially designed to dampen acoustic and temperature variations from the environment. This enclosure not only makes it possible to transfer information well below 1 Å, it also allows the system to easily reach ultra-high resolution routinely in a noisier environment. With Spectra 300 it is possible to install double Cs-corrected optics, firmly based on the Themis mechanical, electronic and thermal stability. In addition, it is also possible to execute precise alignment of advanced components, such as an energy filter or a camera.

Spectra 300 is a fully digital TEM which incorporates a digital search-and-view camera of Thermo Fisher Scientific design specially included to suit the stringent needs of a high-resolution S/TEM. This high-speed digital camera replaces the conventional fluorescent viewing screen and gives users optionally the freedom to operate the Spectra 300 from a remote location. This allows the users to work in basically any environment without the rigid specifications required for high-resolution imaging.

The system is built on the already well-established, world-class Themis technology and is capable of delivering the ultimate performance in all TEM, STEM, EFTEM, diffraction and EELS modes. It is especially suitable for multi-user and multi-discipline environments. An ultra-stable cold trap Dewar provides the Spectra 300 with a supply of up to three days of liquid nitrogen which alleviates the daily maintenance routine.

Spectra 300 is equipped with proven technologies such as:
- Acoustic enclosure, enabling acoustic and temperature variation damping
- Extremely rigid, 300 mm diameter column featuring electron optics optimized for double aberration correctors
- High-speed, digital search-and-view camera
- Modular column design, allowing for easy modification and tailoring to specialized application requirements
- Patented, reliable and accurate mechanical column alignment
- ConstantPower™ design applied to all lenses that are critical in giving Spectra its ultimate stability, and in enabling high controllability and reproducibility. At a given acceleration voltage, this allows for fast switching of modes, magnifications, conditions and techniques, and with minimized stabilization time
- Optimized lens control system, allowing each and every actual microscope setting to be optimized. This guarantees maximized performance while minimizing aligning and tuning
- 3-condenser lens system that extends the experimental parameter space with greater flexibility and accessibility
- Low hysteresis design with minimized cross-talk, which allows much better predictability of the electron beam position. This is essential for the implementation of automated alignments and application software, and makes the operation of the system much more reproducible

Features and specifications:

Digital Search and View Camera
The high-speed and large-dynamic-range digital camera has the following specifications:
- High frame rate: up to 40 frames/sec
- Automatically adaptable gain, large magnification range enabling from looking for a lost beam in low magnification to imaging of focused beams in high magnification
- High Dynamic Range Mode allowing alternating short and long exposures
- Smart user interface to adapt the dynamic range for different tasks so that for example (bright) diffraction spots and (weak) Kikuchi lines can be observed in one image
- Ultra-robust scintillator design, which makes it insensitive to beam damage
- Observation of focused high intensity beams
- Live Fast Fourier Transforms
- False color imaging
- All microscope alignments can be carried out using the camera.

Column
The modular column design features a patented mechanical alignment system for excellent reproducibility in alignment.
- Outer diameter: 300 mm
- Excellent information limit specification
- Embedding of all accessories
- Designed for incorporation of two Cs correctors and a monochromator
- Designed for on-site retrofit of both probe and image corrector technology
- Equipped with a high-speed, digital search-and-view camera. A beam stop is included for diffraction work
- Spectra 300 is supplied with all apertures automated
- Cold trap Dewar for up to three (3) day’s supply of liquid nitrogen and automatic cryo-cycle software to “de-ice” the cold trap weekly

Electron optics
The optical system of Spectra 300 features the ConstantPower lens design without load-bearing lens modules. Some specifications of the electron optical system:
- Optimized magnetic circuitry to reduce cross-talk and hysteresis to a minimum
- High Brightness Schottky Field Emission Gun (X-FEG) The high brightness electron gun can be equipped (option) with a –Thermo Fisher Scientific patented– monochromator for ultimate resolution in spectroscopy. Thermo Fisher Scientific specifies spectroscopy resolution for the total system, not just the energy spread of the electron gun or source, if a spectrometer is included in the configuration (option).
- The acceleration voltage is adjustable from 60 kV to 300 kV (or 30 kV to 300 kV if a 30 kV alignment is optionally purchased). The beam energy, which is equivalent to acceleration voltage, is an intrinsically important experimental parameter for high-resolution S/TEM imaging. For each material, an optimal acceleration voltage represents the best compromise between sample stability (radiation damage), contrast and resolution. At delivery, the microscope is fully aligned at 300 kV in the Thermo Fisher Scientific factory, as well as at one additional voltage to be selected by the customer (30, 60, 80 or 200 kV). At these pre-aligned acceleration voltages, critical microscope characteristics are maximized, helping ultimate performance in imaging and analysis: maximum brightness, current, sample penetration and HR-TEM and HR-STEM resolution. The settings of these alignments are stored and can be recalled by the user. It is possible to purchase alignments at other voltages (see section “System Acceptance Procedure” for details) to optimize the microscope settings for specific tasks, techniques or samples
- Rotation-free imaging for all magnifications
- Symmetric S-TWIN objective lens with ConstantPower design, with a large pole piece gap of standard 5.4 mm, already allowing sub-Ångström performance in STEM from 60 kV to 300 kV. The symmetric design allows changing of the accelerating voltage without the need for adjusting the stage z-position. Additionally, it ensures no performance compromise between TEM and STEM: easy switching between these modes is possible without the need for realignment. This design is unique because U-TWIN or UHR pole pieces with small pole piece gap are not required to guarantee sub-Ångström performance in (S)TEM

The S-TWIN lens allows the use of a tomography holder (freedom of +/-70° tilt). Double-tilt holder rotation is standard +/-40° in alpha and +/-30° in beta. A wide variety of special holders (in-situ, STM, heating, cooling, etc.) that are typically compatible with the S-TWIN lens, can be used on Spectra 300.

Illumination System:
Spectra 300 is equipped with a three-lens condenser system. These 3 lenses together form a double zoom system giving increased flexibility in both TEM and STEM (option) modes. In TEM mode, parallel illumination can be achieved over a wide field of view. In STEM mode, a large variety in probe angles and probe currents are flexibly supported. In combination with a monochromator (option), the monochromatic spot can be demagnified to the sub-Ångström level which allows for high-resolution EELS with very small probes. Spectra 300 features a multiple-
mode illumination system which provides a fine probe mode, a parallel mode and a low-magnification mode. Users can switch freely between these modes without incurring any temperature-induced drift.

Vacuum
Spectra 300 uses a vacuum system, which is entirely oil-free. Differential pumping on the electron column ensures a clean environment for the sample.

Piezo Enhanced CompuStage
The Spectra 300 system is fitted with a side-entry, computerized 5-axes Piezo stage. The stage provides computer-controlled movements of +/-1 mm in X-Y and +/-0.375 mm in Z height. The stage is operated via a joystick that is integrated in the right hand panel. This enables very smooth search and view functionality. Stage movement is through the patented ‘Donator’ drive mechanism. For tomography applications, a special holder is available which allows for a primary tilt of +/- 70 degrees. The Piezo technology enables fine movements in x, y and z direction. The Piezo elements are integrated into the “Donator” drive mechanism and allow step sizes down to 20 pm, with an absolute range of movement of 1.2 μm in x and y directions. The individual Piezo elements can be reset at any given time to extend the range of motion to a larger FOV, while maintaining fine movements.

Scanning system
Spectra 300 can be equipped with a high-resolution, digital scanning engine controlled from the user interface (option).
- Resolution: up to 4k x 4k (option)
- Minimum dwell time: 50 ns/pixel
- Electronic scan rotation

Electronics
The completely customized, high-stability electronics of Spectra 300 are driven by the microscope controller PC. The noise suppressing, self-regulating power supplies ensure both short- and long-term stability. Every board is equipped with accurate auto-diagnostic electronics guaranteeing optimal performance of the system and fast fault finding.

System control
Spectra 300 is controlled from a Windows 10 Graphical User Interface running at a screen resolution of 1600 x 1280 pixels on a dedicated and recently updated microscope control computer to accommodate faster processing and higher data transfer rates. A network computer can be included with the system for running software utilities that could interfere with the control software running on the microscope PC (e.g. LAN connection). The system includes two 24-inch LCD monitors. A unique feature of all Thermo Scientific TEM systems is that they are completely digitally controlled, with a dedicated software service which is in control of all the electron optics, vacuum parts and accessories. This allows for an unrivalled integration/embedding of the capabilities/accessories needed for even the most complex experiments.

Velox Imaging Software for optimum control and analysis
Spectra 300 comes with Velox Imaging Software which provides the new ergonomic approach for multi-signal acquisition and runs on 64 bit Windows 10. Velox provides a range of functions from data acquisition to analysis. Velox Imaging Software features include:
- Acquisition of up to four STEM signals simultaneously when using the HAADF detector and the new Thermo Scientific Panther STEM BF/DF detectors
- Recording images with flexible dwell times up to 2k x 2k (standard) or 4k x 4k (optional)
- Single and continuous acquisition capabilities that allow to record high-quality STEM images and movies
- A new layout of the graphical detector interface which allows for overseeing the status of the detectors in one glance. STEM detector collection angles are indicated. Also, it enables easy adjustment of conditions for optimal imaging, and documentation of the experimental conditions required for quantitative analysis later.

System Acceptance procedure
Spectra 300 is fully aligned in the Thermo Fisher Scientific factory at two operating voltages, i.e. at 300 kV and at a voltage to be selected by the customer (possible choices are 60, 80, 120 or 200 kV). At the maximum operating voltage, the primary optical specifications are tested, verified and the results are stored in the so-called ‘blue book’. Please note that additional alignments (at 30 kV, 60 kV, 80 kV or 200 kV) are available for purchase.

A two-day Customer Witnessed Acceptance Test (CWAT) can optionally be ordered together with the microscope. During this test, which is carried out in our factory, the test results in the ‘blue book’ are discussed, and a set of important performance specifications is demonstrated in the presence of the customer. The functionality of major accessories of the customer’s configuration such as EDS, Lorentz lens, etc. will be demonstrated during the CWAT as well.

After installation of the microscope at the customer’s site, all major resolution parameters are proven again in a System Acceptance Test. During this SAT, which is included standard with Spectra 300, the basic functionality of the major accessories in the configuration will also be demonstrated again.

The test procedures of the optional CWAT and standard included SAT are clearly defined and are available on request. All tests performed conform Thermo Fisher Scientific test protocols using Thermo Fisher Scientific reference samples.

**RAPID**

This instrument is RAPID-enabled. RAPID (Remote Access Program for Interactive Diagnostics) is a highly secure connectivity tool that enables Thermo Fisher Scientific’s service engineers to connect directly to the instrument to address system issues remotely. RAPID can significantly speed up repair time and thus reduce instrument downtimes, while improving Thermo Fisher Scientific’s overall quality of service. Thermo Fisher Scientific’s service engineers use RAPID to perform remote system diagnostics and repairs, support user operation and view images for enhancing system performance. However, customers maintain complete control of how and when RAPID is used -- each RAPID session must be initiated by the customer. RAPID requires a high-speed internet connection (> 5 MB/sec recommended, 1 MB/sec required). For full details please browse to the [RAPID pages](#) on the Thermo Fisher Scientific website

**Installation requirements**

Please refer to the Spectra 300 pre-installation guide for specific installation requirements.

**FP 5703/64**  **Alignment at 200 kV and 300 kV**  
This free of charge set of alignments for high-end transmission electron microscopes ensures that the microscope is aligned in the factory at both 200 and 300 kV. The alignments are carried out on the full system configuration that has been selected by the customer.

**FP 5703/73**  **Alignment at 60 kV**  
This alignment for high-end transmission electron microscopes ensures that the microscope is aligned in the factory at 60 kV. It is carried out on the full system configuration that has been selected by the customer. This alignment can be ordered in addition to FP 5703/62 (Alignment at 80 kV and 300 kV), FP 5703/63 (Alignment at 120 kV and 300 kV) and FP 5703/64 (Alignment at 200 kV and 300 kV).

This alignment (FP 5703/73) is not available when the FEG Unit 300 kV (FP 5702/30) is present. When this alignment is combined with a Cs Image Corrector (1054762, 1113675, 1132192 or FP 5703/57) or Cs Double Corrector (1113677, 1127518, FP 5703/59 or 1158844), the option X-FEG/Monochromator Unit 300 kV (1054756, 1094705 or 1175282) or X-FEG/UltiMono Unit 300 kV (1165266) is mandatory.

**FP 5458/50**  **Magnification Calibration Package**  
The Magnification Calibration Package enables semi-automated magnification calibration of embedded digital camera magnifications in TEM and EFTEM as well as HM-STEM magnifications. It ensures that a correct scale bar is printed on images recorded with an embedded digital camera. For magnification calibrations in EFTEM, a fully embedded filter is required.
In STEM mode, besides carrying out the magnification calibration, image distortions are corrected as well.

Operator assistance is limited to loading the calibration specimen, bringing it to eucentric height and adjusting the illumination and focus. Image recording and calculation of the correct image dimensions is carried out in a fully automatic way.

The calibrations are done using standard test specimens; 2160 l/mm cross grating (Agar Scientific S106) and an oriented gold film (Agar Scientific S135). It should be noted, that these samples do not have any magnification certification.

The results of each calibration are stored on hard disk and can be recalled at any time. Calibration history reports can be generated, and it is also possible to produce a graphical representation of the last twelve calibrations. Included in the package are two test specimens and a code of best practice for conducting a calibration of a TEM microscope. Thermo Fisher Scientific will calibrate a limited set of modes and magnification ranges, that are needed to show the system's specifications.

Magnification Calibration Package requires the presence of an embedded digital camera.

1174688 Remote Monitoring Station
The Remote Monitoring Station allows operators to monitor the microscope performance from a remote location and perform basic microscope operations. The option contains both software and hardware, including the remote computer, a 24” LCD monitor, and two microscope panels (with trackball, knobs and buttons). The software is structured in such a way that only one operator (either local or remote) can operate the microscope panels at the time.

The connection between the remote computer and the microscope system is made through TCP/IP connections. Any firewalls on the route between the remote computer and microscope system need to be opened for a limited number of ports.

The intended use of this solution is monitoring and basic operation. This solution is not suitable for operations requiring high levels of interaction (e.g. alignments, stage movements) and/or streaming of data. For such ‘real-time’ operation of the microscope, other solutions are available.

The Remote Monitoring Station can be installed on all TEM systems.

1101110 Velox Core Offline License (5x)
Velox™ Offline software is the new ergonomic multi-signal imaging and analysis platform by Thermo Fisher Scientific running on 64 bit Windows 7 or higher. It provides a wide range field of applications for the offline analysis of data acquired by Velox™ software that is running on the microscope. Some details:
- Offline version of the Velox software for inspection and processing of data acquired with Velox™.
- Contains processing available in Imaging and Analytical packages.
- Drift corrected frame integration of the S/TEM series.
- Introduction of a new EDS quantification engine, which is optimized for Super-X and Dual-X detectors. Advanced absorption correction takes into account complete geometry including holder shadowing.
- Peel-back function for Spectrum images.
- Spectrum integration, Intensity profile, distance measurement and other processing tools.

This part number (1101110) provides five (5) offline licenses of Velox.

1100486 Ceta 16M Camera 300 kV
Ceta 16M is Thermo Fisher Scientific’s latest 16-megapixel digital camera designed for imaging and diffraction applications. Ceta 16M is retractable and mounted under the microscope in an on-axis position. The optimized phosphorous scintillator is fiber optically coupled to a 4kx4k, 14x14 µm² pixel Peltier cooled CMOS sensor.
The camera's scientific grade sensor provides large field of view images with high sensitivity even under low dose conditions. The CMOS sensor technology allows for fast read-out for dynamic experiments. The camera is fully embedded in the Thermo Fisher Scientific architecture and can easily switch between fast screening and the recording of high quality and high resolution images.

Selected specifications of Ceta 16M:
- Sensor: 4,096 x 4,096 CMOS
- Pixels: 14 x 14 µm²
- Digitization: 16 bit
- Binning: 1x, 2x, 4x, 8x
- Acquisition speeds (fps = frames per second):
  - 4k x 4k: 1 fps
  - 2k x 2k: 8 fps
  - 1k x 1k: 18 fps
  - 512 x 512: 25 fps

This part number (1100486) is suitable for (Titan) Krios, Spectra 300, Themis 300, Themis Z, Themis ETEM and Titan Halo.

**1174289 Ceta Analysis Computer**

The analysis computer is an additional Windows 10 computer with a central role in the microscope data flow. Some features:
- It has a 10 Gbit connection to the Ceta camera for fast transfer of the highest data rates the camera can achieve (40 frames/sec at 4096 x 4096).
- In addition, it has a connection to the microscope computer so data transfer can be initiated directly after the experiment while working on the microscope. Thermo Fisher Scientific proprietary software is running in the background of this computer to establish this. If necessary, data that was recorded and offloaded can be accessed.
- Finally, it has a free 10 Gbit to the customer network to archive data after analysis or transfer it elsewhere directly if analysis elsewhere is preferred.
- The computer is equipped with a fast 4TByte SSD raid volume (the same size as the camera has) to receive and process the dynamic recordings effectively.

**Specifications:**
- 16 GB DDR4-2400 memory
- Intel Xeon E5 processor
- 4 TB SSD raid volume (storage capacity 3.4 TB)
- Separate 960 GB SSD for OS
- Includes one (1) 24” Widescreen LCD monitor.

**1127282 Ceta Speed Enhancement**

Speed upgrade for Ceta 16M camera. This upgrade package includes dedicated electronics and storage capabilities to run an existing Ceta 16M camera at increased speeds and to record and store 40 full (4k x 4k) frames per second (and 320 fps for 512 x 512 pixels).

Acquisition speeds (fps = frames per second):
- 4k x 4k: 40 fps
- 2k x 2k: 80 fps
- 1k x 1k: 160 fps
- 512 x 512: 320 fps

For off-line data storage and processing a dedicated Analysis Computer (W7/64 bit) or an HP Storage Server is required. These are not included in this offer. It also requires an installed Ceta 16M camera and system software 1.6 (Talos) / 2.6 (Titan/Themis) or higher, which are also not included. Ceta Speed Enhancement is suitable for all Spectra software versions.
1148372  Chiller (Air Enhanced)
The Chiller (Air Enhanced) provides the necessary cooling water for Thermo Fisher Scientific Themis microscopes. It is a closed-loop, refrigerated cooler with an air-cooled condenser. The cooling unit fully transfers the heat generated by the system (including the cooling unit itself) to the air in the room. The unit must be installed in an adjoining room that is sufficiently ventilated according to the maximum heat load.

Dimensions (W x D x H): 26” x 34” x 34” or 66cm x 86cm x 86cm
Gross shipping weight: 147 kg
Manufacturer and model: Haskris, model LX3-A5-CAXXX3

9432 909 96281  Compressor 115 V, 50 / 60 Hz
Silent, automatic Junair model 6X/MAXI compressor with start relay and capacitor, thermal protection and intake filter. Provides clean, oil-free and water-free compressed air at 6 Bar (max. 37 Liter/minute), with a noise level of 40 dB(A) at one meter.

Direct-drive 0.34 kW motor mounted on a 25-liter reservoir. Complete with manometer, control valve, pressure switch, air admittance valve and safety valve.

Dimensions 375 x 375 x 540 mm (l x w x h)
Weight 30.5 kg
Power consumption 0.34 kW

1158842  Cs S-CORR Probe Corrector
This probe Cs-corrector is a multi-pole corrector system, which compensates for the spherical aberration (Cs) of the upper objective lens. This compensation improves the point resolution in HR-STEM by creating a smaller probe and allows for an increase in probe current compared to a non-corrected system, which results in an enhancement of the analytical performance of the system. This next generation Cs S-CORR Probe Corrector for Spectra 200 and Spectra 300 can also correct for additional higher order aberrations for all accelerating voltages. These higher order aberrations include 5th order spherical aberration (C5) and six-fold astigmatism (A5). Correcting them allows for improved spatial resolution at low accelerating voltages.

Additionally, improvements in the S-CORR design have resulted in an order of magnitude increase in the stability of the 1st order aberrations. This translates to more time focused on imaging specimens with optimum optical conditions than minimizing aberrations. The S-CORR also comes with auto alignment software (Auto S-CORR) that will automatically correct aberrations from 1st to 4th order using a standard cross grating sample.

1149609  Cs S-CORR Probe Corrector Alignment
Additional alignment of the Cs S-CORR Probe Corrector.

FP 5407/00  Low-Dose Exposure Technique
The Low-Dose technique is intended for applications where the specimen is liable to damage by the electron beam. The Low-Dose technique helps the microscope operator in minimizing the electron dose needed for the total sequence from searching for specimen areas, through focusing, to the final exposure.

The Low-Dose technique has three states, Search, Focus and Exposure, which have independent settings for various electron optical parameters such as spot size, intensity and magnification. Switching between settings only requires a single button to be pressed.
  - The Search state is typically employed at low magnifications or in defocused diffraction and with a low-intensity beam.
  - Focus is typically executed at high magnifications but on an area that lies adjacent to the area of interest.
  - The Exposure is automatically recorded under the proper conditions, started by pressing a single button and with ‘high’ (user-defined) intensity illuminating the specimen only during the actual exposure itself.
A beam blanker is used during Low-Dose state transitions and for the actual exposure. The software arranges automatic switching to the required operational state (screen up/down, camera inserted/retracted, etc.) The beam blanker is also under direct user control.

The Low-Dose technique includes the facility for recording through-focus series. It requires the presence of an embedded digital camera (excluding Gatan OneView)

1160201  **Super-X EDS Detector**

Super-X is Thermo Fisher Scientific’s proprietary EDS detector system with superior sensitivity and ultimate performance in EDS spectroscopy and fast EDS mapping. The integration of Silicon Drift Detector (SDD) technology provides the ideal EDS detector for use with Thermo Fisher Scientific’s high brightness FEG (X-FEG), ultra-high brightness X-CFEG or Cs Probe Correctors. Where traditional Si(Li) detectors start to saturate, the SDD detectors show virtually linear behavior and low dead time up to very high count rates, while maintaining high resolution.

In the Super-X EDS system four SSD’s are perfectly integrated in the S-TWIN objective lens and offer maximum collection efficiency with a solid angle of 0.7 sr. This large solid angle provides quick time-to-data, even for low intensity EDS signals. The high sensitivity and the absence of a detector window allow the detection of all elements down to and including boron. Resolution is specified to ≤136 eV @ Mn-Kα for 10 kcps (output counts) at zero-degree sample tilt. The peak to background ratio is 4,000:1 or better @ Ni-K peak, with our standard test sample. In fast mapping mode, dwell times can be as short as 10 μs.

The increased sensitivity, in combination with the high detector throughput allows for truly fast EDS mapping. The collection time for elemental maps in fast mapping mode can be reduced from hours to minutes or from minutes to seconds.

Super-X is fully integrated in Spectra’s optical and mechanical design, electronics and software. It is cooled by the same system used for the cold trap sharing the same large Dewar. Special mechanical shutters protect the SDD’s from too high X-ray intensities and ice growth.

The Super-X EDS System comprises four channel pulse processor electronics and software modules for data acquisition and analysis and provides all of the needed functionality for qualitative and quantitative EDS analysis and fast mapping, including correction for specimen drift.

This part number (1160201) is suitable for Spectra 300 and Spectra 200. Super-X requires the presence of the High-Visibility Low-background Double-Tilt holder (1097927).

1044275  **Velox Analytical Software**

Velox™ analytical Software is an add-on to the Velox imaging software (1044271) and is the new ergonomic interface for analytical applications by Thermo Fisher Scientific. The software runs on 64-bit Windows 7 or higher. It provides a wide range of applications ranging from acquisition to analysis of data and consists of several optional packages. Some highlights of the functionality of the Analytical Software Package are:

- The EDS software package is dedicated to the Thermo Scientific Super-X detector for high-speed and high-quality data acquisition with dwell times below 10 μsec.
- Acquisition of single spectra and automatic collection of spectrum images, including automatic drift compensation during acquisition.
- Time-resolved spectrum image acquisition with peel-back function, allowing acquisition of the best data, even for (damaged) beam-sensitive samples.
- A robust mapping engine allowing for on-the-fly drift correction with recursive mapping.
- In combination with Super-X G2, recording of individual channels from Super-X sensors, for both single spectra and Spectrum Imaging acquisition.
- Introduction of a new EDS quantification engine, which is optimized for Super-X and Dual-X detectors. Advanced absorption correction takes into account complete geometry including holder shadowing under different tilt conditions.
- Live spectrum integration and quantification offer best on-the-fly analysis of acquired data.
- Live post-filtering of the maps, including Wiener filter optimized for atomic EDS.
- Unique pre-filtering of the Spectrum Images to enhance quantification.

1161217  Additional Alignment Continuum HR/1066
Additional alignment of Gatan Continuum HR/1066 at a high tension between 60 and 300 kV. Includes filter alignment and microscope EFTEM alignment.

1174287  Continuum Support Package
The Continuum Support Package contains software and hardware that allow Gatan Continuum energy filters or spectrometers to be mounted to the microscope. The Continuum is operated via a remotely embedded Gatan computer.

This option (1174287) is suitable for Spectra, Metrios AX and Themis S (with part number 1156787)

1101104  Velox EELS and EDS Option
In combination with Gatan's EELS detectors Velox provides the capability to acquire EDX and EELS signals simultaneously at a rate of 1000 EDX spectra/s and EELS spectra/s. With DualEELS spectrum imaging 500 EDX & DualEELS spectrum pairs per second can be simultaneously acquired. This option requires the presence of the following options (not standard included):
- A fully embedded energy filter or spectrometer
- Thermo Scientific Super-X or Dual-X EDS detector
- For Gatan Quantum or Enfinium: UltraFast EELS or UltraFast DualEELS Spectrum Imaging software from Gatan

1170600  Medium System Enclosure (3.3 m)
The Medium System Enclosure is a casing specially designed to dampen acoustic and temperature variations from the environment. This enclosure not only makes it possible to transfer information well below 1Å, it also allows the system to easily reach ultra-high resolution routinely in a noisier environment.

The acoustic enclosure completely covers the microscope (i.e. the base of the microscope, the column and the Field Emission Gun). Some details:
- Acoustic damping of 20 dBC allowing relaxed acoustic room requirements
- Temperature variation damping allowing peak to peak variations of 0.8 °C
- Easy side door access for sample loading / unloading
- On Screen Display (OSD) at the specimen loading area for convenient access to vacuum and stage controls whilst loading/unloading specimens

The Medium System Enclosure (3.3 m) with part number 1170600 is suitable for single corrected Spectra platform microscopes.
1157630  Global Installation Kit TEM FEG

The Global Installation Kit TEM FEG is a uniform install kit for making the installation of all Thermo Scientific TEM’s with an FEG electron source more efficient. It provides a standard set of gas fittings and a water filtration panel, allowing for a consistent and smooth installation process.

The kit contains SF₆ and N₂ regulators, gas fittings, an SF₆ leak detector, electrical connection adapters for all local markets, and a water filtration panel.

1160306  TEM Lorentz Mode

Lorentz microscopy is based on the Lorentz force that acts on the electrons passing through a magnetic field. Due to the Lorentz force the electrons leaving the specimen are deflected over a certain angle. The polarity of the magnetic domains in the specimen will determine the direction of the deflection. So the deflection angle is a function of the magnetic properties of the specimen. Focusing the Lorentz lens allows imaging of magnetic domains with different properties.

The basic requirements for imaging magnetic structures are a specimen environment that is free of magnetic fields. By switching off the objective lens and exciting the Lorentz lens such a field-free environment can be obtained. For focusing of the specimen, the operator can switch between the objective lens and Lorentz lens.

The TEM Lorentz mode (1160306) includes a column alignment in field-free imaging conditions to allow imaging of sensitive magnetic structures. In combination with a BiPrism it allows electric (e.g. dopant profiling) and magnetic field visualization with a large field of view.

1187622  4D-STEM on Ceta2

"The 4D-STEM option enables acquisition of diffractions patterns in Velox from a rectangle defined on a STEM image in an easy way. The user can setup the dimensions of the rectangle or square to only perform the acquisition on the area of interest. In each pixel of the rectangle an acquisition will be done with the Ceta. It is advised to use the HAADF STEM detector as a reference STEM detector to get the largest field of view on the Ceta camera. High speed is essential to reduce the acquisition total time, therefore 4D-STEM only works in combination with Ceta Speed Enhancement. The diffraction pattern from each pixel will be acquired and stored in an MRC file. System Requirements: 1. Panther STEM 2. Ceta 16M Camera or Ceta-S camera 3. Ceta Speed Enhancement 4. Ceta Analysis Computer or Ceta Storage Server 5. Embedded EDS 6. Velox software version 2.12 or higher is required, as well as TEM software version 3.4 (for Spectra) or version 2.4 (for Talos) or higher."

1163283  CMOS cam for Gatan 1069

This special item is for a Gatan scintillator based CMOS camera to be mounted to the Continuum K3 (HR). This camera is optimized for the voltage range between 30 and 60 kV. The speed of this camera is limited to 2,600 spectra per second. Note: no additional alignments are needed for this camera."

1162879  Continuum K3 HR 300 kV

"This special offering is for a post-column Gatan Continuum 1069 K3 HR imaging filter with a K3 direct electron detection camera that enables electron energy loss spectroscopy (EELS) and energy-filtered TEM (EFTEM) applications. This item includes a K3 camera with 3.4k x 3.4k read area, ultra-fast electrostatic shutter, high-speed DualEELS with 2 kV offset, BF/DF detector with integrated beam stop, aperture assembly with 81-hole mask, 9 mm diagonal imaging aperture, plus 5/1.0 mm diameter EELS apertures, Gatan STEMpack, energy selecting slit unit and a computer. This version delivers the highest energy resolution possible, especially suitable for monochromated TEMs to develop the highest total system energy resolution. At this moment of offering, the exact specifications of the Continuum K3 HR and the possible impact on the overall microscope performance are not validated. Embedded software is scheduled for Q3-2019 earliest. Notes: - The K3 camera can only be operated at high tensions from 80 up to 300 kV. - This item includes the installation & training for the Continuum K3 HR."

1165744  S-TWIN Lens

The S-TWIN lens is a high-resolution objective lens with short focal length, which leaves a sample area between the pole pieces of 5.4 mm. The S-TWIN lens allows for tilts of up to 35 degrees with most holders; however, a 70-degree tilt can still be obtained with a specialized tomography holder. This lens typically allows usage of customized holders such as holders for heating or cryo, and holders of other experimental designs. The point-to-point resolution of the S-TWIN in TEM mode lens with the sample at the eucentric position is 0.20 nm at 300 kV. The resolution of the S-TWIN lens in probe corrected STEM mode with the sample at the eucentric position is <0.06 nm at 300 kV.
1174279  Network Computer
The network computer is a second PC, which connects to the microscope controller with an Ethernet connection taking over the data management task from the microscope controller (which remains dedicated to microscope operation). The network computer enables the user to grow with the speed of computer peripheral innovations during the lifetime of the basic microscope system, without affecting the TEM Microscope Controller and endangering system uptime.

The configuration of the computer supports:
- A second Ethernet card to connect to the LAN or WWW is available. Local IT departments have access to the network computer for (external) network configuration purposes. Internal networking (to the microscope controller) remains the responsibility of Thermo Fisher Scientific
- The network computer may be loaded and/or upgraded with the user’s preferred anti-virus software, office-suite, printer drivers, email and Internet browser software

Specifications:
- Windows 10 operating system
- Includes one 24” Widescreen LCD monitor.

Thermo Fisher Scientific’s warranty and service responsibilities for the network computer are restricted to the delivered configuration, with service arrangements comparable to service arrangements offered by regular PC vendors.

1165268  OptiMono+
OptiMono+ software provides an automated routine to focus and stigmatte the monochromator dispersion line at the energy selecting plane. The monochromator can thus be routinely and easily used at an intermediate excitation for optimized STEM at lower voltages, or at a high excitation to reach the ultimate energy resolution in a quick and easy way. This enables less experienced users to optimize the performance of their monochromated system, and it provides the skilled operator with a faster time to result. In combination with the X FEG / UltiMono unit, OptiMono+ enables fully automated tuning of the monochromator and filter optics to achieve energy resolution in TEM mode at FWHM of 25 meV (at 60 kV). The energy resolution will be proven on the lowest purchased standard high tension.

OptiMono+ (1165268) is available on Spectra 300, and requires the presence of
- X-FEG / UltiMono Unit 300 kV (1165266)
- A fully embedded Continuum 1066 with a scintillator-based CMOS camera. Please note that in absence of a fully embedded energy filter / spectrometer, OptiMono+ only aligns the monochromator.

1165266  X-FEG / UltiMono Unit 300 kV
The ultimate performance of a TEM and STEM system depends highly on the properties and characteristics of the electron source, the gun. High brightness, high temporal coherence as well as high spatial coherence are vital for ultra-high-resolution performance. In STEM, high brightness is a mandatory requirement for ultimate results in atomic resolution imaging and analytical applications. In TEM, a higher spatial coherence results in an improved information transfer or higher resolving power. The unique Thermo Scientific X-FEG builds upon Schottky FEG field emission technology with high brightness and high current stability. In comparison to the standard Schottky-FEG, the X-FEG delivers a dramatically increased brightness. The X-FEG supports the Themis philosophy of maximizing both TEM and STEM performance, without compromising either mode. The combination of the high brightness gun with a monochromator allows operating the TEM with free selectable illumination beam energy width which in comparison to CFEg technology provides higher total current and symmetric intensity distribution versus beam energy for precise high-resolution EELS measurements. The advantage of this technology is that the electron source illumination current does not fluctuate over time (constant emission) and the emission tip does not require flashing or resetting.

The patented monochromator is of the Wien-filter type. It is positioned directly between the emitter and the accelerator and creates an energy dispersive plane at the condenser 1 aperture position. In this energy dispersive plane an energy-selecting slit is positioned to obtain the improved energy resolution in the beam. The compact design of only
5 x 6 cm of the monochromator itself minimizes the Boersch-Effect (electron-electron interactions causing loss of brightness and increase in energy spread). This design is easy to maintain and reliable since there are no moving parts.

The X-FEG / UltiMono unit is capable of achieving higher energy resolution compared with the standard X-FEG / Monochromator through additional stabilization of the monochromator and accelerating voltage electronics.

The control of the monochromator is embedded in the microscope software, fully automated and can be switched on and off within minutes (even without switching off the high tension). In combination with OptiMono+ (1165268), the monochromator can be switched on and tuned from 1 eV to 30 meV completely automatically on an embedded Gatan Continuum 1066 energy filter with a scintillator-based CMOS camera.

The combination of X-FEG with monochromator enables improvement of the information limit in HR-TEM (in combination with a Cs corrector) and to obtain high-resolution EELS spectra for fine structure analysis of inner shell excitations or band-gap studies of semi conducting material. The energy resolution of the monochromator is only guaranteed if it is used in combination with a Gatan high-resolution Continuum energy filter.

X-FEG / UltiMono (1165266) is available on Spectra 300, and requires the presence of
- OptiMono+ (1165268)
- A fully embedded Continuum 1066 with a scintillator-based CMOS camera.

4022 400 44291 DDP Eindhoven / Named place of destination; receiving dock in North America (T-9)
Delivered Duty Paid to named place of destination in North America Incoterms 2010. The Seller’s obligation is fulfilled when the goods have been made available at a specified point in the Buyer’s country. With this term the Seller is also responsible for payment of duties, taxes and other customs clearance charges. The risk of loss or damage passes to the Buyer at the moment the goods have been delivered to the named destination in accordance with Thermo Fisher Scientific’s standard terms and conditions of sale, title transfers at the same point that risk of loss transfers. The price indicated here does not include taxes and/or import duties except as expressly specified by the Seller in this Quotation.

FP 6596/05 CompuStage Single-Tilt Holder
- This holder is designed for general use. The tilt angle depends on the lens;
- Specimen movement is fully controlled by the CompuStage controller making the system fully safe and allowing maximum tilt for each XYZ position;
- It incorporates a Safe ENTRY key for use with the sENTRY system to prevent its insertion into the wrong lens;
- It is incompatible with the U-TWIN lens;
- It is designed to accept the reproducibly insertable specimen grids type 9432 909 96851 as well as standard 3 mm specimen grids;

1097927 High-Visibility Low-Background Double-Tilt Holder
This high-visibility, low back-ground, double-tilt holder has been optimized for general use and for use with EDS. Some technical highlights:
- Designed to give minimal EDS signal shadowing;
- Designed using ‘EDS-friendly’ materials: holder parts exposed to the electron beam are made of beryllium; SoftLoc clips are available in molybdenum and bronze;
- This holder enables the specimen to be tilted in two directions perpendicular to each other, one around the X axis (alpha tilt), the second one around the Y axis (beta tilt). Maximum tilt angles depend on the pole configuration;
- The tilt angles are read out and displayed with an accuracy of 0.01°;
- It incorporates the SoftLoc mounting mechanism, which is ideal for fast and reliable mounting of all specimens;
- Specimen movement is fully controlled by the CompuStage controller making the system fully safe and allowing maximum tilts for each XYZ position;
- It is compatible with all objective lens types;
- Accepts 3.05 mm diameter grid with maximum thickness 0.34 mm;
- The grid height in the holder can be adjusted to get a large horizontal field of view for EDS.
- Included in delivery are 40 SoftLoc clips (20 molybdenum and 20 bronze) and 40 grid height adjusters (20 of 0.1 mm and 20 of 0.2 mm).

**1157118  Advanced STEM Imaging**

The Advanced STEM Imaging package provides unprecedented access to a larger range of elements than has ever previously been possible. Included are a High Angle Annular Dark Field (HAADF) detector and Thermo Fisher Scientific’s latest generation, Panther STEM detection system which is comprised of Silicon solid state, segmented and on-axis disk and annular detectors. Also included are Thermo Fisher Scientific’s new STEM alignment software, OptiSTEM+ and light element (low Z) imaging technique, iDPC.

Both the disk and annular detectors are annularly and radially partitioned into 8 segments resulting in a total of 16 segments over the two detectors. The design allows for simultaneous and independent read out of each ring and the center circle. However, when both arms are inserted, the outer ring of the disk detector is fully shadowed by the inner ring of the annular detector.

The geometry of the detectors has also been optimized to provide HAADF imaging whilst maximizing the collection efficiency for Electron Energy Loss Spectroscopy (EELS) data. Improvements have also been made to the detector amplifiers in order to ensure that the system can accommodate single electron sensitivity in STEM in the future. The Advanced STEM Imaging package provides BF imaging, 3 types of DF imaging by different annular segmentation of the DF detector and HAADF imaging, DPC and iDPC.

The combination of Z contrast capability with simultaneous light element imaging using iDPC provides imaging capability of the largest ever range of elements at atomic resolution. The inclusion of OptiSTEM+ provides automated, reliable, fast and robust correction of first and second order aberrations (defocus, 2-fold astigmatism, coma and 3-fold astigmatism). This makes atomic resolution Z contrast, BF, ADF and iDPC imaging at the ultimate resolution of the system, more accessible to less experienced users and empowers more experienced users with faster time to result. OptiSTEM+ is optimized for use with a S-CORR probe corrector. Although tested on a wide range of materials at all available high tensions, its performance may depend on the sample type, and is not guaranteed on non probe-corrected microscopes.

**1160648  EMPAD**

The EMPAD (Electron Microscope Pixelated Array Detector) is a pixelated detector used in STEM applications to acquire the diffraction pattern at each pixel in a STEM image. It provides considerably more information from the same electron dose, enabling more widespread application of quantitative STEM techniques (e.g. measuring electric fields in the sample, thickness, image contrast tuning).

The sensor is a 128 x 128 direct electron detector with pixels of 150 μm in size. It is sensitive to a single electron and has a dynamic range of 30 bit in single shot mode allowing for a maximum detectable current per pixel of 1.4 pA at 300 kV. This unique capability is enabling the acquisition of high dynamic range diffraction patterns in STEM.

The EMPAD system is delivered with a separate Linux computer enabling the acquisition of maps of diffraction patterns with the speed of up to maximum 1100 diffraction patterns per second. The EMPAD can be mounted on Spectra platforms. It is mounted on a retraction mechanism and is therefore compatible with the HAADF detector, BF/DF STEM detectors, Ceta camera and energy filters. The Thermo Scientific external scan interface is used to connect the EMPAD solution to the tool scan coils.

**1165270  Standard Apertures**

**1156683  System Column**

System column and mandatory ancillary components required to drive column optics.
**1149913 Analytical Tomography Holder**

The Analytical Tomography Holder is a High-visibility, Low-background Tomography holder that is optimized for Energy-Dispersive X-ray Spectroscopy. The holder tip and clamps are manufactured from beryllium to minimize X-ray interference when conducting the elemental analysis of the specimen. This holder enables imaging specimens at extremely high tilt angles with large fields of view in systems equipped with a TWIN, X-TWIN, C-TWIN or S-TWIN objective lens.

The Analytical Tomography Holder is ideal for electron tomography when the combination of structural and elemental composition is required, as well as any for other application that requires a high specimen tilt angle. Tomography can be performed routinely in a range of -70° to +70°.

A streamlined specimen clamping mechanism eliminates the shadowing associated with most holders at high-tilt angles. The clamping mechanism accepts a standard, 3-mm diameter TEM specimen and accommodates a wide range of specimen thicknesses. The specimen clamping mechanism produces an evenly distributed force on the specimen. The tapered, self-centering specimen cup guides the specimen into position.

**1050139 EDS Tomography Data Acquisition**

The optional package EDS Tomography Data Acquisition provides the capability to obtain 3D chemical information in addition to 3D structural information from STEM imaging. Automated EDS Tomography is an extension of the STEM tomography package and is available on Themis and Talos. Tomography data acquisition is driven by the STEM tomography package, while EDS spectrum images are acquired by Velox. This combination delivers a comprehensive workflow.

Automated EDS Tomography Software requires the following:
- TEM Server software 1.5/2.5 or above
- Super-X detector with 4 SDD’s
- Velox Analytical package 1.2.2 or higher
- STEM Tomography 4.3.1 or higher
- Analytical Tomography Holder (1149913) on Themis

**Recommended:**
- To process data efficiently, Inspect 3D 4.1.2 or higher is recommended
- To visualize the 3D information, Avizo is recommended.

**Functionality:**
- Automated and unattended EDS tilt series acquisition
- Easy in setting up acquisition parameters with a workflow GUI in STEM Tomography and chemical mapping parameters in Velox
- Flexible choice of all relevant tomography parameters for tilt range, tilt step, drift and focus compensation before/after each tilt
- Flexible parameterization of EDS acquisition settings: mapping sizes, dwell time, detector choices and elements selected
- Automatic drift compensation during 2D EDS mapping in the workflow
- Automatic close of gun valve at end of series recording
- Automatic generation of .mrc stacks of EDS maps per each element. Option to include automatically quantified results
- Optional Inspect 3D software enables to analyze in 3D the element distribution as provided by the .mrc files
- Supports MRC 2014 format

**Note:** STEM Tomography, Inspect3D, Avizo, Super-X (with Velox), and sample holders are not included in this line item.
Inspect3D Xpress

Inspect3D Xpress comprises all hardware and software required for carrying out alignment of tomography data and subsequent ultra-fast tomographic reconstruction of the resulting aligned tilt series.

Software

Inspect3D involves an x-y alignment, which can be based on either bead tracking or image cross-correlations. These cross-correlations can be improved by a multitude of filter options. Fine-tuning of the tilt axis position can be carried out interactively. Bead tracking traces multiple round particles on the specimen throughout the tilt series. Apart from x-y alignment, bead tracking can also correct rotation and magnification changes for each image. Beads used for the alignment can be removed from the data sets prior to reconstruction by means of a unique “bead cloaking” algorithm. This prevents nasty streaking artifacts from gold beads in the reconstructed volume. By partly executing these algorithms on the GPU and by a minimum of user interaction, these alignment algorithms execute very efficiently and quickly.

Reconstruction of the tilt series into a 3D volume of arbitrary size can be carried out by two different algorithms: weighted back projection (WBP) and simultaneous iterative reconstruction technique (SIRT), which are both executed on the GPU.

Inspect3D also supports ‘Dual Axis Tomography’. In this case, two data sets of the same area are taken, but they are rotated in-plane by about 90 degree with respect to each other. Inspect3D then determines the transformation parameters between the two sets and adds them, either in Fourier space or in real space.

The resulting reconstructed volumes can directly be read into the software packages Amira or Avizo for further advanced visualization and analysis.

Please note that Inspect3D Xpress does not include Amira/Avizo.

Added Key features
- Inspect3D is scriptable through any COM aware language (e.g. JavaScript, MATLAB, and Python)
- GPU acceleration of e.g. cross correlation alignment step, general feature tracking, and reconstruction
- New user interface guides the user more seamlessly through the workflow
- Fully 64-bit: arbitrarily large data volumes can be handled

Hardware

Inspect3D Xpress includes a preconfigured PC, optimized for Inspect3D, which is equipped with a dedicated, high-end graphics card (GPU) and Microsoft Windows 8.1. A 23" widescreen monitor, keyboard and mouse are also included.

STEM Tomography 4.x Data Acquisition Software

The STEM Tomography Data Acquisition Software package provides add-on functionality to the standard TEM Tomography Data Acquisition Software package.

All tilt series options are identical to those in TEM Tomography, including the low dose and batch options. Dynamic focusing keeps flat tilted specimens in focus across the whole scan range. Low convergence angle STEM modes (with large depth of focus) are supported for tilt series acquisition on thick specimens.

Multiple detectors can be used simultaneously.

System requirements:
- TEM Tomography Data Acquisition Software installed (1050133 or 1115604)
- STEM hardware, including an HAADF or Thermo Scientific On-axis Bright-Field / Dark-Field Detector
- For Tecnai: PIA scan generator (National Instruments is not supported)
TEM Tomography Data Acquisition Software

TEM Tomography Data Acquisition Software provides a user-friendly and fast way for the acquisition of tilt series for three-dimensional (3D) reconstruction. In brief, a specimen is tilted along a single axis over a large angular range (typically +/- 70°) with small angular tilt increments (typically 1°), and an image is recorded at every tilt angle.

The software includes the possibility to generate a grid overview, providing an easy way to identify the regions of interest. Predefined acquisition parameters help with the navigation on the specimen across different magnification levels, and several auto-functions are provided (focus, eucentric height, drift). Tilt series can be acquired one by one, but regions of interest can also be stored for later, unattended, data acquisition, also known as “Batch Tomography”.

Setting up tomography data acquisition in low-dose mode, by defining separate focus, tracking, and exposure positions for each tilt angle, can be done intuitively by placing areas onto an overview image.

Several features are available to minimize the lateral shifts and focus changes between the subsequent images of the acquired tilt series. First of all, the software automatically determines the position of the mechanical tilt axis and then aligns the microscope to center it in the field of view. Additional features are:

- Holder calibration (storing and compensating for reproducible specimen movements as a function of tilt angle)
- Tracking after (correction on the basis of the latest acquired image)
- Tracking before (acquiring an intermediate image and correcting for the movement before the real image is acquired)
- Automatic focusing

The tomography acquisition parameters can be tuned to the specific instrument type, specimen holder, specimen type (flat or rod-shaped), and application requirements.

Reconstruction and visualization SW, Inspect 3D and Amira/Avizo are not included in the package and can be purchased separately.

System requirements:
- Microscope manufactured in 2004 or later
- Latest released microscope platform software version
- A Thermo Fisher Scientific-embedded camera or fully embedded energy filter
- Tomography approved holder: Tomography Holder FP 5341/00, Tomography Holder (High Field-of-View) 9432 909 97191, Talos Arctica or Titan Krios)
- Magnification Calibration Package FP 5458/50

On-site Application Professional Services (APS) - Americas (1 month)

One (1) month On-site Application Professional Services (APS) - comprising twenty (20) days of on-site support, and including all travel and expenses. For customers located in the Americas.

The support program will be fully customized to the customer needs and is typically delivered in 1-week blocks (four (4) or five (5) consecutive days) by the USA-based Applications team; it should be scheduled within one (1) year of microscope installation completion (or within one (1) year of purchase in case APS is not ordered as part of a microscope purchase).

The tailor-made support program will accelerate the buildup of skill in the customer’s organization, ensure scientific or production goals are met on time, and provide access to the critical resources to allow optimization of experiments setup and execution.

Avizo for EM Systems (Materials Science) - Local, 1-user License

Avizo for EM Systems is a software package for advanced visualization and analysis of reconstructed tomography data, acquired using electron and correlative microscopy systems. Avizo for EM Systems consists of the base Avizo package, augmented with various additional packages. A license is included for 1 (one) user that is restricted to a
single designated workstation and includes 12 (twelve) months of maintenance service (hotline and product upgrades).

Avizo is a software package for rapid exploration and analysis of 3D-image data, as well as for generation of numerical 3D models for advanced analysis and simulation. Avizo for EM Systems is a tailored version of the Avizo software, solely distributed by Thermo Fisher Scientific, currently published by the Thermo Fisher Scientific’s Visualization Sciences Group; more information can be found at http://www.avizo3d.com.

Avizo for EM Systems includes dedicated data import filters for loading EM data obtained from Thermo Scientific tools into the software. The software also supports image to image alignment with pixel accuracy. Visualization modules include orthographic and oblique sections, efficient surface, mesh and volume rendering, iso-surfacing and iso-lines, simultaneous display of multiple datasets, virtual 3D navigation, movie clip generation, animation generation tools, and more. Thanks to the embedded XLVolume module, Avizo for EM Systems can display even very large datasets (up to hundreds of GB) at interactive speed on regular desktop or laptop computers.

The dedicated DualBeam™ 3D Wizard provides a unique and efficient support for the FIB/SEM image data acquisition workflow. Avizo for EM Systems supports a variety of semi-automatic and interactive tools for segmentation, providing the ability to construct 3D models of structures present in the image data, and defining complex regions of interest for analysis purposes. It comes with numerous tools for data analysis, including data probing, measurement of distances, regions, and volumes, and advanced quantification and statistical analysis tools on multiple regions of interest.

Avizo for EM Systems offers support for presentations, by providing the capability of making snapshots, exporting movie files and single images, as well as 3D representations by exploiting advanced stereoscopic display technology.

The Avizo for EM Systems - Materials Science provides a comprehensive digital lab for advanced 2D and 3D materials characterization, especially aimed at scientists and engineers who require insight into the details of materials properties on full 3D structures in a wide range of materials science research areas and for many types of materials (porous materials, metals and alloys, fibrous materials, composites, food...). The license for Avizo for EM Systems includes one year of Maintenance Service (which features on-line help via the World Wide Web and free-of-charge updates, both for the duration of one year). Upgrades and/or updates to Avizo for EM Systems after the initial year of Maintenance Service will require the payment of software maintenance fees. The Maintenance Service for Avizo for EM Systems (including help, updates, and ongoing software maintenance) will be provided directly by Thermo Fisher Scientific Visualization Sciences Group. Details and Terms & Conditions of the Avizo Maintenance Service can be found on the Thermo Fisher Scientific website.

The warranty period for Avizo is started six months after the software is shipped from the Visualization Sciences Group, which might result in a reduced warranty period on-site, in case of long microscope installation times.

Avizo software yearly maintenance service is not part of the Thermo Fisher Scientific system support service. Thermo Scientific system customers will receive a separate maintenance renewal offer for the Avizo software.

**Platform requirements**
- Avizo for EM Systems runs on:
  - Microsoft Windows 64-bit
  - Linux x86_64 (64-bit)
  - Mac OS X (64-bit)
- A 2 GHz minimum CPU processor is required. Multi-core CPUs recommended. 16 GB RAM minimum is required; 32 GB recommended
- A graphic board which supports a complete implementation of OpenGL is required. Recent graphic board supporting OpenGL 3D texturing and programmable shaders is recommended
- A CUDA-enabled graphic board (list on https://developer.nvidia.com/cuda-gpus) is a plus, especially to benefit from the Avizo’s GPU-accelerated algorithms
For detailed information on supported and recommended hardware and operating systems for Avizo for EM Systems please read the Amira-Avizo System Requirements on the Thermo Fisher Scientific website.

1086580   Power Supply - UPS
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