High Precision
Industrial Motion Solutions

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Industrial Line

Nanoprecise Positioning at Ambient Temperature

TOP 100
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Industrial Line Positioners

nanoprecise positioning at ambient temperature

ECC100 Motion Controller with goniometers and linear nanopositioners.

With Industrial Line positioners, attocube has genuinely combined highest precision piezodrive technology with extremely rugged, yet cost effective design. All ECS positioners of the Industrial Line are dedicated for operation at ambient temperature and depending on the model for pressures ranging from atmospheric to UHV. The ECS drive series is precisely engineered for today's room temperature applications, where space is frequently constrained while load and torque applied to the positioning units may be significant. This powerful performance is supplemented by the ECC100 drive electronics which enables open and closed loop positioning with 1 nm/1 µ° position resolution[1].

High Loads

Facilitated by their unique piezodrive technology, their stiff mechanical design, and the application of crossed roller bearings, ECS positioners are capable of moving and placing loads of up to several kg on the nanometer scale.

Materials & Life Expectancy

For Industrial Line positioners special emphasis was put on both life endurance and cost effective manufacturing. The room temperature optimized drive mechanism, combined with the choice of aluminum or stainless steel as main body material, enables a significant cost reduction compared to positioners of the Premium Line, while achieving a life span longer than 500,000 cycles[2].

Multi Axis Operation

attocube's ECS positioners are available in a wide variety of designs, sizes, and travel ranges and can be stacked directly on top of each other for multi axis operation.

Closed Loop Control

In conjunction with the three-axis drive electronics ECC100, ECS positioners are capable of a closed loop[1] positioning resolution of 1 nm/1 µ° while providing travel velocities of up to 4.5 mms^{-1} / 10°s^{-1}. A position repeatability of 50 nm / 50 µ° tops off the specifications of the Industrial Line.

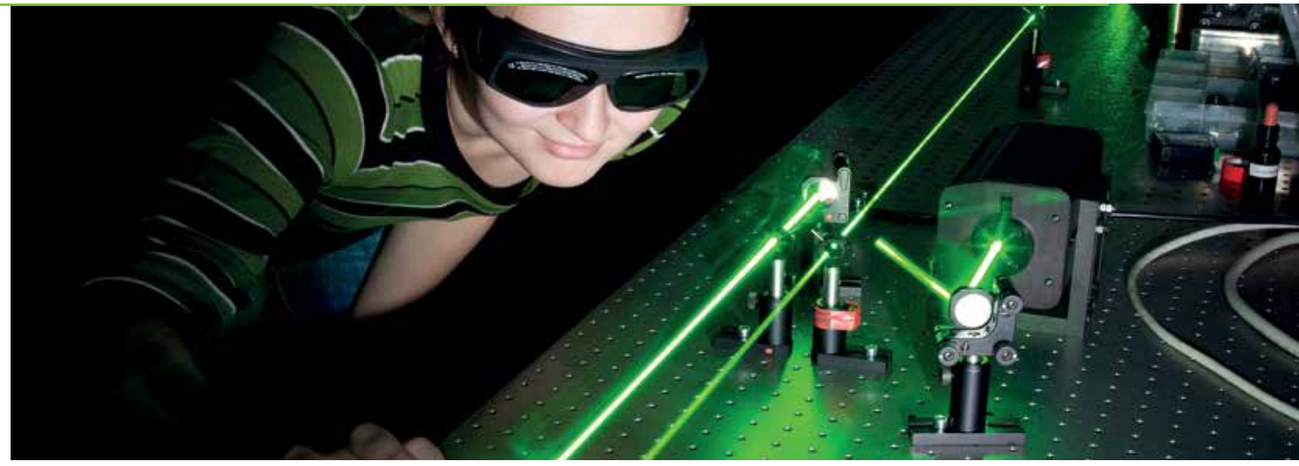
Large Travel Ranges

Positioners of the ECS series take advantage of a drive mechanism based on attocube's patented inertial drive technology, modified specifically for applications at ambient temperature where large travel ranges of several centimeters are mandatory.

Vacuum Compatibility

Positioners of the Industrial Line are dedicated for operation at room temperature and pressures ranging from ultra high vacuum to ambient. All stages are either available in anodized aluminum or stainless steel, satisfying both optical and UHV applications.

1) Position encoders on ECS drives are optionally available. In open loop operation, the smallest physical step size is limited to approx. 50 nm / 0.1 m°. 2) Depending on actual positioner and environment.



The ultimate industrial positioning solution from the leaders in nanopositioning.

For vacuum applications, the ECS positioners are manufactured from stainless steel.

MAIN ADVANTAGES OF THE ECS INDUSTRIAL LINE

- Highest precision motion on the nanometer scale over centimeter travel range, rated for loads up to several kg
- ECC100 drive electronics operating at < 45 V, no need for specific high-voltage shielding (rated for low voltages)
- Optical position encoders with 1 nm/1 µ° resolution, 50 nm/50 µ° repeatability, and < 0.01 % absolute accuracy
- Superior mechanical stiffness and life endurance, combined with cost efficient design
- Made from non-reflective anodized aluminum for optical applications and stainless steel for high/ultra high vacuum environments
- Magnetic quick-exchange sample holder available, e.g. for optical components

Product Quick Finder

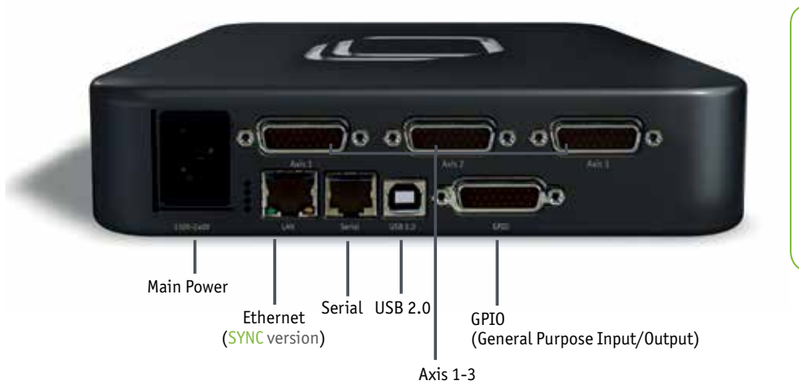
ECS nanopositioners offered by attocube

	Linear Positioners							Goniometers		Rotators		
Product Name	ECS3030	ECS3040	ECS3050	ECS3060	ECS3070	ECS3080	ECS5050	ECGt5050	ECGp5050	ECR3030	ECR4040AP	ECR5050
Pressure Options	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT, /HV, /UHV	/RT	/RT, /HV, /UHV
Encoder Option	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	optoelectronic (/NUM)	/NUM	optoelectronic (/NUM)
Closed Loop Travel Properties Position Resolution Position Repeatability Accuracy	1 nm 50 nm < 0.01% of travel range	1 nm 50 nm < 0.01% of travel range	1 nm 50 nm < 0.01% of travel range	1 nm 50 nm < 0.01% of travel range	1 nm 50 nm < 0.01% of travel range	1 nm 50 nm < 0.01% of travel range	1 nm 50 nm < 0.01% of travel range	1 µ° +/- 50 µ° approx. 1 m°	1 µ° +/- 50 µ° approx. 1 m°	0.01 m° +/- 0.5 m° approx. 2 m°	0.04m° +/-2m° approx. 10m°	0.01 m° +/- 0.5 m° approx. 2 m°
Open Loop Travel Properties Minimum step size Fine positioning range	50 nm 1.6 µm	50 nm 1.6 µm	50 nm 1.6 µm	50 nm 1.6 µm	50 nm 1.6 µm	50 nm 1.6 µm	50 nm 1.6 µm	0.1 m° 1.4 m°	0.1 m° 1.1 m°	0.4 m° 12 m°	0.2m° 6m°	0.2 m° 6 m°
Maximum Drive Velocity[1)]	4.5 mm/s	4.5 mm/s	4.5 mm/s	4.5 mm/s	4.5 mm/s	4.5 mm/s	4.5 mm/s	approx. 3 °/s	approx. 3 °/s	approx. 10°/s	approx. 10°/s	approx. 10°/s
Travel Range[1)]	20 mm	25 mm	30 mm	35 mm	40 mm	50 mm	30 mm	10 °	10 °	360 °	360 °	360 °
Drive Force / Drive Torque @ ambient conditions	1 N	1 N	1 N (5 N optionally)	1N (5 N optionally)	1 N (5 N optionally)	1 N (5 N optionally)	1 N (5 N optionally)	8.7 Ncm (43.5 Ncm optionally)	7 Ncm (35 Ncm optionally)	2 Ncm	2 Ncm	4 Ncm
Maximum Load[2)]	90 N (9 kg)	120 N (12 kg)	150 N (15 kg)	180 N (18 kg)	210 N (21 kg)	240 N (24 kg)	150 N (15 kg)	10 N (1 kg)	10 N (1 kg)	20 N (2 kg)	20 N (2 kg)	20 N (2 kg)
Footprint x Height	30 x 30 x 9.5 mm^3	30 x 40 x 9.5 mm^3	30 x 50 x 9.5 mm^3	30 x 60 x 9.5 mm^3	30 x 70 x 9.5 mm^3	30 x 80 x 9.5 mm^3	50 x 50 x 9.5 mm^3	50 x 50 x 17 mm^3	50 x 50 x 17 mm^3	30 x 30 x 13.5 mm^3	40 x 40 x 14.5 mm^3	50 x 50 x 13.5 mm^3
Maximum Size	30 x 51.6 x 9.5 mm^3	30 x 66.6 x 9.5 mm^3	30 x 81.6 x 9.5 mm^3	30 x 96.6 x 9.5 mm^3	30 x 111.6 x 9.5 mm^3	30 x 131.6 x 9.5 mm^3	50 x 66.6 x 9.5 mm^3	50 x 67.6 x 19.4 mm^3	50 x 69.8 x 19.5 mm^3	30 x 30 x 13.5 mm^3	40 x 40 x 14.5 mm^3	50 x 50 x 13.5 mm^3
Materials	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum stainless steel	aluminum	aluminum stainless steel
Weight aluminum stainless steel	29 g 51 g	39 g 71 g	49 g 90 g	59 g 110 g	69 g 129 g	78 g 147 g	70 g 149 g	137 g 247 g	137 g 247 g	28 g 66 g	54 g	100 g 215 g
Guiding Accuracy Roll Pitch Yaw	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing < 0.1 mrad < 0.1 mrad < 0.1 mrad	Crossed Roller Bearing	Crossed Roller Bearing	Ball Bearing	Ball Bearing	Ball Bearing
1) Valid for both open and closed loop positioners. 2) Maximum drive performance applicable for horizontal mounting only.												

Closed Loop Control of ECS Positioners

providing highest sensor resolution for travel ranges up to the centimeter range

ECC100



PRODUCT KEY FEATURES

> quick and easy handling via plug & play design
> controller drives open and closed loop positioners
> DLL, LabView™ drivers, stand-alone application for Windows available (standard version or upgraded PRO version)
> PC connection via USB 2.0 (all versions) and Ethernet (SYNC version)

Three-axis digital motion controller

The ECC100 is a new generation of motion controller, designed specifically for the operation of positioners of the Industrial Line. The ECC100 consists of a fully digital control unit and an analog amplification circuit, enabling the simultaneous operation of up to three ECS units at any one time. The ECC100 is designed for open and closed loop control of ECS positioners, yielding a position resolution of 1 nm in case of linear positioners and up to 1 µ° in case of goniometric/rotative drive units. The ECC100 is PC-connectable via USB and Ethernet* and is delivered with DLL and LabView™ drivers for higher integration.
The ECC100 operates at low drive voltages below 45 V, compatible with low voltage requirements. The ECC100 is not compatible with positioners of the Premium Line.

*Ethernet optional (SYNC option), see key features

Closed Loop Control

The closed loop functionality takes advantage of measuring the actual location of a positioner using an encoder. The detected position is then compared to a fixed setpoint. Any difference between the two values is compensated by using a feedback loop.

Resolution

All Industrial Line positioners are either available as standard open loop models, or with fully integrated optoelectronic /NUM encoders for closed loop position control.
A stunning resolution of 1nm/1µ° and a position repeatability of 50 nm/50µ°can be achieved in combination with the dedicated piezo controller ECC100. More detailed information on the definition of „sensor resolution“ or „repeatability“ can be found in the glossary.

Glossary

precision and control

SENSOR RESOLUTION

The term sensor resolution or sensitivity indicates the smallest quantity detectable by a sensor. If the sensitivity is not fundamentally limited due to mechanical properties such as friction, the sensitivity is almost always bandwidth dependent. attocube specifies the resolution of optoelectronic (/NUM) sensors at a measurement bandwidth of 1 kHz.

SENSOR ACCURACY

The term sensor accuracy represents the absolute deviation of any measurement from a calibrated, metrologically traceable standard. The best accuracy is often obtained by interferometric sensors, facilitating well-known laser lines from thermally stabilized single mode gas lasers. Sensor accuracy does not necessarily relate to sensor sensitivity and repeatability, i.e. a sensor may provide a very high sensitivity and repeatability, yet lack a high accuracy.

SENSOR REPEATABILITY

The sensor repeatability represents the maximum (position) error when repeatably approaching a certain sensor value. At attocube, the sensor repeatability is measured in conjunction with an actual positioner,i.e. parameters such as minimum step size, thermal expansion, and resolution all contribute to the sensor repeatability. The repeatability for each closed loop positioner is determined by the value of the standard deviation (σ).

GUIDING ACCURACY

The guiding accuracy describes the deviation of the motion of a positioner from a purely linear behavior in terms of roll, θ_x, pitch, θ_y, and yaw, θ_z. Vertical and horizontal runouts are frequently also considered when referring to the term guiding accuracy. In real life, position sensors detect the motion of a positioner but do not provide real-time information on the guiding accuracy .

MINIMUM POSITIONER STEP SIZE

The minimum step size of a positioner is defined as the smallest repeatable motion which the positioner can achieve in coarse positioning mode. This parameter includes the positioner backlash.

OPEN LOOP POSITION CONTROL

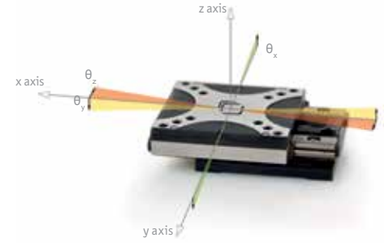
The open loop functionality of a positioner does not take advantage of a feedback loop in order to determine and control the actual position of a positioner. Depending on the number (frequency) of steps and the adjusted step size (voltage), a rough estimate of the actual position after any motion task can be deduced.

CLOSED LOOP POSITION CONTROL

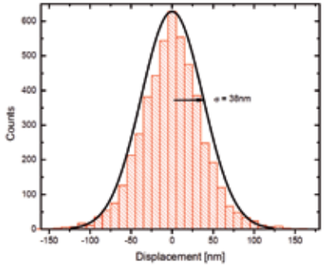
The closed loop functionality takes advantage of measuring the actual position of a positioner using an encoder. This position is then compared to a setpoint, where any difference between the two values is compensated for using a feedback loop. For attocube positioners equipped with an encoder, positioning setpoints can either be set in a software interface or on the front panel of the closed loop electronics (depending on type).

OPTOELECTRONIC POSITION SENSOR

This optoelectronic (/NUM) readout allows fully automated, closed-loop positioning operation with high resolution, compatible with ambient conditions, ultra high vacuum, and magnetic fields up to 7 T. It delivers a relative position to a reference with a sensor resolution of 10 nm and a repeatability of ± 50 nm. /NUM sensors are full integrated into the piezo stepper device.



Industrial Line positioners provide the highest guiding accuracy due to crossed roller bearings.



The figure above shows the histogram of the bidirectional repeatability measurements for a closed loop positioner with an optoelectronic encoder (/NUM).