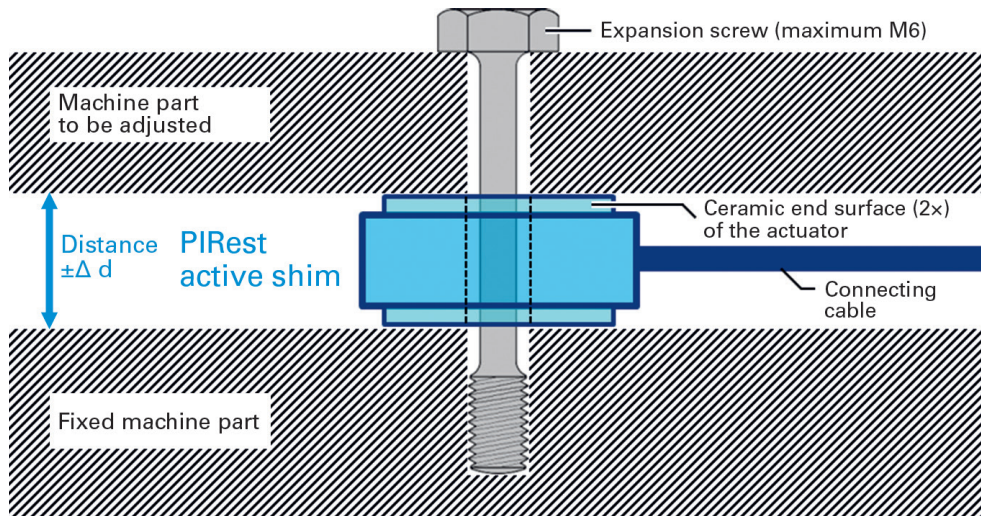


# PIRest Actuators

ACTIVE SHIMS WITH LONG-TERM STABILITY  
AND NANOMETER RESOLUTION

# PIRest Technology



Using PIRest active shims

## COMPLETELY NEW PIEZO TECHNOLOGY FOR ACTIVE ADJUSTMENT OF CONSISTENTLY STABLE GAPS

When a target or actual gap between two components in a machine changes, it may be necessary to adjust it.

The disadvantage of classical flat washers that are ground exactly to the required gap, is that they need to be inserted mechanically. It is not always possible to adjust them as finely as required and the predefined gap cannot be changed any more.

This is different in the case of the piezo-based PIRest active shims, which only need to be inserted once and can actively adjust or readjust the gap between two components.

Conventional piezoceramic actuators were not suitable for this purpose. The electrical voltage (offset voltage) at the actuator needs to be maintained as long as the displacement is required – a considerable disadvantage for the lifetime of the actuator and the equipment of the machine, which also requires an additional and stable power supply.

Although the PIRest technology is based on piezo actuators, it nevertheless maintains a stable displacement with nanometer accuracy after adjusting even without offset voltage.

## EASY TO USE

The active shims are already designed into the machine during the initial construction. They can be made in virtually any shape and size and integrated almost anywhere – as plates or rings or even complex hybrid drive components that actively compensate vibration beyond static adjustment or perform other motion with nanometer accuracy.

To readjust the static gap, a voltage connection is provided for the active shim, which only needs to be connected to a voltage source for the respective adjusting process. PI offers a mobile power supply for this adjusting process that makes setting very easy.

This considerably simplifies adjustment at inaccessible places because any cables required can be considered during the design of the machine and therefore routed permanently in the system.

## LONG-TERM STABILITY

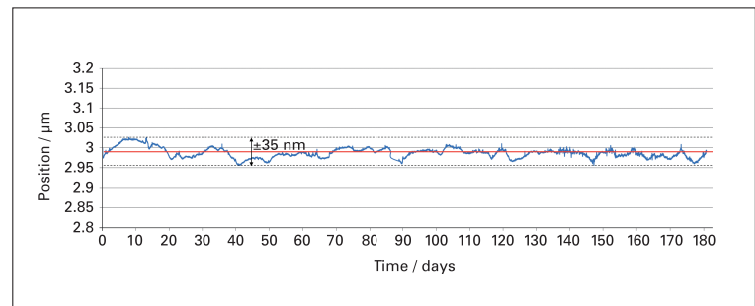
Tests at PI have demonstrated that the stability of the displacement of PIRest actuators depends only on changes in the ambient temperature. Using an actuator with 5  $\mu\text{m}$  nominal adjustment range, long-term tests indicated a position drift of less than  $\pm 35$  nm in a temperature-stable environment that does not deviate by more than 1 K.

## NANOMETER RESOLUTION

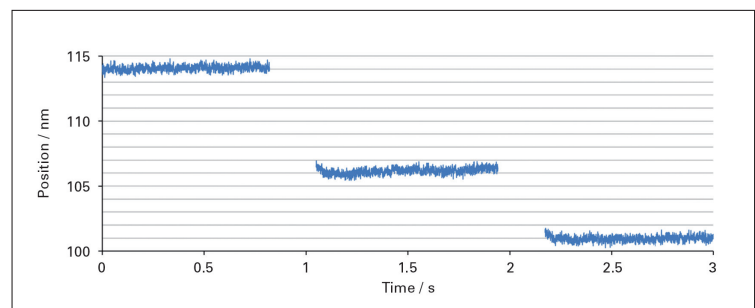
The system, consisting of a PIRest actuator and a manual control device, can generate changes in length of a few nanometers irrespective of the load.

### The advantages of PIRest at a glance

- No permanent voltage required to hold the position. Saves costs during initial installation and makes adjustment much easier
- Flexible shapes and functions. The manufacturing process for PIRest actuators is largely identical to classical piezoceramic actuators, which PI can already produce in large quantities, and is also in a position to shape them according to customer specifications.
- Actuator lifetime of >20 years assuming an average of 3 adjusting procedures daily
- Travel ranges up to 10  $\mu\text{m}$  as standard product (longer travel ranges possible with custom products)
- Nanometer resolution, micrometer displacement. PIRest have the same classical properties as piezoceramic actuators.
- Long-term position stability
- Easy adjustment of the displacement, e.g., with a handheld device
- Hybrid actuators with the capability of adjusting over several millimeters or compensating vibration dynamically
- One to six-axis versions are possible. Optional temperature sensor for the actuator



Position stability of the P-131.12 PIRest active shim over 180 days,  $\pm 35$  nm



PIRest precision positioning: Length changes in the range of only a few nanometers

# Applications

Applications for active shims can be found everywhere, where the gap between two assemblies is critical and needs to be readjusted as a result of drifting or changes in tolerance. Particularly when the ambient conditions and the accessibility make manual intervention complicated, PIReSt actuators are a feasible option

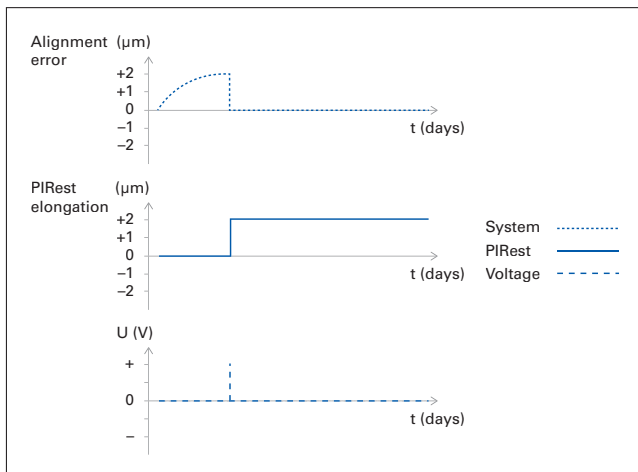
- For qualification and calibration of a machine
- During first installation of machines at the customer's location

- Realignment as a consequence of temperature drift
- During realigning due to changed dimensions of components, for example

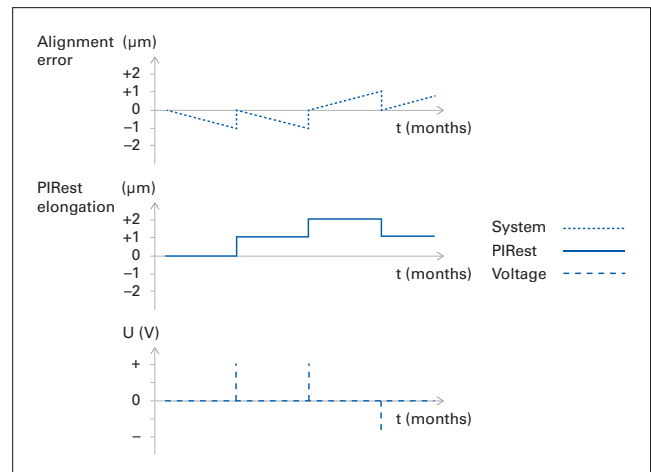
Due to the actuator's high resolution of only a few nanometers, not only those applications in classical mechanical engineering are included, but also alignment of optical components in astronomy, or material research in synchrotrons, and in semiconductor manufacturing for example.

PIReSt actuators can be used to compensate misalignment caused by settling after the initial setup of a machine at the customer's location.

PIReSt actuators can be used to compensate mechanical drift during operation of a precision machine.



Compensation of settling after the initial setup of a machine



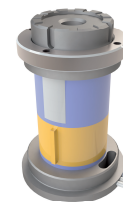
Compensation of machine drift during operation

## Flexibility due to hybrid actuators

Hybrid actuators consist of a classical and a PIReSt piezo actuator. While the PIReSt actuator part corrects the position permanently as described, it is possible to use this as a basis for performing dynamic motion via the classical actuator. This can be helpful for dynamic compensation of vibration in a range of several 10 Hz or for readjusting a focal plane during a measuring or scanning process, or for controlling a laser beam in measuring technology or material processing.



**Hybrid PIReSt actuator**  
available as custom product



**PIReSt active shim (blue)**  
Adjustment range: 4.6 µm  
**PICMA® actuator (yellow)**  
Adjustment range: 5 µm  
Resolution: <50 µm

# P-131 PIRest Actuators

Active Shims with Nanometer Resolution and Long-Term Stability



- Long-term stability without permanent power supply
- Easy readjustment of machines at inaccessible locations
- Avoids time-consuming manual adjusting processes
- Nanometer resolution and micrometer displacement
- Load capacity up to 4000 N per actuator
- Temperature sensor

#### Fields of application

- Set-and-forget applications
- Adaptive mechanics
- Drift compensation
- Alignment of optical components
- Precision mechanics
- Static precision positioning
- Metrology / interferometry

#### Long-term stable positioning without permanent power supply

Once displaced, actuators with PIRest technology hold their position stable without permanent control voltage. Nanometer precision, maintenance-friendly and inexpensive adjustments are possible even at inaccessible locations.

#### High user-friendliness due to automatic configuration

Important operating parameters are stored on the mechanic's ID chip and are read out automatically when the electronics are switched on.



# Ordering Information

## **PIRest active shims**

- P-131.11**      PIRest active shim, 2  $\mu\text{m}$  travel range
- P-131.12**      PIRest active shim, 5  $\mu\text{m}$  travel range
- P-131.13**      PIRest active shim, 10  $\mu\text{m}$  travel range

## **Accessories**

- E-815.AK200**   PIRest adapter cable, 2 channels, 2  $\times$  HD D-sub 15 (f) to HD D-sub 15 (m), 0.5 m
- E-815.AK300**   PIRest adapter cable, 3 channels, 3  $\times$  HD D-sub 15 (f) to HD D-sub 15 (m), 0.5 m
- E-815.AK600**   PIRest adapter cable set, 6 channels, consisting of 2  $\times$  E-815.AK300  
(channels 1 to 3 and channels 4 to 6)

# E-135 PIRest Drive Electronics

## Control of up to 6 PIRest Active Shims



- Easy readjustment of machines at inaccessible locations
- Control of up to 6 PIRest active shims
- Independent adaptation of operating parameters to the ambient conditions
- ID chip detection for automatic configuration of operating parameters
- Interfaces: TCP/IP, USB

### Long-term stable positioning with PIRest active shims

The PIRest drive electronics are only necessary during the adjustment process of the PIRest compensating actuators. Once displaced, actuators with PIRest technology hold their position stable without permanent control voltage. Nanometer precision, maintenance-friendly and inexpensive adjustments are possible even at inaccessible locations. Up to 6 actuators can be connected and adjusted one after each other.

### High user-friendliness due to automatic configuration

Important operating parameters are stored on the mechanic's ID chip and are read out automatically when the electronics are switched on. The operating parameters are adapted to the ambient conditions independently during the adjusting procedure.

### Easy integration and handling

All PIRest active shims are equipped with a D-sub connector. The cable for connecting to the drive electronics is available in several variants and must therefore be ordered separately. A PC controls the drive electronics via an Ethernet or USB interface. Software support is included in the scope of delivery.

### Application fields

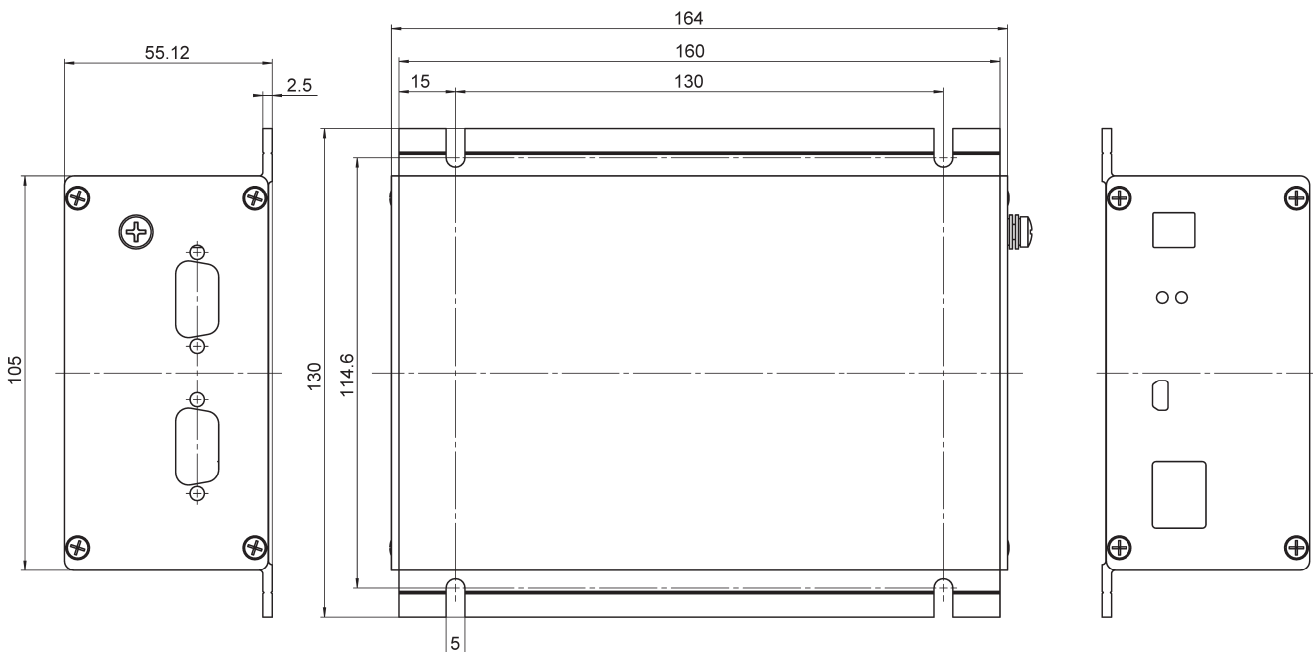
- Set-and-forget applications
- Adaptive mechanics
- Drift compensation
- Adjustment of optical components
- Precision mechanics
- Static precision positioning
- Metrology and interferometry



<b>E-135.601M</b>	
Function	Drive electronics for PIRest active shims
Channels	6; individual control one after another
<b>Output signal</b>	
Output voltage	-100 to 125 V
Max. output current	500 mA
Current limitation	Short-circuit proof
<b>Interfaces</b>	
Actuator connection	HD D-sub 15 (f)
Communication	TCP/IP, USB
Separate protective earth connection	Yes
Display and indicators	LEDs for Power, Error
<b>Operation</b>	
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / Python, drivers for NI LabVIEW
Supported functions	ID chip detection, temperature evaluation
<b>Miscellaneous</b>	
Operating temperature range	5 °C to 40 °C
Operating voltage	24 V DC (external power adapter in the scope of delivery)
Max. power consumption	17 W
Mass	0.7 kg

Ask about customized versions.

E-135.601M: Dimensions in mm



# Ordering Information

## **PIRest drive electronics**

**E-135.601M** PIRest drive electronics for up to 6 actuators, HD D-sub 15 sockets, TCP/IP and USB interface

## **Accessories**

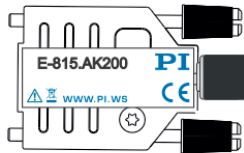
**E-815.AK200** PIRest adapter cable, 2 channels, 2 × HD D-sub 15 (f) to HD D-sub 15 (m), 0.5 m

**E-815.AK300** PIRest adapter cable, 3 channels, 3 × HD D-sub 15 (f) to HD D-sub 15 (m), 0.5 m

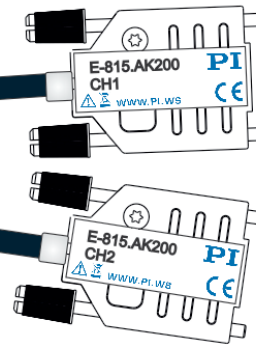
**E-815.AK600** PIRest adapter cable set, 6 channels, consisting of 2 × E-815.AK300 (channels 1 to 3 and channels 4 to 6)

E-815.AK200: PIRest adapter cable, 2 channels, 0.5 m

HD D-sub 15 (m)

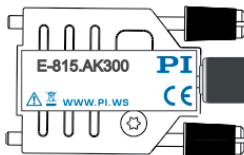


2 × HD D-sub 15 (f)

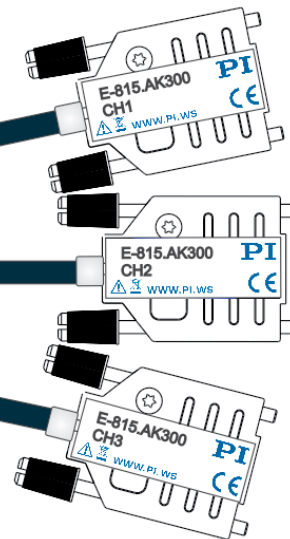


E-815.AK300: PIRest adapter cable, 3 channels, 0.5 m

HD D-sub 15 (m)



3 × HD D-sub 15 (f)





## Headquarters

### GERMANY

**Physik Instrumente (PI) GmbH & Co. KG**  
 Auf der Roemerstrasse 1  
 76228 Karlsruhe  
 Phone +49 721 4846-0  
 Fax +49 721 4846-1019  
 info@pi.ws  
 www.pi.ws

### PI miCos GmbH

Freiburger Strasse 30  
 79427 Eschbach  
 Phone +49 7634 5057-0  
 Fax +49 7634 5057-99  
 info@pimicos.com  
 www.pi.ws

### PI Ceramic GmbH

Lindenstrasse  
 07589 Lederhose  
 Phone +49 36604 882-0  
 Fax +49 36604 882-4109  
 info@piceramic.com  
 www.piceramic.com

## ACS Motion Control

### ISRAEL

**ACS Motion Control Ltd.**  
 Ramat Gabriel Industrial Park  
 1 Hataasia St.  
 Migdal HaEmek, 2307037  
 POB 984  
 Phone +972-4-6546440  
 Fax +972-4-6546443  
 info@acsmotioncontrol.com  
 www.acsmotioncontrol.com



## PI Subsidiaries

### USA (East) & CANADA

**PI (Physik Instrumente) L.P.**  
 Auburn, MA 01501  
 www.pi-usa.us

### USA (San Francisco Bay Area)

**PI (Physik Instrumente) L.P.**  
 Sausalito, CA 94965  
 www.pi-usa.us

### ITALY

**Physik Instrumente (PI) S. r. l.**  
 Bresso  
 www.pionline.it

### FRANCE

**PI France SAS**  
 Aix-en-Provence  
 www.pi.ws

### JAPAN

**PI Japan Co., Ltd.**  
 Tokyo  
 www.pi-japan.jp

### CHINA

**Physik Instrumente (PI Shanghai) Co., Ltd.**  
 Shanghai  
 www.pi-china.cn

### SOUTHEAST ASIA

**PI (Physik Instrumente) Singapore LLP**  
 Singapore  
 www.pi-singapore.sg  
 For ID / MY / PH / SG / TH / VNM

### KOREA

**PI Korea Ltd.**  
 Seoul  
 www.pikorea.co.kr

### USA (West) & MEXICO

**PI (Physik Instrumente) L.P.**  
 Irvine, CA 92620  
 www.pi-usa.us

### UK & IRELAND

**PI (Physik Instrumente) Ltd.**  
 Cranfield, Bedford  
 www.physikinstrumente.co.uk

### NETHERLANDS

**PI Benelux B.V.**  
 Sint-Oedenrode  
 www.pi.ws/benelux

### SPAIN

**Micos Iberia S.L.**  
 Vilanova i la Geltrú  
 www.pimicos.es

**PI Japan Co., Ltd.**  
 Osaka  
 www.pi-japan.jp

**Physik Instrumente (PI Shanghai) Co., Ltd.**  
 Beijing  
 www.pi-china.cn

### TAIWAN

**Physik Instrumente (PI) Taiwan Ltd.**  
 Taipei  
 www.pi-taiwan.com.tw

© Physik Instrumente (PI) GmbH & Co. KG

All contents, including texts, graphics, data etc., as well as their layout, are subject to copyright and other protective laws. Any copying, modification or redistribution in whole or in parts is subject to a written permission of PI.

Although the information in this document has been compiled with the greatest care, errors cannot be ruled out completely. Therefore, we cannot guarantee for the information being complete, correct and up to date. Illustrations may differ from the original and are not binding. PI reserves the right to supplement or change the information provided without prior notice.

Follow us on:

