

**Technical specifications:
Nanotec Scanning Probe Microscope
I. Control System (Electronics)**



SPM Control system: Dulcinea electronics

AlphaContec cooperates with Nanotec Electronica and offers the most powerful and flexible SPM Control system, including Dulcinea electronics, M6701 Digital Signal Processor (DSP) and a last generation Dell Computer with 17" TFT screen, all controlled by the WSxM Scanning Probe Microscopy software.

DULCINEA Electronics with M6701 DSP

- Dual high voltage outputs for +X, -X, +Y, -Y, +Z and -Z signals
 - +/- 150V range*
 - bipolar (+/-150V) or monopolar (-10V/140V) options for each axis available under customer request
 - 16-bit offset with fixed 15 gain
 - 16-bit scan with continuous gain from 0.06 to 15 (basis of +/-10V)
 - Noise level < 2mV RMS**
 - Manual/Software control of the Z offset
 - Secure button for fast withdrawing the tip
- High voltage output for Bias signal
 - +/-150V range
 - 16-bit resolution
 - Two gains available: 1 (+/-10V) and 15 (+/-150V)
 - Noise level < 2mV RMS**
- Other 8 16-bit +/-10V output signals (3 of them available via free BNCs)
- 16 16-bit input signals (+/-10V input range)
 - 8 of them with variable gain and offset
 - Variable gain inputs allow continuous gains from 0.65 to 9.8.
 - 4 of them available via free BNCs
- 32 digital signals
 - 8 available as software configurable trigger signals
 - 8 available as input counter
 - 16 dedicated to specific tasks of the system
- 8 BNCs for internal signals monitoring and external conditioning inputs
 - Photodiode output, PLL (Phase Lock Loop) output***, generated AC signal for dynamic modes*** and internal voltage ramp for the modulation of the AC frequency monitoring***
 - external modulation of the voltage applied to the Z scanner
 - external modulation of the bias voltage applied between the tip and the sample
 - external input of the AC signal for Dynamic modes (to be used instead of normal force)***
 - AC current source with software configurable frequency (useful for excitation of magnetic driven cantilevers).
- 15 different analog signals can be monitorized through 4 software configurable BNCs
- Graphic display for real time information
- Independent High Voltage & Low Voltage connectors

* +/-300V differential

** 100 KHz Bandwidth

*** Only useful if the Dynamic Force Board is installed on the Dulcinea electronics

**Technical specifications:
Nanotec Scanning Probe Microscope
II. Control System (Computer)**



SPM control system: Dell Computer

DELL Computer

- Intel Pentium IV computer with
 - >2GHz CPU speed
 - 256MB RAM
 - 40GB disk space
 - DVD reader+CD reader&writer
 - 17" TFT screen
 - Windows 2000 Professional
 - 3 years Dell Guarantee
 - mouse and keyboard
 - Radiofrequency joystick for remote control of the system [Optional]
 - pre-installed M6701 DSP
 - pre-installed WSxM software
 - WSxM 2.0 software manual

Technical specifications: Nanotec Scanning Probe Microscope III. Control System (Software)

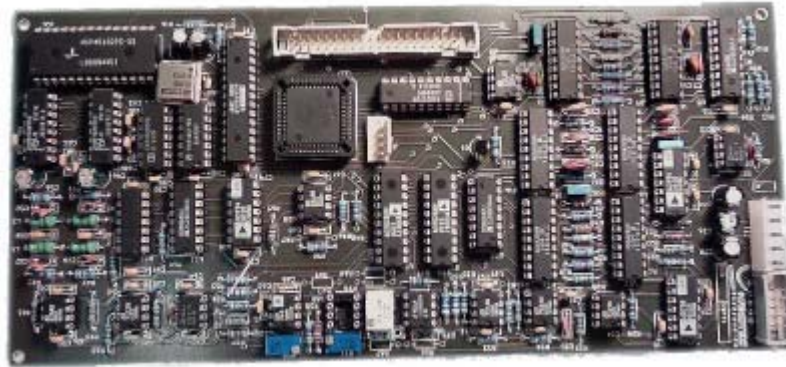


SPM control system: WSxM software

WSxM Scanning Probe Microscopy software

- Free update via web on <http://www.nanotec.es>
- It can be downloaded and used for free for SPM data processing, as it reads most available SPM files.
- Real time control
 - Simulation mode for previous evaluation downloading the software
 - Up to 17 independent channels can be displayed simultaneously
 - Each channel can be displayed as top-view or oscilloscope graph
 - Possibility of applying real time filters from offset/plane subtraction to FFT
 - Acquisition of movies with automatic correction of the thermal drift for analyzing dynamic processes
 - Automatic detection of the cantilever resonance frequency for dynamic mode operation
 - Phase Lock Loop (PLL)
 - Real Time non linear correction for X-Y scan
 - Powerful Force vs. Distance (FZ) acquisition allowing
 - Basic mode for simple FZ acquisition
 - Limits selection for avoiding risks on the sample
 - Statistics over up to 1000 curves
 - Performing IV curves in the approach point of the FZ
 - Processes can be applied without moving to the Data Processing part
 - Jumping Mode allowing
 - Acquisition of adhesion maps
 - Measurements on liquid environment minimizing the applied force over the sample
 - Retrace mode allowing
 - Dual bias operation
 - Dual set point operation
 - Lift mode for far distance forces (MFM/EFM, ...) measurement
 - Plane Scan mode allowing measurement on constant plane for far distance forces measurement
 - Unique 3dModes allowing
 - Maps of the resonance frequency peak variation approaching to the sample
 - Performing Force-Distance curves over a line
 - Performing Current-Voltage curves during the approach to the sample
 - Many other channels combinations
 - Second feedback allows to control more magnitudes on your experiment (not only cantilever deflection)
 - Lithography mode allowing the design of your experiment using scripts
 - Ultra High Vacuum (UHV) STM specific features. As the control system is often used for connection with UHV STMs, it has several specific features for this kind of systems:
 - CITS (Current Imaging Tunnelling Spectroscopy)
 - Current-Voltage (IV), Current-Distance (IZ) and Voltage-Distance (ZV) spectroscopy
- Data Process
 - Compatible with Windows 95/98/Me/2000/XP
 - Possibility of independent installation in any Windows system (free installation for any number of different computers)
 - Reading of most available SPM files (not only WSxM generated)
 - Easy-to-use data browsing system
 - Representation and processing of any acquired data (curves, images or movies)
 - Easy export of data to other Windows applications
 - Three-dimensional projections
 - All the standard SPM filters like plane subtraction, flatten, equalization, change of the color palette, rotations, smoothing, etc.
 - Profiles for measuring the different features in the images
 - Numeric derivation
 - Roughness Analysis
 - Fourier analysis, including window filtering
 - Movie creation from a set of images
 - Statistical and individual analysis of particle sizes
 - Surface and perimeter histograms with fractal analysis
 - Multiple zoom and multiple profile
 - Tip convolution
 - Other sophisticated data analysis processes including dl/dV normalization, matrix convolution, line removal, non-linear correction, ...

**Technical specifications:
Nanotec Scanning Probe Microscope
IV. Control System (Dynamic Force Board)**



Dynamic Force board designed for the Dulcinea high voltage unit.

This board is a software programmable two channels lock-in amplifier. It allows non contact SFM operation, electrostatic studies, Magnetic Force Microscopy (MFM), Scanning Near Optical Microscopy (SNOM), It is optional with the Dulcinea electronics, and it is shipped integrated in the Dulcinea electronics box.

Detailed information:

- Frequency generation range from 0 to 1 MHz [other ranges available under user requirement]
- Frequency generation accuracy: 1 part over 2^{32} (~ 0.2 mHz over 1 MHz).
- Independent X (usually amplitude) and Y (usually phase) output channels.
- Automatic tune by software (WSxM).
- Frequency scan mode
- Fixed Frequency or Phase Lock Loop (PLL) operation mode.

**Technical specifications:
Nanotec Scanning Probe Microscope
V. SPM Chassis**



SPM chassis with XY screws for the use with optical microscope

Nanotec® Optical chassis for SFM/STM with X-Y motion control through micrometric screws. It consists on a basis of 30 x 30 cm over which the SFM chassis is mounted. Between the table and the chassis there is an allocated place for the scanner and its connections. Those are protected by a surrounding anodized steel tube. It is designed for its combination with an optical microscope for accurate tip position control.

- Overall dimensions: 30 x 30 x 25 cm (12 x 12 x 10 inch).
- Available horizontal sample size: 2cm x 2cm (0.8 x 0.8 inch).
- Available vertical sample size: 7mm (0.28 inch).
- Maximum sample weight: 10 grm.
- Coarse horizontal positioning range: 3mm x 3mm (0.12 inch x 0.12 inch).
- Micrometers range for positioning below the optical microscope: 26mm x 26mm (1.02 inch x 1.02 inch).
- Three magnetic cylinders for holding the head apart during laser adjustment or sample handling.
- Approach:
 - One motor for the automatic approach and two micrometer screws for manual approach.
 - Approach micrometer screws range: 13mm (0.5 inch.).
 - The three support points allow easy selection of any tilt direction for the head, providing easy selection of the cantilever to use when using multicantilever chips.
- Open configuration:
 - Easy access to the approach system for manual or automatic approach.
 - Easy swapping of the piezoelectric scanner.
- Vibration isolation:
 - Four soft-balls are provided to give a basic isolation for the system.
 - Two springs for retention of the head.
- Atmosphere control:
 - Glass cover for atmosphere control and acoustic and ambiental isolation.
 - Three configurable holes - 12mm (0.47 inch.) diameter - for atmosphere control.
- Other options: Classic chassis or mini chassis for systems not combined with optical microscope

**Technical specifications:
Nanotec Scanning Probe Microscope
VI. SPM Scanners**



Long Scanner and Short scanner

Nanotec® patented AFM and MFM piezoelectric scanners with concentric tubular design minimizing the thermal drift. Three screws allow to easily change from one scanner to a different one. It is recommended to purchase a long scanner for big surfaces or heights and a short one for the best resolution measurements.

AFM Long Scanner

- Overall dimensions: 19.1 mm (0.75 inch) diameter and 100 mm (3.94 inch) length.
- Maximum horizontal range: 70 μm X 70 μm (typical).
- Maximum vertical range: 12 μm (typical).
- Magnet for the best fixing.
- X,Y,Z calibration parameters included.
- Optional: MFM long scanner removing the magnet

AFM Short Scanner

- Overall dimensions: 19.1 mm (0.75 inch) diameter and 65 mm (2.56 inch) length.
- Maximum horizontal range: 10 μm X 10 μm (typical).
- Maximum vertical range: 2 μm (typical).
- Magnet for the best fixing.
- X,Y,Z calibration parameters included.
- Optional: MFM short scanner removing the magnet

**Technical specifications:
Nanotec Scanning Probe Microscope
VII. SPM Head**

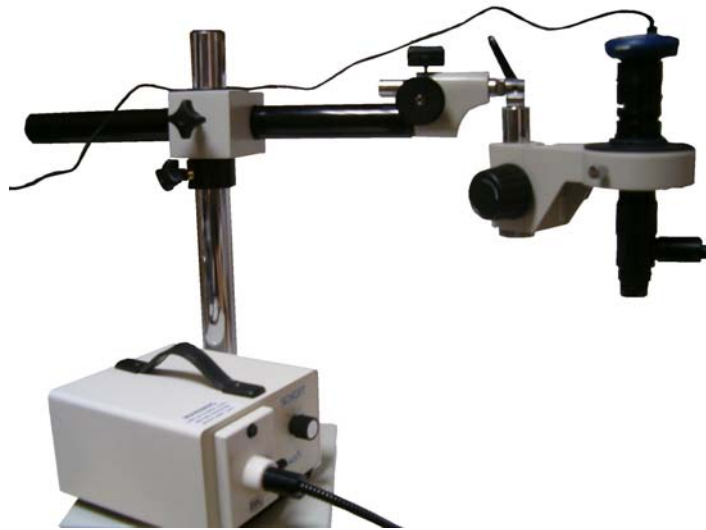


AFM Head

Nanotec® standard head for Scanning Force Microscopy. It includes the optical system for cantilever deflection measurement using the laser beam deflection method and the cantilever holder. Its design includes magnets for best stability of the system.

- Overall Dimensions: 12 x 6 x 14 cm (4,8 x 2,4 x 5,6 inch).
- Coarse horizontal positioning range: 4mm x 4mm (0.16 inch. x 0.16 inch.).
- Two micrometer screws allow easy adjustment of the laser beam to focus on any cantilever.
- Axis view of cantilever and sample available for optical microscope combination.
- Two lateral screws allow the retention of the head from the chassis springs.
- Laser
 - Wavelength: 632nm.
 - Power: 0.9mW.
 - Minimum laser beam diameter: 26-30um.
- Photodiode:
 - 4-quadrants photodiode for simultaneous measurement of Normal Force and Lateral Force.
 - Wide photodiode movement range helps finding the reflected spot easily using two screws for fixing the rough positioning of the photodiode and two micrometer screws for the fine adjustment.
- Cantilever holder:
 - Easy handling of the cantilever holder with magnetic fixing to the head.
 - The cantilever holder is designed for allowing easy use of multicantilever chips, including those with cantilevers in both sides without damaging the unused cantilevers.
 - Cantilever holder placing conserving the last position.
 - Piezoelectric scanner for dynamic modes integrated in the cantilevers holder.
 - Easy access to the electronic signals going to the cantilever
- Optional: MFM head removing the magnets

**Technical specifications:
Nanotec Scanning Probe Microscope
VIII. Optical Microscope**

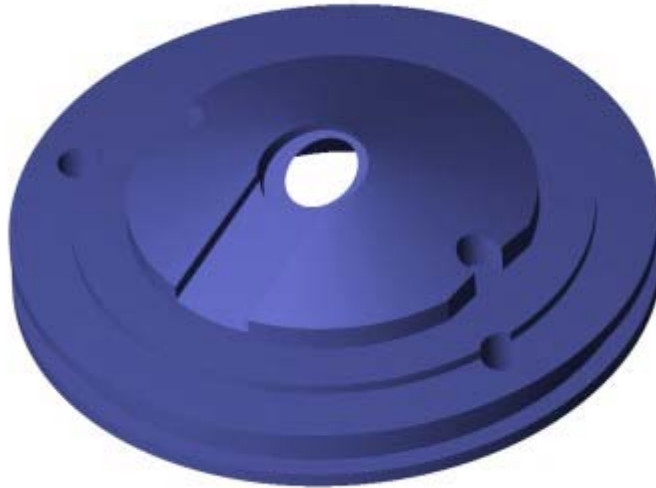


Optical Microscope

The optical microscope system offered by Nanotec Electronica gives you the possibility of easily monitorize the position of the cantilever over the sample, making easier the scanning of particular features accesible to the optical microscopy. The combination of lens with CCD technology provides an impressive magnification, allowing the user to observe the cantilever movement over the sample in real time in the computer screen simultaneously with the image acquired.

- Adjustable focus allows focusing on the cantilever or in the sample when the cantilever is far away from the sample.
- Freedom of movement of the microscope allows to easily remove the optical microscope when it is not needed and to get it back to its original position when required.
- Total amplification: **138.6** to **891**
 - Optical amplification: **2.1** to **13.5** with manually adjustable zoom.
 - CCD size: **4mm x 3mm** (0.16 x 0.12 inches)
 - Extra Amplification (to 17" screen, 1024x768 pixels): **66**
 - CCD resolution: **640x480** pixels

**Technical specifications:
Nanotec Scanning Probe Microscope
IX. Liquid Cell (Optional)**

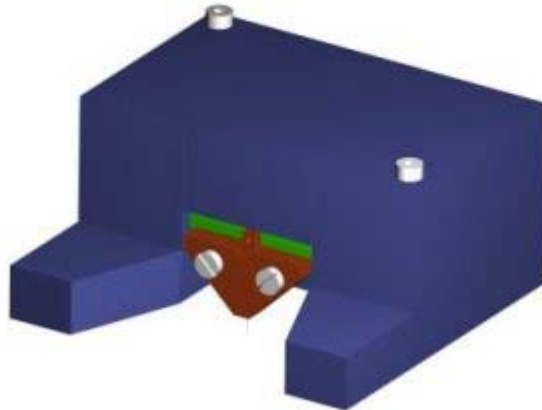


Liquid cell

Nanotec® cantilever holder and sample holder for experiments in liquids. The cantilever holder is made of anodised aluminium and the sample holder is made of methacrylate.

- Overall dimensions: 15mm radius (0.59 inch).
- Available horizontal sample size: 15mm radius (0.59 inch).
- Sapphire window for perfect focusing of the laser beam onto the cantilever.
- Mechanical drainage system.
- Two tubes are attached to the liquid cell for liquids interchange.
- Compatible with Nanotec AFM/MFM heads and scanners.

**Technical specifications:
Nanotec Scanning Probe Microscope
X. STM Head (Optional)**



Ambient air STM head

The ambient air STM head allows STM examination of conductive or semiconductor samples, like gold or HOPG.

- Lateral resolution: 0.2nm
- Vertical resolution: 0.002 nm
- HOPG atomic resolution tested
- Compatible with the standard Nanotec chassis, which provides the automatic approach.
- Two magnets and two springs provide the best stability fixing the head to the chassis.
- Integrated IV converter
 - Gain 10^8 (Other gains available under user requirement)
- 5 cm Pt/Ir wire for tips