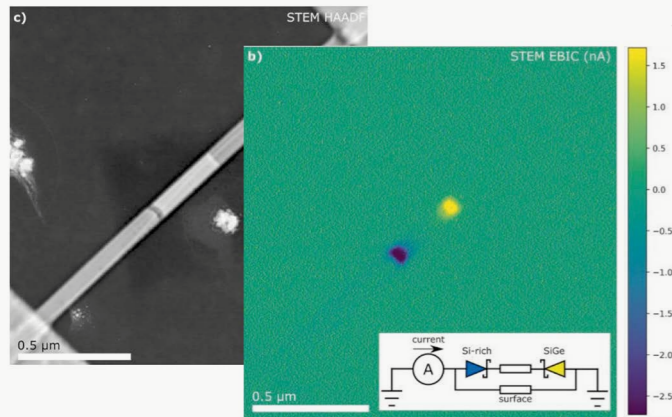
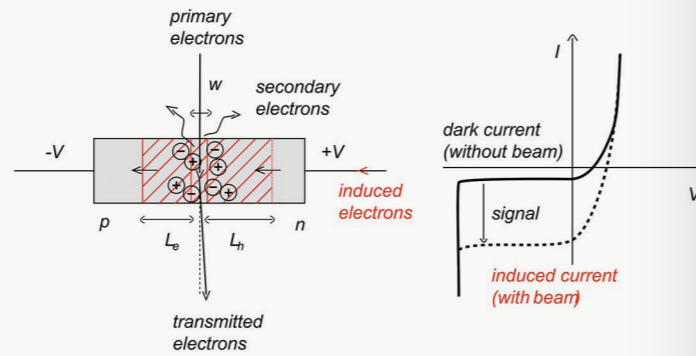


# Electrical Analysis for TEM

In-situ imaging of electrical activity at the nanoscale

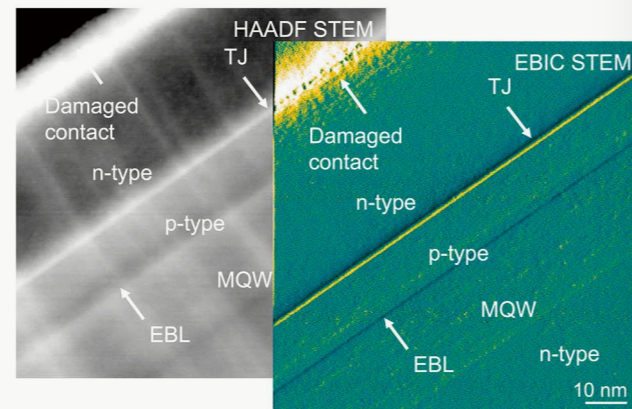
### Add the Electron Beam Induced Current (EBIC) technique to TEM

- Inelastic loss induces electron-hole pairs in the lamella
- Internal electric fields separate electrons and holes
- Current is measured to acquire EBIC STEM images



### Reveal internal electric fields

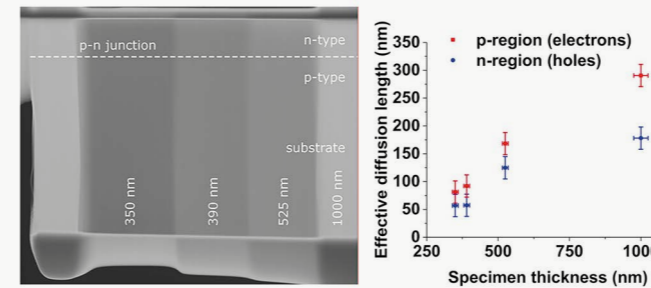
- Map junctions and contacts in devices
- Validate doping profiles against design
- Correlate with device model and parameters



### Discover electrical activity of each layer

- Localize sites with increased recombination activity
- Distinguish defects with/without electrical activity
- Continue with high-resolution techniques

# Enable direct correlation of electrical activity with high resolution data



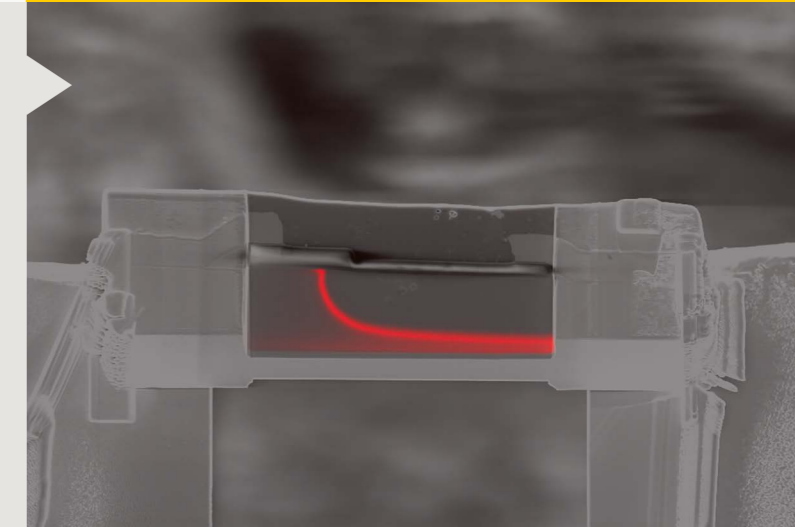
### Determine fundamental parameters

- Depletion width at junctions
- Diffusion length of minority carriers
- Recombination strength of dislocations

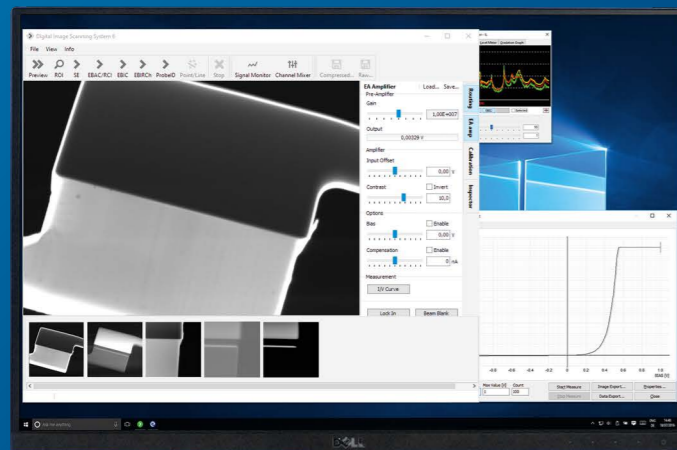
## EA for TEM

### Screen FIB-SEM samples

- Apply standard FIB workflows for in-situ biasing
- Use wide field-of-view of EA in SEM to select target
- Verify lamellas in SEM for preparation damage



# Turn-key solution for in-situ TEM



## Electronics are fully integrated and software controlled

- Fast amplification optimized for imaging
- Wide gain range to fit all techniques
- Miniaturized on-holder electronics
- Automated signal routing
- Reference sample for training\*



\* optional

## EA for TEM



### EA electronics for in-situ biasing holders

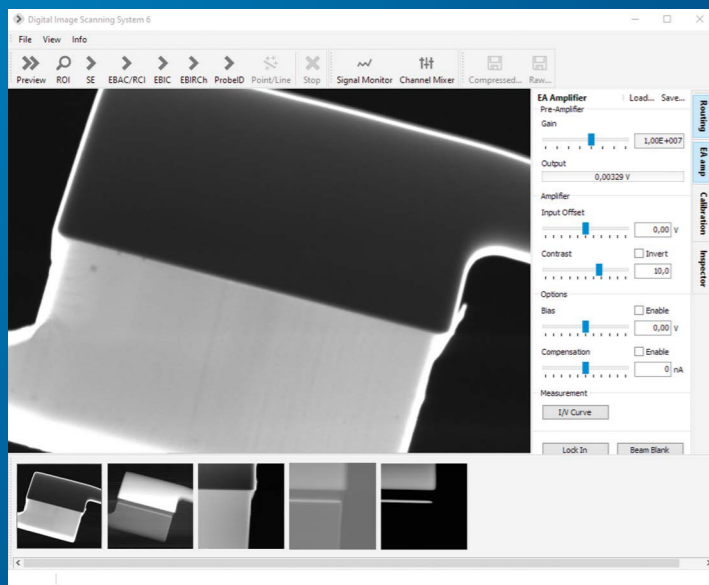
- First stage analog amplification for minimum noise
- Wide gain range for all EA techniques and samples
- Built-in voltage bias and current compensation
- Automated signal routing to avoid electric discharge
- Switchable low passes for signal filtering
- Automated zero adjustment

### TEM Scan Controller (DISS6)

- Integrated scan generator and image acquisition
- Large pixel resolution and high scanning speed
- Second stage digital amplification for EA
- Simultaneous BF, HAADF and EA inputs



# Integrated and easy-to-use quantitative software

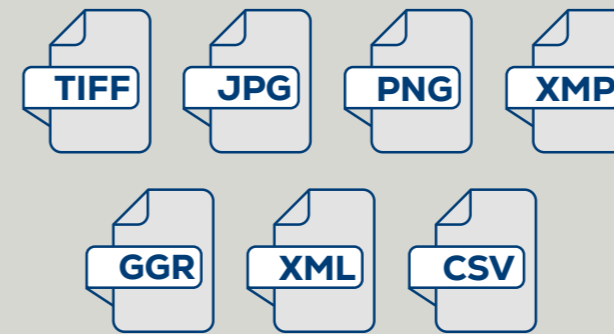
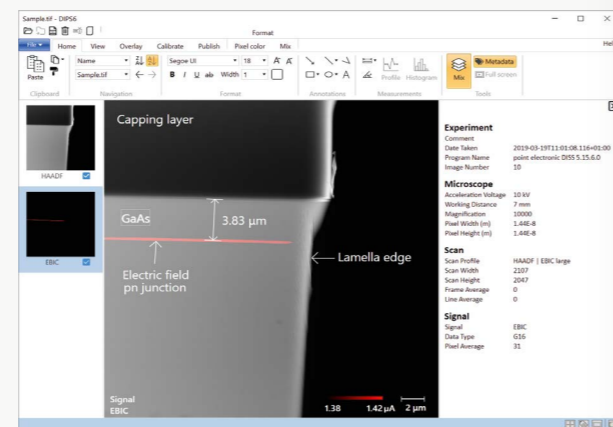


## DISS6 - control and acquisition software

- EA amplifier control
- EA, HAADF and BF image acquisition
- Automatic quantification to  $\mu\text{A}\dots\text{fA}$
- Current-voltage sweep tool
- Live image colour mix tool
- Standard file formats

## DIPS6 - processing software

- Full image and metadata viewer
- Automatic quantification to  $\mu\text{A}\dots\text{fA}$
- Gradient-based pseudocolours
- Colour mix of signals for visualization
- Export of quantitative pixel values



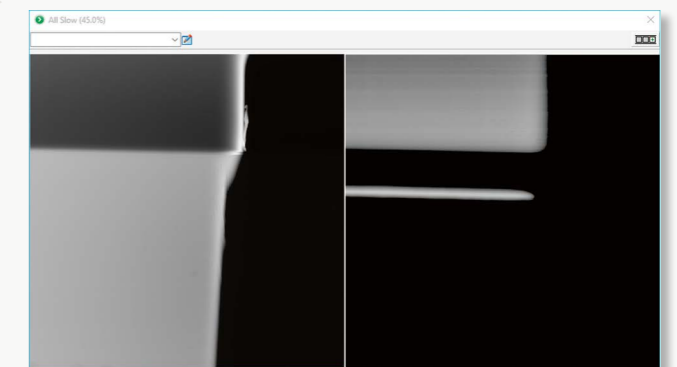
## Standard file formats

- TIF un-compressed grayscale data
- JPEG compressed grayscale data
- PNG colour images
- XMP metadata
- GGR colour gradients
- XML formulas
- CSV pixel values

## EA for TEM

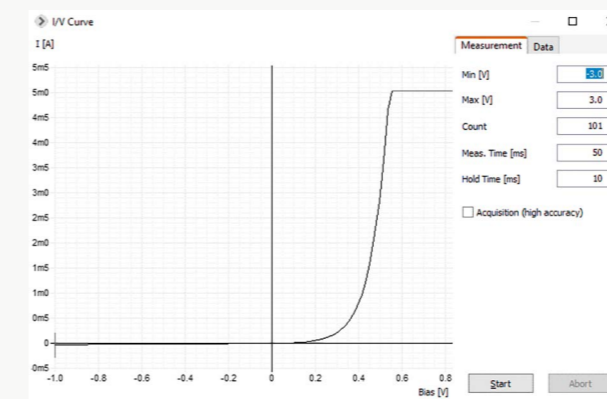
## Automatic quantification of pixel values

- Analog EA signals are factory calibrated
- DISS6 and DIPS6 softwares show quantified values
- Metadata includes calibration parameters



## Integrated current-voltage sweep tool

- Configurable range, points and measure time
- Verify electrical connections to device
- Inspect for electron beam damage



### EA electronics for in-situ biasing holders

<b>Input channels</b>	4x to in-situ biasing holder, or 6x to in-situ biasing holder
<b>Routing</b>	EA high (pre-amplifier) EA low (ground or bias voltage) External
<b>Pre-amplifier</b>	10 <sup>4</sup> ... 10 <sup>9</sup> V/A variable gain approx. 100 kHz bandwidth at 10 <sup>7</sup> V/A
<b>Internal sources</b>	-5 ... 5 V, 16-bit bias voltage -1 ... 1 $\mu$ A, 16-bit compensation current 10 $\mu$ A, 30 $\mu$ A and 100 $\mu$ A bias current limits

### TEM Scan Controller (DISS6)

<b>Signal inputs</b>	1x calibrated EA 4x STEM
<b>Digitization</b>	20-bit EA, saved to 16-bit, 1 Msps 12-bit STEM, saved to 16-bit, 100 Msps
<b>Scan generator</b>	X and Y scan outputs (calibrated) Beam blank output (optional) 64k $\times$ 64k pixels maximum resolution 0.5 GPixels maximum frame size (software limit) 1 $\mu$ s minimum pixel dwell time (EA input limit)
<b>Synchronization</b>	Pixel, Line and Frame trigger outputs 10ns.... 100ms trigger lengths Pixel, Line and Frame trigger inputs

### PC/Laptop, Display

<b>PC/Laptop</b>	Intel Core i3 minimum 2x USB 2.0 minimum
<b>Display</b>	1,280 x 1,024 resolution minimum
<b>Operating systems</b>	Windows 11 ... 7 Network recommended for remote support

### DISS6 software

<b>EA amplifier control</b>	Gain, Contrast, Brightness, Bias, Compensation, Inv. Save/load amplifier profile
<b>TEM Scan Control (DISS6)</b>	Configurable scan profiles Signals, pixel resolution, speed, averaging, sync Manual/automatic image range
<b>Inspector tool</b>	Automatic quantification of pixel values Editable formula files
<b>Current voltage (IV) tool</b>	Voltage range, steps, time Live plot with data and graph export
<b>Image mixing tool</b>	Manual colour assignment Live mix with image export
<b>Save file formats</b>	uncompressed 8-bit or 16-bit multi-page TIF compressed JPEG XMP metadata embedded into TIF and JPEG
<b>Operating systems</b>	Windows 11 ... 7

### DIPS6 software

<b>Input file formats</b>	Uncompressed 8-bit or 16-bit multi-page TIF Compressed JPEG XMP metadata embedded into TIF and JPEG
<b>Export file formats</b>	PNG images CSV data with pixel values
<b>View modes</b>	Single page image and metadata Multiple pages/file Layers/image mix view
<b>Quantification</b>	Automatic, using XMP values and formulas Manual, using XML formulas
<b>Pseudo-colour</b>	GGR gradient based colour mapping Automatic and manual control of range
<b>Annotations</b>	Labels, arrows, lines, rectangles, circles
<b>Measurements</b>	Distances, angles Line profile Histogram
<b>Operating systems</b>	Windows 11 ... 7

### Parts and Cables

EA biasing holder electronics	Standard	1x
TEM scan controller (DISS6) with LIA input	Standard	1x
EA biasing holder cable	Standard	1x
EA ground strap	Standard	1x
TEM signal cable	Standard	1x
TEM external scan interface cable	Standard	1x
USB cable	Standard	1x
USB memory stick with software	Standard	1x
EA reference sample	Optional	1x
PC, keyboard, mouse	Optional	1x
Display	Optional	1x

### Software packages

Drivers	PEUSB
Libraries	DISS6Control
Software	DISS6 software DIPS6 software EMGateway server

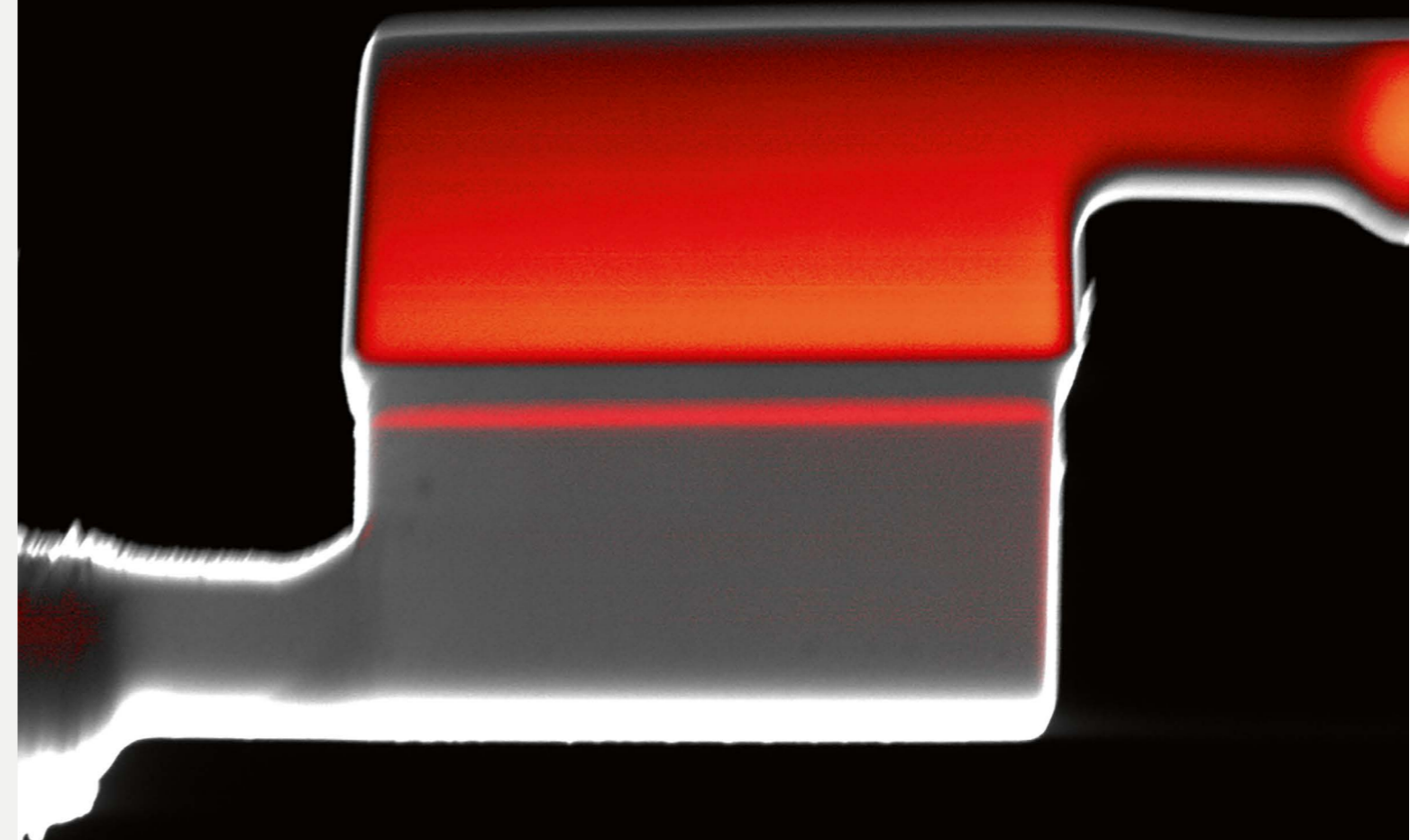
### Weight & Dimensions

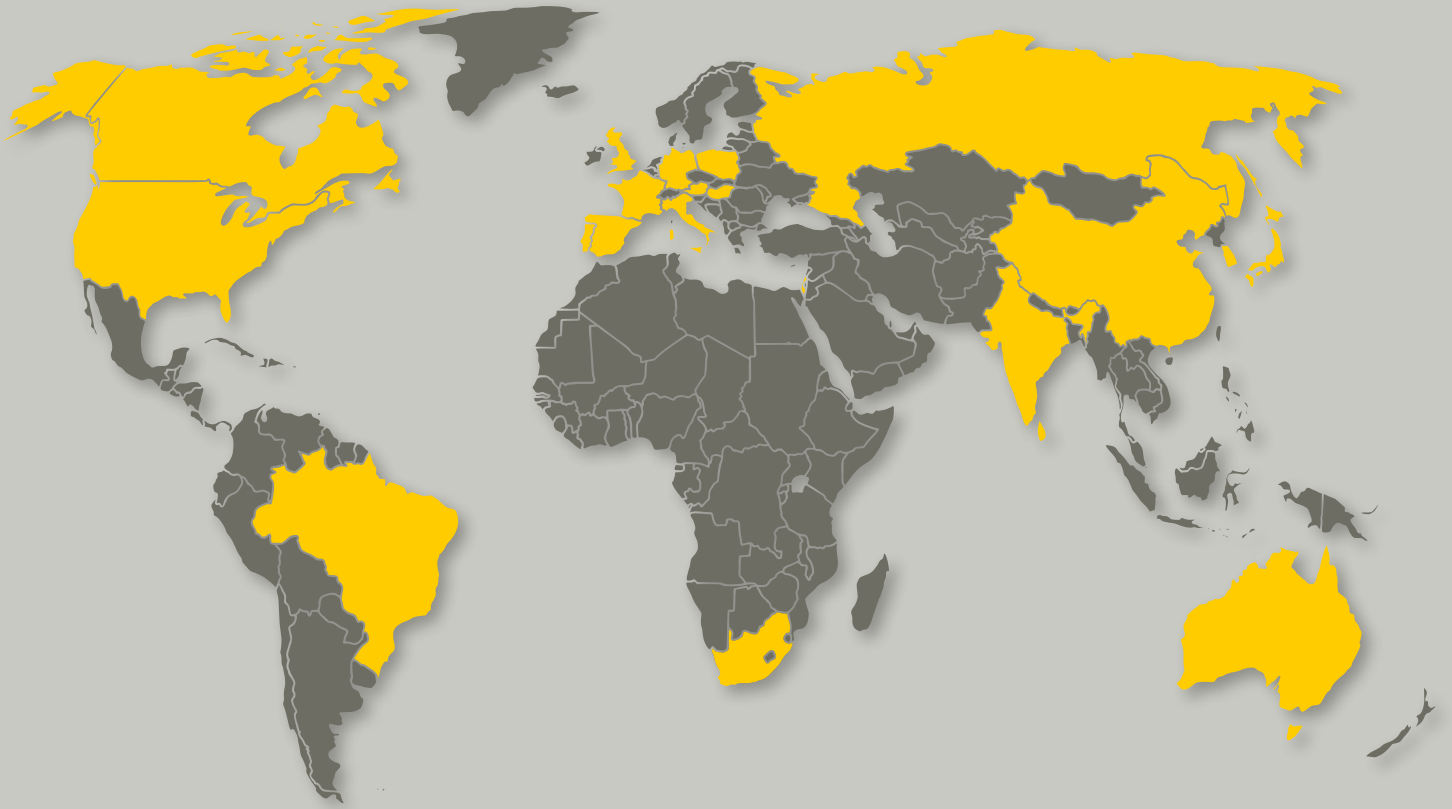
EA biasing holder electronics	66 mm length typ. 60 mm diameter
EA DISS6 imaging	64 x 8.7 x 29.5 cm 3.4 kg
Shipping	typ. 64 x 32 x 56 cm typ. 7.5 kg

### Site requirements

Power	1x mains 110/220 VAC single phase 50-60 Hz on the same earth as the microscope
Microscope	1x biasing holder (see compatible models) 1x external scan interface 1x video connection (HAADF preferred) 1x microscope ground
Space	EA electronics must be mounted on the TEM in-situ biasing holder TEM scan controller may be placed in a TEM electronics rack

# EA for TEM





#### **SALES & SERVICE**

[sales@pointelectronic.de](mailto:sales@pointelectronic.de)  
+49 345 1201190

#### **SUPPORT & TRAINING**

[support@pointelectronic.de](mailto:support@pointelectronic.de)  
+49 345 1201190

#### **CUSTOM ENGINEERING**

[engineering@pointelectronic.de](mailto:engineering@pointelectronic.de)  
+49 345 47225619

**point electronic GmbH** | Erich-Neuß-Weg 15 | 06120 Halle (Saale) | Germany  
Tel.: +49 345 1201190 | Fax: +49 345 1201223 | [info@pointelectronic.de](mailto:info@pointelectronic.de) | [www.pointelectronic.de](http://www.pointelectronic.de)