C3000

High-end AFM controller for performance and precision

- All-digital signal processing for maximum freedom of operations
- Very sensitive 24-bit ADC/DACs for precise zoom-in and data acquisition
- Differential signal pathways for highest quality signal handling and low noise
### C3000 controller — Standard functionality

<table>
<thead>
<tr>
<th>Standard imaging modes</th>
<th>Static force, dynamic force, phase contrast, MFM, friction force, force modulation, spreading resistance</th>
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| Imaging functions      | • Up to 8000×8000 data points with 24-bit zoom in  
                         • 8 acquisition channels with dynamic digital filters  
                         • X/Y sample slope correction |
| Standard spectroscopy modes | • Force–distance, amplitude–distance, phase–distance  
                               • Tip current–tip voltage |
| Spectroscopy functions | • Setup wizard for each spectroscopy mode  
                           • X/Y-position table: point, line, and grid (max. 64 positions)  
                           • 3 distinct spectroscopy phases |
| Standard lithography modes | • Free vector objects drawing or real-time drawing by mouse  
                                • Tip lift or force control during movement from point to point |
| Sample approach        | • Fast home, retract, and advance movement  
                           • Automatic approach with definable final end position  
                           • Continuous or step-by-step approach mode |

### C3000 controller — Core hardware specifications

| X/Y/Z-axis scan and position controller | 3x 24-bit DAC (200 kHz) |
| X/Y/Z-axis position measurement        | 3x 24-bit ADC (200 kHz) |
| Excitation & modulation outputs        | 4x 16-bit DAC (20 MHz) |
| Analog signal input bandwidth          | 0–5 MHz |
| Main input signal capturing            | 2x 16-bit ADC (20 MHz)  
                                                   2x 24-bit ADC (200 kHz) |
| Additional user signal outputs         | 3x 24-bit DAC (200 kHz) |
| Additional user signal inputs          | 3x 24-bit ADC (200 kHz) |
| Additional monitor signal outputs      | 2x 24-bit ADC (200 kHz) |
| Digital synchronization                 | 2x digital out, 2x digital in, 2x I2C Bus |
| FPGA module and embedded processor     | ALTERA FPGA, 32-bit NIOS-CPU, 80 MHz, 256 MB RAM, multitasking OS |
| Communication                          | USB 2.0 Hi-Speed to PC and scan head interface |
| System clock                           | Internal quarts (10 MHz) or external clock |
| Power                                  | 90–240 V AC, 70 W, 50/60Hz |

### C3000 signal I/O option

| Clock input                        | Input for an external digital clock (10 MHz, ±1 V)  
                                        Synchronization of internal Lock-In, PLL, function generators |
| Analog inputs                      | 2 user inputs for imaging and spectroscopy  
                                        2 user outputs for imaging and spectroscopy |
| Analog outputs                     | 2 user outputs for spectroscopy modulation, Z-control, etc.  
                                        2 digital outputs for synchronization |
| Digital sync                       |                                        |

### C3000 stage control option

| Drivers                            | Direct control for all supported stage controllers |
| Manual move                        | Via buttons in the C3000 control software |
| Batch Manager                      | Automated movement via position list and scripts |

### C3000 cantilever calibration option

- Spring constant calibration
  - Free resonance detection via thermal tuning  
    - Q-Factor calculation  
    - Spring constant calculation by Sader method  
    - FFT spectrum analyzer, many windowing modes, averaging  
- Deflection sensitivity calibration  
  - Wizard for deflection sensitivity calculation from force–distance measurements  
  - Automatic mode or user-defined parameters

### C3000 advanced spectroscopy option

- Additional spectroscopy functions  
  - Additional “Stop by input value reached” modulation mode  
    - Automatic cantilever drift recalibration  
    - Unlimited number of spectroscopy data points  
    - 5 distinct spectroscopy phases

### C3000 advanced lithography option

- Additional lithography modes  
  - Vector-based lithography with objects on layers with different lithography parameters  
    - Bitmap-based lithography  
    - Nano printing

### C3000 advanced modes option

- Additional operating modes
  - Enables advanced measurement modes via an additional digital 2-channel Lock-In. Measure amplitude and phase of an additional signal from many inputs. (e.g. higher harmonics, higher resonances, torsional cantilever oscillations, tip voltage modulation, etc.) during imaging and spectroscopy
  - Secondary lock-in amplifier  
    - Frequency range: 100 Hz–5 MHz  
    - Demodulation bandwidth: 11 Hz–23 kHz  
    - Amplitude resolution: 20 bit; Phase range: ±180°  
    - Reference phase shift: 0–360° (digital)  
    - Excitation: tip voltage, 2x user output

### C3000 KPFM work package

- Extends the advanced modes option with the Kelvin probe force microscopy (KPFM) mode. In addition to the Lock-In, it provides a tip voltage feedback controller through a special user interface. In addition to the standard signals, contact potential can be measured during imaging and spectroscopy

### C3000 PFM work package

- Extends the advanced modes option with the Piezoresponse force microscopy (PFM) mode through a special user interface. In addition to the standard signals, amplitude and phase of the piezo response signal can be measured during imaging and spectroscopy

### C3000 scripting interface option

- Internal scripting  
  - Visual Basic script editor  
  - Ribbon drop-down menu to access user scripts  
- COM-API  
  - Control of measurement process and data analysis
- Compatibility  
  - All applications that support the Microsoft COM Automation standard: e.g. LabVIEW, C#, etc.