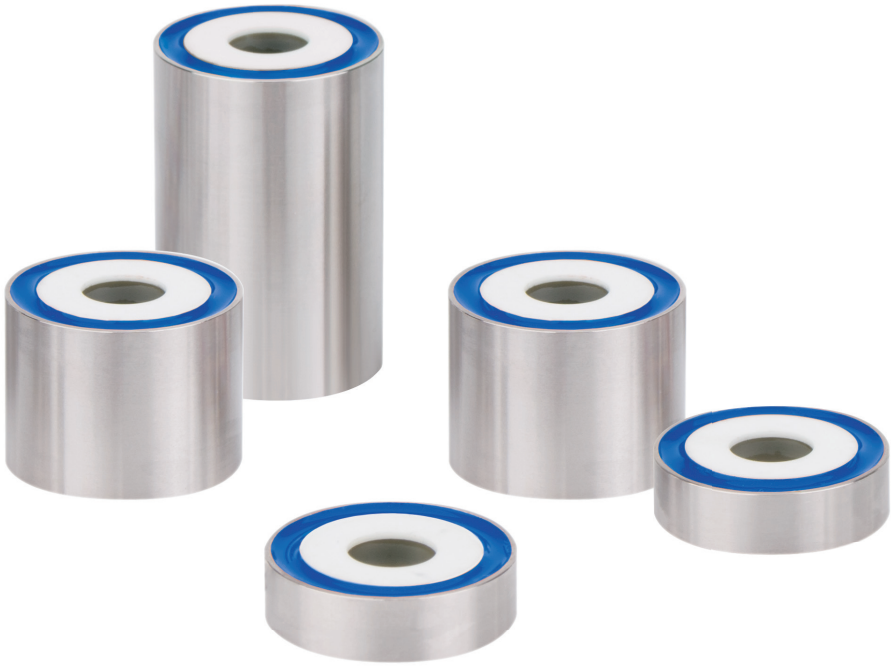
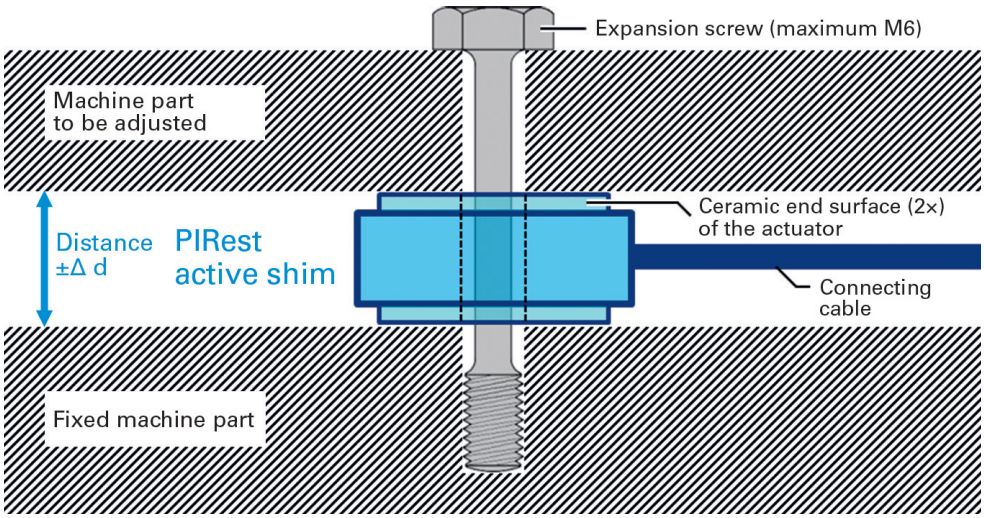


# PIRest Actuators

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.

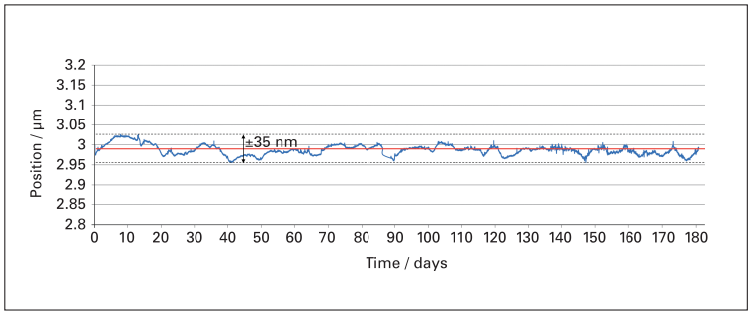
This considerably simplifies adjustment at inaccessible places because any cables required can be considered during the design of the machine and therefore routed permanently in the system.

**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 µm 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

## LONG-TERM STABILITY

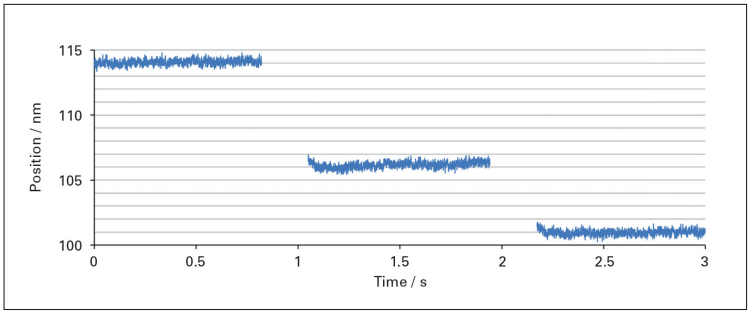
Tests at PI have demonstrated that the stability of the displacement of PIRest actuators depends only on changes in the ambient temperature. Using an actuator with 5 µm nominal adjustment range, long-term tests indicated a position drift of less than ±35 nm in a temperature-stable environment that does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




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

## 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.




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

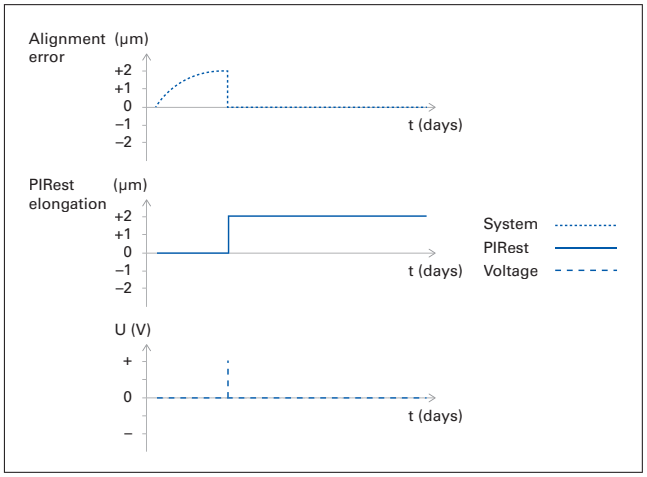
# Applications

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

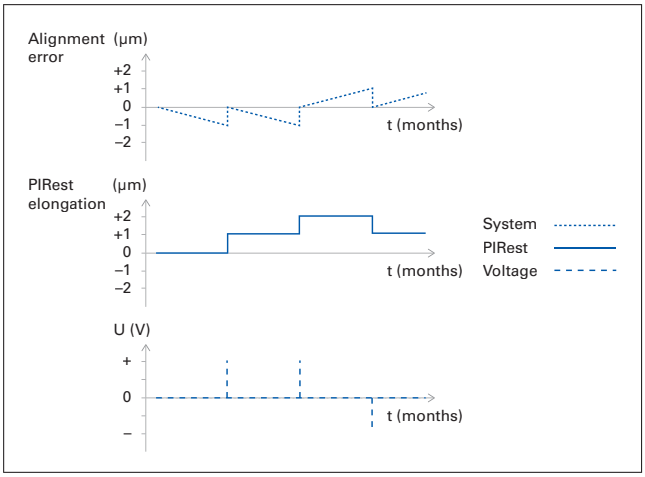
Due to the actuator's high resolution of only a few nanometers, not only those applications in classical mechanical engineering are included, but also alignment of optical components in astronomy, or material research in synchrotrons, and in semiconductor manufacturing for example.

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




Compensation of settling after the initial setup of a machine

PIRest actuators can be used to compensate mechanical drift during operation of a precision 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 pm

# 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.

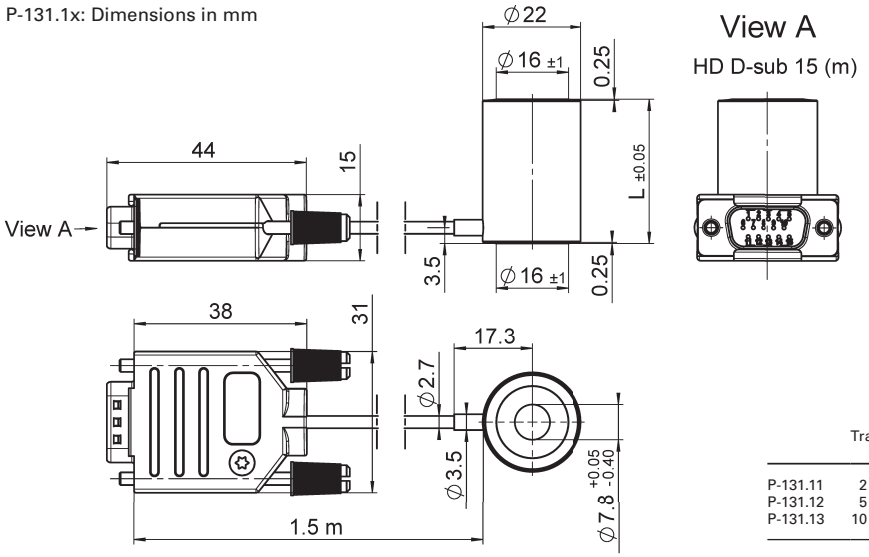
**High user-friendliness due to automatic configuration**

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

| | P-131.11 | P-131.12 | P-131.13 | Unit | Tolerance |
|---|---|---|---|---|---|
| Dimensions OD × ID × L | 22 × 8 × 7 | 22 × 8 × 17 | 22 × 8 × 32 | mm | |
| Nominal travel range* | 2 | 5 | 10 | µm | ±20 % |
| Min. incremental motion* | <10 | <10 | <10 | nm | |
| Load capacity | 4000 | 4000 | 4000 | N | max. |
| Stiffness | 1000 | 350 | 170 | N/µm | typ. |
| Electrical capacitance | 3.4 | 10.2 | 20.4 | µF | ±20 % |
| **PIRest operating modes** | | | | | |
| Operating point for active adjustment | 120 | 120 | 120 | V | max. |
| Operating point a for long-term stable position | 0 | 0 | 0 | V | |
| **Miscellaneous** | | | | | |
| Cable length | 1.5 | 1.5 | 1.5 | m | |
| Voltage connection | HD D-sub 15 (m) | HD D-sub 15 (m) | HD D-sub 15 (m) | | |
| ID chip | Yes | Yes | Yes | | |
| Temperature sensor | Yes | Yes | Yes | | |
| Operating temperature range | 5 to 40 | 5 to 40 | 5 to 40 | °C | |
| Recommended electronics | E-135 | E-135 | E-135 | | |
| | | | | | |

* At room temperature
Vacuum versions available on request.
Ask about customized versions.

P-131.1x: Dimensions in mm




| | Travel range | L |
|---|---|---|
| P-131.11 | 2 µm | 7 mm |
| P-131.12 | 5 µm | 17 mm |
| P-131.13 | 10 µm | 32 mm |

# Ordering Information

**PIRest active shims**

| | |
|---|---|
| **P-131.11** | PIRest active shim, 2 µm travel range |
| **P-131.12** | PIRest active shim, 5 µm travel range |
| **P-131.13** | PIRest active shim, 10 µm travel range |

**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-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 und 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.

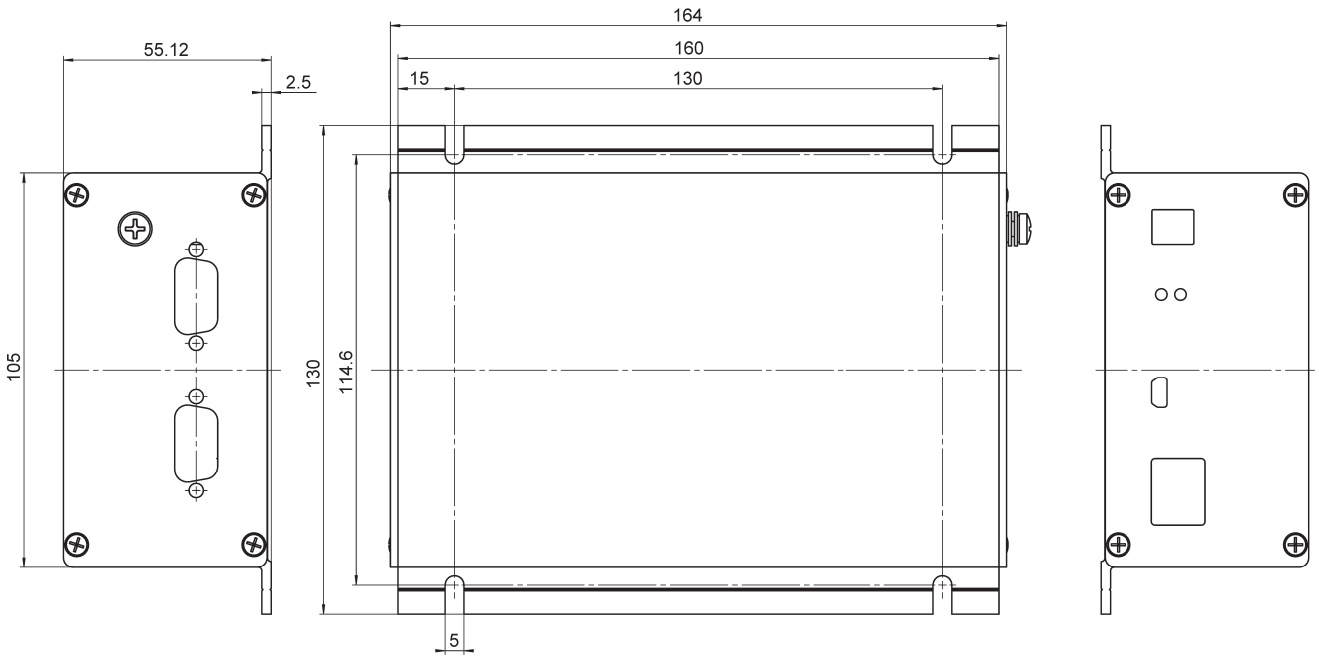
**Application fields**

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

| | E-135.601M |
|---|---|
| Function | Drive electronics for PIRest active shims |
| Channels | 6; individual control one after another |
| **Output signal** | |
| Output voltage | –100 to 125 V |
| Max. output current | 500 mA |
| Current limitation | Short-circuit proof |
| **Interfaces** | |
| Actuator connection | HD D-sub 15 (f) |
| Communication | TCP/IP, USB |
| Separate protective earth connection | Yes |
| Display and indicators | LEDs for Power, Error |
| **Operation** | |
| 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 |
| **Miscellaneous** | |
| 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

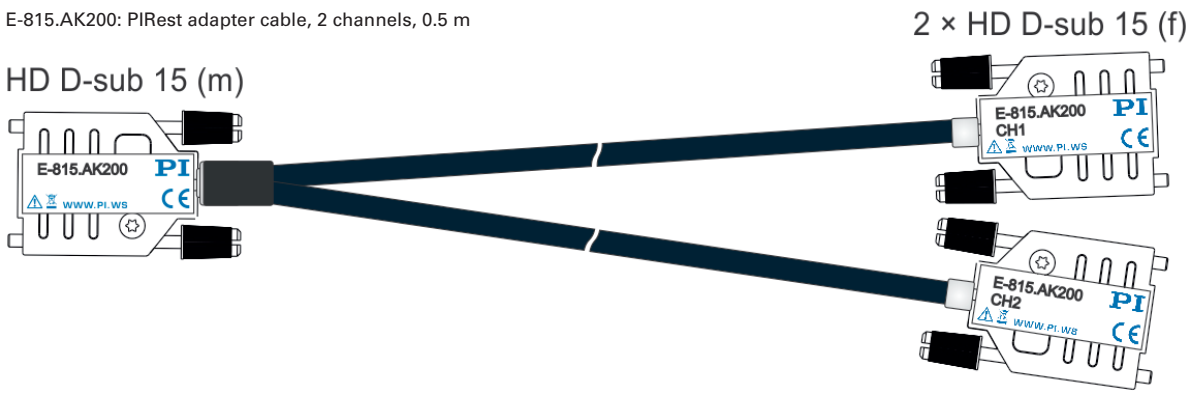
**Accessories**

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

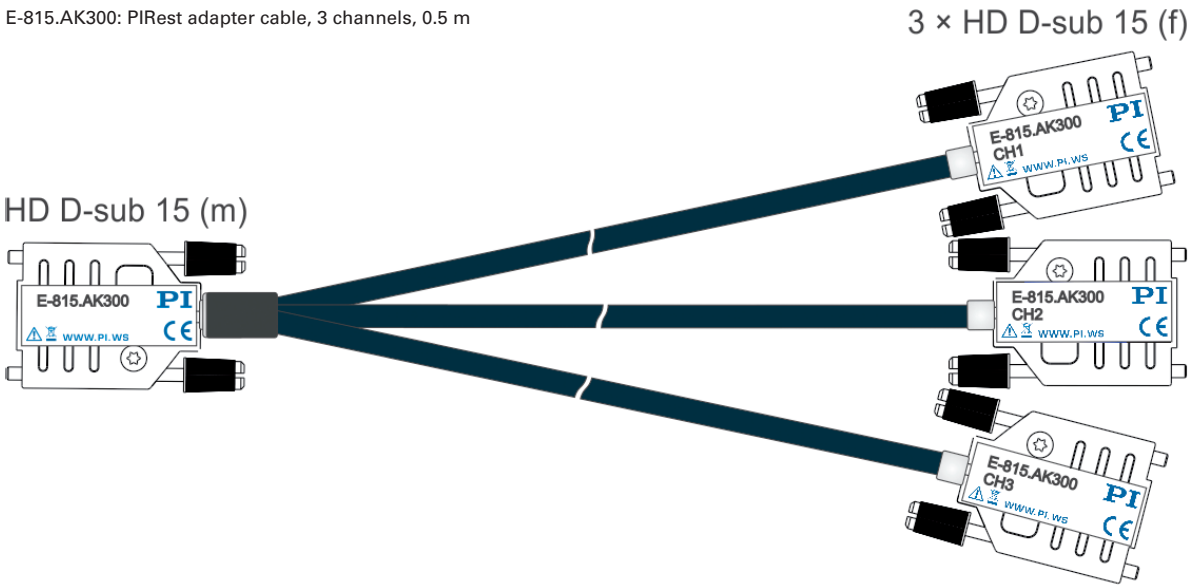
**E-815.AK300** PIRest adapter cable, 3 channels, 3 × HD D-sub 15 (f) to HD D-sub 15 (m), 0.5 m

**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




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



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