attocube
pioneers of precision

attoCONTROL

Electronic & Software Control Units

attocube systems AG | Königinstrasse 11a | D - 80539 München | Germany
Tel.: +49 89 2877 809 - 0 | Fax: +49 89 2877 809 - 19 | info@attocube.com
www.attocube.com

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Electronic & Software Control Units

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Electronics & Software Control Units

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 designs 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, PRFM, CFM, SHPM, SNOM, STM, and many more measurement techniques are available. The ASC500 features optional closed loop f unctionality. 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 attoFPSensor, lateral resolutions of < 1 nm are achieved. This unique concept provides not only compensation of the piezo-inherent scan non-linearities, but also location triggered data acquisition and hence a perfect repeatability of points-of-interest over the full coarse range (typ. 5 mm) with sub-nm resolution.

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.

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.

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.

FPGA-based electronics

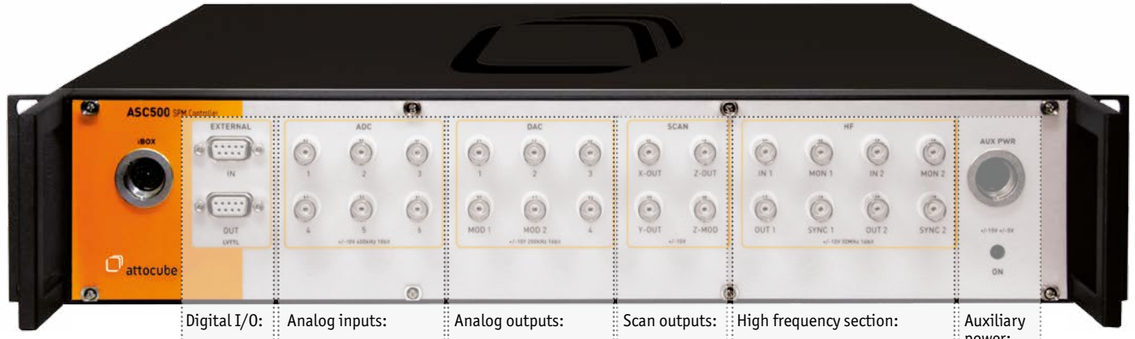
attocube's electronics are state-of-the-art, fully digital FPGA-based control and sensor units, guaranteeing highest performance. Easy-to-use firmware upgrade tools enable the user to take advantage of software upgrades for years to come.

ASC500

fully digital SPM controller with xy-scan generator and z feedback control, phase-locked loop (PLL)

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.



Digital I/O:	Analog inputs:	Analog outputs:	Scan outputs:	High frequency section:	Auxiliary power:
8 inputs 8 outputs 40 MHz	6 converters 400 kHz 18 bit	4 converters 200 kHz 16 bit 2 analog modulation inputs	3 converters 4 MHz in xy; highest resolution, z modulation input	2 independent HF channels with each: 50 MHz, 16 bit input 50 MHz, 16 bit output Sync output Preamplified signal monitor	±5 V ±15 V

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

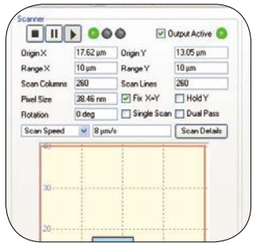
Lior Embon

"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 adjust our measurement scheme to meet the needs of the moment. It has proven to be a powerful tool for scanning probe microscopy"

(Group of Prof. Eli Zeldov, Weizmann Institute of Science, Israel)

Hard- and Software features

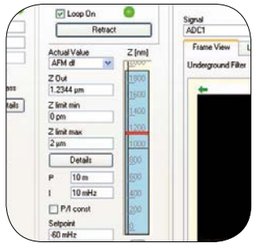
ASC500 SPM controller and Daisy software interface



Scan Engine

The ASC500 uses a dedicated hardware with a 4 MHz scan generator to create the voltages necessary for the raster motion. The 16 bits of the xy outputs are always automatically mapped to the actual scan field, yielding a virtually unlimited bit resolution. Further features are:

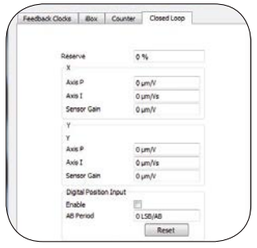
- hardware rotation of the field of view
- hardware slope and drift compensation
- fully software integrated control
- LabVIEW™ interface



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 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

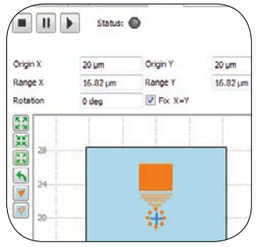


Closed Loop

The ASC500 now supports closed loop scanning at low temperatures as an upgrade option. With different sensors closed loop positioning ranges up to 5 mm are possible with extremely high resolution. This unique concept provides not only compensation of scan non-linearities, but also full repeatability/recovery of positions over the full coarse range with nm resolution. Switching back and forth between different hot spots on the complete sample has never been easier. The ASC500 is fully compatible with the FPS3010/FPS 19".

Hard- and Software features

ASC500 SPM controller and Daisy software interface



Lithography

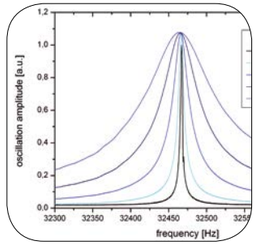
The ASC500 also offers a lithography mode. Any geometrical shape composed from convex polygons and single dots can be scanned with full control over scan speeds and line spacings for each shape unit. Shape definition is done via text files for full flexibility. Furthermore, a shutter can be controlled 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

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, 18 bit
- 2 high frequency ADC inputs with 50 MS/s, 16 bit
- 4 DAC outputs with 200 kS/s, 16 bit
- software defineable transfer function

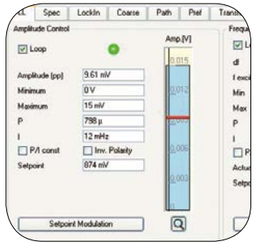


Q Control

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



PLL

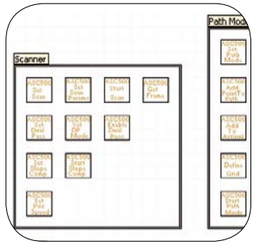
A fully digital phase-locked loop is implemented into the ASC500. It uses the high frequency inputs / outputs with 50 MHz bandwidth. A high-speed Lock-In demodulator and two PI control loops are used to control the amplitude of an oscillator and to follow any resonance shifts. The frequency resolution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

- gain access to direct measurement of force gradients by means of measuring
- Δf have a clear PLL concept with graphical interface and access to all data
- streams in the PLL chain

Measurement Modes

STM: constant height (with tilt correction), constant current

AFM: contact mode, amplitude modulation, frequency modulation (PLL), Kelvin Probe, Scanning Gate Microscopy (SGM), Piezo Response Force Microscopy (PRFM) MFM: constant height (with tilt correction), dual pass mode, CFM: constant height, step scan mode for increased scan ranges.



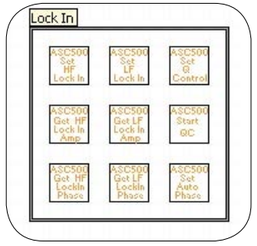
Data Processing

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 and background filtering
- 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

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

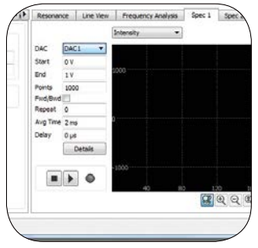
easy integration with 3rd party instrumentation

Full package of LabView drivers is included in every unit at no extra price. The LabView package comes with many programming examples such as:

automatic slope compensation

automatic temperature monitoring with background scan voltage adjustment

large area scan via sequence of images with intermediate coarse steps



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

ASC500 SPM controller

Interface	
xy scan voltage output	2 x -10 .. +10 V, 16 (+16) bit, 4 MHz with programmable tilt correction uni-/bipolar, output limiter, slewrate control
z voltage output	-10 .. +10 V, 18 bit, 200 kS/s uni-/bipolar, output limiter, slewrate control
analog ADC inputs	6 x -10 .. +10 V, 18 bit, 400 kS/s ADC with programmable offset and gain compensation
analog DAC outputs	4 x -10 .. +10 V, 16 bit, 200 kS/s DAC switchable 2nd order low pass 3 kHz / 100 kHz noise: 16 µVrms (10 Hz .. 100 kHz)
analog modulation inputs	-10 .. +10 V, DC .. 50 kHz for DAC 1, DAC 2, and Z-Out
high frequency section	2 x 16 bit, 50 MS/s ADC with continuous signal amplification 2 x monitor output of preamplified signal 2 x 16 bit, 50 MS/s DDS-DAC, oscillation excitation 2 x SYNC output with fixed 10 V amplitude
general purpose digital interface	8 bit LVTTL trigger input 8 bit LVTTL trigger output for optional programmable in / out sync, counter e.g. pixel-, line-, frame-clock
digital serial interface (RS232)	connection to ANC300 for coarse movement
digital serial interface (NSL)	connection to ANC350 for closed loop coarse movement
host computer interface	USB 2.0 high speed, LAN 100 Mbit
auxiliary power outlet	±5 V (0.2 A) and ±15 V (0.1 A)
out- and input connector	front side BNC sockets for all analog signals; 9 pin D-Sub for LVTTL lines
Scan Generation	
generation bandwidth	5 MHz pixel frequency
resolution	16 bit auto projected on scan area
features	hardware rotation and zoom, slew-rate controlled movement, slope compensation, switchable uni-/bipolar
scan speed	1 pm/s .. 2 mm/s
max. frame rate	20 Hz @ 100 x 100 pixel
Closed Loop Scanning (optional)	
sensors	interferometric (FPS 19" SLIMLINE) or position triggered scanning

Specifications

ASC500 SPM controller

Z Controller	
type	digital PI, anti wind-up
resolution	18 bit
bandwidth	50 kHz
control signal	any internal signal channel
features	external modulation input, setpoint modulation, invertable feedback gain and output polarity, PI gains in physical units

Phase Locked Loop (PLL)	
features	2 PI controllers with graphical interface
frequency resolution	0.14 µHz
frequency range	1 kHz .. 2 MHz

Q Control	
type	electronic, phase controlled
efficiency	decrease or increase of Q by factor 10 typical

Frame View	
display modes	2 frame views, 2 line views, easy generation of additional frames possible
options	oversampling, autosave (png, ASCII, bcrf), line subtraction line view with up to 16 subsequent lines
selection tools	frame alignment, frame centering, zoom function, path mode, grid mode

Spectroscopy	
physical arrangement	point/line/grid spectroscopy (up to 1024 x 1024 pixel)
spectroscopy types	z-spectroscopy, bias spectroscopy, soft spectroscopy (all GUI parameters), dI/dV with internal Lock-In
averaging	25 µs up to 160 ms per data point
parameters	control loop off, signal limiter

Second Pass Mode	
working principal	2nd pass with height offset or different scan parameter set
parameters	height offset, wait time, slew rate, alternative DAC, alternative setpoint
application	MFM, SGM

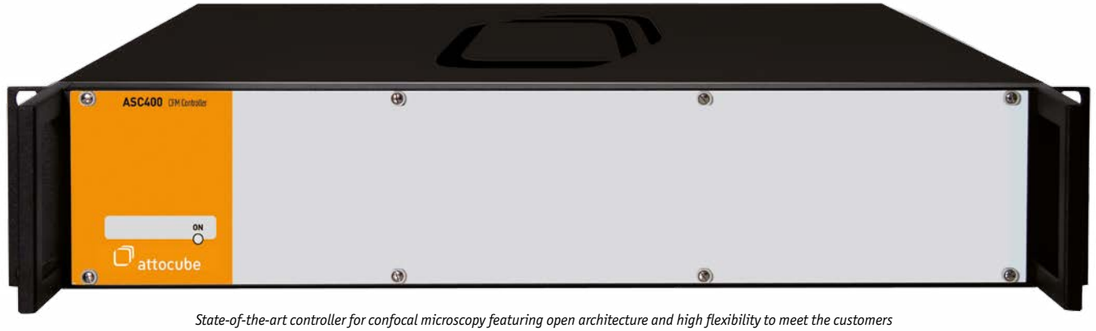
Lock-In		
low frequency Lock-In	1 mHz .. 20 kHz	
modulation	all DAC channels	
demodulation	any internal signal	
integration time	up to 128 periods	
usage	spectroscopy, vibrational analysis, Hall probe etc.	
high frequency Lock-In	1 kHz .. 2 MHz	
integration time	up to 512 periods	
usage	AFM cantilever signal, tuning fork signal etc.	
Visualization		
oscilloscope	arbitrary channel vs. time; time base 2.5 µs .. 150 ms, 32000 pixel max. trigger: amp/edge/auto/single	
FFT	for every channel, 0 .. 200 kHz range, 1 .. 128 x averaging, windowing options, scaling: magnitude/power density/power spectrum	
Path Mode		
working principle	action executed along user defined path	
action list	user definable, spectroscopies, manual handshake, TTL handshake	
Transfer Functions		
functionality	ADC/DAC offset adjustment, linear transfer function programming, preamp for each ADC channel (1 .. 64 x gain)	
Crosslink		
functionality	two generic PI loops, input/output for all ADC/DAC channels, map any internal signal to any arbitrary output channel	
Electrical Supply		
power supply	110 .. 230 V (autorange), 50 .. 60 Hz	
connector	IEC inlet	
power consumption	max. 80 W	
Dimensions		
chassis	19" rack, 2 rack units, 84 horizontal pitches (9 x 45 x 39 cm^3 without handles)	
weight	10 kg	
Models and Part Numbers		
SPM controller incl. software	ASC500	(art. no. 1000876)

ASC400

confocal microscope controller and software

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.



State-of-the-art controller for confocal microscopy featuring open architecture and high flexibility to meet the customers individual needs.

Specifications

ASC400 confocal microscope controller

CFM Control	
features	2x 18 bit 400 kS/s ADC input channel for the CFM signal DAC-spectroscopy feature direct FFT of input signal external spectrometer control via TTL pathmode for direct addressing of interesting features for spectroscopy
Scan Generation	
scan engine	2D xy-scan generator with 4 MHz pixel frequency 16 bit resolution full range mode (16 bit offset + 16 bit scan)
features	hardware rotation hardware zoom slewrate controlled movement
on request	hardware cross talk compensation
Interfaces	
analog scan voltage output	2 x 0 .. 10 V, 16 (+16) bit, 4 MHz
analog DAC output	2 x -10 .. +10 V, 16 bit, 200 kS/s DAC
analog input	2 x -10 .. +10 V, 18 bit, 400 kS/s ADC
connection to PC	USB 2.0
ANC150 remote control	RS232 interface
general purpose digital interfaces	optional 2 x 8 bit LVTTL/TTL I/O trigger interface optional programmable in / out sync, counter e.g. pixel-, line-, frame-clock
Other	
online data processing	averaging, line fit, offset correction for- and backward filter, FFT, DAC1 spectroscopy mode
data save formats	SPIP ™ compatible data format, open ASCII formats for multi purpose data processing (Origin, Sigma Plot, Excel, ...)
Electrical Supply	
power supply	100/115/230 V, 50 .. 60 Hz
connector	IEC inlet
power consumption	max. 80 W
Dimensions	
chassis	19“ rack, 2 rack units, 84 horizontal pitches (9 x 45 x 39³ cm without handles)
	10 kg
Models and Part Numbers	
CFM controller incl. software	ASC400 (art. no. 1002115)

ACC100

5-slot chassis with power supply for all attocube ACC modules

More details about available ACC modules on the next page.

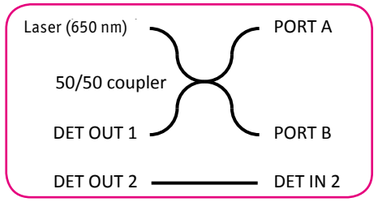
This chassis can house up to five different modules such as the Laser Detector Modules LDM600 and LDM1300.

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 BNCs, 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)
Compatible Modules		
laser detector module, 1310 nm	LDM1300	(art. no. 1001591)
laser detector module, 650 nm	LDM600	(art. no. 1001411)
Options		
19" rack mounting kit	handles for 19" racks	(art. no. 1002073)

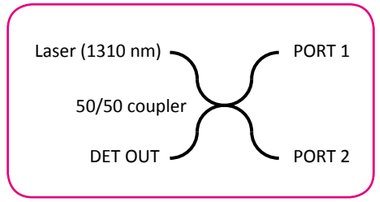
LDM600 / LDM1300 - Modules

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.



LDM600: schematics



LDM1300: schematics

Laser	LDM600	LDM1300
wavelength	650 nm	1310 nm
maximum optical power	500 µW per optical port (total 1000 µW)	100 µW per optical port (total 200 µW)
minimum optical power	33 µW per optical port	33 µW per optical port
Detector		
type	Si-diode	InGaAs-diode
gain	5E6 V/A (others on request)	1E6 V/A (others on request)
quantum efficiency	0.8 A/W @ 650 nm	0.8 A/W @ 1310 nm
detector bandwidth	35 kHz (others on request)	200 / 500 kHz (switchable)
detector output	0 .. +10 V	0 .. +10 V
typical noise	< 1 mV	< 1 mV
Dimensions		
type	module for ACC chassis, 19" rack	module for ACC chassis, 19" rack
module size	3 rack units, 14 horizontal pitches (13.5 x 7.5 x 34.5 cm^3)	3 rack units, 14 horizontal pitches (13.5 x 7.5 x 34.5 cm^3)
weight	1 kg	1 kg
Electrical Supply		
voltages supplied by ACC chassis	GND, +5 V, -15 V, +15 V	GND, +5 V, -15 V, +15 V
ACC chassis input voltage	100/115/230 V (switchable), 50 .. 60 Hz	100/115/230 V (switchable), 50 .. 60 Hz
power consumption	max. 10 W	max. 10 W
Interfaces		
detector output	BNC, 50 Ohm	BNC, 50 Ohm
optical ports	2x FC/APC connectors	2x FC/APC connectors
connection to optional DAQ card	25 pin D-Sub connector on ACC chassis	25 pin D-Sub connector on ACC chassis
Models and Part Numbers		
laser detector module	LDM600 (art. no. 1001411)	LDM1300 (art. no. 1001591)
19" chassis with power supply	ACC chassis (art. no. 1002073)	ACC chassis (art. no. 1002073)

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.

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.

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 – world wide.

Remote Control

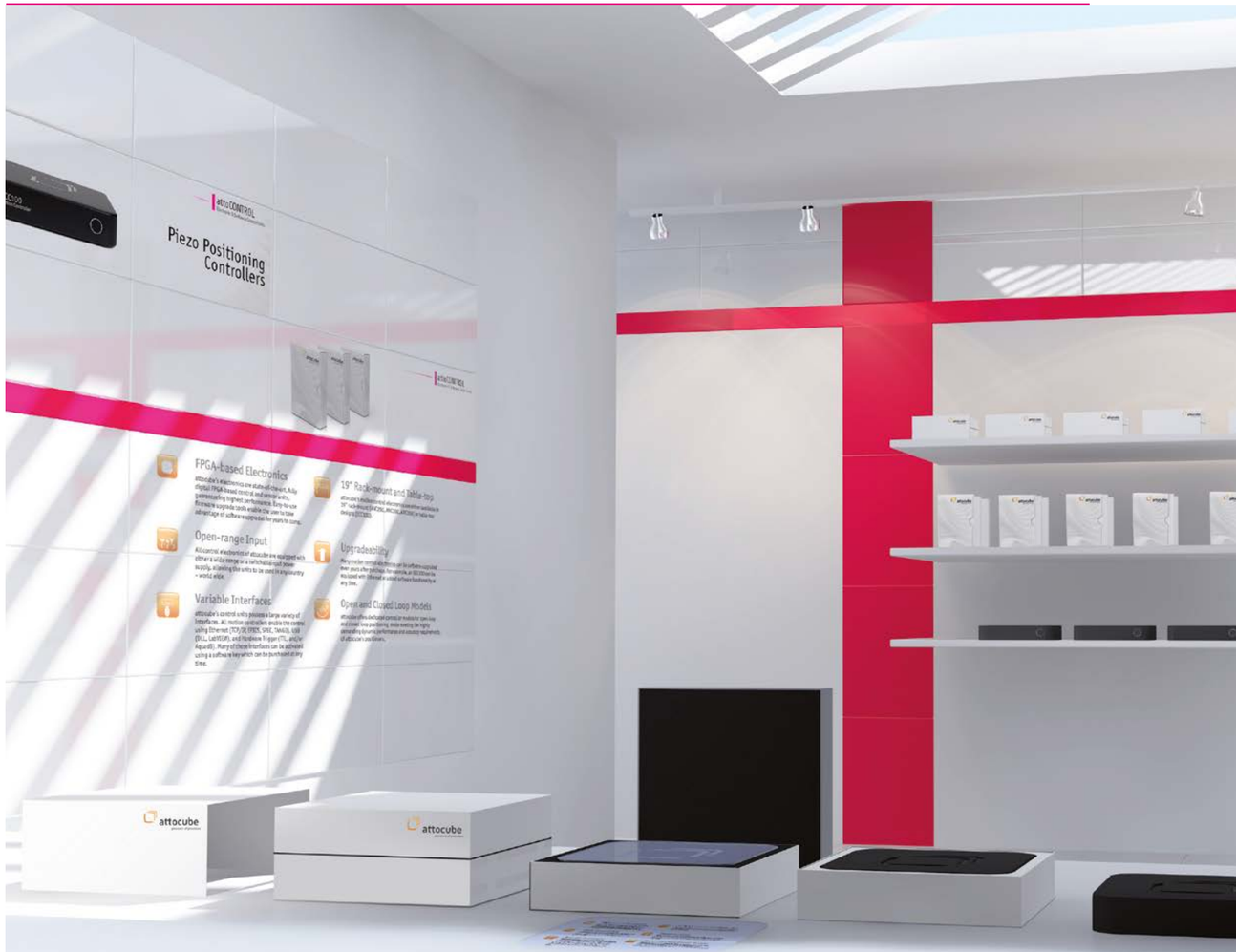
All attoMOTION controllers are compatible with the optional attoNAV remote control upgrade package. It contains the intuitive 3D mouse SpaceNavigator® as a joystick via USB interface to PC, and a dedicated software upgrade.

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.

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, LabViewTM, and EPICS (optional) drivers set.

3D mouse SpaceNavigator®

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

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 XP™, Vista™, 7™, 8™ DLL LabVIEW™

Output Signals	
stepping - voltage range	0 .. 45 V
stepping - frequency range	0 .. 5 kHz (1 axis) 0 .. 2 kHz (3 axes simultaneously)
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
setpoint bandwidth	20 Hz
Trigger Signals	
trigger level definition	TTL
input trigger	1 per axis
trigger interface	GPIO - port
Options and Upgrades	
/PRO software upgrade	activation code (art. no. 1007995)
/SYNC ethernet upgrade	activation code (art. no. 1007438)
attoNAV	SpaceNavigator® (art. no. 1009915)

Overview ECC100 Models - Specifications

	ECC100/STD	ECC100/SYNC	ECC100/PRO	ECC100/SYNC/PRO
Modes of Operation				
stepping	■	■	■	■
fine positioning			■	■
closed loop positioning	■	■	■	■
multi-device operation			■	■
Remote Operation				
USB2.0	■	■	■	■
Ethernet		■		■
Trigger Signals				
TTL	■	■	■	■
AquadB			■	■
input trigger	1 per axis	1 per axis	1 per axis (TTL or AquadB)	1 per axis (TTL or AquadB)
output trigger	---	---	1 per axis (AquadB)	1 per axis (AquadB)
trigger interface	GPIO port	GPIO port	GPIO port	GPIO port
Software Drivers				
Standard Daisy	■	■		
PRO software (upgraded Daisy)			■	■
DLL	■	■	■	■
LabView™	■	■	■	■
EPICS		■		■
Options and Upgrades				
ethernet	■		■	
PRO software	■	■		
Models and Part Numbers				
positioning controller	1005701	1008254	1008255	1008279

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 (-10 V...+10 V) generate differential scan voltages (x+, x-, y+, y-, z) up to 200 V. The ANC250 is notable for its ultra low noise specifications with an ouput noise of only 20 µV RMS.

Modes of Operation	
scan mode	input signal amplified with gain 20
Controller Hardware	
chassis	19" rack, 2 rack units, 9 x 45 x 40 cm³
weight	7.5 kg
power supply	100/115/230 V, 50..60 Hz
power consumption	max. 60 W
connector	fused IEC inlet
connecting cable (ELE - POS)	1 per axis, length: 2 m
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

Output Signals	
scanning -output voltage range	-220..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
Models and Part Numbers	
piezo tube controller	ANC250 (art. no. 1002701)
Options & Upgrades	
19" rack mounting kit	handles (art. no. 1001606)
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.

3D mouse SpaceNavigator®

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

Modes of Operation	
open loop positioning	depending on ANM module
remote operation	USB2.0, ethernet, RS232
modular design	7 slots for ANM modules
capacitance measurement	50 .. 5500 nF
Controller Hardware	
chassis	19" rack, 3 rack units, 13.5 x 45 x 34.5 cm³
weigth	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 textbased console programmable LUA console (see www.lua.org) LabVIEW™

Output Signals	
	depending on ANM module
Trigger Signals	
trigger level definition	LVTTL (3.3 V)
input trigger	16 (trigger inputs freely assignable)
output trigger	4 (trigger outputs freely assignable)
trigger interface	25-Pin SubD connector (female)
Model and Part Numbers	
positioning controller	ANC300 Base (art. no. 1003821)
stepping module	ANM150 (art. no. 1005251)
scanning module	ANM200 (art. no. 1005252)
stepping & scanning module	ANM300 (art. no. 1003822)
Options & Upgrades	
19" rack mounting kit	handles (art. no. 1001606)
vacuum feedthrough for HV	VFT/HV cabling set (KF flange)
vacuum feedthrough for UHV	VFT/UHV cabling set (CF flange)
vacuum feedthrough for LT	VFT/LT cabling set
attoNAV	SpaceNavigator® (art. no. 1010521)

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 .. 150 V
stepping - frequency range	0 .. 10 kHz
stepping - maximum current	100 mA, 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 .. 150 V
scanning - gain	15
scanning - maximum current	100 mA
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)
output filter	additional switchable output filter (1.6, 16, 160, 1600 Hz)
maximum capacitive load	5 µF
zero voltage output in GND mode	connected to chassis ground directly
output connectors	BNC, 50 Ohm
Input Signals	
DC in voltage range	-10..+10 V
AC in voltage range	max. ±5 V AC
coupling	DC, programmable offset
input resistance	10 kOhm
input connectors	BNC, 50 Ohm

ANM300

stepping & scanning module

Output Signals	
stepping - voltage range	0 .. 150 V
stepping - frequency range	0 .. 10 kHz
stepping - maximum current	100 mA, 4.5 A peak (max. 1 ms)
scanning - output voltage range	0 .. 150 V
scanning - gain	15
scanning - maximum current	100 mA
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
Input Signals	
DC in voltage range	-10..+10 V
AC in voltage range	max ±5 V AC
coupling	DC, programmable offset
input resistance	10 kOhm
input connectors	BNC, 50 Ohm

ANC350

multi-functional piezo controller for driving attocube closed loop positioners

The ANC350 is attocube's multi-functional piezo controller which meets the highly demanding dynamic performance and accuracy requirements of multi-axis nanopositioning setups. Dedicated controller models for driving either positioners with resistive encoders (ANC350/RES) or positioners with optoelectronic encoders (ANC350/NUM) are available either in a three-axes version. Open loop positioners can be controlled in closed loop mode in combination with the three-axis version ANC350/FPS and attocube's stunning interferometer FPS1010, FPS3010, FPS3010-19" setups.

3D mouse SpaceNavigator®

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

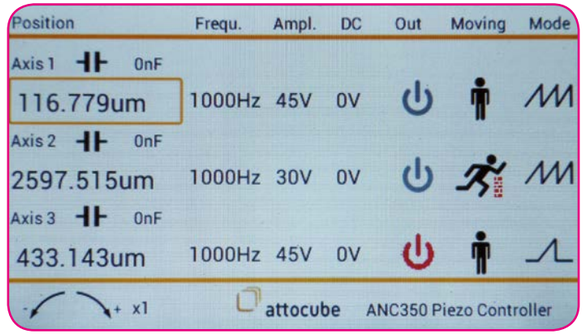
Modes of Operation	
open loop positioning	stepping and fine positioning of attocube positioners
closed loop positioning	depending on encoder system
capacitance measurement	50...5000 nF
remote operation	USB 2.0, ethernet optional
Controller Hardware	
chassis	19" rack, 2 rack units, 9 x 45 x 28.5 cm³
weight	5 kg
power supply	90 - 240 VAC, 50..60 Hz
power consumption	max. 100 W
connector	fused IEC inlet
connecting cable (ELE - POS)	1 per axis, length: 2 m
Trigger Signals	
trigger level definition	LVTTL (3.3 V), AquadB
input trigger	1 per axis (TTL or AquadB)
output trigger	1 per axis (AquadB)
trigger interface	GPIO port (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 (16 bit)
output noise	<8 mVpp (20 MHz bandwidth)
output filter	additional switchable output filter (2.5 kHz)
maximum capacitive load	1.5 µF (more with reduced bandwidth)
zero voltage output in GND mode	connected to chassis ground directly
output connectors	SubD-Mix connector (female)
Software Drivers	
Windows, Linux	Stand-alone application for Windows XP™, Vista™, 7™,8™ DLL LabVIEW™ Epics (ethernet required) spec (ethernet required) Tango (ethernet required)
Upgrades and Options	
attoNAV	SpaceNavigator® (art. no. 1010522)

ANC350 Versions

NEW

- touchscreen based user interface
- enhanced linearity for /RES positioners
- reduced heat dissipation for /RES and /NUM encoders
- 250x faster encoder sampling rate
- faster closed loop position control

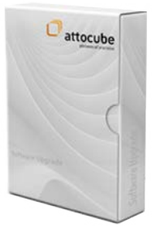


Versions Overview

ANC350/3/RES	
version	closed loop control for /RES encoded positioners
positioning controller	ANC350/3/RES/RT (art. no. 1003064) ANC350/3/RES/Vac (art. no. 1008440)
upgrade option	ethernet port (activation code) (art. no. 1004201)
ANC350/3/NUM	
version	closed loop control for /NUM encoded positioners incl. duty cycle option
positioning controller	ANC350/3/NUM/RT (art. no. 1003063) ANC350/3/NUM/Vac (art. no. 1008439)
upgrade option	ethernet port (activation code) (art. no. 1004201)
ANC350/3/FPS	
version	closed loop control of open loop positioners with attoFPS setup
positioning controller	ANC350/3/FPS/RT (art. no. 1008239) ANC350/3/FPS/Vac (art. no. 1008443)
interferometer setup	FPS1010 (art. no. 1007419) FPS3010 (art. no. 1007418) FPS3010-19" (art. no. 1008535)

Accessories

Microscopy Controllers



Kelvin Probe Force Microscopy Upgrade

Via an optional software upgrade, the ASC500 (Hardware Version v2 or higher) can be used for Kelvin Probe Force Microscopy. The module allows measurements of the surface contact potential difference (CPD) in a dual pass mode: during the first line, the topography signal is recorded, which serves as a reference base line during the data acquisition in the second line, so that topography features are cancelled out.

Article	Art. No.
ASC500 Software Upgrade KPFM	1009977

Closed Loop Scanning

Based on additional hardware (attoFPSensor & suitable microscope housing), most 2" attocube microscopes can be upgraded with closed loop scanning capabilities to correct for piezo-inherent nonlinearities, hysteresis and creep. Contact us for more details on how to upgrade your setup.

Article	Art. No.
Closed loop add-on for attocube microscope	1008634

Accessories

Motion Controllers

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

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 ANC300.

Article	Art. No.
AAC300/1	1001326

Accessories

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.

Article	Art. No.
AAC350/NUM/RT (for closed loop /NUM positioners)	1003806
AAC350/NUM/Vac (for closed loop /NUM positioners)	1003807
AAC350/NUM/STP (for open loop positioners)	1004597
AAC350/RES (for closed loop /RES positioners)	1003814
AAC350/RES/STP (for open loop positioners)	1004596
AAC350/SCN (for scanners)	1003810

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.

Article	Art. No.
attoNAV/100 - SpaceNavigator software upgrade for ECC100	1009915
attoNAV/300 - SpaceNavigator software upgrade for ANC300	1010521
attoNAV/350 - SpaceNavigator software upgrade for ANC350	1010522