Electronic & Software Control Units

attoCONTR0L
Cutting-edge applications and experiments in excellent research and industry labs around the world make highest demands both on the measurement hardware referring to positioning systems and complete microscope setups as well as the corresponding electronic controllers and their software algorithms and features.

attocube’s FPGA-based controller design as well as a large variety of interfaces and software drivers for all controllers in combination with an easy software-based upgradeability of most controllers makes them the ideal add-on for all attocube product lines.

**Microscopy Controllers**: The ASC500 is attocube’s state-of-the-art controller for all scanning probe microscopy experiments featuring open architecture while offering superior performance and unprecedented variety of control concepts.

**Motion Controllers**: Highest precision piezo positioning systems require state-of-the-art positioning control electronics. Suitable models for driving all attoMOTION products either in open loop or closed loop mode together with matching software modules are part of the attoCONTROL portfolio.

Visit attoCONTROL online
Microscopy Controllers
Multi-purpose SPM Electronics

The ASC500 is a modular and flexible digital SPM controller which combines state-of-the-art hardware with innovative software architecture, offering superior performance and unprecedented variety of control concepts. It was developed with the goal to never be the limiting factor in any scanning probe microscopy (SPM) experiment. All desirable functions and high-end specifications for conducting the experiment of your choice in AFM, MFM, KPFM, FMFM, CPFM, DFM, SNOM, STM, and many more measurement techniques are available. The ASC500 features optional closed loop functionality fully supporting attocube’s FPS interferometric sensors.

The ASC400 is a flexible digital confocal microscope controller, and combines state-of-the-art hardware with innovative software concepts to offer an unmatched variety of controlling many different confocal microscopy applications. Scan control combined with data acquisition, and straightforward interfacing to external devices such as e.g. a spectrometer are just some of the convenient features.

Q control
The ASC500 provides full control over the Q factor of any driven oscillator system by means of electronic Q control. The natural Q factor can be varied by typically more than one order of magnitude in each direction. This allows to enhance the signal sensitivity or to improve on scan speed, as well as to use well-known room temperature scan parameters also for low temperature experiments with help of Q reduction.

Closed loop scan engine
The world’s first low temperature compatible closed loop scan engine is fully integrated into the ASC500 as an upgrade option. Based on our award-winning fiber interferometer FPSensor, the lateral resolution is about 1 nm. This unique concept provides not only compensation of the piezo-inherent scan non-linearities, but also allows for convenient sample navigation and feature retrieval over the full 5 mm x 5mm.

Phase locked loop
A fully digital phase locked loop is implemented into the ASC500. It uses the high frequency inputs/outputs with 50 MHz bandwidth. A high-speed lock-in demodulator and two PI control loops are used to control the amplitude of an oscillator and to follow any resonance shifts. The frequency resolution is below 0.2 μHz in a range of 1 kHz up to 2 MHz.

FPGA-based electronics
attocube’s electronics are state-of-the-art, fully digital FPGA-based control and sensor units, guaranteeing highest performance. Easy-to-use firmware upgrade tools enable the user to take advantage of software upgrades for years to come.

Generic ADCs & DACs
Multiple generic digital/analog converter in- and outputs enable the user to configure the microscopy controller for his particular measurement task. On-board preamplifiers, switchable low-pass filtering, oversampling and offset compensation, software definable transfer functions and analog modulation inputs are just some of the features.

LabVIEW remote control
A full package of LabVIEW drivers for all software functions incorporated in the original graphical user interface (GUI) is included at no additional cost. It allows for convenient measurement automation, user-defined experiments, and an easy integration with third party instrumentation.
The ASC500 is a modular and flexible digital SPM controller which combines state-of-the-art hardware with innovative software architecture, offering superior performance and unprecedented variety of control concepts. It was developed with the goal to never be the limiting factor in any scanning probe microscopy (SPM) experiment. All desirable functions and high-end specifications for conducting the experiment of your choice in AFM, MFM, KPFM, PRFM, CFM, SHPM, SNOM, STM, and many more measurement techniques are available. The ASC500 features optional closed loop functionality, fully supporting attocube’s FPS interferometric sensors.

Z Controller
The z scanner output is controlled by a digital PI algorithm with a bandwidth of 50 kHz. The z output DAC has a resolution of 18 bit, yielding a 4 pm resolution on a 1 µm scan range.

• highly versatile; all signal channels can be used as control inputs
• physical units of PI gain
• setpoint modulation for PI fine tuning
• inversion of feedback gain
• inversion of output polarity

Closed loop scanning & global sample coordinates
Based on our patented FPSensor, a fiber-based interferometer, our microscopes can now be equipped with position sensors featuring a steady-state resolution of down to 1 nm even in cryogenic working environment. At the same time, we implemented a fully digital scan engine in the ASC500 SPM controller, which now features location based data acquisition (as opposed to time-triggered data acquisition on open loop systems). In closed loop mode, this results in perfectly linearized images. The sophisticated scan engine even allows for an adjustment of the scan acceleration to smooth the scanning motion at the turning points, which is especially useful for higher scan speeds.

The most useful new feature however is that since the FPSensor covers the full 5 mm x 5 mm range of the positioners, the scan widget now contains ‘global’ sample coordinates: usually, the maximum range accessible in closed loop mode is limited by the maximum range of the scanners. With our ultra-large range ANSx150 scanners, this is a massive 125 μm at cryogenic temperatures. Now, if the user wants to scan outside of this area, he can simply use the global sample coordinate system for navigation. To further facilitate this, any measured SPM images can simply be decorated onto the scan widget’s sample ‘canvas’ via drag-and-drop, where they are put exactly at the measured coordinates. Hence, a virtual map of the whole sample gradually evolves within the scan widget. Retrieving regions of interest on the nanoscale, which has always been extremely difficult and time consuming especially at low temperatures, is now an easy task thanks to this global sample coordinate system.

Hard- and Software Features
ASC500 SPM controller and Daisy software interface

Z Controller
The z scanner output is controlled by a digital PI algorithm with a bandwidth of 50 kHz. The z output DAC has a resolution of 18 bit, yielding a 4 pm resolution on 2 um scan range.

• highly versatile; all signal channels can be used as control inputs
• physical units of PI gain
• setpoint modulation for PI fine tuning
• inversion of feedback gain
• inversion of output polarity

CUSTOMER FEEDBACK
Dr. Benjamin Bryant
"The attocube low-temperature AFM is a versatile instrument which provides a good balance between the flexibility of a user-built setup and the reliability and ease of installation of a commercial instrument. I particularly recommend the ASC500 SPM controller, as it allows for advanced control modes such as phase lock loop (PLL), but still provides a great deal of flexibility in configuration, and ready access to all signals."

(London Centre for Nanotechnology)

CUSTOMER FEEDBACK
Lior Emron
"Working with an evolving self-developed technique means our needs constantly and rapidly change. It is thus very important for us to have a controller with high flexibility and versatility. The ASC500 allows us to easily and smoothly adapt our measurement schemes to meet the needs of the moment. It has proven to be a powerful tool for scanning probe microscopy."

(Group of Prof. Dr. Zeldov, Weizmann Institute of Science, Israel)
PLL
A fully digital phase-locked loop is implemented into the ASC500. It uses the high frequency inputs/outputs with 50 MHz bandwidth. A high-speed Lock-In demodulator and two PI control loops are used to control the amplitude of an oscillator and to follow any resonance shifts. The frequency resolution is below 0.2 μHz in a range of 1 kHz up to 2 MHz. Therefore, it is possible to gain access to a direct measurement of force gradients by means of measuring ∆f. Besides, all data streams in the PLL chain are accessible for a deeper analysis.

Supported Microscopy Modes
• AFM: contact mode, amplitude modulation, frequency modulation (PLL)
• Conducting-tip AFM
• MFM: constant height (with tilt correction), dual pass mode
• Piezoresponse Force Microscopy (PFM)
• Kelvin Probe Microscopy (KPFM; optional upgrade)
• Scanning Hall Probe Microscopy
• Confocal Microscopy: constant height, point/path/grid mode spectros copy
• Scanning Gate Microscopy (SGM)
• STM: constant height (with tilt correction), constant current

Data Processing
Collection of data is the most important task in every experiment. The ASC500 was built to give the user every possibility to view, process, and save all data streams. Data can be visualized in 1D, 2D, or 3D displays. Furthermore, the ASC500 features are:
• real-time FFT calculation
• full control over all raw and processed data
• global snapshot functionality: a user definable collection of data can be saved with only one mouse click
• saving of parameters in a text file

Q Control
The ASC500 provides full control over the Q factor of any driven oscillator system by means of electronic Q control. The natural Q Factor can be varied by typically more than one order of magnitude in each direction. Benefits are:
• to gain sensitivity due to increased Q factor
• to gain scan speed in ultra-high Q setups by reducing the Q factor
• to use well-known room temperature scan parameters also for low temperature experiments with help of Q reduction

Digital/Analog Converters (DAC/ADC)
The outstanding input and output capabilities of the ASC500 are the key to highest precision measurements. Its analog-digital converters use state-of-the-art hardware with lowest possible noise. On-board preamplifiers and switchable low-pass filtering allow for maximum signal-to-noise ratio. The high frequency in- and output section of the ASC500 allows for sophisticated measurement concepts. Additional features include:
• oversampling and offset compensation
• analog modulation inputs for the most important channels
• 6 ADC inputs with 400 kS/s, 16bit
• 2 high frequency ADC inputs with 50 MS/s, 16bit
• 4 DAC outputs with 200 kS/s, 16bit
• software definable transfer function

Lithography
The ASC500 also offers a lithography mode. Any geometrical shape composed from convex polygons and single dots can be scanned with full control over scan speeds and line spacings for each shape unit. Shape definition is done via text files for full flexibility. Furthermore, a shutter can be controlled via TTL pulses for each shape unit. Lithography can operate in both open and closed loop mode.
• scanning of arbitrary shapes composed from polygons and dots
• full speed control for each shape unit
• very flexible shape definition
• shutter controller via TTL

Hard- and Software Features
ASC500 SPM controller and Daisy software interface
LabVIEW™ Control

The LabVIEW™ interface provides full control over all ASC500 features with the following benefits:

- measurement automatization
- user-defined experiments
- easy integration with 3rd party instrumentation

The full package of LabVIEW™ drivers is included in every unit at no extra price.

Spectroscopy

The ASC500 features advanced spectroscopy techniques such as z spectroscopy and bias voltage spectroscopy. These measurements are supported by an internal Lock-In and a limiter functionality which drastically reduces the likelihood of a tip crash. Spectroscopy measurements can be automatically triggered on line, grid, or point-by-point paths. Combinations of spectroscopies can be defined in action lists.

Specifications

<table>
<thead>
<tr>
<th>ASCII00 Versions</th>
<th>full</th>
<th>basic</th>
<th>upgrades</th>
</tr>
</thead>
<tbody>
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<td>Art. No.</td>
<td>1008958</td>
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<tr>
<th>Interface</th>
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<td>xy scan voltage output</td>
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<td>z voltage output</td>
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<td>analog ADC inputs</td>
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<td>digital serial interface (NI)</td>
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<td>out- and input connector</td>
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<td>pixel clock</td>
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<td>resolution</td>
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<td>features</td>
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<td>scan speed</td>
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<td>max. frame rate</td>
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<th>Closed Loop Scanning (optional)</th>
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<tr>
<td>sensors</td>
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<td>coordinate system</td>
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# Specifications

## ASC500 SPM controller

<table>
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<tr>
<td>Z Controller</td>
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<td>type</td>
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<td>bandwidth</td>
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<tr>
<td>control signal</td>
<td>any internal signal channel</td>
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<tr>
<td>features</td>
<td>feedback gain and output polarity, PI gains in physical units</td>
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<tr>
<td>Phase Locked Loop (PLL)</td>
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<tr>
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<td>Spectroscopy</td>
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<tr>
<td>physical arrangement</td>
<td>point-line/grid spectroscopy (up to 1024 x 1024 pixel)</td>
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<td>spectroscopy types</td>
<td>z-spectroscopy, bias spectroscopy, with spectroscopy (all 64 parameters), 40 dB with internal lock-in</td>
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<td>averaging</td>
<td>25 ps up to 180 ms per data point</td>
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<td>parameters</td>
<td>control loop off, signal better</td>
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<td>Second Pass Mode</td>
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<td>working principal</td>
<td>2nd pass with height offset or different scans parameter set</td>
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<td>parameters</td>
<td>height offset, x-ray time, x-ray scan, alternative DAC, alternative setpoint</td>
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<tr>
<td>application</td>
<td>AFP, SPM</td>
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## ASC500 Versions full basic upgrades

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<tr>
<td>Lock-In</td>
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<td>low frequency Lock-In</td>
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<tr>
<td>demodulation</td>
<td>all DAC channels</td>
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<tr>
<td>integration time</td>
<td>up to 128 periods</td>
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<tr>
<td>usage</td>
<td>spectroscopy, interferometric analysis, Hall probe etc.</td>
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<tr>
<td>high frequency Lock-In</td>
<td>1 kHz .. 500 kHz</td>
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<tr>
<td>integration time</td>
<td>up to 512 periods</td>
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<td>usage</td>
<td>AFM cantilever signal, i.e. lock-in etc.</td>
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<td>Visualization</td>
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<tr>
<td>oscilloscope</td>
<td>arbitrary channel vs. time; time base 2.5 μs .. 150 ms, 10220 pixel max. trigger, easy/edge/same/single</td>
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<tr>
<td>FFT</td>
<td>for every channel, 0 .. 20 kHz range, 1 .. 128 x averaging, windowing options, zooming: magnitude/power density/power spectrum</td>
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<tr>
<td>Path Mode</td>
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<td>working principle</td>
<td>action executed along user defined path</td>
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<tr>
<td>action list</td>
<td>user definable, spectroscopies, manual handshake, TTL handshake</td>
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<tr>
<td>Transfer Functions</td>
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<tr>
<td>functionality</td>
<td>AES/DAC offset adjustment, linear transfer function programming, prepare for each ADS channel (1 .. 64 x gain)</td>
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<td>Crosslink</td>
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<tr>
<td>functionality</td>
<td>two generic PI loops, input/output for all ADS/DAC channels</td>
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<tr>
<td>functionality</td>
<td>map any internal signal to any arbitrary output channel</td>
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<tr>
<td>Electrical Supply</td>
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<tr>
<td>power supply</td>
<td>110 .. 115 V / 230 V (autorange), 50 .. 60 Hz</td>
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<tr>
<td>power consumption</td>
<td>max. 80 W</td>
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<tr>
<td>Dimensions</td>
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<td></td>
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<tr>
<td>chassis</td>
<td>19&quot; rack, 2 rack units, 84 horizontal pitches (9 x 65 x 39 cm without handle)</td>
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<td></td>
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<tr>
<td>weight</td>
<td>15 kg</td>
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ACC100
5-slot chassis with power supply for all attocube ACC modules

Dimensions
- Chassis: 19" rack, 3 rack units, 84 horizontal pitches
  (13.5 x 45 x 34.5 cm³)
- Weight: approx. 5 kg
- Single-module size: 3 rack units, 14 horizontal pitches wide, maximum 5 modules

Electrical Supply
- Power supply: 100/115/230 V (switchable), 50...60 Hz
- Connector: IEC inlet
- Max. power consumption: max. 50 W

Output Voltages
- Module supply voltages: GND, +5 V, -15 V, +15 V

Communication
- Bus System: Internal bus system to connect to modules
  Internal bus system to backside connectors

Interfaces
- Module slots: 5 slots for attocube’s modules
- Connectors per module: 3 BNC, 15-pin D-Sub connector
- Connector to optional DAQ card: 25-pin D-Sub connector

Models and Part Numbers
- 19" chassis with power supply: ACC100 chassis
  (Art. no. 1001917)
- Laser detector module, 1310 nm: LDM1300
  (Art. no. 1001591)
- Laser detector module, 650 nm: LDM600
  (Art. no. 1001411)
- 19" rack mounting kit: handles for 19" racks
  (Art. no. 1002073)

This chassis can house up to five different modules such as the Laser Detector Modules LDM600 and LDM1300.
LDM600/LDM1300 Modules
ACC laser detector module with 650 or 1310 nm wavelength

The LDM600 and LDM1300 laser detector modules are fully equipped readout modules for interferometric measurements.
Motion Controllers
Piezo Positioning Electronics

Highest precision piezo positioning systems require state-of-the-art positioning control electronics. attocube’s FPGA-based motion controllers are adapted to the technical challenges of positioners and scanners dedicated for cutting-edge applications and experiments. Suitable models for driving all attoMOTION products either in open loop or closed loop mode (depending on positioner model) together with matching software modules are part of the attoCONTROL portfolio. A sophisticated product design as well as a large variety of interfaces and software drivers for all controllers in combination with an easy software-based upgradeability of most controllers makes them the ideal add-on for all of attocube’s positioners and scanners.

FPGA-based Electronics
attocube’s electronics are state-of-the-art, fully digital FPGA-based control and sensor units, guaranteeing highest performance. Easy-to-use firmware upgrade tools enable the user to take advantage of software upgrades for years to come.

Open-range Input
All control electronics of attocube are equipped with either a wide-range or a switchable input power supply, allowing the units to be used in any country – worldwide.

Upgradeability
Many motion control electronics can be software-upgraded even years after purchase. For example, an ECC100 can be equipped with Ethernet or added software functionality at any time.

Variable Interfaces
attocube’s control units possess a large variety of interfaces. All motion controllers enable the control using Ethernet (TCP/IP, EPICS, SPEC, TANGO), USB (DLL, LabVIEW), and Hardware Trigger (TTL and/or AquadB). Many of those interfaces can be activated using a software key which can be purchased at any time.

Remote Control
All attoMOTION controllers are compatible with the optional attoNAV remote control upgrade package. It contains the intuitive 3D mouse SpaceNavigator as a joystick via USB interface to PC, and a dedicated software upgrade.

Open and Closed Loop Models
attocube offers dedicated controller models for open loop and closed loop positioning mode meeting the highly demanding dynamic performance and accuracy requirements of attocube’s positioners.
ECC100
three axes piezo motion controller for driving attocube’s ECS positioners

The three axes controller ECC100 is driving and controlling all ECS positioners in open and closed loop mode. The ECC100 can be controlled through USB, input/output triggers, or Ethernet (optional) and is delivered with Windows based Software, DLL, LabVIEW™, and EPICS (optional) drivers set.

ECC100 Versions

Modes of Operation
versions ECC100/STD, /PRO, /SYNC, /SYNC/PRO
open loop positioning stepping signals for ECS positioners
closed loop positioning closed loop control for ECS/NUM positioners
remote operation USB 2.0

Controller Hardware
chassis approx. 21 x 21 x 5 cm³
weight 1.9 kg
power supply 100/115/230 V, 50...60 Hz
power consumption max. 100 W
connector IEC inlet
connecting cable (ELE - POS) 1 per axis, length: 2 m

Software Drivers
Windows, Linux Stand-alone application for Windows 8, Vista, 7, and 6
DLL LabVIEW™ available in our webshop shop.attocube.com

Output Signals
stepping - voltage range 0...-45 V
stepping - frequency range 0...5 kHz (1 axis)
stepping - maximum current > 5 A peak
resolution of signal generation 680 µV (16 bit)
output noise < 5 mVpp (500 kHz bandwidth)
maximum capacitance load 2 µF
output connectors 15-Pin SubD connector

Trigger Signals
trigger level definition TTL, optionally A-quad-B
input trigger 1 per axis
trigger interface EERI – port

Options and Upgrades
/PRO software upgrade activation code (art. no. 1007995)
/SYNCH software upgrade activation code (art. no. 1009748)
attoshop SpaceNavigator® (art. no. 1009915)

Availability of SpaceNavigator®
available in our webshop shop.attocube.com

PRODUCT KEY FEATURES
• software control via DLL, LabVIEW™ or Windows GUI
• manual control via optional 3D joystick
• hardware control via TTL or optionally A-quad-B pulses

PRO-VERSION
• end of travel detection
• real device operation
• enhanced sampling rate
• additional trigger possibilities

SYNC-VERSION
• Ethernet connectivity
• EPICS driver

3D mouse SpaceNavigator®
• intuitive remote control (optional)
• specially programmed software interface

Modes of Operation
ECC100/STD • • • •
ECC100/SYNC • • • •
ECC100/PRO • • • •
ECC100/SYNC/PRO • • • •

Controller Hardware
chassis approx. 21 x 21 x 5 cm³
weight 1.9 kg
power supply 100/115/230 V, 50...60 Hz
power consumption max. 100 W
connector IEC inlet
connecting cable (ELE - POS) 1 per axis, length: 2 m

Output Signals
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Options and Upgrades
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/SYNCH software upgrade activation code (art. no. 1009748)
attoshop SpaceNavigator® (art. no. 1009915)

Software Drivers
Windows™ Software • • • •
PRO software (upgraded GUI) - - • •
DLL • • • •
LabVIEW™ • • • •
EPICS - • - •

Article Art. No.
ECC100/STD 100701
ECC100/SYNC 1008274
ECC100/PRO 1008255
ECC100/SYNC/PRO 1008279

attoshop SOFT/HARDWARE
R&D ENGINEER
MIC
DEVELOPMENT
MIO. €
REVENUE
€
ANC250
ultra low noise scan voltage amplifier

The ANC250 is attocube’s high-end scan voltage amplifier for piezo scanning tubes and flexure scanners. All three input channels (-10V...+10V) generate differential scan voltages (x+, x-, y+, y-, z) up to 200V. The ANC250 is notable for its ultra low noise specifications with an output noise of only 20 µV RMS.

Output Signals

- Scanning - output voltage range: -200...200 V
- Scanning - gain: 20
- Scanning - maximum current: 10 mA
- Scanning - power bandwidth: 650 Hz @ sinus output 400 Vpp
- Scanning - small signal bandwidth: 2 kHz (response corresponding to 2nd order Bessel filter)
- Scanning - slow rate: 800 V/ms (without load)
- Amplification accuracy: < 0.2%
- Amplification T coefficient: < 50 ppm/K
- Output noise: 20 µV (RMS)
- Output filter: ---
- Maximum capacitive load: 1 µF
- Zero voltage output in GND mode: connected to chassis ground directly or via 100 kOhm

Input Signals

- DC in voltage range: -10...+10 V
- AC in voltage range: -10...+10 V
- Coupling: DC, zero offset
- Input resistance: 1 Mohm AC
- Input current: < 2 µA
- Input connectors: BNC, 50 Ohm

Controller Hardware

- Chassis: 19” rack, 2 rack units, 9 x 65 x 40 cm³
- Weight: 7.5 kg
- Power supply: 100/115/230 V, 50...60 Hz
- Power consumption: max. 60 W
- Connector: IEC inlet
- Connecting cable (ELE - POS): 1 per axis, length: 2 m

Models and Part Numbers

- Piezo tube controller: ANC250 (art. no. 1002701)
- Options & Upgrades:
  - 19” rack mounting kit: handles (art. no. 1001609)
  - Faster amplifier: signal bandwidth 10 kHz (ask for details)
ANC300
piezo positioning controller for driving attocube positioners

The ANC300 is a modular positioner control unit providing suitable drive signals to actuate attocube’s open loop positioners or scanners manually or under computer control. The ANC300 is available as a modular housing that can host up to seven plug-in modules. The touch screen allows for ease of operation.

ANC300 Plug-In Modules
open loop control for attocube positioners

The ANC300 offers a completely modular design with up to seven slots for dedicated stepping (ANM150), scanning (ANM200) or combined stepping and scanning (ANM300) modules.

ANM150
stepping module

Output Signals
- stepping - voltage range 0 .. 150V
- stepping - frequency range 0 .. 10kHz
- stepping - maximum current 100mA, 4.5 A peak (max. 1 ms)
- resolution of signal generation 2.3 mV (16 bit)
- output noise < 5 mVpp (20 MHz bandwidth)
- maximum capacitive load 5 μF
- zero voltage output in GND mode connected to chassis ground directly
- output connectors BNC, 50 Ohm

ANM200
scanning module

Output Signals
- scanning - output voltage range 0 .. 150V
- scanning - gain 15
- scanning - maximum current 100mA
- scanning - offset programmable offset
- scanning - power bandwidth DC .. 500 Hz (1 µF load)
- scanning - small signal bandwidth DC .. 100 kHz (1 µF load) via DC input, up to 500 kHz via AC input
- scanning - slew rate 800 V/ms (1 µF load)
- resolution of signal generation 2.3 mV (16 bit)
- output noise < 5 mVpp (20 MHz bandwidth)
- maximum capacitive load 5 μF
- zero voltage output in GND mode connected to chassis ground directly
- output connectors BNC, 50 Ohm

ANM300
stepping & scanning module

Output Signals
- stepping - voltage range 0 .. 150V
- stepping - frequency range 0 .. 10kHz
- stepping - maximum current 100mA, 4.5 A peak (max. 1 ms)
- resolution of signal generation 2.3 mV (16 bit)
- output noise < 5 mVpp (20 MHz bandwidth)
- maximum capacitive load 5 μF
- zero voltage output in GND mode connected to chassis ground directly
- output connectors BNC, 50 Ohm

Modes of Operation
- open loop positioning depending on ANM module
- remote operation 1682.2, ethernet, E2532
- modular design 7 slots for ANM modules
- capacitance measurement 50 .. 5500 nF

Controller Hardware
- chassis 39” rack, 9 rack units, 15.5 x 45.5 x 36.5 cm³
- weight 7.5 kg (chassis only)
- power supply 100/115/230 V, 50 .. 60 Hz
- connector fused IEC inlet
- connecting cable (ELE-POS) 1 per axis, length: 2 m

Software Drivers
- Windows, Linux programming via standard terminal interface
- programmable LUA console (see www.lua.org)
- LabVIEW™

Output Signals
- depending on ANM module

Trigger Signals
- trigger level definition LVTTL (2.3 V)
- input trigger 18 (trigger inputs freely assignable)
- output trigger 4 (trigger outputs freely assignable)

Metal and Part Numbers
- positioning controller ANC300 Base (art. no. 303821)
- stepping module ANM150 (art. no. 1005251)
- scanning module ANM200 (art. no. 1005252)
- stepping & scanning module ANM300 (art. no. 1003822)

Options and Upgrades
- 39” rack mounting kit handles (art. no. 0015166)
- vacuum feedthrough for HV VFT/HV cabling set (KF flange)
- interface VFT/LT cabling set (KF flange)
- interface VFT/LT cabling set
- attocAW SpaceNavigator® (art. no. 1010521)

Trigger Signals
- trigger level definition LVTTL (2.3 V)
- input trigger 18 (trigger inputs freely assignable)
- output trigger 4 (trigger outputs freely assignable)

Output Signals
- depending on ANM module

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ANC350
multi-functional piezo controller for driving attocube's closed loop positioners

The ANC350 is attocube's high-end piezo controller which meets the highly demanding dynamic performance and accuracy requirements of multi-axis nanopositioning setups. Dedicated controller models for driving up to three positioners either with resistive (ANC350/3/RES) or optoelectronic encoders (ANC350/3/NUM) are available.

Open loop positioners can be controlled in closed loop mode in combination with the ANC350/3/FPS and attocube's stunning interferometer FPS1010, FPS3010, FPS3010-19" setups (see attoSensorics section).

ANC350 Versions

ANC350/3/RES
for closed-loop control of up to three positioners with resistive encoders
- NEW: featuring extra low sensor dissipation through integrated lock-in technology
- NEW: improved linearity with look-up tables (delivered with all new positioners with resistive sensor)

ANC350/3/NUM
for closed-loop control of up to three positioners with /NUM encoders
- extra low sensor dissipation via duty-cycle readout
- ease of use and large voltage range

ANC350/3/FPS
for closed-loop control of up to three positioners with separate interferometric sensor FPS3010
- sub-nm precise closed-loop positioning
- direct control of the position of interest
- available as retrofit to existing setups

Product Key Features
- manual control via touch screen interface or 3D joystick
- software control via DLL, LabVIEW, EPICS or Windows GUI
- hardware control via TTL or A-quad-B pulses
- fast encoder sampling rate for quicker closed loop control
- piezo capacity measurement
- end of travel detection

Optional Features
- intuitve remote control (optional)
- specially programmed software interface

Options and Upgrades
- attoNAV SpaceNavigator® (art. no. 1010522)
- ethernet port activation code (art. no. 1004201)

Options and Upgrades
- * suitable cabling for vacuum conditions
- ** suitable cabling for ambient conditions

Intuitive touchscreen interface in addition to computer control

3D mouse SpaceNavigator®
- * intuitive remote control (optional)
- ** specially programmed software interface

Modes of Operation
- open loop positioning: stepping and fine positioning of attocube positioners
- closed loop positioning: depending on encoder system (resistive or optoelectronic)
- capacitance measurement: 50 - 5000 Ω
- remote operation: USB 2.0, ethernet optional

Controller Hardware
- chassis: 20” rack, 2 rack units, 9 x 45 x 28.5 cm³
- weight: 5 kg
- power supply: 90 - 240 VAC, 50..60 Hz
- power consumption: max. 105 W
- connector: fused IEC inlet
- connecting cable: SubD-Mix (female)

Trigger Signals
- trigger level definition: LVTTL (1.5 V), AquadB
- input trigger: 2 per axis (TTL or AquadB)
- output trigger: 2 per axis (AquadB)
- trigger interface: GPIB port (with 26-Pin SubD connector)

Output Signals
- stepping – voltage range: 0 ... 70 V
- stepping – frequency range: 0 ... 2 kHz
- stepping – maximum current: > 8 A peak
- resolution of signal generation: 1.1 mV (18 kHz)
- output noise: < 5 mV (20 MHz bandwidth)
- output filter: additional switchable output filter (2.5 kHz)
- maximum capacitive load: 1.5 µF (60 MHz bandwidth)
- output connectors: SubD-Mix connector (female)

Software Drivers
- Windows, Linux
- Stand-alone application for Windows XP, Vista, 7, 8
- DLL, LabVIEW®
- EPICS (ethernet required)

Options and Upgrades
- attoNAV SpaceNavigator® (art. no. 1010522)
- ethernet port (art. no. 1054201)

ART.

ANC350/3/RES 1008440 1003064
ANC350/3/NUM 1008439 1003063
ANC350/3/FPS 1008443 1008239

Useful References
- ACC350 User Manual (PDF)
- ACC350 Technical Data Sheet
- ACC350 Application Notes

3D mouse SpaceNavigator®
With the IMC from attocube, the integration of nanodrives into your own control system was never easier. With just one power source of 12 V, 30 W needed, it offers simultaneous operation of up to three closed-loop axes with NO/N-encoder and output voltages up to 130 V.

The IMC offers diverse trigger in- and outputs to control piezo-steppers in multiple ways and set coordinates directly (closed-loop) via A-quad-B interface. The IMC accepts (LV-)TTL as well as differential input signals. It also features a webinterface and can be controlled via JSON commands, a DLL or LabView. As a development kit it comes with the necessary heat sink, power supply and additional service included.

**Modes of Operation**
- open loop positioning
- stepping signals for slip-stick positioners, fine-positioning mode for positioners
- closed loop positioning
- closed loop control for ECS/NUM positioners
- remote operation
- Ethernet, WLAN (optional, planned), USB for hand-held control/prototypes, (planned)
- multi device operation
- control of multiple IMC via one PC

**Interfaces**
- protocols (diff. & single ended) AquadB, HSSL, SPI, WLAN on request
- trigger
- Directdrive, Stepp & Direction
- communication speed - AquadB up to 25 MHz
- communication speed - HSSL up to 12.5 MHz

**Software Drivers**
- all platforms integrated Webserver (TCP/IP), JSON
- Windows 7 , 8, 10 (1607) DLL, LabVIEW™
- communication speed - LabVIEW™ up to 300 Hz

**Controller Hardware**
- PCB size: 100 x 200 x 25 mm³
- weight: 268 g
- power supply: 12 V DC
- power consumption max. 30 W
- power connector:
  - PTSM 0,5/ 2-2,5-H THR R24
  - PTSM 0,5/ 2-HH-2,5-THR R16
  - SACC-DSIV-M 8FS-3CON-L 90
- connector for positioner: 3 x D-Sub H/D 26pin
- temperature range: 0 .. 40°C, non condensing

**Output Signals - stepping mode**
- voltage range: 0 .. 65 V
- frequency range: 0 .. 10kHz (1 axis), 0 .. 4kHz (3 axes simultaneously)
- output noise: < 3 mVpp (500kHz bandwidth)
- maximum capacitive load: 2 µF per axis

**Output Signals - fine positioning mode**
- voltage range: ± 130 V DC
- output noise: < 1.3 mVpp (500kHz bandwidth)
- setpoint bandwidth: 1 kHz

**Article Art. No.**
- AEC100/RT 1007316
- AEC100/VAC 1007317

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**AEC Connection Cables**

All Industrial Line positioners are delivered with a set of test cables which connect directly from the electronics to the positioners and are designed for direct table-top testing. As a standard all cables feature a length of 2 m. AEC connection cables are available both for positioners working under ambient conditions (RT) or positioners working in vacuum environments (VAC).

**Article Art. No.**
- AEC100/RT 1007316
- AEC100/VAC 1007317

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**AAC300 Connection Cable**

All Premium Line positioners are delivered with a set of test cables which connect directly from the electronics to the positioners and are designed for direct table-top testing. As a standard all cables feature a length of 2 m. The AAC300 connection cable connects a single open loop positioner to the open loop electronics ANC100.

**Article Art. No.**
- AAC300/1 1001326

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**AAC Connection Cables**

All Premium Line positioners are delivered with a set of test cables which connect directly from the electronics to the positioners and are designed for direct table-top testing. As a standard all cables feature a length of 2 m. AAC300 connection cable connects a single open loop positioner to the open loop electronics ANC100.
Accessories
optional items for the attoCONTROL product line

AAC350 Connection Cables
All Premium Line positioners are delivered with a set of test cables which connect directly from the electronics to the positioners and are designed for direct table-top testing. As a standard all cables feature a length of 2 m. AAC350 connection cables connect open or closed loop positioners to the closed loop electronics ANC350 (/NUM or /RES) and are available for different working environments.

<table>
<thead>
<tr>
<th>Article Art. No.</th>
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<td>AAC350/SCI (for scanners)</td>
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For more replacement parts please visit our webshop at shop.attocube.com

3D mouse SpaceNavigator®
The 3D mouse SpaceNavigator® (designed and produced by 3Dconnexion) allows for intuitive remote control of all attocube piezo drives via a specially programmed software interface. Each degree of freedom can be assigned to one specific positioner: A push, pull, twist or tilt of the SpaceNavigator® is translated into the corresponding movement. The perfect choice for demanding positioning tasks with up to six degrees of freedom (6DOF). Available for ECC100, ANC300 & ANC350.