



# ebsCENTER

electronics based systems

managed by

**TU Graz Errichtungs- und Betreiber GmbH**

on campus of



## EBS-Lab

### EBS-Lab - Equipment Overview

Graz, Sept 2021

<https://www.tugraz.at/sites/ebs/ebs-center>

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# EBS-Lab at a Glance

- **Established in 2020**
- **Scope** EBS – Electronics Based Systems
- **Offer** Measurement & Characterization Equipment  
**for use by companies and university**
- **Run by** TU Graz Errichtungs- und Betreiber GmbH  
in co-operation with TU Graz – Faculty of  
Electrical and Information Engineering



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## Partners @ EBS-Center

### Labs & Offices of Companies at EBS Center

- Silicon Austria Labs GmbH
- AVL List GmbH
- AVL DiTEST GmbH
- Innofreight IT Solutions GmbH
- Kestrel Eye GmbH
- Silicon Alps Cluster GmbH



### Labs & Offices of TU Graz at EBS Center

- IHF Institut für Hochfrequenztechnik / Microwave and Photonic Engineering
- EMS Institut für Elektrische Messtechnik und Sensorik / Electrical Measurement and Sensor Systems
- IFE Institut für Elektronik / Electronics
- ETIT Fakultät für Elektrotechnik und Informationstechnik / Electrical and Information Engineering

# Lab-Equipment – Overview 1/3

Device	Key Researcher
<b>VNA</b> Vector Network Analyzer 70 kHz ...150 GHz Anritsu ME7838D, Rekirsch	Prof. Gadringer IHF Hochfrequenztechnik
<b>VNA</b> Vector Network Analyzer 9 kHz...14 GHz Keysight ENA Series vector network analyzer	Prof. Pommerenke IFE Elektronik
<b>PSO</b> Probe Station Formfactor SUMMIT 200 with <b>SiPh</b> Silicon Photonics Platform Formfactor SiPh	Prof. Gadringer IHF Hochfrequenztechnik Prof. Bergmann EMS Elektr. Messtechnik & Sensorik
<b>AWG</b> Arbitrary Waveform Generator Tektronix AWG5208	Prof. Gadringer IHF Hochfrequenztechnik
<b>OSC</b> Oscilloscope Tektronix 4x 50 GHz or 8x 33 GHz Tektronix DPS75004SX	Prof. Gadringer IHF Hochfrequenztechnik
<b>OSC</b> Sampling oscilloscope Keysight 4x 35 GHz Keysight DCA-X Mainframe	Prof. Gadringer IHF Hochfrequenztechnik

# Lab-Equipment – Overview 2/3

Device	Key Researcher
<b>TDR</b> Time Domain Reflectometry System Keysight DCA-X Mainframe	Prof. Gadringer IHF Hochfrequenztechnik
<b>SPA</b> Semiconductor Parameter Analyzer x.test	Ass.Prof. Michalowska-Forsyth IFE Elektronik
<b>MAS</b> Micro-Assembly System finetech Fineplacer lambda2	Prof. Bergmann EMS Elektr. Messtechnik & Sensorik
<b>X-Ray</b> Röntgen Imager factronix Nikon XTV 160 + 1512 Dexela Detektor Panel	Prof. Bergmann EMS Elektr. Messtechnik & Sensorik
<b>DMP</b> Dimatix Material Printer Integrity DMP-2850	Prof. Bergmann EMS Elektr. Messtechnik & Sensorik
<b>3DP</b> 3D-Printer Creatbot PEEK-300 3D Fabrik	Prof. Bergmann EMS Elektr. Messtechnik & Sensorik

# Lab-Equipment – Overview 3/3

Device	Key Researcher
<b>TPC</b> Tergeo Plasma Cleaner PIE-Scientific	Prof. Bergmann EMS Elektr. Messtechnik & Sensorik
<b>SPC</b> Spin Coater SPS	Prof. Bergmann EMS Elektr. Messtechnik & Sensorik
<b>TLP</b> Transmission Line Pulser ESDEMC 100A + 40A TLP & vf-TLP device & system level	Prof. Pommerenke IFE Elektronik
<b>TLP-2</b> vf-Transmission line pulser ESDEMC 40ps rise time, 20 A	Prof. Pommerenke IFE Elektronik

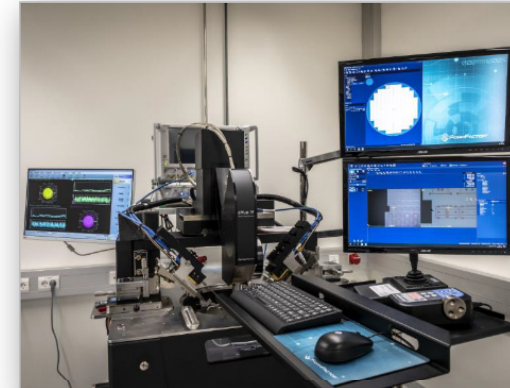
# PSO Probe Station w. Photonics Platform

## Formfactor SUMMIT 200

1/2

### Specifications

- Semi automatic probing system, 200 mm wafer stage
- Motorized microscope
- Three auxiliary chucks  
one auxiliary chuck made out of absorber material
- Four RF positioners
- eVue IV digital imaging system  
provides two optical paths and two camera systems supporting different magnification for each path
- Supports wafer mapping, scripting as well as flexible remote control operation



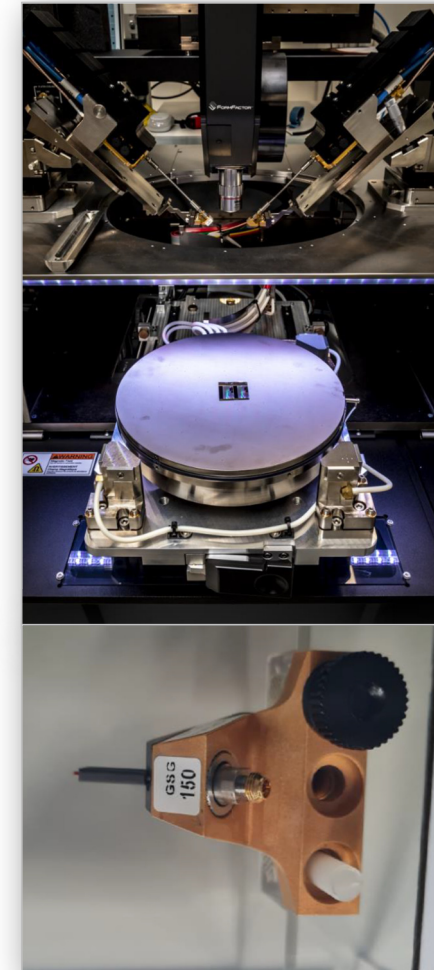
# PSO Probe Station w. Photonics Platform

## Formfactor SUMMIT 200

2/2

### Unique properties

- System optimized for non-silicon substrates up to 150 GHz
- Allows > 100 cm probe spacing
- Microscope movement > 100 cm (in x-direction)
- Custom developed 150 GHz probes optimized for non-planar substrates
- Unique integration of the Anristu 150 GHz mm-wave heads



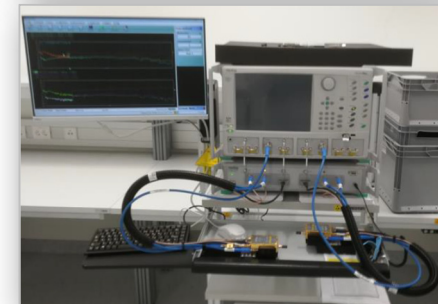


# VNA Vector Network Analyzer 70 kHz - 150 GHz

## Anritsu ME7838D, Rekirsch

### Specifications

- Broadband two port VNA
- Frequency range: 70 kHz – 150 GHz (single-sweep)
- PC 0.8 mm coaxial connector interface
- Adapters PC 0.8 mm to PC 1.0mm
- PC 0.8mm, PC 1.85 mm and PC 2.92 mm mechanical calibration kits
- Test Port Cable, PC 0.8 mm, 10 cm
- Test Port Cable, PC 1.85 mm, 0.9 m
- Active measurement suite included
- 70 kHz Kelvin Bias-Tee
- Tested operation with Formfactor WinCal software for on-wafer calibration



# OSC Oscilloscope Tektronix

## Tektronix DPS75004SX

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### Specifications

- Real-time oscilloscope, supporting:
  - 4 Channels, 50 GHz bandwidth, 200 GS/s sampling rate
  - 8 Channels, 33 GHz bandwidth, 100 GS/s sampling rate
- Software upgrade to 70 GHz bandwidth possible
- 1 GSsample memory at each channel @ 200 GS/s sampling rate
- Composed of four DPO75002SX units connected by the UltraSync bus system
- Each of the units can be operated stand-alone or flexible grouped together, for example:
  - 2 Channels 50 GHz bandwidth, 4 Channels 33 GHz bandwidth
  - 2x (1 Channels 50 GHz bandwidth, 2 Channels 33 GHz bandwidth)
  - 4x (2 Channels 33 GHz bandwidth), etc.



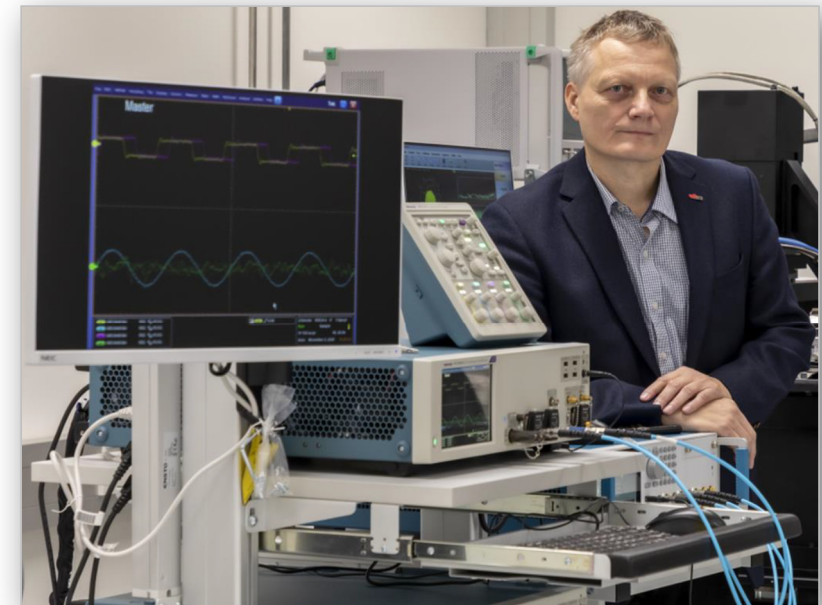
# OSC Oscilloscope Tektronix

## Tektronix DPS75004SX

2/2

### Unique properties

- De-embedding of signal-path (cables, probes, fixtures, etc.) components supported
- Vector signal analysis and streaming capabilities for RF signal handling
- Live data evaluation using own MATLAB ® code within the Tektronix Open Windows user interface
- 25 GHz bandwidth low noise Trimode probe (P7625)
- This probe supports conducting differential, single ended, and common mode measurements without moving the probes connection points



# AWG Arbitrary Waveform Generator

## Tektronix AWG5208

### Specifications

- 8 Channel arbitrary waveform generator
- 16 bit vertical resolution, 5 GS/s nominal data rate
- 10 GS/s data rate using interpolation
- 2 GSamples per channel memory
- Single-ended and differential outputs at each channel
- Up to 4 marker outputs for each channel (overall 32 marker outputs)
- Built-in digital IQ modulator
- 4 DAC modes supported
- AWG provides comprehensive sequencer functionality
- Output pre-compensation capabilities using a Tektronix scope



# TDR Time Domain Reflectometry System

## Keysight DCA-X Mainframe

### Specifications

- Wide bandwidth sampling oscilloscope mainframe
- 4 channel 35 GHz, electrical remote sampling heads with TDR/TDT measurement capability (expandable to 16 TDR channels)
- The 4 remote sampling heads can be operated as a 4 channel sampling oscilloscope
- 10 ps receiver transition time
- TDR step transition time: 15 ps (with TDR calibration)
- 16 bit vertical resolution
- Support single-ended and differential measurements
- Enhanced impedance and S-parameter analysis options
- Automatic fixture removal and de-embedding software support



# TLP Systems Transmission Line Pulser

## Specifications

- Maximum charge voltage:  $\pm 5.1$  KV, 2 kV in vf-TLP configuration
- Rise time: about 250ps, 40ps in the vf-TLP configuration, adjustable rise time
- Oscilloscope: DSA91204A 12GHz, 40GSa/s
- Pulse lengths: 5ns – 100ns, longer pulses possible with additional cables
- Used for non linear device characterization and soft failure analysis



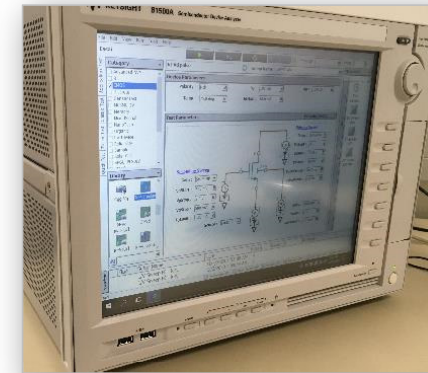
# Semiconductor Parameter Analyzer Keysight B1500A

## Specifications

- 4 SMU channels (1 A, 200 V / 1 fA, 0.5  $\mu$ V)
- Multi-frequency Capacitance Measurement Unit (1 kHz .. 5 MHz, 1 mVRMS, 100 V DC)
- Waveform Generator Fast Measurement Unit (100 ns pulse / 5 ns sampling)
- Unify units to combine measurement setups I-V / C-V / fast I-V

## Application examples

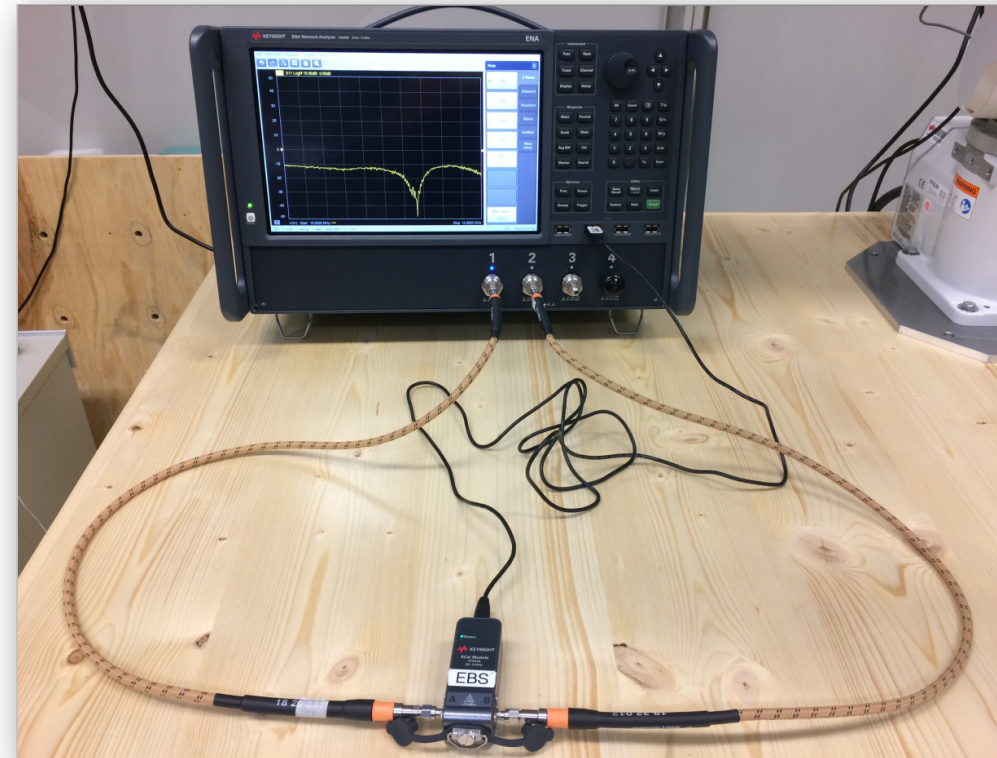
Automated characterization of *diode, MOSFET, bipolar, power devices, solar cells, memories, organic devices, nano devices*: I-V, C-V, C-f, C-t, components mismatch, stress/monitoring of degradation [Breakdown Voltage, Bias Temperature Instability, Electromigration, Hot Carrier Injection Degradation, Voltage-Dependent Dielectric Breakdown], Lifetime evaluation



# Four Port VNA Vector Network Analyzer

## Specifications

- General Purpose VNA
- 9 kHz to 14 GHz
- Four Port
- E-cal and mechanical calibration for N and SMA
- Time domain transformation
- Tuned receiver mode for phase measurements on external sources

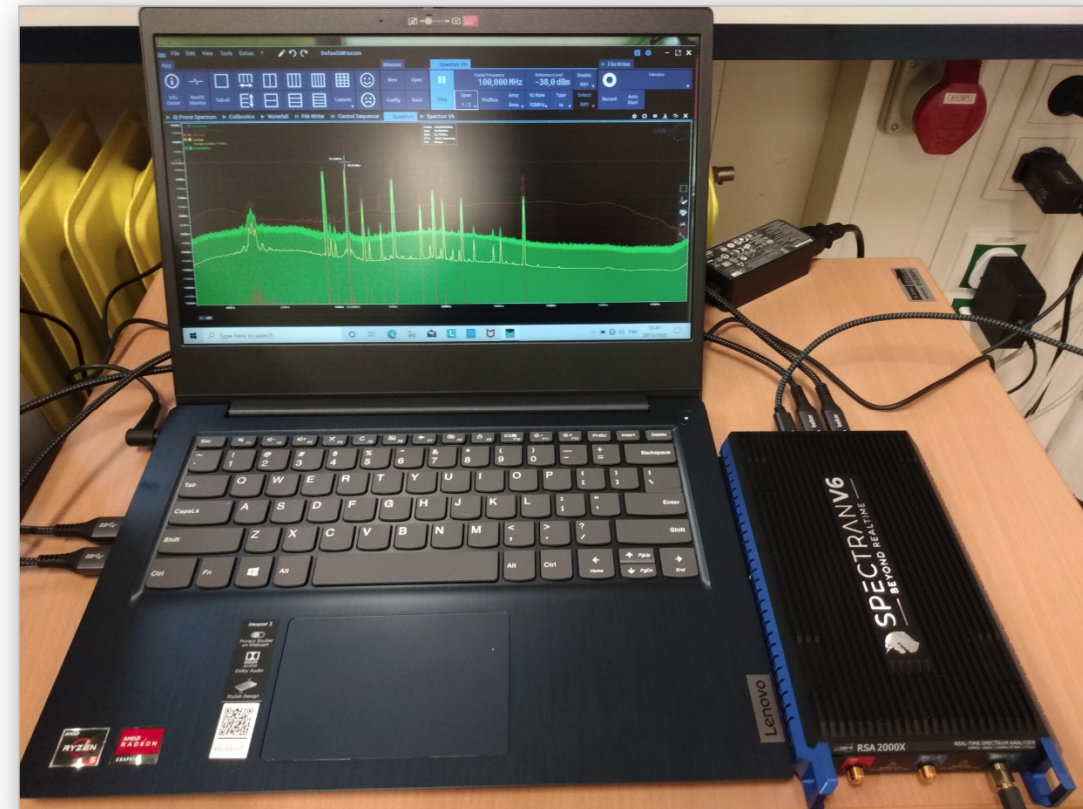




# SA Dual Port SA Spectrum Analyzer

## Specifications

- 10 MHz to 6 GHz
- Two port allows phase measurements
- Scan up to 6 GHz in 5 ms
- 244 MHz real time analysis bandwidth
- 120 MHz I/Q bandwidth
- 120 MHz Vector Signal Generator
- Continues I/Q streaming via 3 USB 3.0 connections



# MAS Micro-Assembly System

## finetech Fineplacer lambda2

### Specifications

- Accuracy 0.5  $\mu\text{m}$
- Thermocompression bonding
- Soldering
- Heating temperature (component and substrate) 40 - 450  $^{\circ}\text{C}$
- Dispense module for adhesive bonding
- Bonding Force 0.1 - 400 N
- Component size from 0.03  $\text{mm}^2$  to 20  $\text{mm}^2$
- Component and substrate height up to 10 mm
- Max. substrate size 150  $\text{mm}^2$



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# X-Ray Röntgen Imager

## factronix Nikon XTV 160 + 1512 Dexela Detektor Panel

### Specifications

- Power rating: 20 W (radiography), 10 W (CT)
- Focal spot size 1  $\mu\text{m}$  (below 2 W)
- Defect recognition capability 500 nm
- Geometric magnification 2,046x
- System magnification up to 36,000
- Manipulator 5-axis (X,Y,Z,T,R)
- Rotate axis included
- Tilt 0 - 72 degrees
- Max. physical sample size 711 x 762 mm
- Max. sample weight 5 kg



<https://www.nikonmetrology.com/en-gb/product/xt-v-160>

# DMP Dimatix Material Printer

## Integrety DMP-2850

### Specifications

- Repeatability:  $\pm 25 \mu\text{m}$
- Heated vacuum platen; ambient to  $60 \text{ }^\circ\text{C}$
- Printable area:
  - < 0.5 mm thickness, 210 x 315 mm
  - 0.5 - 25 mm thickness, 210 x 260 mm
- Materials compatibility:  
Many water-based, solvent, acidic or basic fluids
- 16 nozzles, single row, 100 dpi
- Drop volume 1 and 10 picoliter nominal
- Built-in drop jetting observation system
- Fiducial camera for substrate alignment and measurement



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# 3DP 3D-Printer Creatbot PEEK-300

## 3D Fabrik

### Specifications

- Build volume 300 x 300 x 400 mm
- Print resolution 0.04 - 0.4 mm
- High temperature material:  
PPSU, PEI, PA12, PSU, PPS, PA-CF, POM, PP
- Ultra-performance material:  
PEEK, PEKK, CF-PEEK, GF-PEEK, etc.
- Dual extruder
- Max. nozzle temperature 500 °C
- Max. platform temperature 200 °C
- Chamber temperature 120 °C



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# TPC Tergeo Plasma Cleaner

PIE-Scientific

## Specifications

- Different cleaning modes for surface modification, gentle surface contamination or pulsed operation for extremely delicate samples
- RF power of 150 W (13.56 MHz)
- Edwards nXDS10i dry scroll pump; pressure 5 - 20 mTorr
- Three mass flow controlled gas inputs
- Quartz chamber size: ID 160 mm, depth 280 mm



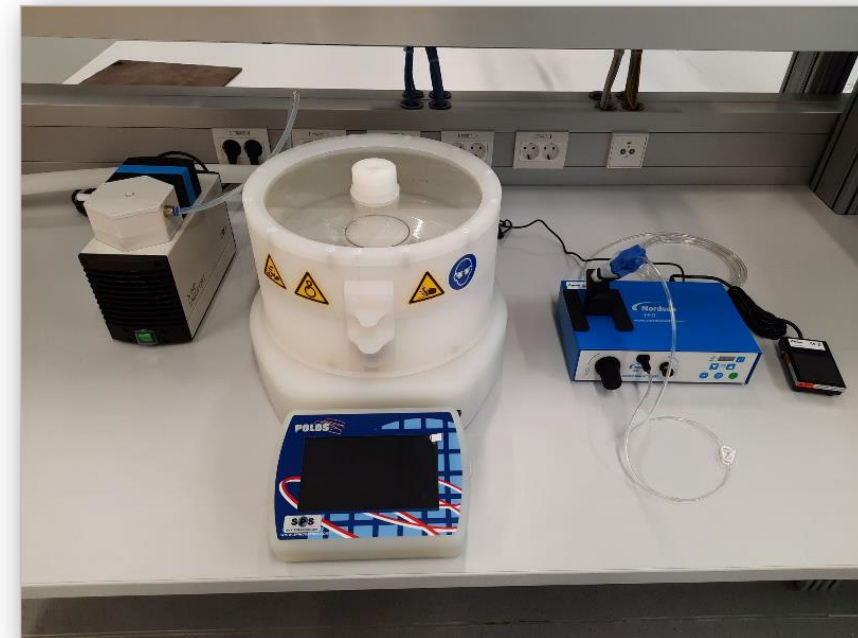
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# SPC Spin Coater

## SPS Polos SPIN200i

### Specifications

- For up to 200 mm wafers
- For up to 150 mm substrates
- 12,000 rpm (depending on substrate/chuck)
- High acceleration and accuracy
- Nordson Performus Dispenser x100
- LABOPORT N 840 pump



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## CONTACT

**for scientific-technological matters**

**Dr. Martin Medebach**

Lab Manager of EBS-Lab

[martin.medebach@tugraz.at](mailto:martin.medebach@tugraz.at), +43 316 873-4420

**for commercial matters**

**Mag. Heimo Theuretzbacher-Fritz**

CEO & Business Director of EBS Center

[theuretzbacher-fritz@tugraz.at](mailto:theuretzbacher-fritz@tugraz.at), +43 316 873-32650

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