

ProSEM

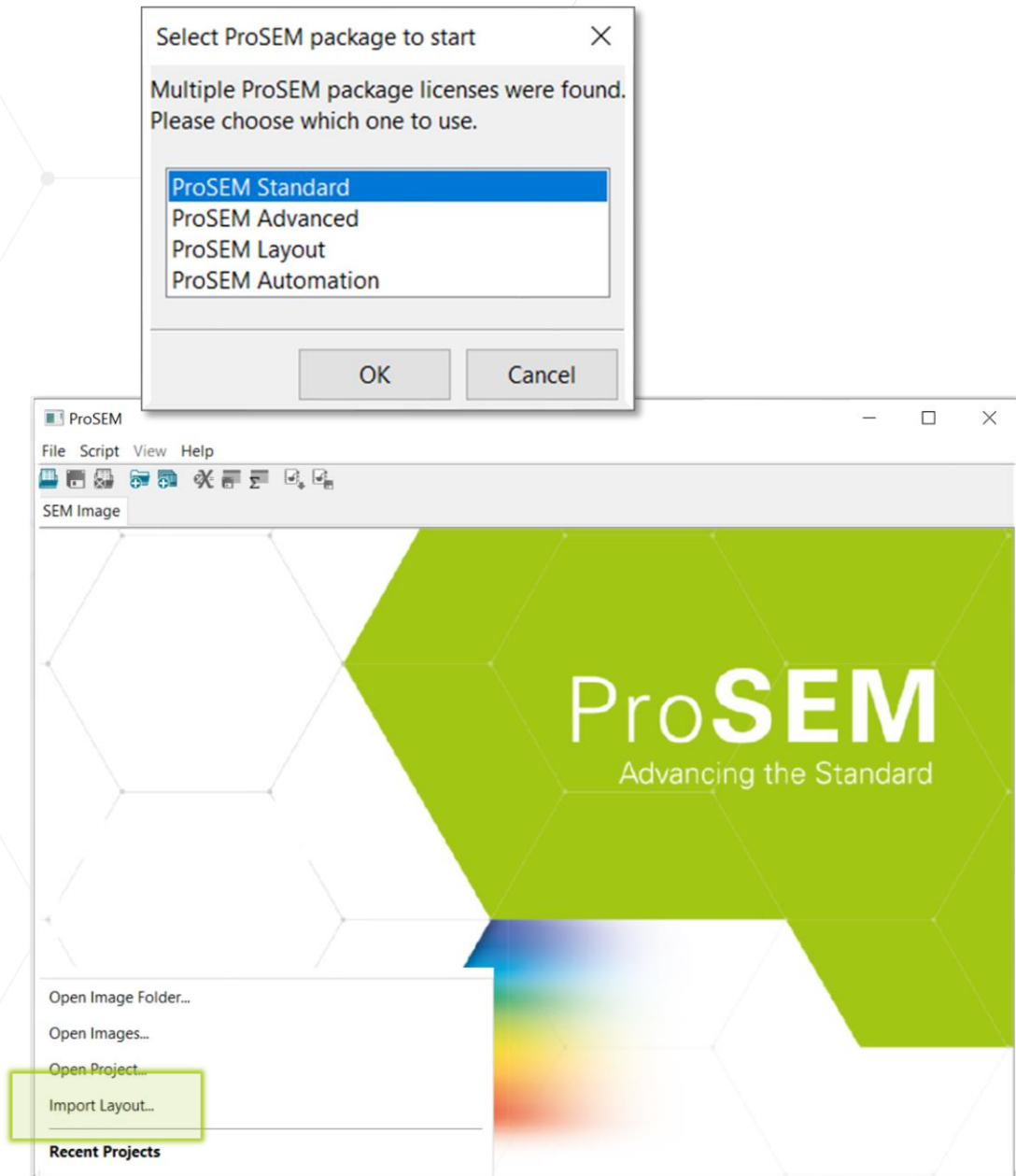
What's New in ProSEM 3.2

ProSEM 3.2 Key News

- General
 - ProSEM Packages
 - Handling of multi-page TIFF
- Feature Detection and Export
 - 2-pass detection for fitted 2D features including cutline
 - Export (GDS, CSV) for segmented contours
- Layout Integration
 - New GUI: image/layout in parallel, metrology list
 - Extended to multiple layers and more feature types
- SEM Automation: Completely New Functionality

General

- ProSEM packages
 - New selection panel on starting ProSEM
 - Only in case different packages are available
- Opening splash screen
 - Added *Import Layout...*
 - Enables easy project start with layout file only
 - Only applies to Layout Package or higher

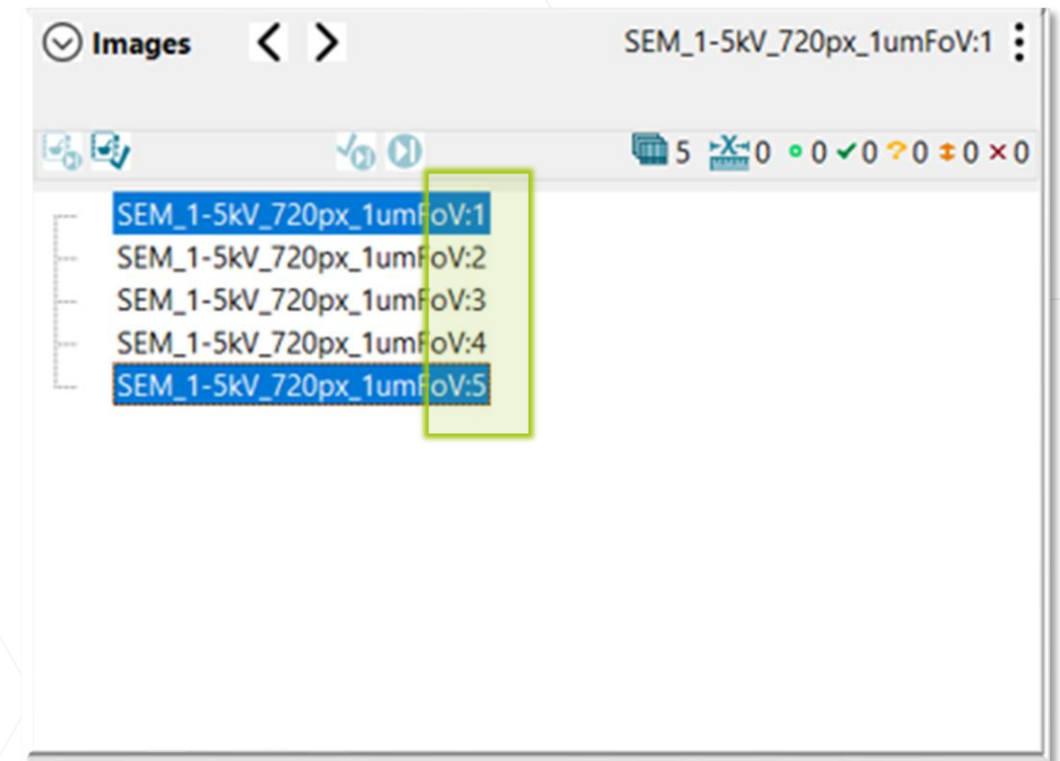


New ProSEM packages

- Replace the previous standard ProSEM with options
- Increasing / inclusive regarding their content
- Licensed Packages
 - Standard equivalent to ProSEM
 - Advanced will get more features
 - Layout is extended as well
 - All new is the SEM automation

| Before Packages | ProSEM (P300) | Advanced Contour Meas. (PO301) | Layout Integration (PO302) | SEM Automation <i>NEW</i> |
|--------------------|------------------|--------------------------------------|----------------------------------|---------------------------------|
| Standard | X | | | |
| Advanced | X | X | | |
| Layout | X | X | X | |
| Automation | X | X | X | X |

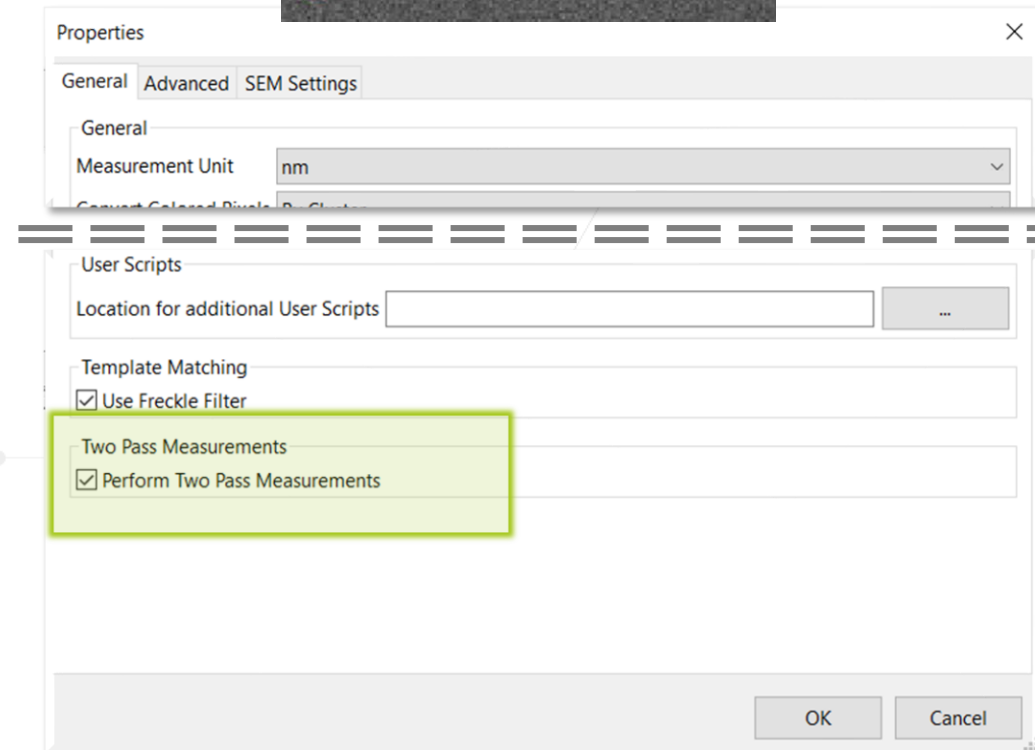
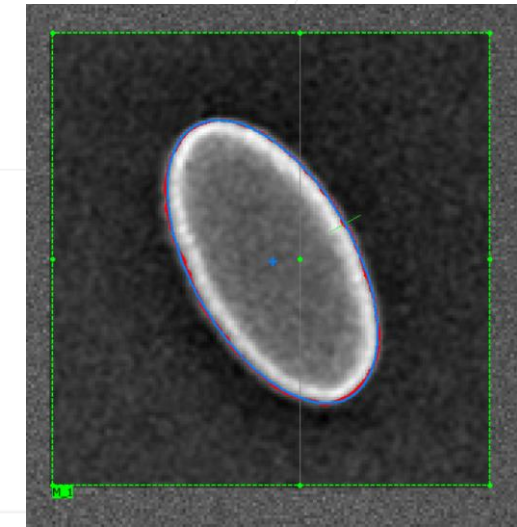
- Handling of TIFF images with multiple pages implemented
 - Loading of all image pages
 - Excluding thumbnails, alpha masks etc.
 - Imported as separate images in project tree
 - In case a pixel size is included, it is applied to all images



Feature Detect/ Export

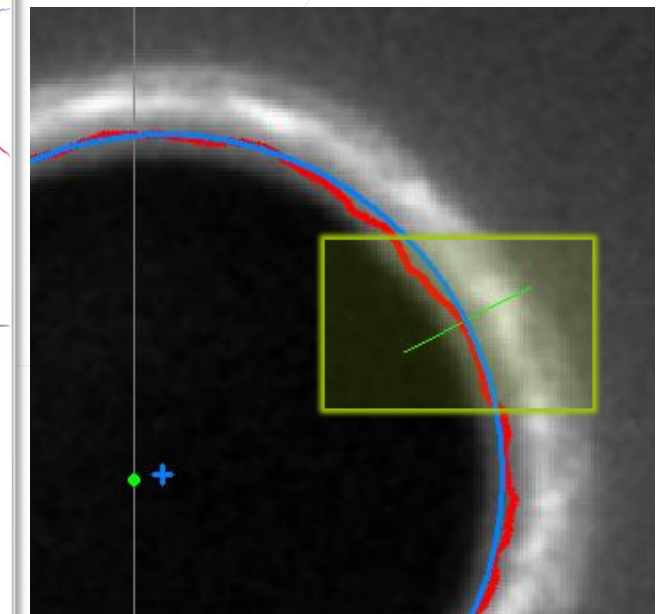
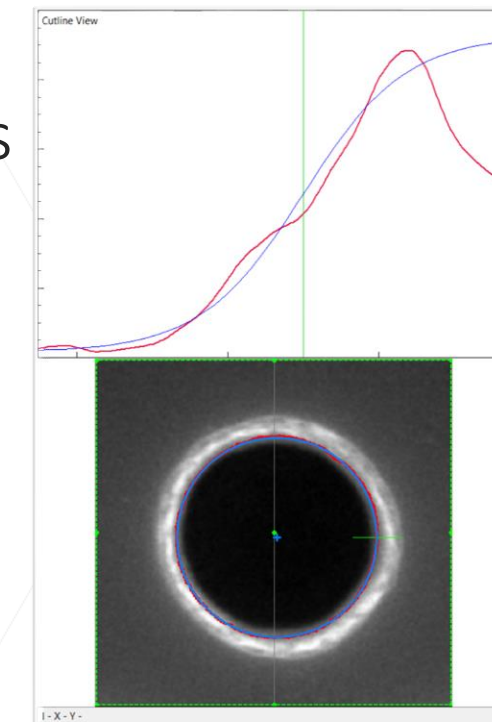
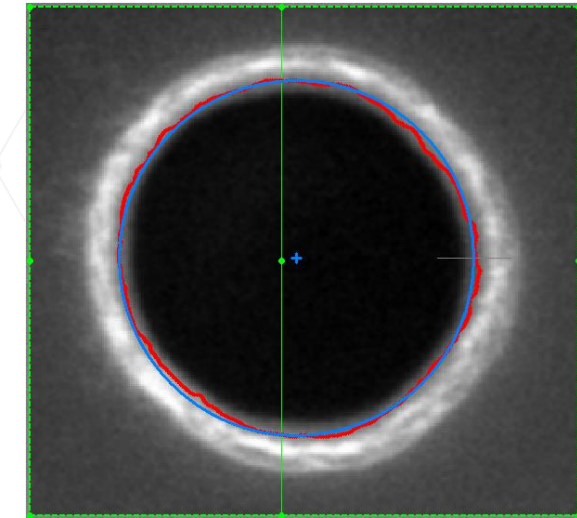
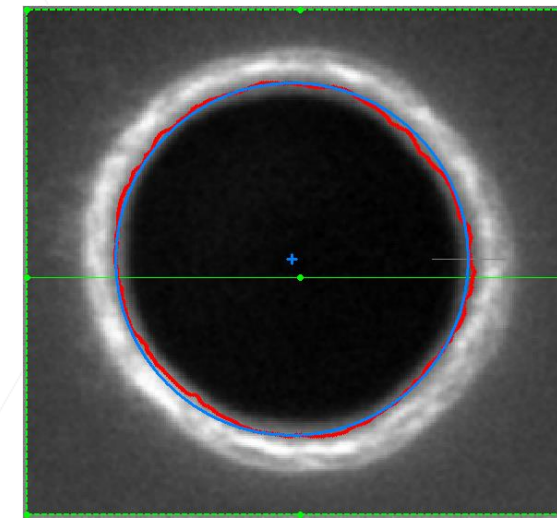
Two-pass Feature Detection

- Two-pass for fitted 2D features (non L&S)
 - Implemented a 2nd pass for shape construction
 - Applies to rectangle, circle, ellipse and triangle
 - Orthogonal scanregions are used for fine detection
 - Improves the quality with 2D contours on noisy images
-
- Settings two-pass
 - In properties dialogue under general tab
 - Default is “on”
 - Tic box applies both to L&S and fitted 2D features



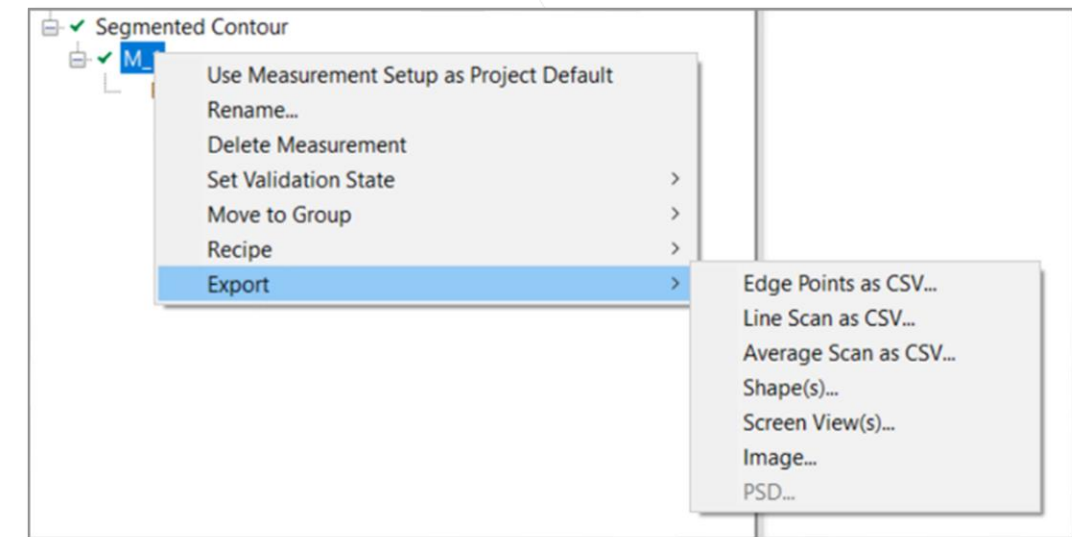
Second Cutline „non-cartesian“

- Standard cutline still available
 - In X or Y direction
 - Position can be shifted in cartesian directions
- New alternative cutline for fitted 2-pass features
 - 2nd cutline representing orthogonal scanregions
 - Can be moved along fitted shape
 - Switch between both types



Export for Segmented Contours

- Export into GDS and CSV
 - So far, only export of closed shapes possible
 - GDS export now established for segmented contours
 - Segments are exported as single polygons
 - Edge points can also be exported as CSV
(Available with Advanced Package or higher)
- Other line groups (L&S or multi-edge)
 - Individual lines are exported as separate polygons

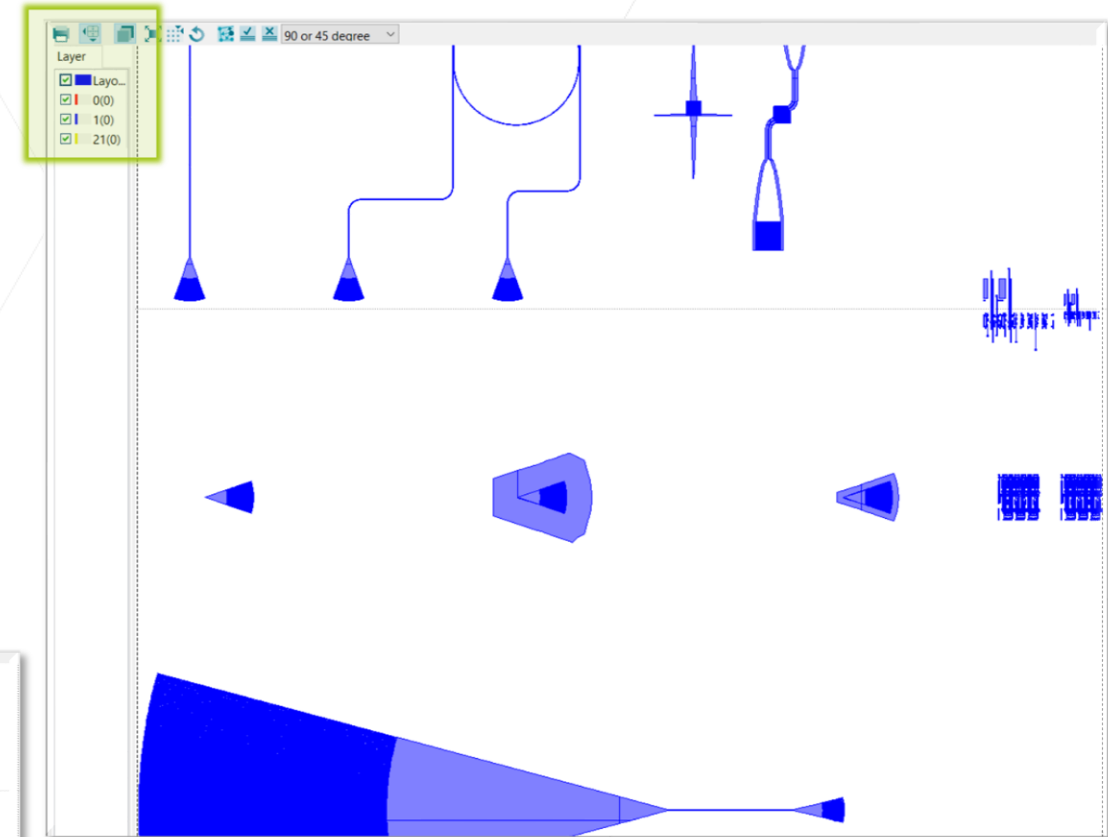
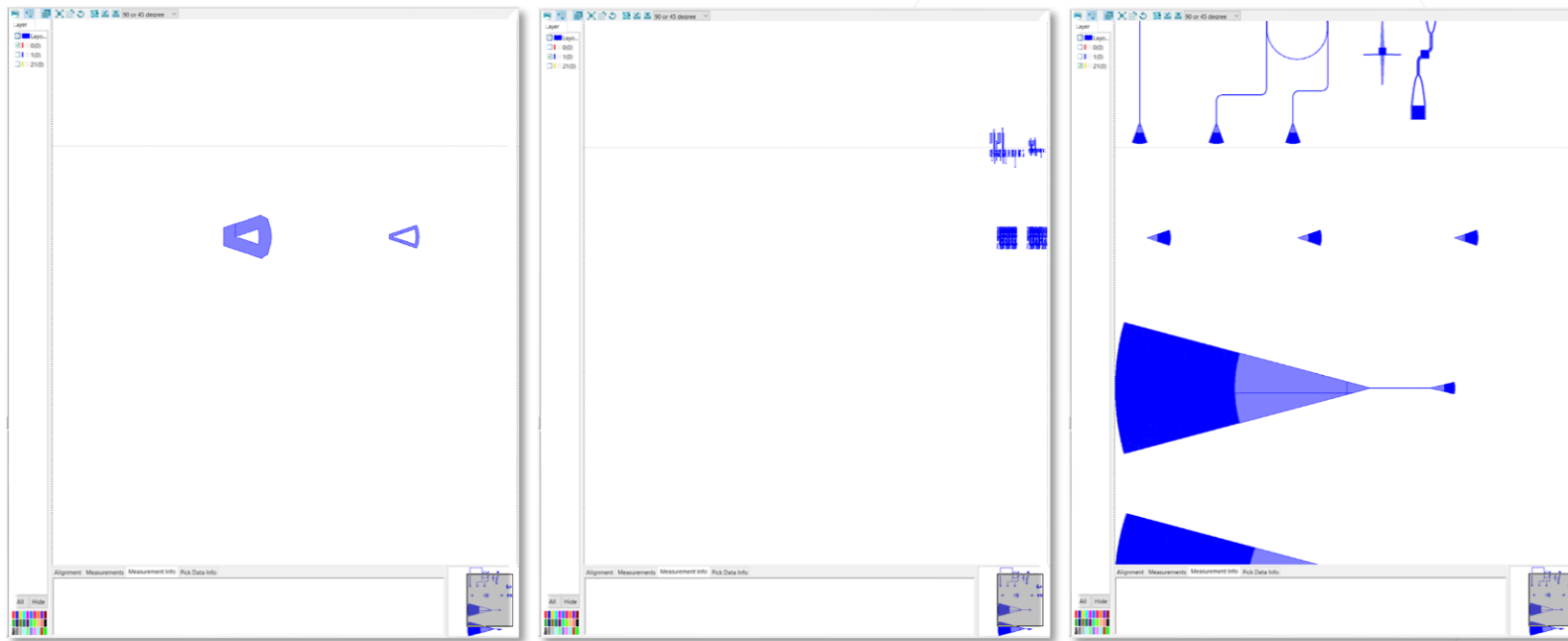


Layout Integration

Layout or Automation Package

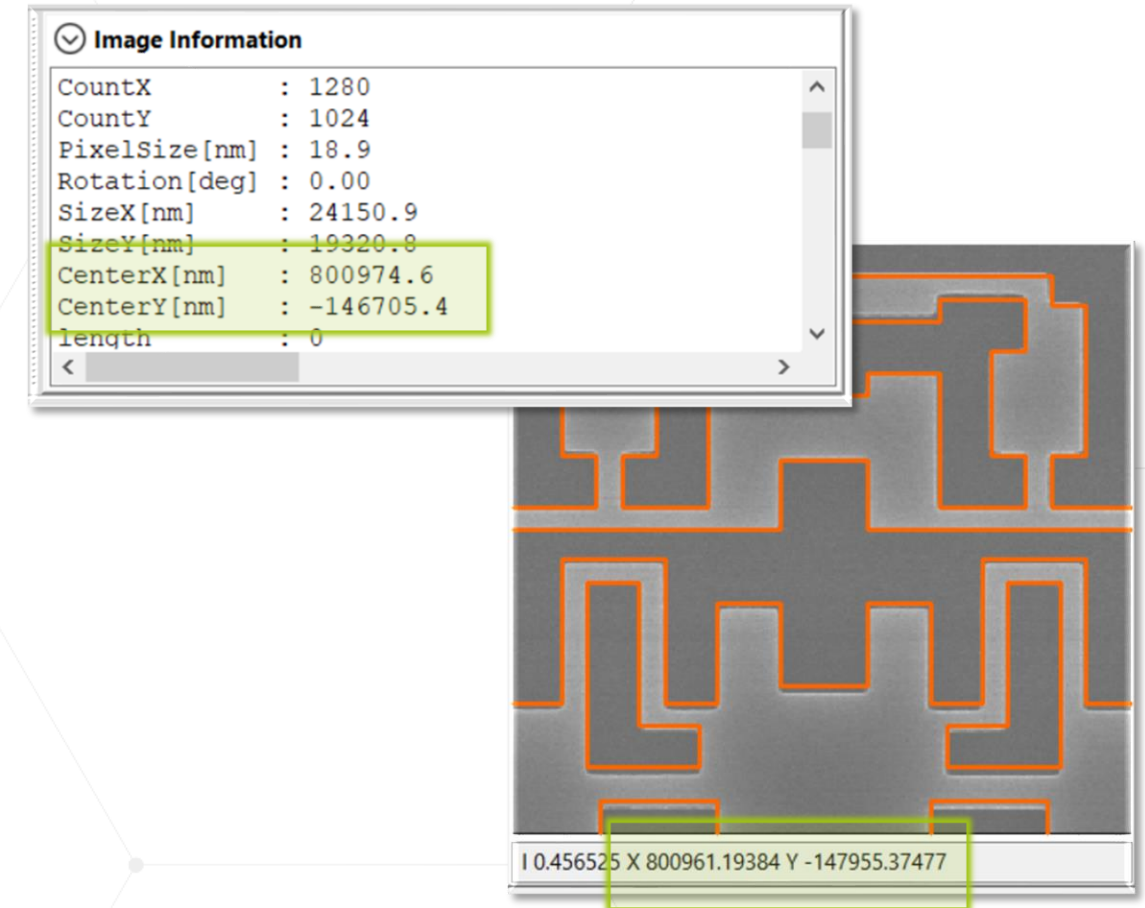
Multi-layer Layouts

- Handling of layouts with multiple layers
 - Loading of layers separately (no heal)
 - Switch layers in view
 - Define metrology tasks based on specific layer



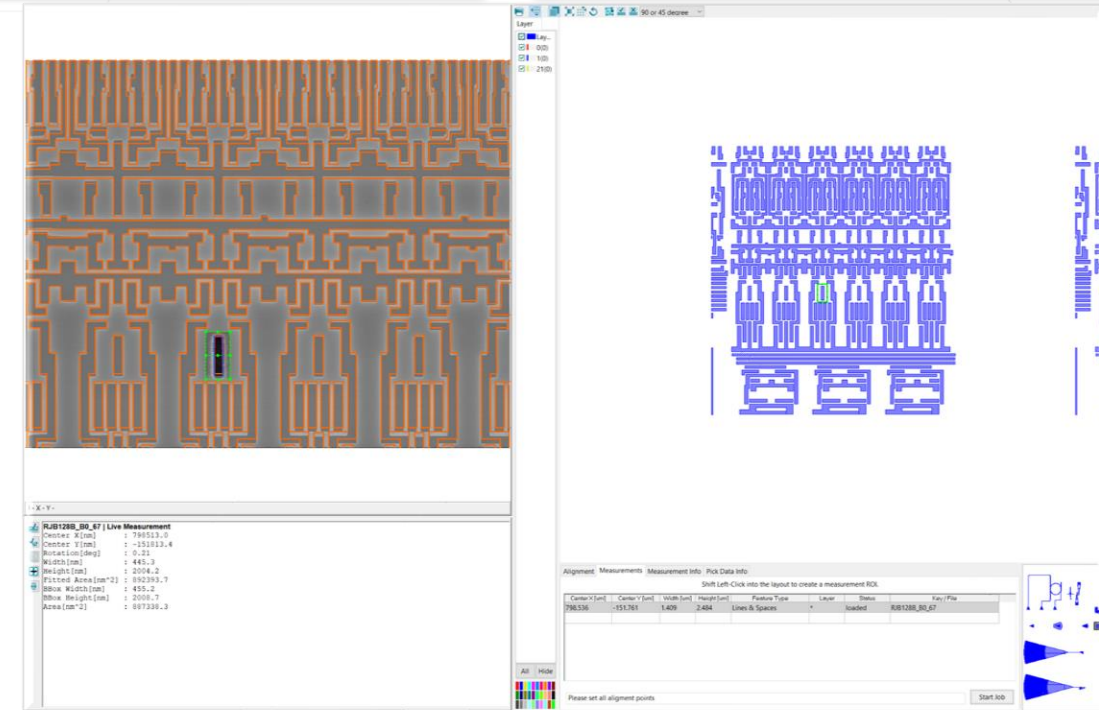
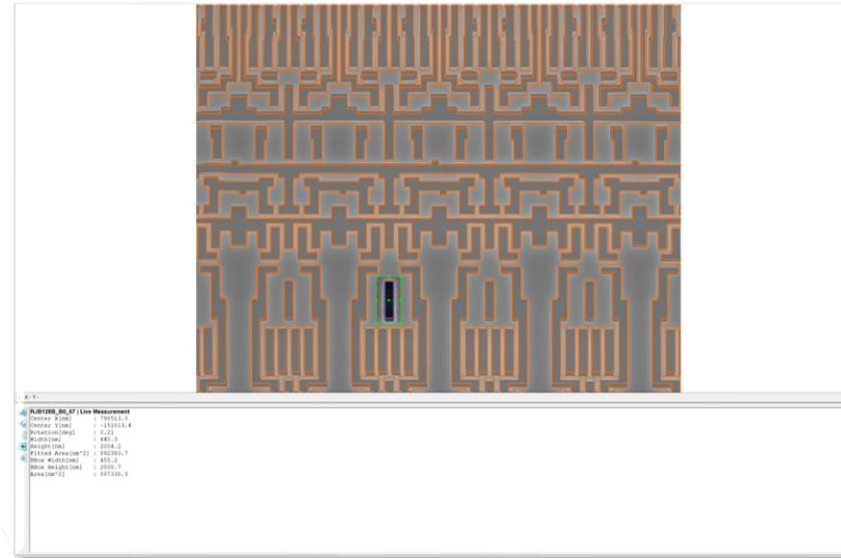
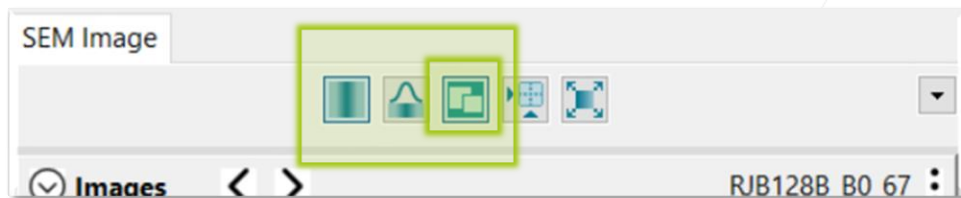
Layout Registration Improvements

- Registered coordinate system
 - Show positions in layout coordinates
 - Image info panel: image center position
 - Below image: current mouse position
- In addition: registration quality improved



- Layout and/ or Image View
 - Image (2D/ 1D) or Viewer
 - Both in parallel

→ Convenient switching



- Metrology list
 - Now integrated in Viewer tabs as “Measurements”
 - Supports existing functionality (image key/ identifier)
 - Now extended to other feature types than L&S
 - Context menu allows for direct image import/ select



Measurements Measurement Info Pick Data Info

Shift Left-Click into the layout to create a measurement ROI.

| Center X [um] | Center Y [um] | Width [um] | Height [um] | Feature Type | Layer | Status | Key / File |
|---------------|---------------|------------|-------------|----------------|-------|------------|------------|
| 0.000 | 0.000 | 0.000 | 0.000 | Lines & Spaces | * | not loaded | _65 |

Shift Left-Click into the layout to create a measurement ROI.

| Height [um] | Feature Type | Layer | Status |
|-------------|----------------|-------|------------|
| 0.000 | Lines & Spaces | * | not loaded |

Key / File

RJB128B_B0_67

Remove Measurement
Clear all
Append Predefined
Use Existing Image
Import Image File

RJB128B_B0_65
RJB128B_B0_66
RJB128B_B0_67
RJB128B_B2_68
RJB128B_B2_69

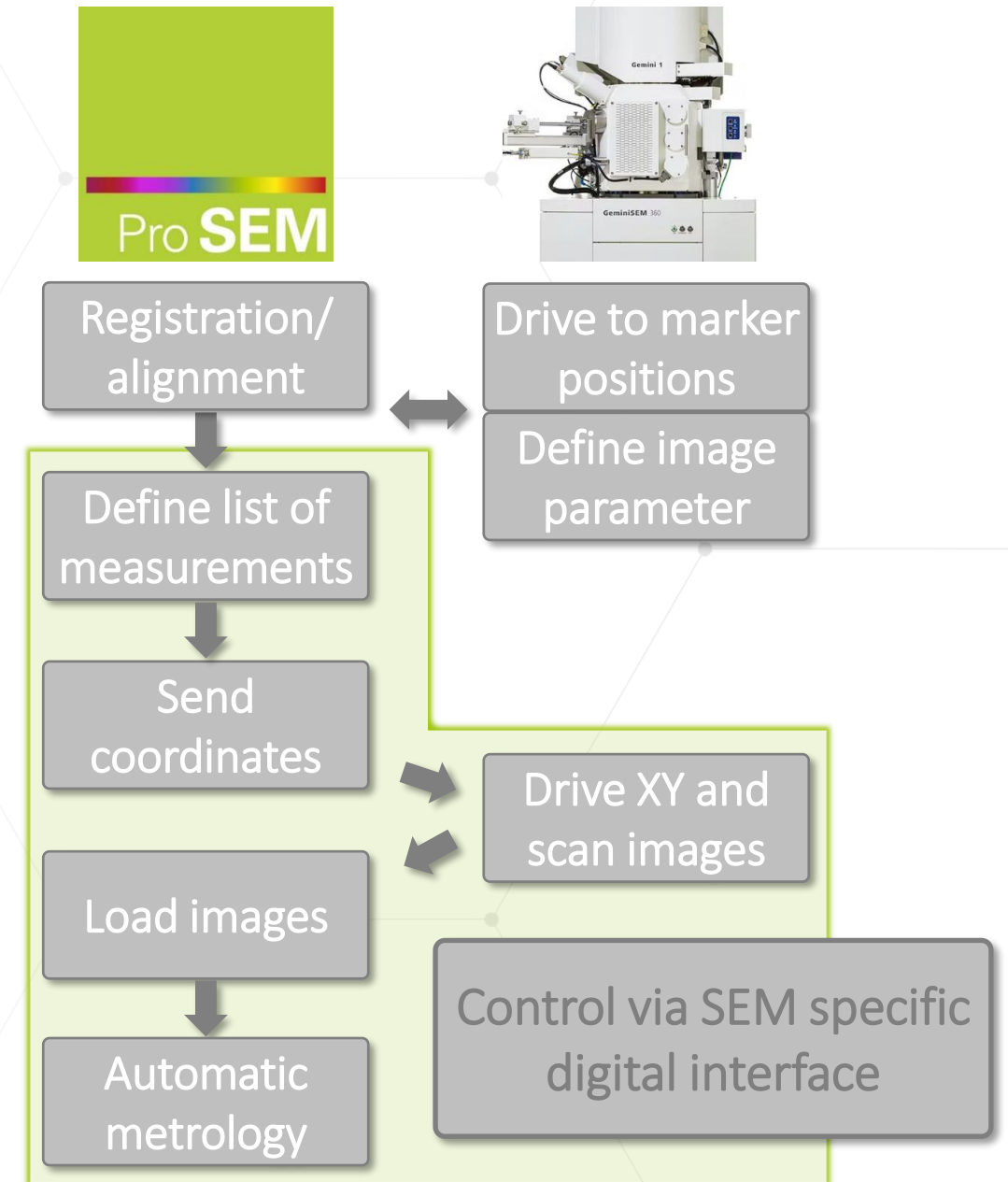
SEM Automation

Automation Package

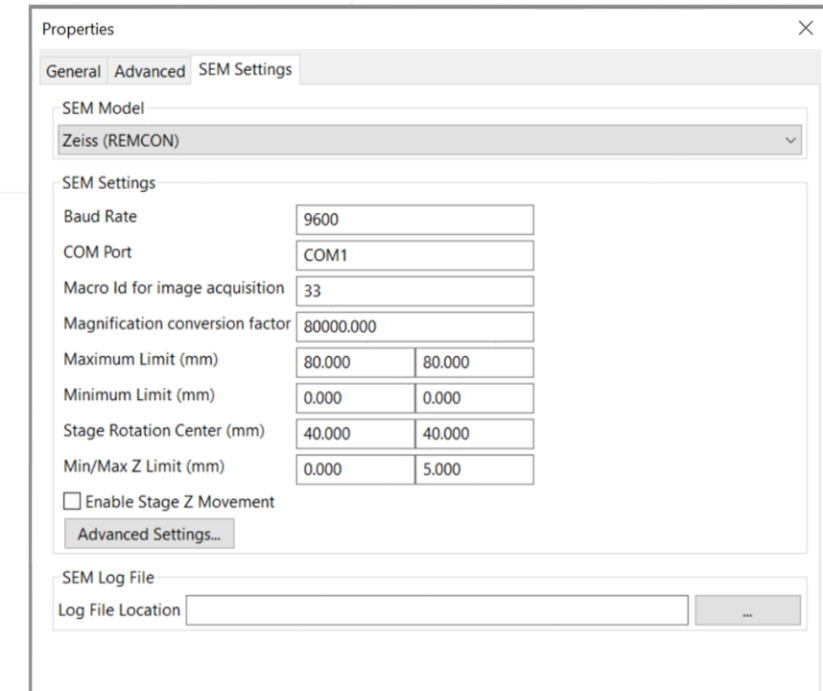
New SEM Automation Package

- Digital interface to SEM PC
 - Currently available for ZEISS “Remcon”
 - Next planned interfaces for FEI and JEOL
- 3-point alignment of stage & layout coordinates
- Define list of measurements based on layout
- Send SEM drive and image scan commands
- Load set of images
- Execute automated metrology measurements

→ For workflow steps see appendix



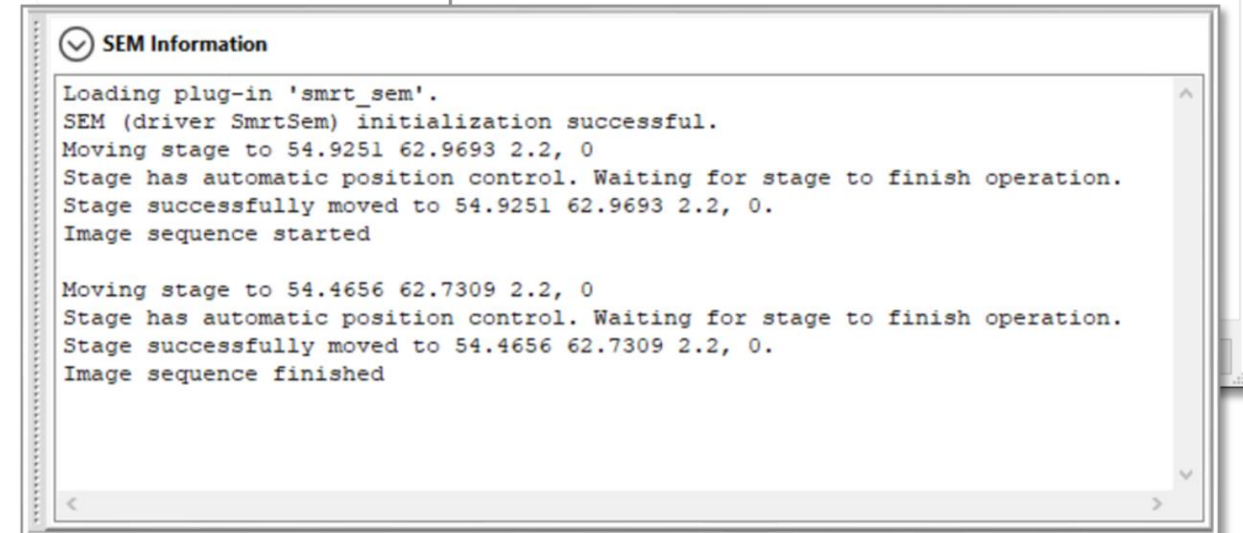
- SEM settings dialogue
 - Tab in properties menu
 - Includes settings for PC interface
 - Currently only ZEISS Remcon supported
 - Separate manual on setup of COM interface available
- SEM information panel
 - Provides logging of SEM status
 - Displays coordinates and hardware messages



The screenshot shows the 'Properties' dialog box with the 'SEM Settings' tab selected. The 'SEM Model' is set to 'Zeiss (REMCON)'. The 'SEM Settings' section includes the following fields:

| | |
|---------------------------------|---------------|
| Baud Rate | 9600 |
| COM Port | COM1 |
| Macro Id for image acquisition | 33 |
| Magnification conversion factor | 80000.000 |
| Maximum Limit (mm) | 80.000 80.000 |
| Minimum Limit (mm) | 0.000 0.000 |
| Stage Rotation Center (mm) | 40.000 40.000 |
| Min/Max Z Limit (mm) | 0.000 5.000 |

There is an unchecked checkbox for 'Enable Stage Z Movement' and an 'Advanced Settings...' button. At the bottom, there is a 'SEM Log File' section with a 'Log File Location' text box and a browse button.



The screenshot shows the 'SEM Information' panel with a log of SEM status messages:

```

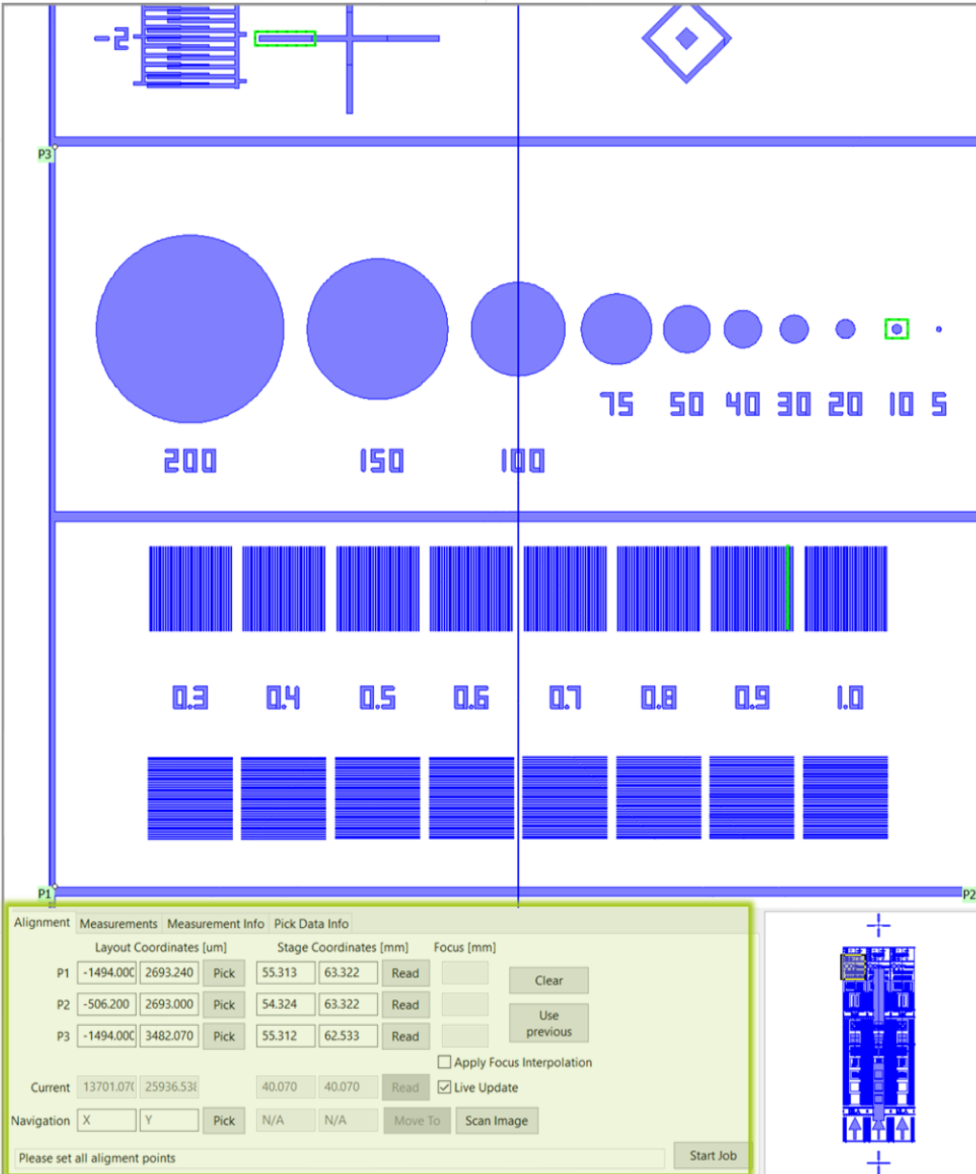
Loading plug-in 'smrt_sem'.
SEM (driver SmrtSem) initialization successful.
Moving stage to 54.9251 62.9693 2.2, 0
Stage has automatic position control. Waiting for stage to finish operation.
Stage successfully moved to 54.9251 62.9693 2.2, 0.
Image sequence started

Moving stage to 54.4656 62.7309 2.2, 0
Stage has automatic position control. Waiting for stage to finish operation.
Stage successfully moved to 54.4656 62.7309 2.2, 0.
Image sequence finished
  
```

Coordinates Alignment Tab

- Alignment mode
 - Integrated in Viewer tabs
 - Procedure for alignment of stage to layout coordinates
 - Apply previous alignment if available
- “Start Job” for automated SEM procedure
 - Only with valid alignment and measurements defined
 - Shows progress of automated image acquisition

| Alignment | Measurements | Measurement Info | Pick Data Info |
|--|---|---|---|
| | Layout Coordinates [um] | Stage Coordinates [mm] | Focus [mm] |
| P1 | -1494.000 2693.240 <input type="button" value="Pick"/> | 55.313 63.322 <input type="button" value="Read"/> | <input type="button" value="Clear"/> |
| P2 | -506.200 2693.000 <input type="button" value="Pick"/> | 54.324 63.322 <input type="button" value="Read"/> | <input type="button" value="Use previous"/> |
| P3 | -1494.000 3482.070 <input type="button" value="Pick"/> | 55.312 62.533 <input type="button" value="Read"/> | <input type="button" value="Use previous"/> |
| <input type="checkbox"/> Apply Focus Interpolation | | | |
| Current | 13701.070 25936.530 <input type="button" value="Read"/> | 40.070 40.070 <input type="button" value="Read"/> | <input checked="" type="checkbox"/> Live Update |
| Navigation | X Y <input type="button" value="Pick"/> | N/A N/A <input type="button" value="Move To"/> | <input type="button" value="Scan Image"/> |
| Please set all alignment points <input type="button" value="Start Job"/> | | | |

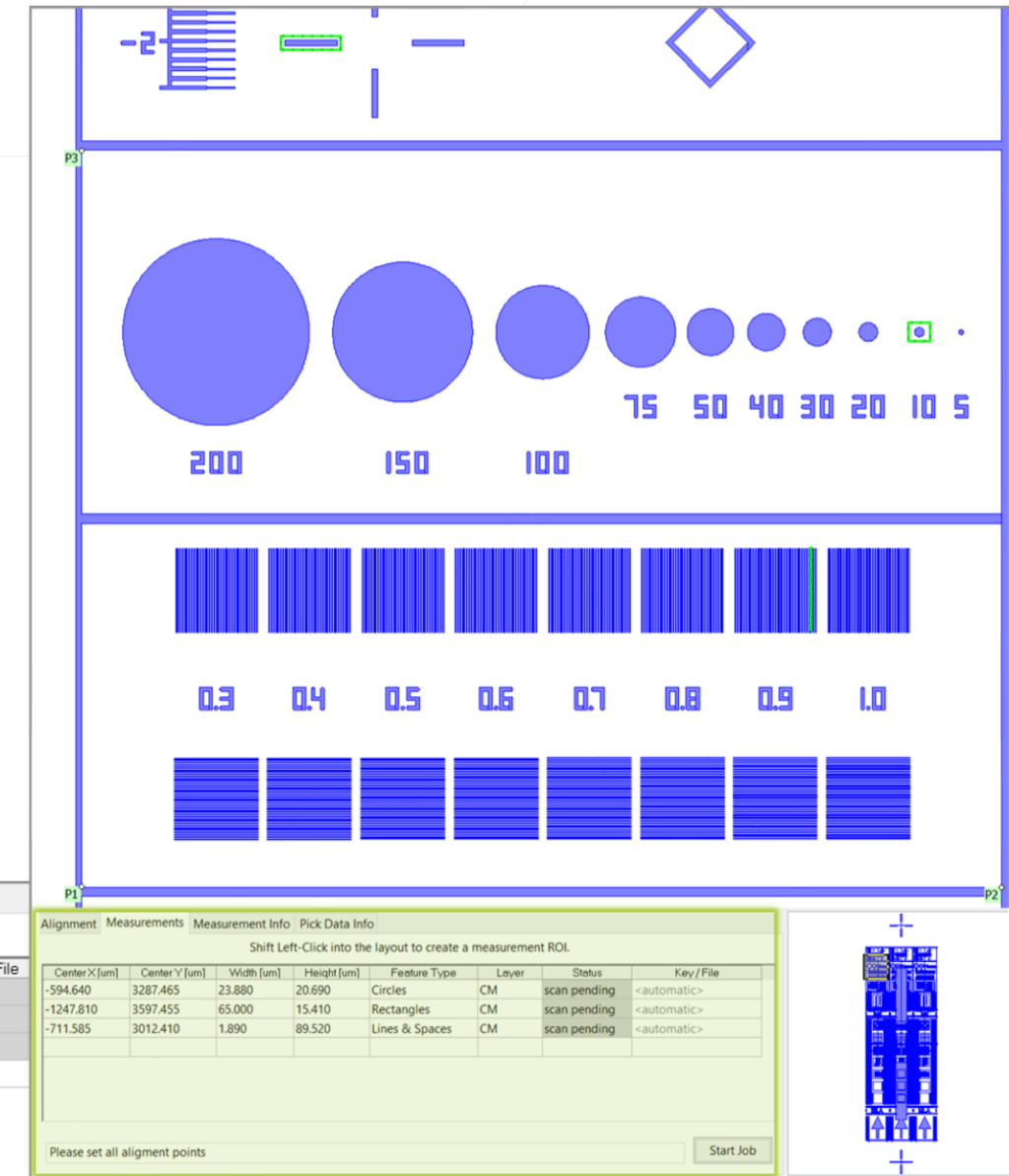


The SEM viewer interface displays a grid of alignment points (P1, P2, P3) and a series of circular patterns representing different magnifications (200, 150, 100, 75, 50, 40, 30, 20, 10, 5). Below the grid, there are several rows of data, including layout coordinates, stage coordinates, and focus values. The interface also includes a navigation panel on the right side with a small image of the sample.

| Alignment | Measurements | Measurement Info | Pick Data Info |
|--|---|---|---|
| | Layout Coordinates [um] | Stage Coordinates [mm] | Focus [mm] |
| P1 | -1494.000 2693.240 <input type="button" value="Pick"/> | 55.313 63.322 <input type="button" value="Read"/> | <input type="button" value="Clear"/> |
| P2 | -506.200 2693.000 <input type="button" value="Pick"/> | 54.324 63.322 <input type="button" value="Read"/> | <input type="button" value="Use previous"/> |
| P3 | -1494.000 3482.070 <input type="button" value="Pick"/> | 55.312 62.533 <input type="button" value="Read"/> | <input type="button" value="Use previous"/> |
| <input type="checkbox"/> Apply Focus Interpolation | | | |
| Current | 13701.070 25936.530 <input type="button" value="Read"/> | 40.070 40.070 <input type="button" value="Read"/> | <input checked="" type="checkbox"/> Live Update |
| Navigation | X Y <input type="button" value="Pick"/> | N/A N/A <input type="button" value="Move To"/> | <input type="button" value="Scan Image"/> |
| Please set all alignment points <input type="button" value="Start Job"/> | | | |

SEM Automation List

- Automation list
 - Combines functionality of acquisition and metrology
 - Define ROI in layout and specify measurement
 - Positions are used for image acquisition
- “Start Job” for automated SEM procedure
 - Only with valid alignment and measurements defined
 - Shows progress of automated image acquisition



| Alignment Measurements Measurement Info Pick Data Info | | | | | | | |
|---|---------------|------------|-------------|----------------|-------|--------------|-------------|
| Shift Left-Click into the layout to create a measurement ROI. | | | | | | | |
| Center X [um] | Center Y [um] | Width [um] | Height [um] | Feature Type | Layer | Status | Key / File |
| -594.640 | 3287.465 | 23.880 | 20.690 | Circles | CM | scan pending | <automatic> |
| -1247.810 | 3597.455 | 65.000 | 15.410 | Rectangles | CM | scan pending | <automatic> |
| -711.585 | 3012.410 | 1.890 | 89.520 | Lines & Spaces | CM | scan pending | <automatic> |

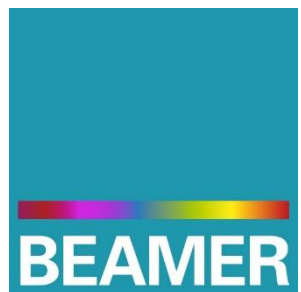
| Status | Key / File |
|---------------|-------------|
| scan finished | <automatic> |
| scan finished | <automatic> |
| scanning | <automatic> |

| Status | Key / File |
|--------|-------------------|
| loaded | himt_app_test_p05 |
| loaded | himt_app_test_p05 |
| loaded | himt_app_test_p06 |

Start Job

Thank You!

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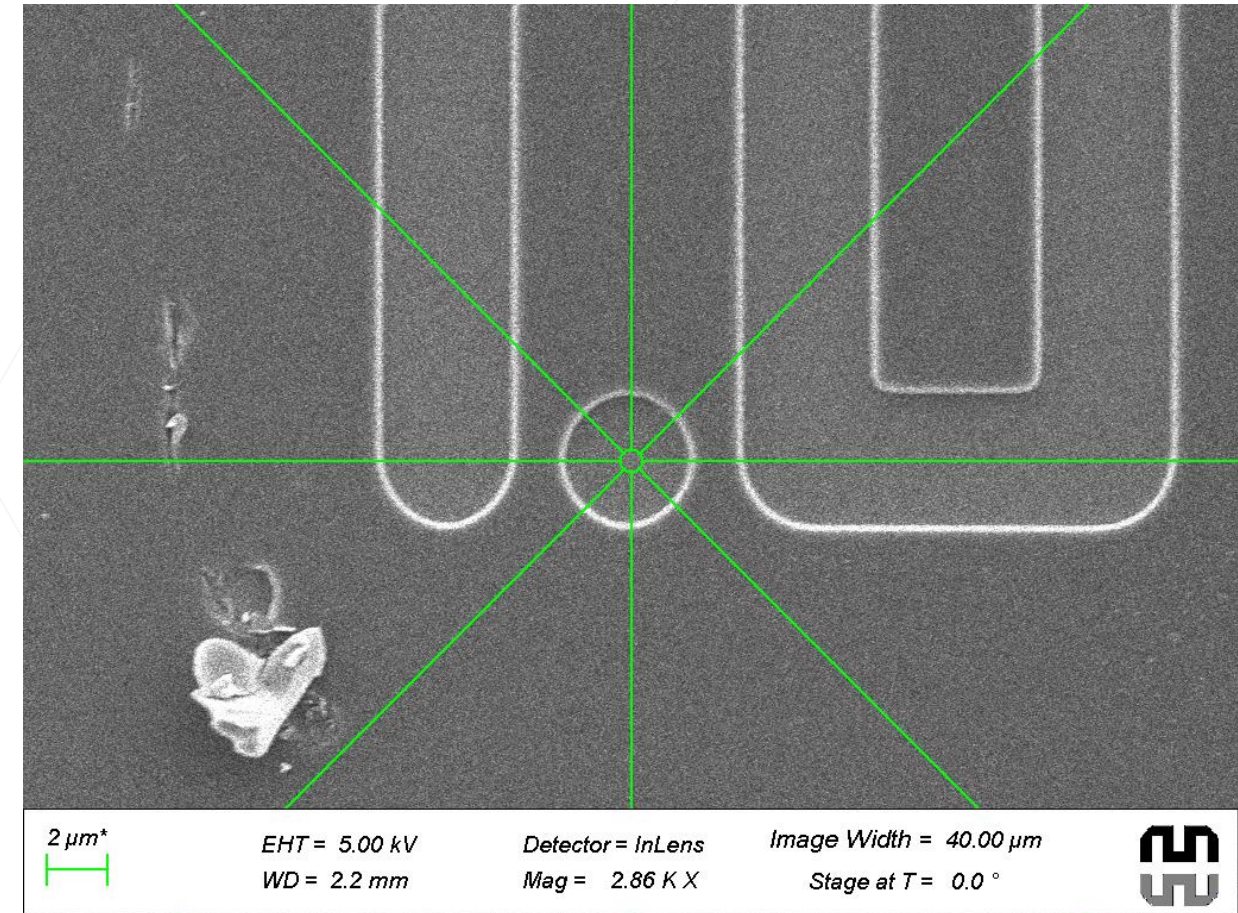
📠 +81 (0)45-532-6933

✉ apsales@genisys-gmbh.com

Preparation of SEM microscope

Get ready for image scan and save

- Focus, aperture align and stigmation
- Beam energy and detector
- Contrast and brightness
- Field of view
- Scan speed and averaging
- Predefine image name/ extension and folder

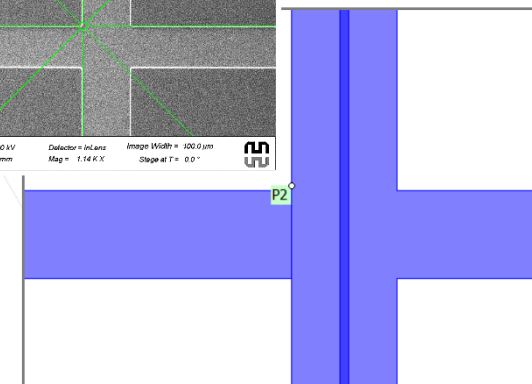
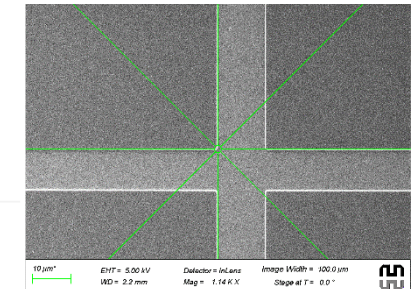
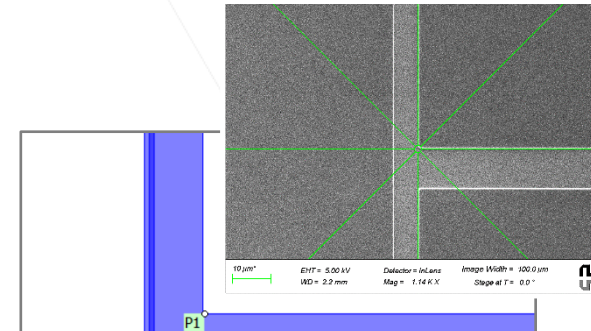
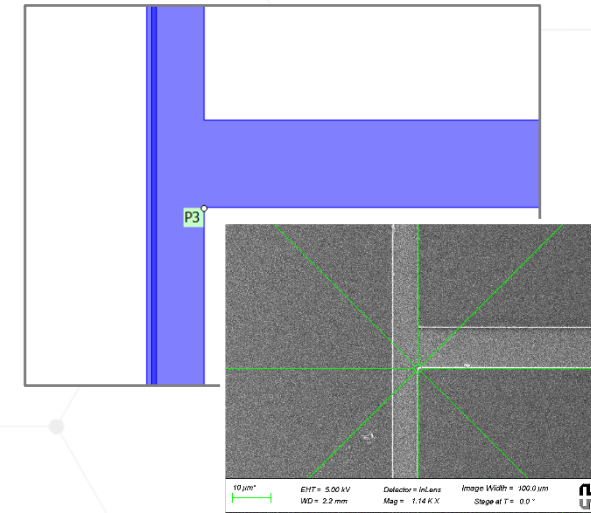


Alignment of SEM and ProSEM

Match positions and coordinate systems

- Use 3 markers or specific locations
- Pick layout coordinates from design in ProSEM
- Drive to corresponding sample locations
- Read SEM stage coordinates in ProSEM

| Alignment | Measurements | Measurement Info | Pick Data Info |
|------------|-------------------------|------------------|--|
| | Layout Coordinates [um] | | Stage Coordinates [mm] Focus [mm] |
| P1 | -1494.000 | 2693.240 | Pick 55.313 63.322 Read |
| P2 | -506.200 | 2693.000 | Pick 54.324 63.322 Read |
| P3 | -1494.000 | 3482.070 | Pick 55.312 62.533 Read |
| | | | Clear |
| | | | Use previous |
| | | | <input type="checkbox"/> Apply Focus Interpolation |
| Current | 13701.070 | 25936.530 | 40.070 40.070 Read <input checked="" type="checkbox"/> Live Update |
| Navigation | X | Y | Pick N/A N/A Move To Scan Image |



Preparation of Job List in ProSEM

Automation and measurement list

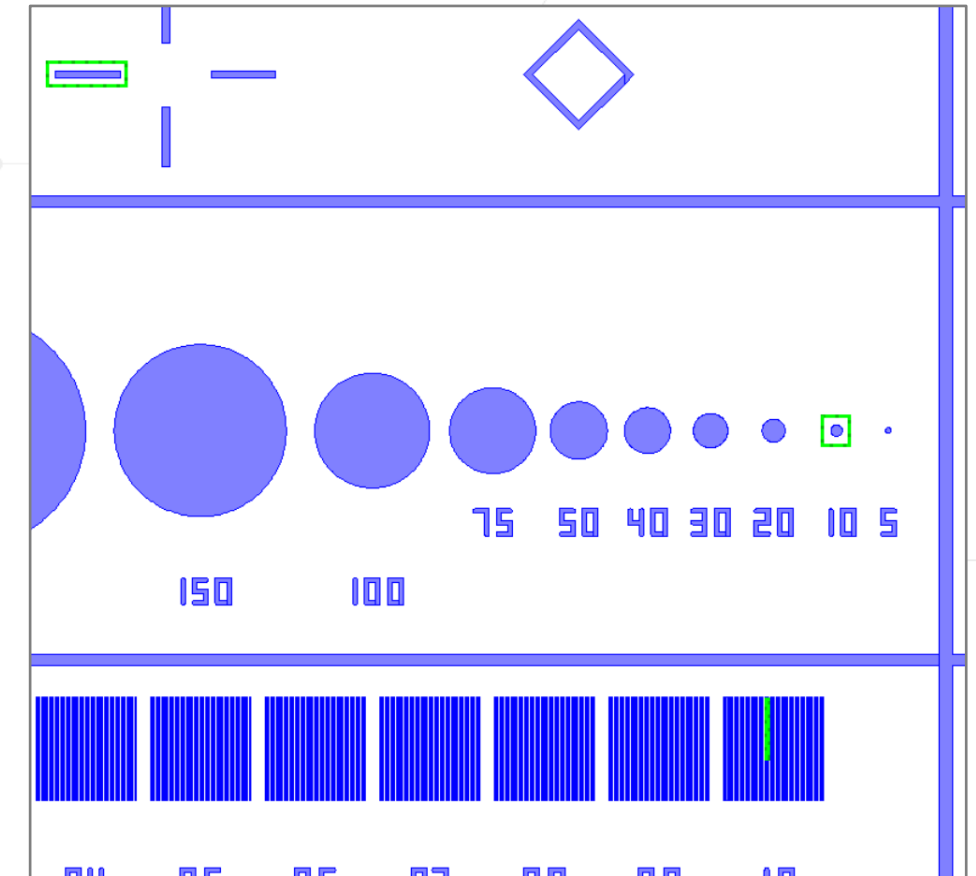
- Define ROI's around features in layout
- Entry in table is created with position for image
- Specify feature type (and layer optionally)

→ Create full job list

→ Start job

| Shift Left-Click into the layout to create a measurement ROI. | | | | | | | |
|---|---------------|------------|-------------|----------------|-------|--------------|-------------|
| Center X [um] | Center Y [um] | Width [um] | Height [um] | Feature Type | Layer | Status | Key / File |
| -594.640 | 3287.465 | 23.880 | 20.690 | Circles | CM | scan pending | <automatic> |
| -1247.810 | 3597.455 | 65.000 | 15.410 | Rectangles | CM | scan pending | <automatic> |
| -711.585 | 3012.410 | 1.890 | 89.520 | Lines & Spaces | CM | scan pending | <automatic> |
| | | | | | | | |
| | | | | | | | |

Stop



Acquisition & Metrology with ProSEM

Automated metrology

- Drive SEM stage and acquire image
- Load images into ProSEM
- Apply pre-defined measurement

