

## Helios NanoLab™ 600i

### Advanced DualBeam™ for ultra-high resolution imaging, analysis and fabrication at the nanoscale

The Helios NanoLab™ 600i builds on the success of FEI's winning DualBeam™ series offering advances in the ion beam, electron beam, patterning and a range of features to make milling, imaging, analysis and sample preparation down to a nanoscale, standard applications in the lab.

The innovative Elstar™ electron column forms the basis of the Helios NanoLab's outstanding high resolution imaging performance. The Elstar features unique technologies, such as constant power lenses for higher thermal stability, electrostatic scanning for higher detection linearity and speed, and unique column design for pin sharp imaging in all conditions. Its improved through-the-lens detector (TLD), set for highest collection efficiency of SE (Secondary Electrons) and on-axis BSE (Backscattered Electrons), is complemented by FEI's latest advanced suite of detectors including the retractable solid state backscatter detector and the multisegment STEM detector, for stunning low kV SE/BSE and BF/DF/HAADF imaging respectively, as well as the optional ICE detector for optimized FIB-SE (Focused Ion Beam-Secondary Electron) and -SI (Secondary Ion) imaging.

#### Key benefits

- Best in class Elstar™ Schottky field-emission SEM technology and performance
- FEI's exclusive Tomahawk FIB featuring outstanding low kV operation down to 500 V and beam currents up to 65 nA
- New differential pumping & TOF correction for higher resolution ion beam imaging, milling and deposition
- 150 x 150 mm high precision, high stability piezo stage
- Unique imaging technologies and solutions, including generation II of Helios advanced detectors, process monitoring, FEI SmartSCAN™ and DCFI to help imaging charging samples
- Most complete and integrated suite of prototyping capabilities, with 16-bit pattern generator for FIB & SEM, advanced patterning features library, and an extensive range of gas chemistries and expertise
- Best-in-class thin sample preparation and 3D characterization and analysis
- Most advanced process monitoring and endpointing capabilities

The Tomahawk FIB, FEI's latest ion column, provides the Helios NanoLab 600i with unrivalled fast, precise and reliable milling, patterning and ion imaging. The Tomahawk's exceptional low-voltage performance is proven to produce the world's best quality thin samples for high resolution STEM and atom probe microscopy. Not only does it boast excellent ion imaging resolution, but with its integrated differential pumping and time-of-flight correction, it also delivers a tighter beam and a more accurate scan profile for extremely precise ion milling. Creating the most complex structures at the nanoscale is made possible, thanks to FEI's own extensive range of beam chemistries (gas injection), 16-bit pattern generator and integrated CAD, script or library-based patterning. Robust, precise FIB slicing, combined with a high precision piezo stage and superb SEM performance, open the door to a new generation of automated software for unattended sample preparation or 3D characterization and analysis.

Empowered by its evolutionary xT software platform, the Helios NanoLab 600i addresses both the occasional user with its robustness and comprehensive interface, and the FIB expert who can rely on the instrument flexibility and extended controls for advanced SEM and FIB work. Join the Helios NanoLab and FEI FIB communities of scientists and technologists, and be the next one to contribute to expanding the boundaries at the nanoscale with DualBeams.

## Essential specifications

### Elstar UHR immersion lens FESEM column

- Elstar electron gun with:
  - Schottky thermal field emitter
  - Hot-swap capability
- 60 degree dual objective lens with pole piece protection
- Heated objective apertures
- Electrostatic scanning
- ConstantPower™ lens technology

### Tomahawk ion column

- Superior high current performance, with:
  - up to 60 A/cm<sup>2</sup> beam current density
  - up to 65 nA max beam current
- Lowest voltage (500 V) for ultimate sample preparation quality
- 2-stage differential pumping
- Time-of-flight (TOF) correction
- 15 apertures

### Source lifetime

- Electron source: 12 month lifetime
- Ion source: 1,000 hours guaranteed

### Electron beam resolution @ optimum WD

- 0.8 nm at 30 kV (STEM)
- 0.9 nm at 15 kV
- 1.4 nm at 1 kV

### Electron beam resolution @ coincident point

- 1.0 nm at 15 kV
- 1.6 nm at 5 kV
- 2.5 nm at 1 kV

### Ion beam resolution @ coincident point

- 4.5 nm at 30 kV using preferred statistical method
- 2.5 nm at 30 kV using selective edge method

### Maximum horizontal field width

- E-beam: 2.3 mm at beam coincident point (WD 4 mm)
- I-beam: 1.0 mm at 5 kV at beam coincidence point

### Landing voltage range

- E-beam: 350 V - 30 kV (50V - 30 kV with Beam Deceleration mode option)
- I-beam: 500 V - 30 kV

### Probe current

- E-beam: up to 22 nA
- I-beam: 1 pA - 65 nA (15 position aperture strip)

### High precision 5-axes motorized stage

- XY: 150 mm, piezo-driven
- Z: 10 mm motorized
- T: - 10° to + 60°
- R: n x 360° (endless), piezo-driven
- Tilt accuracy (between 50° to 54°): 0.1°
- X,Y repeatability: 1.0 μm

### Detectors

- Elstar in-lens SE detector (TLD-SE)
- Elstar in-lens BSE detector (TLD-BSE)
- Everhart-Thornley SE detector (ETD)
- IR camera for viewing sample/column
- Door-mounted Nav Cam™\*
- High performance SE and SI (secondary ion) detector (ICE)\*
- Retractable low voltage, high contrast solid-state electron detector (DBS)\*
- Retractable STEM detector with BF/DF/HAADF segments\*
- Beam current measurement

### Vacuum system

- 1 x 210 l/s TMP
- 1 x PVP (dry pump)
- 4 x IGP (total for electron column and ion column)
- Chamber vacuum: < 2.6\*10<sup>-6</sup> mbar (after 24 h pumping)

### Chamber

- 4 mm E- and I-beam coincidence point at analytical WD
- Angle between electron and ion columns: 52°

### Sample size

- Maximum size: 150 mm diameter with full rotation (larger samples possible with limited rotation)
- Maximum clearance between stage and coincidence point: 55 mm
- Weight: max. 500 g (including the sample holder)

### Sample holders

- Single stub mount, mounts directly onto stage
- Vise Specimen Holder to clamp irregular, large or heavy specimens to the specimen stage\*
- Universal Mounting Base (UMB) for stable, flexible mounting of many combinations of samples and holders such as flat and pretilt stubs, and row holders for TEM grids\*
- Various wafer and custom holder(s) available by request\*

### Image processor

- Dwell time range from 0.025 to 25,000 μs/pixel
- Up to 4096 x 3536 pixels
- File type: TIFF (8, 16, 24-bit), BMP or JPEG standard
- Single frame or 4-quad image display
- SmartSCAN™ (256 frame average or integration, line integration and averaging)

### System control

- 32-bit GUI with Windows® XP, keyboard, optical mouse
- Two 19 inch LCD displays, SVGA 1280 x 1024
- MagicSwitch (software controlled switchbox)
- Joystick\*
- Multifunctional control panel\*

\*optional

### Supporting software

- 'Beams per quad' graphical user interface concept, with up to 4 simultaneously active quads
- FEI SPI™, iSPI™, iRTM™ and FIB immersion mode for advanced, real-time SEM/FIB process monitoring and endpointing
- Drift Compensated Frame Integration (DCFI)
- Patterns supported: lines, rectangles, polygons, circles, donut, cross section and cleaning cross section
- Image registration
- Directly imported BMP file or streamfile for 3D milling and deposition
- Material file support for 'minimum loop time', beam tuning and independent overlaps

### Common accessories

- **Gas Injection System:** up to 5 units for enhanced etch or deposition (other accessories may limit number of GIS available)
- **GIS - Beam chemistry options**
  - Platinum deposition
  - Tungsten deposition
  - Carbon deposition
  - Insulator deposition II
  - Gold deposition
  - Enhanced Etch™ (iodine, patented)
  - Insulator enhanced etch (XeF<sub>2</sub>)
  - Delineation Etch™ (patented)
  - Selective Carbon Mill (patented)
  - Empty crucibles for FEI approved user supplied materials
- **in situ sample lift-out system** (OmniProbe™ 100.7, AutoProbe 200.2 or other manipulators)
- **Charge Neutralizer**
- **Fast Beam Blanker**
- **EDS:** integration kit (EDAX/Oxford Instruments) and options
- **QuickLoader™:** loadlock for fast sample transfer

### Exclusive cryo solution for DualBeam

- FEI/ Quorum PP2000T for universal cryo preparation and cryo stage
- FEI / Quorum CryoMAT for material science cryo applications

### FEI acoustic enclosure

- **Electron beam deceleration mode kit**
- **Integrated FEI plasma cleaner**
- **FEI cryo cleaner**

### Consumables (partial list)

- Replacement Ga-ion source
- Replacement Schottky electron source module
- Aperture strips for electron and ion columns
- Gas chemistry crucible

### Software options

- **AutoFIB™** package for macro and script based DualBeam automation
- **AutoTEM™** wizard – automated sample preparation with section wizard
- **GDSstoDB™** and **NanoBuilder™** – respectively basic and advanced FEI proprietary CAD based (GDSII) solutions for FIB and beam deposition optimized nanoprototyping of complex structures
- **AutoSlice and View™** – automated sequential mill and view to collect series of slice images for 3D reconstruction
- **EBS3™** – automated sequential mill and acquire EBSD maps to collect series of texture or orientation maps for 3D reconstruction
- **EDS3™** – automated sequential mill and acquire EDS data to collect series of chemical maps for 3D reconstruction
- 3D reconstruction software
- Knights Technology CAD navigation
- Web enabled data archive software
- Image analysis software

### Warranty and training

- 1 year warranty
- Choice of service maintenance contracts
- Choice of operation / application training contracts

### Installation requirements

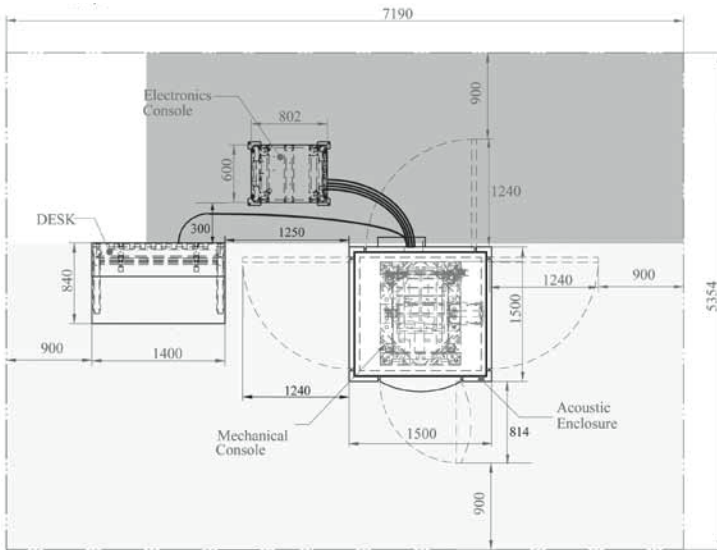
*[Refer to preinstall guide for detailed data]*

- Power:
  - voltage 230 V (+ 6 %, - 10 %),
  - frequency 50 or 60 Hz (± 1%)
- Power consumption: < 3.0 kVA for basic microscope
- Earth resistance: < 0.1 Ω
- Environment:
  - temperature 20 °C ± 3 °C
  - relative humidity below 80 % RH
  - stray AC magnetic fields: < 100 nT
  - a-synchronous, < 300 nT synchronous for line times > 20 ms (50 Hz mains) or > 17 ms (60 Hz mains)
- Door width: 120 cm
- Weight: column console 850 kg
- Dry nitrogen:
  - system (0.7 to 0.8 bar, max 10 l/min during vent)
  - dry pump (1.0 bar, 2 l/min)
- Compressed air 4 to 6 bar - clean, dry and oil-free
- System chiller
- Acoustics guidelines: < 50 dBC (no acoustic enclosure) < 65 dBC (with acoustic enclosure present) (site survey required as acoustic spectrum relevant)
- Floor vibrations: site survey required as floor spectrum relevant
- Vibration isolation table available as option

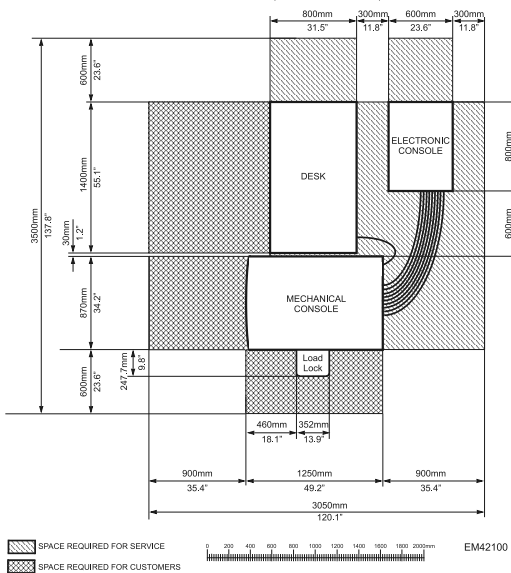
### Documentation and support

- On-line help
- Prepared for RAPID™ (remote diagnostic support)
- Free access to FEI for owners on-line resources
- Free membership in the FEI FIB User Club

Floorplan with enclosure



Floorplan without enclosure



TÜV Certification for design, manufacture, installation and support of focused ion- and electron-beam microscopes for the Electronics, Life Sciences, Research and Industry markets.

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