User Manual

PZ290E, valid for E-135.601M

BRo, 7/7/2020

E-135 PIRest Drive Electronics

For P-131 PIRest Active Shims

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Contents

About this Document

Designations

The designations "PIRest Active Shim", "PIRest actuator" and "actuator" are used synonymously in this document.

The designations "axis" and "channel" are used synonymously in this document; for more information, see p. 9.

Symbols and Typographic Conventions

CAUTION

Dangerous situation

If not avoided, the dangerous situation will result in minor injury.

➢ Measures for avoiding the risk.

NOTICE

Dangerous situation

If not avoided, the dangerous situation will result in damage to equipment.

➢ Measures for avoiding the risk.

INFORMATION

Information for easier handling, tricks, tips, etc.

The following symbols and typographic conventions are used in the user manuals of PI:

Symbol	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant
▪	Lists
p. 5	Cross-reference to page 5

Symbol	Meaning
`SVO?`	Command line or a command from PI's General Command Set (GCS) (example: command to get the servo mode).
RS-232	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning signs affixed to the product that refer to detailed information in this manual.
Device S/N	Parameter name (example: parameter where the serial number is stored)
Start > Settings	Menu path in the PC software (example: to open the menu, the Start and Settings buttons must be clicked successively)
5	Value that must be entered or selected via the PC software

Other Applicable Documents

Manuals for PIRest actuators:

Document number	Document type	Product
PZ291EN	User Manual	P-131.11 PIRest Active Shim
PZ292EN	User Manual	P-131.12 PIRest Active Shim
PZ293EN	User Manual	P-131.13 PIRest Active Shim

Documentation for the available PC software:

Description	Document
GCS Data	SM146E Software Manual
GCS Driver Set for use with NI LabVIEW software	SM158E Software Manual
Merge Tool for use with driver sets for NI LabVIEW software	SM154E Software Manual
PI GCS 2 DLL	SM151E Software Manual
PI MATLAB Driver GCS 2.0	SM155E Software Manual
PIMikroMove	SM148E Software Manual
PI Update Finder	A000T0028 User Manual

The latest versions of the user manuals are available for download (p. 6) on our website.

Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service department (p. 30).

Downloading manuals

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., P-882) or the product family (e.g., PICMA® bender).
3. Click the corresponding product to open the product detail page.
4. Click ***Downloads***.

   The manuals are shown under ***Documentation***.
5. Click the desired manual and fill out the inquiry form.

   The download link will then be sent to the email address entered.

Safety

Intended Use

The E-135.601M drive electronics are laboratory devices according to DIN EN 61010-1. They are intended for indoor use and use in an environment that is free of dirt, oil, and lubricants.

According to their design, the E-135.601M drive electronics are intended for operating P-131 PIRest actuators. PIRest actuators are to be used as electrically adjustable shims for compensating drift or tolerances.

The E-135.601M drive electronics are not intended for applications in areas where failure would result in considerable risks for human beings or the environment.

The E-135.601M drive electronics may not be used for purposes other than those stated in this user manual.

The E-135.601M drive electronics may only be used in compliance with the technical specifications and instructions in this user manual. The operator is responsible for process validation.

General Safety Instructions

The E-135.601M drive electronics are built according to state-of-the-art technology and recognized safety standards. Improper use of the E-135.601M may result in personal injury and/or damage to the E-135.601M itself.

- Only use the E-135.601M for its intended purpose, and only use it if it is in perfect condition.
- Read the user manual.
- Eliminate any faults and malfunctions that are likely to affect safety immediately.

The operator is responsible for correct installation and operation of the E-135.601M.

Organizational Measures

User manual

- Always keep this user manual available when using the E-135.601M.
  The latest versions of the user manuals are available on our website (p. 6) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the E-135.601M to a third party, also include this user manual as well as all other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- Only install and operate the E-135.601M after you have read and understood this user manual.

Personnel qualification

The E-135.601M may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

Product Description

Scope of Delivery

Product number	Description
E-135.601M	PIRest drive electronics for up to 6 actuators, HD Sub-D 15 sockets, TCP/IP and USB interface
C-501.24050H	Power adapter 24 V, 50 W incl. power cord (#3763)
000036360	USB cable
E-135.CD	CD with software and user manuals for the E-135.601M
PZ290E	User manual for E-135.601M, this document

Accessories

Product number	Description
E-815.AK200	PIRest adapter cable, 2 chan., 2 × HD Sub-D 15 (f) to HD Sub-D 15 (m), 0.5 m
E-815.AK300	PIRest adapter cable, 3 chan., 3 × HD Sub-D 15 (f) to HD Sub-D 15 (m), 0.5 m
E-815.AK600	PIRest adapter cable set, 6 chan., consisting of 2 × E-815.AK300 (channels 1 to 3 and channels 4 to 6)

Product View

Figure 1: E-135.601M front panel

Labeling	Type	Function
24 VDC	Barrel connector socket (input)	Connector for the supply voltage
STA	LED green	State: ▪ Lights up continously: E-135.601M is ready for normal operation ▪ Flashing: E-135.601M is in firmware update mode ▪ Off: E-135.601M reads the ID-chips or is not connected to the supply voltage
ERR	LED red	Error indicator: ▪ Lights up continuously: Error ▪ Flashing: E-135.601M reads the ID-chips ▪ Off: No error
	Mini-USB type B	Universal serial bus for connection to the PC
	RJ45 socket	Network connection via TCP/IP

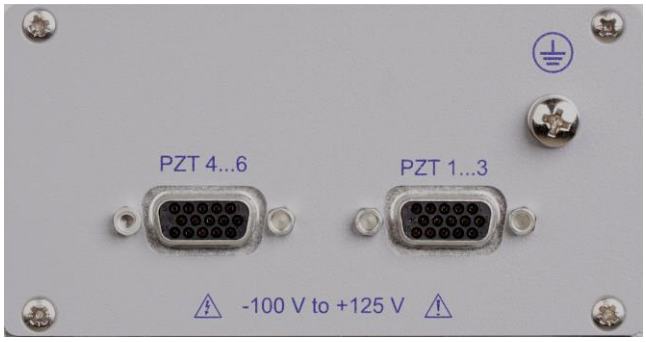


Figure 2: E-135.601M rear panel

Labeling	Type	Function
PZT 1…3 **PZT 4…6** **-100 V to +125 V**	HD D-Sub 15 (f) (p. 49)	Connector for each of three actuators via adapter cable. PIRest active shims only! ▪ Piezo voltage ▪ Data line
	Threaded bolt with mounting hardware for protective earth conductor	Protective earth connection (p. 15) The threaded bolt must be connected to a protective earth conductor because the E-135.601M is not grounded via the power adapter connector.

Axes and Channels

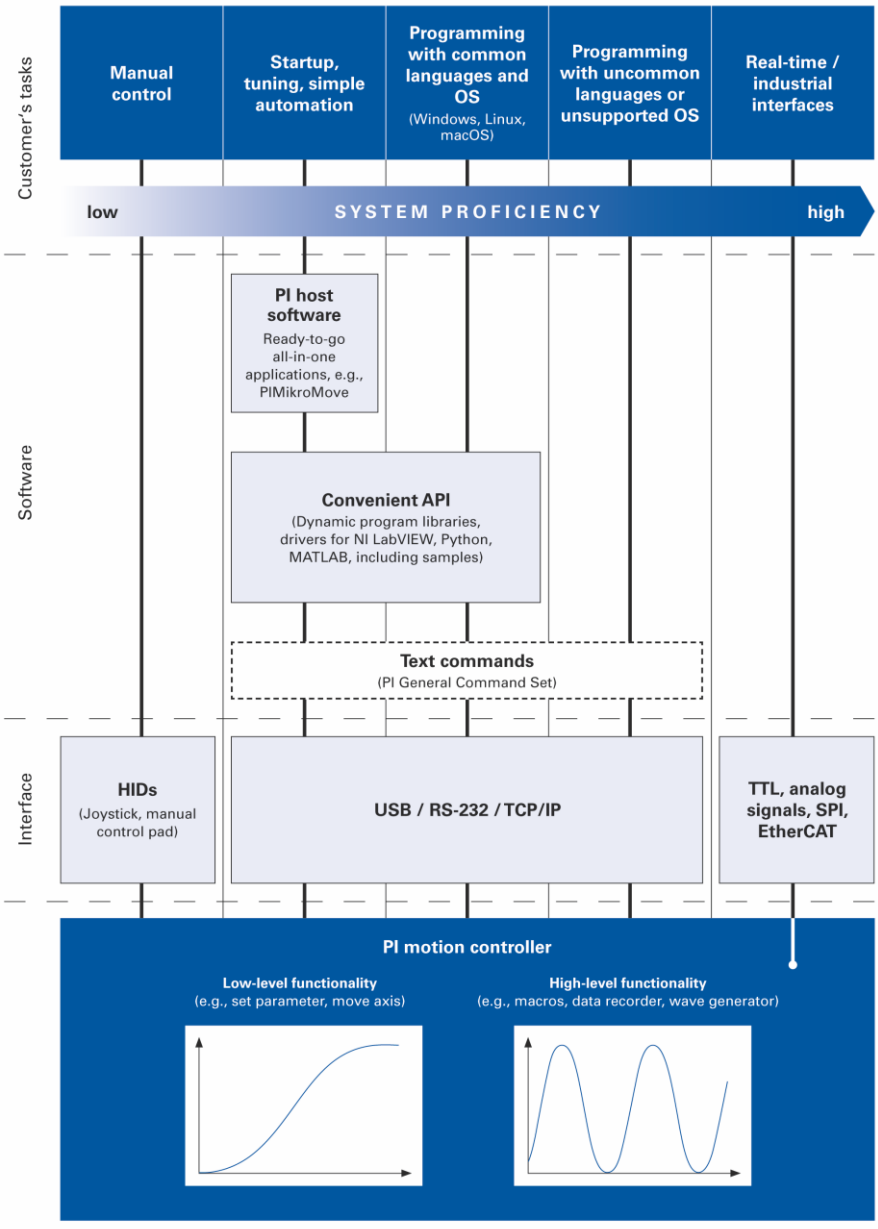
The designations “axes” and “channels” are used synonymously for the actuators in the firmware (commands, parameters; p. 31), software (p. 10) and documentation.

Up to six PIRest actuators can be adjusted with the E-135.601M drive electronics.

- The identifiers of actuators/axes/channels are 1 to 6, e.g., when accessed with the commands of the PI General Command Set (GCS).
- The individual actuators are always adjusted **one after another**. The drive electronics will prevent adjustment of any of the other actuators while an actuator is being adjusted.
- Several actuators can be assigned to a common direction of motion ("Axis") in the ***Coupled Movements*** window of PIMikroMove (p. 24).

Overview of PC Software

Basically, PI systems can be controlled as follows:



The following table shows the PC software that is included in the installation medium supplied with the product. The given operating systems stand for the following versions:

- Windows: Versions 8.1, 10 (32-bit, 64-bit)
- Linux: Kernel 2.6, GTK 2.0, from glibc 2.15

PC software	Operating system	Short description	Recommended use
Dynamic program library for GCS	Windows, Linux	Allows software programming for the E-135.601M with programming languages such as e. g. C++. The functions in the dynamic program library are based on the PI General Command Set (GCS).	For users who would like to use a dynamic program library for their application. Is required for PIMikroMove. Is required for the drivers for NI LabVIEW software.
Drivers for use with NI LabVIEW software	Windows	NI LabVIEW is a software for data acquisition and process control (must be ordered separately from National Instruments). The driver library is a collection of virtual instrument drivers for PI electronics The drivers support the PI General Command Set.	For users who want to use NI LabVIEW to program their application.
Merge Tool for use with drivers for NI LabVIEW software	Windows	The Merge Tool allows you to combine product-specific drivers from PI with each other.	For users who want to operate several products from PI at the same time while using NI LabVIEW.
MATLAB drivers	Windows	MATLAB is a development environment and programming language for numerical calculations (must be ordered separately from MathWorks). The PI MATLAB driver consists of a MATLAB class that can be included in any MATLAB script. This class supports the PI General Command Set. The PI MATLAB driver does not require any additional MATLAB toolboxes.	For users who want to use MATLAB to program their application.

PC software	Operating system	Short description	Recommended use
PIPython	Windows, Linux, OS X	Python is a programming language that is also used as a script language (obtainable separately as open-source software). PIPython is a collection of Python modules that support the GCS. The PIPython modules can be used with Python 2.7+ and 3.4+. Use on other operating systems is also possible via sockets.	For users who want to use Python to program scripts for their application.
PIMikroMove	Windows	Graphic user interface for Windows with which the E-135.601M and other electronics from PI can be used: ▪ The system can be started without programming effort ▪ Macro functionality for storing command sequences on the PC (host macros) ▪ Complete environment for command entry, for trying out different commands ▪ No command knowledge is necessary to operate PIMikroMove. PIMikroMove uses the dynamic program library to supply commands to the electronics.	For users who want to perform simple automation tasks or test their equipment before or instead of programming an application. A log window showing the commands sent makes it possible to learn how to use the commands.
PITerminal	Windows	Terminal program that can be used for nearly all PI electronics (see the description of the ***Command Entry*** window in the PIMikroMove user manual).	For users who want to send GCS commands directly to the electronics.
PI Update Finder	Windows	Checks the PI software installed on the PC. If more current versions of the PC software are available on the PI server, downloading is offered.	For users who want to update the PC software.
PI Firmware Updater	Windows	Program for user support when updating firmware of the E-135.601M.	For users who want to update the firmware.
USB driver	Windows	Driver for the USB interface	For all users.

Installation

Installing the PC Software

Various PC software applications are available for communication with the E-135.601M.

Performing Initial Installation

Accessories

- PC with Windows (8.1, 10; 32-bit, 64-bit) or Linux operating system and at least 30 MB free memory
- Installation medium (included in the scope of delivery)

Installing the PC software in Windows

1. Start the installation wizard by double-clicking the ***PI_ E-135.CD_Setup.exe*** file in the installation directory (root directory of the installation medium).

   The ***InstallShield Wizard*** window for the installation of programs and manuals for the E-135.601M opens.

2. Follow the instructions on the screen.

   You can choose between default installation (*Complete*) and user-defined installation (*Custom*).

   With default installation (recommended), all components are installed. These include among others:

   - Driver for use with NI LabVIEW software
   - Dynamic program library for GCS
   - PIMikroMove
   - PC software for updating the firmware of the E-135.601M
   - PI Update Finder for updating the PC software
   - USB drivers

   With user-defined installation, you have the option of excluding individual components from the installation.

Installing the PC software in Linux

1. Unpack the tar archive from the /linux directory of the installation medium to a directory on your PC.
2. Open a terminal and go to the directory to which you have unpacked the tar archive.
3. Log on as a superuser (root rights).
4. Enter ./INSTALL to start the installation.
   Pay attention to lower and upper case when entering commands.
5. Follow the instructions on the screen.

You can select individual components for installation.

Installing Updates

PI is constantly improving the PC software.

- ➢ Always install the latest version of the PC software.

Requirements

- ✓ Active connection to the Internet.
- ✓ If your PC uses a Windows operating system:
  - – You have installed (p. 13) the PI Update Finder from the installation medium.
  - – You have the A000T0028 user manual for the PI Update Finder ready.
- ✓ If your PC uses a Linux operating system:
  - – You have the access data (user name and password) for the E-135.601M. Information regarding the access data can be found in the file "xxx_Releasenews.pdf" (x_x_x: Version number of the installation medium) in the \Manuals folder on the installation medium.

Updating the PC software in Windows

- ➢ Use the PI Update Finder:
  - – Follow the instructions in the A000T0028 user manual.

Updating the PC software in Linux

1. Open the website www.pi.ws.
2. Click ***Login***.
3. Log in with the user name and password for the E-135.601M.
4. Click ***Search***.
5. Enter the product number up to the period (e. g., E-135) into the search field.
6. Click ***Start search*** or press the Enter key.
7. Open the corresponding product detail page in the list of search results:
   a) If necessary: Scroll down the list.
   b) If necessary: Click ***Load more results*** at the bottom of the list.
   c) Click the corresponding product in the list.
8. Click the ***Downloads*** tab and scroll to ***Software Files***.
9. Click on the archive file "CD Mirror" or the associated download link.
10. In the following request, select the option to save the file to your PC.

    If you do not specify anything else, the "CD Mirror" archive file is stored in the default download directory of your PC.

11. Unpack the archive file into a separate installation directory.
12. Go to the ***linux*** subdirectory in the directory with the unpacked files.
13. Unpack the archive file in the ***linux*** directory by entering the command tar -xvpf <name of the archive file> on the console.
14. Read the accompanying information on the software update (readme file and/or "xxx_Releasenews.pdf" file) and decide whether the update makes sense for your application.
    - If no: Stop the update procedure.
    - If yes: Go through the following steps.
15. Log onto the PC as a superuser (root rights).
16. Install the update.

INFORMATION

If software is missing in the ***Downloads*** area or problems occur with downloading:

➢ Contact our customer service department (p. 30).

Connecting the Drive Electronics to the Protective Earth Conductor

INFORMATION

➢ Pay attention to the applicable standards for connecting the protective earth conductor.

Requirements

✓ You have read and understood the general safety instructions. (p. 6).

✓ The E-135.601M is switched off, i.e., the power adapter is not connected to the E-135.601M.

Tools and accessories

- Suitable protective earth conductor:
  - Cable cross section ≥ 0.75 mm^2
  - Contact resistance < 0.1 ohm at 25 A at all connection points relevant for attaching the protective earth conductor
- Mounting hardware for the protective earth conductor, which, starting from the housing, sits on the protective conductor connector (threaded bolt) in the following order when the E-135.601M drive electronics are dispatched:
  - Toothed washer
  - Nut

  - Flat washer
  - Safety washer
  - Nut
- Suitable wrench

Connecting the E-135.601M to the protective earth conductor

1. If necessary, attach a suitable cable lug to the protective earth conductor.
2. Remove the outer nut from the protective earth connector on the rear panel of the E-135.601M drive electronics (threaded bolts marked with ⏚ (p. 9)).
3. Connect the protective earth conductor:
   a) Push the cable lug of the protective earth conductor onto the threaded bolt.
   b) Screw the nut onto the threaded bolt. In this way, the cable lug of the protective earth conductor is wedged between the toothed washer and the nut.
   c) Tighten the nut with at least three turns and a torque of 1.2 Nm to 1.5 Nm.

Connecting the Actuator to the Drive Electronics

Tools and accessories

- If more than two PIRest actuators are to be connected at the same time: Suitable adapter cable from PI, available as accessory (p. 8)
- If necessary: Suitable screwdriver for the locking screws of the connectors.

Requirements

✓ You have read and understood the general safety instructions. (p. 6).

✓ The E-135.601M is switched off, i.e., the power adapter is not connected to the E-135.601M.

NOTICE

Damage due to incorrect connection of the PIRest actuator!

Connecting a wrong cable can damage the PIRest actuator or the electronics.

➢ Use cables from PI only to connect the PIRest actuator to the drive electronics.

Connecting the PIRest actuator to the E-135.601M drive electronics

1. If you use an adapter cable: Connect the plug connector of each actuator to a socket connector of the adapter cable. Pay attention to the assignment of the actuators to each individual channel of the electronics.
2. Connect the actuator or the plug connector of the adapter cable to the **PZT 1…3** or **PZT 4…6** socket connector of the electronics.
3. Secure the connectors against unintentional removal.

Connecting the Drive Electronics to a PC

The E-135.601M drive electronics have the following interfaces for communicating with a PC for startup and operation:

- TCP/IP
- USB

The TCP/IP interface of the drive electronics is set at the factory to get the IP address via DHCP.

Tools and accessories

- If you want to connect the drive electronics via the TCP/IP interface:
  Suitable network cable (not in the scope of delivery)
- If you want to connect the drive electronics via USB:
  USB cable from the scope of delivery (p. 7)

Requirements

- ✓ The drive electronics are switched off, i.e., the power adapter is not connected to the E-135.601M.
- ✓ If you want to use the TCP/IP interface: The drive electronics are not connected to the PC via USB. **The TCP/IP interface is deactivated when the drive electronics are connected to the PC via the USB cable.**

Connecting the E-135.601M drive electronics to a PC

- ➢ Connect the drive electronics to the network access point or the PC with the appropriate cable.

Connecting the Power Adapter to the Drive Electronics

Tools and accessories

- Included 24 V wide input range power supply (for line voltages between 100 and 240 V AC at 50 or 60 Hz)
- Included power cord

Requirements

- ✓ The power cord is **not** connected to the power socket.

Connecting the power adapter to the E-135.601M drive electronics

- ➢ Connect the power adapter to the **24 VDC** input on the drive electronics.
- ➢ Connect the power cord to the power adapter.

Startup and Operation

Adjusting PIRest Active Shims

PIMikroMove is used in the following to adjust an PIRest actuator.

Tools and accessories

- ✓ External position-measuring device

Requirements

- ✓ You have read and understood the general safety instructions (p. 6).
- ✓ You have installed the software and hardware properly (p. 13).
- ✓ If the TCP/IP interface is used: A DHCP server must be available so that the drive electronics can get its IP address.

CAUTION

Risk of electric shock if the protective earth conductor is not connected!

If the protective earth conductor is missing or not properly connected, dangerous touch voltages can occur on the E-135.601M in the event of malfunction or failure of the system. If touch voltages exist, touching the drive electronics can result in minor injury from electric shock.

- ➢ Connect the drive electronics to a protective earth conductor before startup (p. 15).
- ➢ Do **not** remove the protective earth conductor during operation.
- ➢ If the protective earth conductor has to be temporarily removed (e.g., for modifications), reconnect the drive electronics to the protective earth conductor before restarting.

NOTICE

Destruction of the piezo actuator due to electric flashovers!

Using the PIRest actuator in environments that increase the electrical conductivity can lead to the destruction of the piezo actuator by electric flashovers. Electric flashovers can be caused by moisture, high humidity, liquids, and conductive materials (e.g., metal dust). In addition, electric flashovers can also occur in certain air pressure ranges due to the increased conductivity of the air.

- ➢ Avoid operating the PIRest actuator in environments that can increase the electric conductivity.
- ➢ Only operate the PIRest actuator within the permissible ambient conditions and classifications (p. 48).

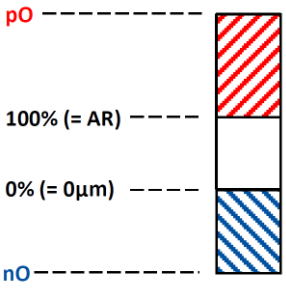
NOTICE

Damage due to collisions!

When motion is commanded, the PIRest actuator can overshoot its travel range limits **in both directions** before finally reaching the target position. In applications with limited installation space, overshooting can cause collisions between moving and fixed parts and lead to damage.

➢ Be aware that the PIRest actuator can overshoot its nominal travel range (AR) as follows:

- When expanding, positive overshooting (pO) occurs:
  with P-131.11, up to 5.1 µm (±20 %)
  with P-131.12, up to 16.4 µm (±20%)
  with P-131.13, up to 34 µm (±20%)
- When contracting, negative overshooting (nO) occurs:
  with P-131.11, up to 2.3 µm (±20 %)
  with P-131.12, up to 8.5 µm (±20%)
  with P-131.13, up to 18.1 µm (±20%)



INFORMATION

E-135.601M reads the data from the ID-chips of the actuators at power-on or reboot. Some of these parameters are immediately overwritten with values from the nonvolatile memory of the E-135.601M. To make sure that the parameter values from the ID-chips are used, send the following command in a terminal, e.g. in the ***Command entry*** window of PIMikroMove, after each power-on or reboot:

➢ Read out the ID-chips again by sending `ZZZ 100 IDC`

This way the parameter values are copied from the ID-chips to the volatile memory of the E-135.601M.

INFORMATION

A PIRest actuator does not require electrical voltage to maintain its position, i.e., it only needs to be supplied with voltage during adjusting. The actuator can be disconnected from the drive electronics after adjusting has been completed.

Starting E-135.601M and PIMikroMove

1. Switch the drive electronics on by connecting the power cord of the power adapter to the power socket.
2. Run PIMikroMove on the PC.

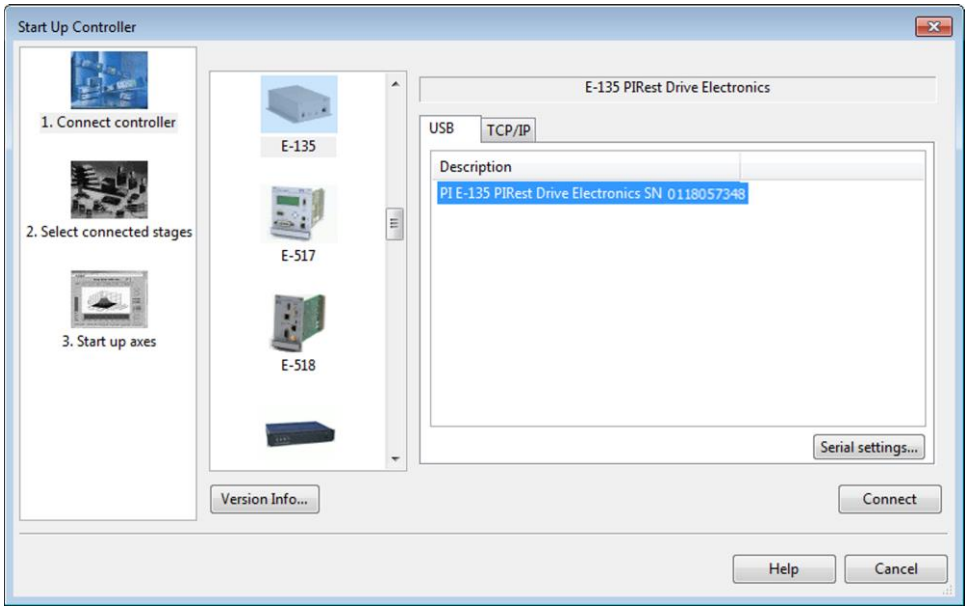
Establishing communication

3. Establish communication in PIMikroMove in the ***Start up controller*** window, ***Connect controller*** step.
   a) Select ***E-135*** in the field for controller selection.

b) Depending on the interface to be used, select the ***USB*** tab or the ***TCP/IP*** tab on the right-hand side of the window.

c) On the tab, select the connected E-135.601M.

d) Click ***Connect*** to establish communication.



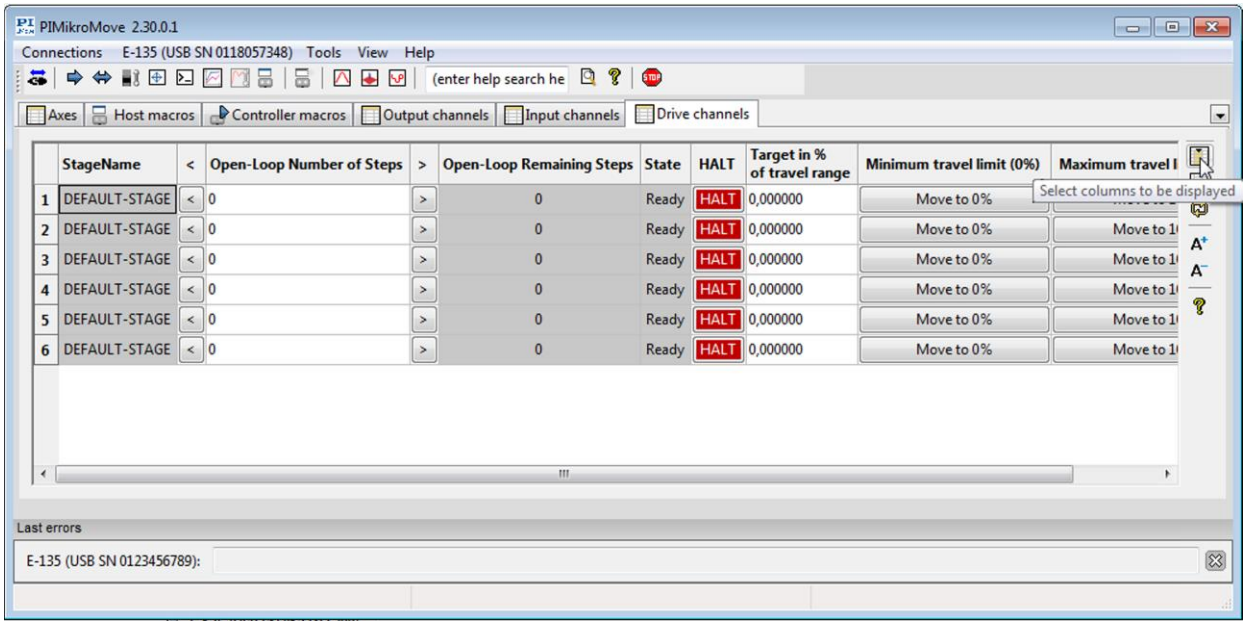
The main window of PIMikroMove opens.

4. If it is not displayed on the ***Drive channels*** tab, show the ***Stage Type (0x0F000100)*** column.

   From the information in this column you can see which actuator is connected to the corresponding channel of the E-135.601M. If the entry is empty, either nothing is connected to the channel, or the connected actuator has no ID-chip.

   Proceed as follows to show the ***Stage Type (0x0F000100)*** column:

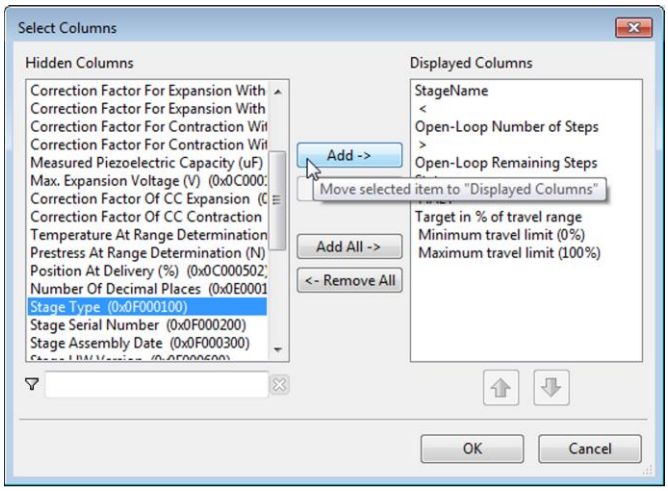
   a) On the right margin of the ***Drive channels*** card, click  (***Select columns to be displayed***).



The ***Select Columns*** dialog opens.

b) In the ***Select Columns*** dialog, go to the ***Hidden Columns*** area and select the ***Stage Type (0x0F000100)*** line.

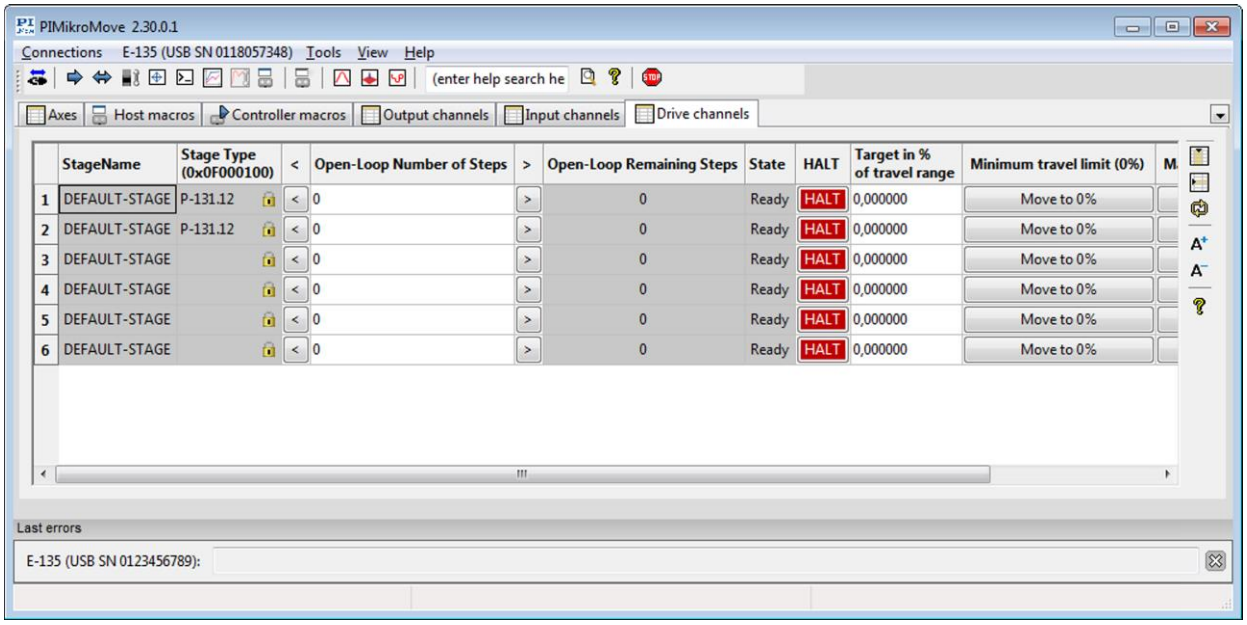
c) In the ***Select Columns*** dialog, click ***Add ->***.



d) Move the ***Stage Type*** line up in the ***Displayed Columns*** list.

e) Close the ***Select Columns*** dialog by clicking ***OK***.

The ***Stage Type (0x0F000100)*** column is now shown with ID-chip information from the connected actuators.



Optional: Configuring the actuators

5. If necessary, make some settings for the actuators in their ***Parameter Panel*** windows, see p. 38 for how to open and use the windows.

   – Only if the actuator has **no** temperature sensor: Make sure that the ***Use Stage Internal Temperature Sensor?*** parameter (ID 0x23001200) has the value 0, and enter the current ambient temperature of the actuator as value of the ***Stage Temperature*** parameter (ID 0x57).

   – Optional: Deactivate creep compensation via the ***Creep Compensation*** parameter (ID 0x23000800). Creep compensation minimizes actuator creeping, but also reduces the available travel range.

   – Optional: Configure step-by-step adjustment:

     ▫ Change the value of the ***Time At Zero Voltage (s)*** parameter (ID 0x23000200). The value specifies the length of the pause (0.5 ms to 60 s) between the individual steps.

     ▫ Change the value of the ***Voltage Increment*** parameter (ID 0x23000500). The value specifies the voltage increase (0.0 to 120.0 V) during the step-by-step adjustment. The greater the value, the larger the steps.

Optional: Moving to travel range limits

6. Expand and contract the actuator to its absolute limits using the ***Set to 100% travel range*** and ***Set to 0% travel range*** buttons in the main window of PIMikroMove. This may be useful during the first startup of the actuator to identify its maximum travel range.

   Note that the actuator overshoots the specified limit before finally remaining at the limit.

   Recommended: Use every button only once after switch-on or reboot of the E-135.601M. Multiple usage can shift the “zero point” and the maximum of the travel

range. This should therefore be avoided if repeatability is important. For further adjustment to a specific target, use the ***Target value in % of travel range*** column; see step 7 below.

The ***Set to 100% travel range*** and ***Set to 0% travel range*** buttons correspond to the POL command (p. 35).

Adjusting the actuators

7. Adjust the actuators in the main window of PIMikroMove. You have the following options:
   - Adjusting the actuators step-by-step
   - Moving the actuators to a specific target within the travel range

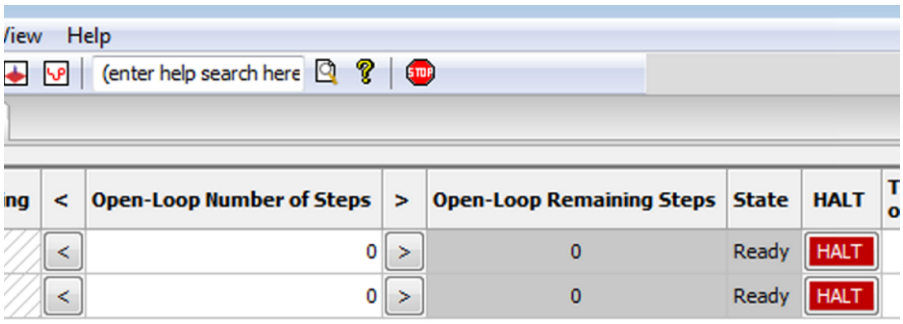
   The individual actuators are always adjusted one after another. The drive electronics will prevent adjustment of any of the other actuators while an actuator is being adjusted.

   Step-by-step adjustment:

   a) Enter the number of steps in the ***Open-Loop Number of Steps*** column.

   b) Start the stepwise contraction or expansion of the actuator with the corresponding arrow buttons. This corresponds to the OSM command (p. 34).
   You can check how many steps are still to be performed in the ***Open-Loop Remaining Steps*** column. This corresponds to the OSN? command (p. 35).

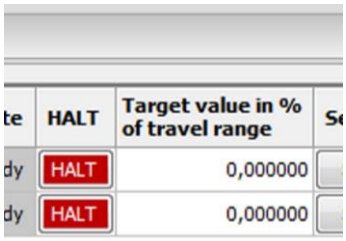
   Note that the actuator can overshoot its nominal travel range!



   Motion to specific target:

   - Enter the target value in percent of the travel range in the ***Target value in % of travel range*** column. Possible values: 0 to 100. Press the Enter key on the PC keyboard or click outside the input field with the mouse to start the adjustment. This corresponds to the SVA command (p. 36).

     Note that the actuator can overshoot its nominal travel range in both directions before finally reaching the specified target! The adjustment can take up to 25 s.

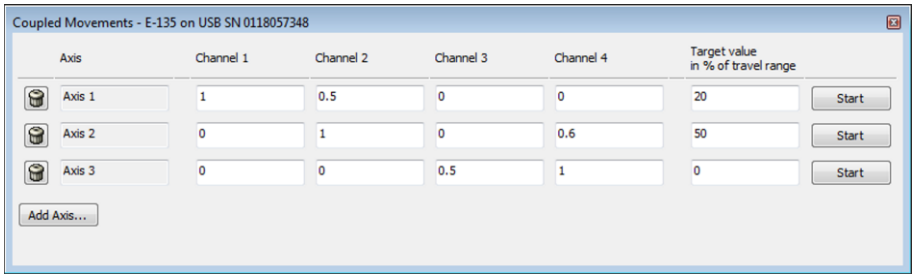


8. Use an external position-measuring device to check whether the desired position has been reached.
9. When the desired position has been reached:
   - Switch the drive electronics off.
   - Optional: Disconnect the actuators from the drive electronics.
10. When an actuator needs to be readjusted:
    a) Reconnect all components to each other (see "Installation", p. 13).
    b) Redo steps 1 to 9 in these instructions.

Assigning Actuators to Axes

It is possible to assign several actuators for a common direction of motion ("axis") in the ***Coupled Movements*** window of PIMikroMove. The actuators for an axis are moved to a specific target within their travel range one after another. This corresponds to a sequence of SVA commands.

You can open the ***Coupled Movements*** window using the ***E-135 > Show Coupled Movement window*** menu entry in the PIMikroMove main window.



Add axes:

➢ ***Add Axis …*** button

Define axis:

➢ Enter the name into the ***Axis*** input box

➢ Enter the axis motion value for each actuator into the ***Channel*** input boxes as floating point number. Multiplied as factor with the specified target. Value range: 0 to 1
Actuators with zero motion value are excluded from the motion (no SVA command will be sent for them).

Delete axis:

- ***Delete axis definition*** button

Specify target for axis:

- Target in % of the travel range via the ***Target value*** input box

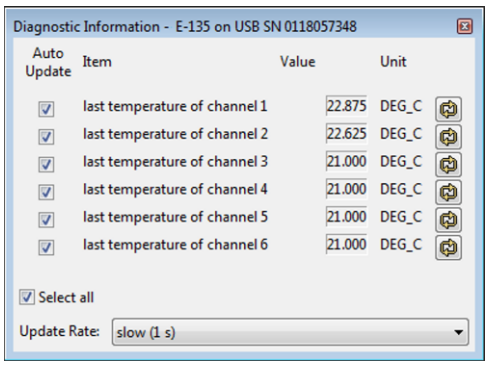
Move to target for axis:

- ***Start*** button

Reading the Actuator Temperature

For actuators equipped with temperature sensor, you can read the current sensor value in the ***Show Diagnostic Information*** window of PIMikroMove. This corresponds to the DIA? command.

You can open the ***Show Diagnostic Information*** window using the ***E-135 > Show diagnostic information*** menu entry in the PIMikroMove main window.



The sensor value should be updated manually since the time span between two updates must be at least 60 s.

- Set ***Update Rate:*** to *off (manual update)*.
- To update a value, click the corresponding ***Update now*** button.

Maintenance

Updating Firmware

INFORMATION

To update the firmware, the E-135.601M and PC must communicate via the USB interface.

INFORMATION

The `*IDN?` command reads the version number of the firmware among other things.

Example of a E-135.601M response:

```
(c)2018 Physik Instrumente (PI) GmbH & Co. KG, E-135.601M,
118057348, 01.024
```

- E-135.601M: Device name
- 118057348: Serial number of the device.
- 01.024: Firmware version

INFORMATION

The E-135.601M is in firmware update mode when the **STA** LED flashes. If you have started the firmware update using the ***PI Firmware Updater*** but the **STA** LED does not flash and the update fails, proceed as follows:

1. Close the ***PI Firmware Updater*** program on the PC.
2. Activate the firmware update mode in PIMikroMove or PITerminal:
   a) If the window for sending commands is not already open in PIMikroMove, select the menu item ***Tools> Command entry*** in the main window or press the F4 key on the keyboard.
   b) Send the following commands one by one:
      ```
      ZZZ 100 Flash
      rbt
      ```
      The E-135.601M reboots. If the E-135.601M is in firmware update mode after rebooting, the **STA** LED will flash.
3. Close PIMikroMove or PITerminal.
4. Start the ***PI Firmware Updater*** again and execute the update.

The E-135.601M does not leave the firmware update mode until it is **restarted** after a **successful** firmware update.

If the **STA** LED still flashes, even though the E-135.601M has been restarted after the firmware update:

- ➢ Repeat the firmware update. Be sure to use the USB interface.
- ➢ If the update of the firmware fails, contact our customer service department (p. 30).

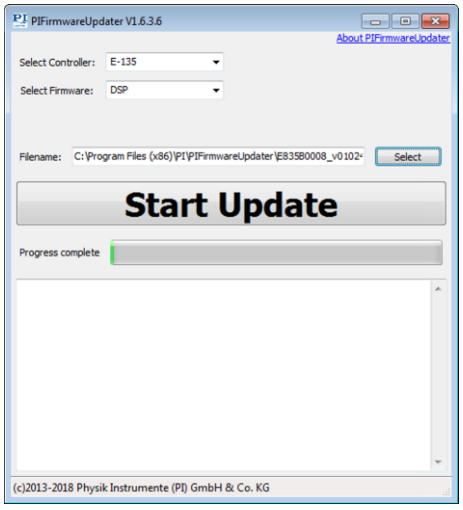
Requirements

- ✓ You have connected the E-135.601M to the PC **via the USB** interface (p. 17).
- ✓ The ***PI Firmware Updater*** program is installed on the PC (p. 13).
- ✓ You have copied the new firmware file, which you have received from our customer service department, to a directory on the PC.
- ✓ You have read and understood the documentation which you received from our customer service department together with the new firmware.

Updating the firmware of the E-135.601M

1. Start the ***PI Firmware Updater*** program on the PC.

   The ***PI Firmware Updater*** window opens.
2. Set the following in the selection fields:
   - In the ***Select Controller:*** field, select the *E-135* entry.
   - Do not change the ***Select Firmware:*** field. The "DSP" (DSP = Digital Signal Processor) is automatically entered when selecting the *E-135*.
3. Select the new firmware file:
   a) Click the ***Select*** button.
   b) In the file selection window, go to the directory in which you have stored the firmware file.
   c) Double-click on the new firmware file (filename .hex) to enter the file path in the ***Filename*** field.

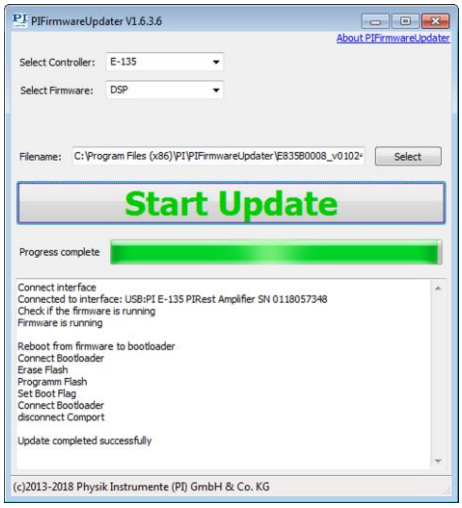


4. Start the firmware update by clicking on the ***Start Update*** button.

   First, the ***Connect*** dialog opens.
   - In the ***Connect*** dialog, select the ***USB*** tab, click on the line of your E-135.601M, and click ***OK*** to establish the connection. The dialog closes.

The firmware of the E-135.601M is updated. The update progress is displayed in the message list and by the progress bar.

The update was successful when the `Update completed successfully` message appears as the last entry in the message list.



5. Close the ***PI Firmware Updater*** program by clicking the cross in the top right corner of the window.
6. Switch off the E-135.601M by pulling out the power cord of the power adapter from the power socket.
7. Switch on the E-135.601M again by connecting the power cord of the power adapter to the power socket.

   If the firmware update was successful, the E-135.601M exits the firmware update mode and the **STA** LED lights up continuously.

Cleaning

Other materials required

- Soft, lint-free cloth
- Mild cleaning agent (e.g., isopropyl alcohol)

If you have any questions on the other recommended materials, contact our customer service department (p. 30).

Requirements

✓ You have disconnected the E-135.601M drive electronics from the power supply.

NOTICE

Short-circuiting due to cleaning fluid penetrating the housing!

Cleaning fluid penetrating the housing can short-circuit the E-135.601M drive electronics.

The E-135.601M drive electronics contain electrostatically sensitive components that can be damaged by short circuits or flashovers if cleaning fluids penetrate the housing.

- ➢ Before cleaning, disconnect the drive electronics from the power supply by pulling the power plug.
- ➢ Before cleaning, disconnect the actuator from the drive electronics.
- ➢ Prevent cleaning fluid from penetrating the housing of the drive electronics.

Cleaning the E-135.601M drive electronics

1. Dampen the cloth lightly with the cleaning agent.
2. Wipe the surfaces of the drive electronics carefully.

Faults and Remedies

No or limited motion	
Cable not connected correctly	➢ Check the cable connections.
Excessively high preload	➢ Reduce the preload while considering the static and dynamic forces expected for your system.
Excessive preload element stiffness	➢ Use a preload element (e.g., expansion screw or screw with spring washer) with lower stiffness. Example: The actuator achieves 90 % of its travel range when the preload element has 10 % of the actuator stiffness.
Actuator damaged by exceeding the load capacity	➢ If possible, replace the defective actuator with another actuator and test the new combination.
Drive electronics' voltage output is deactivated due to overheating	Excessive ambient temperature and a high number of adjustments performed in immediate succession can cause the drive electronics to overheat. 1. Switch the drive electronics off (disconnect from the power adapter). 2. Allow the drive electronics to cool down for 20 to 30 minutes. 3. Switch the drive electronics on again.

Customer Service Department

For inquiries and orders, contact your PI sales engineer or send us an email (mailto:service@pi.de).

- If you have any questions concerning your system, provide the following information:
  - Product and serial numbers of all products in the system
  - Firmware version of the controller (if applicable)
  - Version of the driver or the software (if applicable)
  - Operating system on the PC (if applicable)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

The latest versions of the user manuals are available on our website (p. 6) for download.

Commands and Parameters

GCS Commands

The E-135.601M supports the PI General Command Set (GCS). GCS commands are accessible via the TCP/IP, and USB interfaces.

Notation

The following notation is used in this chapter to define the GCS syntax and to describe the commands:

<...>	Angle brackets indicate an argument of a command, can be an item identifier (e.g., axis ID/channel ID) or a command-specific parameter
[…]	Square brackets indicate an optional entry
{…}	Curly brackets indicate a repetition of entries, i.e. that it is possible to access more than one item (e.g. several axes) in one command line.
LF	LineFeed (ASCII char #10), is the default termination character (character at the end of a command line)
SP	Space (ASCII char #32), indicates a space character
"..."	Quotation marks indicate that the characters enclosed are returned or to be entered.

GCS Syntax for Syntax Version 2.0

A GCS command consists of 3 characters, e.g. CMD. A query command has a question mark added to the end, e. g. CMD?.

Command mnemonic:

CMD ::= character1 character2 character3 [?]

Exceptions:

- Single-character commands, e. g. fast query commands, consist only of one ASCII character. The ASCII character is written as combination of # and the character code in decimal format, e. g. as `#24`.
- `*IDN?` (for GPIB compatibility).

The command mnemonic is not case-sensitive. The command mnemonic and all arguments (e. g. axis identifiers, channel identifiers, parameters, etc.) must be separated from each other by a space (SP). The command line ends with the termination character (LF).

CMD[{SP}<Argument>}]LF

CMD?[{SP}<Argument>}]LF

Exception:

- Single-character commands are not followed by a termination character. The response to a single-character commands is followed by a termination character, however.

The argument <AxisID> is used for the axes (= channels with E-135.601M) of the electronics. See "Axes and Channels " (p. 9) for the identifiers supported by the E-135.601M.

Example 1:

Axis 1 is to be moved to 10.0% of its travel range.

Send: `SVA SP 1 SP 10.0 LF`

More than one command mnemonic per line is not allowed.

When a part of a command line cannot be executed, the line is not executed at all.

When all arguments are optional and are omitted, the command is executed for all possible argument values.

Example 2:

All parameters in the volatile memory are to be reset.

Send: `RPA LF`

Example 3:

The number of remaining steps is to be queried for all axes.

Send: `OSN? LF`

The response syntax is as follows:

[<Argument>[{SP<Argument>}]"="]<Value>LF

With multi-line replies, the space preceding the termination character is omitted in the last line:

{[<Argument>[{SP<Argument>}]"="]<Value>SPLF}
[<Argument>[{SP<Argument>}]"="]<Value>LF for the last line!

In the response, the arguments are listed in the same order as in the query command.

Query command:

CMD?SP<Arg3>SP<Arg1>SP<Arg2>LF

Response to this command:

<Arg3>"="<Val3>SPLF
<Arg1>"="<Val1>SPLF
<Arg2>"="<Val2>LF

Example 4:

Send: `OSN? SP 2 SP 1 LF`

Receive: `2=20 SPLF`
`1=0 LF`

Command Overview

The table below lists the GCS commands supported by the E-135.601M in alphabetical order.

Command	Format	Short Description
#5	#5	Request Motion Status
#7	#7	Request Controller Ready Status
#24	#24	Stop All Axes
*IDN?	*IDN?	Get Device Identification
CCL	CCL <Level> [<PSWD>]	Set Command Level
CCL?	CCL?	Get Command Level
CST?	CST? [{<AxisID>}]	Get Assignment Of Stages To Axes
CSV?	CSV?	Get Current Syntax Version
DIA?	DIA? [{<MeasureID>}]	Get Diagnosis Information
ERR?	ERR?	Get Error Number
HDI?	HDI?	Get Help For Interpretation Of DIA? Response
HLP?	HLP?	Get List Of Available Commands
HPA?	HPA?	Get List Of Available Parameters
HPV?	HPV?	Get List Of Possible Parameter Values
IFC?	IFC? [{<InterfacePam>}]	Get Current Interface Configuration
IFS?	IFS? [{<InterfacePam>}]	Get Interface Parameters As Default Values
MAN?	MAN? <CMD>	Get Help String For Command
OSM	OSM <AxisID> <NumberOfSteps>	Start Step-by-Step Movement, see p. 34
OSN?	OSN? [{<AxisID>}]	Get Number of Remaining Steps, see p. 35
POL	POL <AxisID> <0|1>	Move to Minimum (0) or Maximum (1) Limit of Travel Range, see p. 35
RBT	RBT	Reboot System
RPA	RPA [{<ItemID> <PamID>}]	Reset Volatile Memory Parameters
SAI?	SAI? [ALL]	Get List Of Current Axis Identifiers
SEP	SEP <Pswd> {<ItemID> <PamID> <PamValue>}	Set Nonvolatile Memory Parameters
SEP?	SEP? [{<ItemID> <PamID>}]	Get Nonvolatile Memory Parameters
SPA	SPA {<ItemID> <PamID> <PamValue>}	Set Volatile Memory Parameters
SPA?	SPA? [{<ItemID> <PamID>}]	Get Volatile Memory Parameters
SRG?	SRG? [{<AxisID> <RegisterID>}]	Query Status Register Value, see p. 36

Command	Format	Short Description
STP	STP	Stop All Axes
SVA	SVA <AxisID> <float>	Set Target (0% to 100% of travel range), see p. 36
VER?	VER?	Get Versions Of Firmware And Drivers
WPA	WPA <Pswd> [{<ItemID> <PamID>}]	Save Parameters To Nonvolatile Memory
ZZZ	ZZZ 100 IDC	Read Parameters From ID-Chip, see p. 36

Descriptions of Selected Commands

OSM (Start Step-by-Step Movement)

Description: Adjustment of the actuator: Start step-by-step movement of the given actuator by specifying the number of steps.

Format: OSM <AxisID> <NumberOfSteps>

Arguments: <AxisID> is the identifier of the actuator channel, can be 1 to 6

<NumberOfSteps> integer value that gives the number of steps; value range is -10000 to 10000. Negative values trigger contraction, and positive values trigger expansion of the actuator. The value 0 stops the actuator.

Response: none

Notes: The actuator can overshoot its nominal travel range; see p. 19 for overshoot values.

The step-by-step movement can be configured with the following parameters:

- ***Time At Zero Voltage (s)***, ID 0x23000200: The timespan specifies the length of the pause between the individual steps for step-by-step adjustment of the actuator.
- ***Voltage Increment***, ID 0x23000500: Voltage increase during step-by-step adjustment of the actuator; the greater the value, the larger the step size.

For further configuration parameters and details on parameter handling, see “Parameters”, p. 38.

To make the whole travel range available, it can be necessary to command a full expansion and contraction of the actuator with POL (p 35) before OSM is used.

As long as the adjustment has not finished yet, SVA and POL commands are not permitted.

OSN? (Get Number of Remaining Steps)

Description:	Gets the number of steps still to be performed for the given channel after the last OSM command.
Format:	OSN? [{<AxisID>}]
Arguments:	<AxisID> is the identifier of the actuator channel, can be 1 to 6
Response:	{<AxisID>"="<NumberOfSteps>LF} where <NumberOfSteps> is an integer value that gives the number of steps still to be performed.

POL (Move to Minimum (0) or Maximum (1) Limit of Travel Range)

Description:	Adjustment of the actuator: Move the actuator to the minimum or maximum limit of its nominal travel range.
Format:	POL <AxisID> <0|1>
Arguments:	<AxisID> is the identifier of the actuator channel, can be 1 to 6 <0|1> gives the limit to which the actuator is to be moved, can be 0 or 1: 0 = minimum limit (0% of nominal travel range), which means full contraction 1 = maximum limit (100% of nominal travel range), which means full expansion
Response:	none
Notes:	The actuator overshoots the specified limit before finally remaining at the limit; see p. 19 for overshoot values. Recommended use: Use POL only once after switch-on or reboot of the E-135.601M to identify the maximum travel range of the actuator. A sequence of multiple POL commands in the same direction can shift the “zero point” and thus the nominal travel range. This should therefore be avoided if repeatability is important. As long a the adjustment has not finished yet, new adjustment commands (OSM, SVA, POL) are not permitted.

SRG? (Query Status Register Value)

Description:	Returns register values for queried channels and registers.
Format:	SRG? [{<AxisID> <RegisterID>}]
Arguments:	<AxisID> is the identifier of the actuator channel, can be 1 to 6 <RegisterID> is the ID of the specified register, can be 1
Response:	{<AxisID><RegisterID>"="<Value> LF} where <Value> indicates if the channel is in motion and can be as follows: 0x0 = The channel is not in motion 0x2000 = The channel is in motion.

SVA (Set Target (0% to 100% of travel range))

Description:	Adjustment of the actuator: Move the actuator to a specific target within the travel range.
Format:	SVA <AxisID> <float>
Arguments:	<AxisID> is the identifier of the actuator channel, can be 1 to 6 <float> gives the target in percent of the travel range, can be 0% to 100%
Response:	none
Notes:	The actuator can overshoot its nominal travel range in both directions before finally reaching the specified target. See p. 19 for overshoot values. The adjustment can take up to 25 s. As long a the adjustment has not finished yet, new adjustment commands (OSM, SVA, POL) are not permitted. For configuration parameters and details on parameter handling, see “Parameters”, p. 38.

ZZZ (Read Parameters From ID-Chip)

Description:	Reads parameter values from the ID-chips of the actuators and copies them to the volatile memory of the E-135.601M.
Format:	ZZZ 100 IDC

Arguments:	100 is password for reading the parameter values IDC stands for “ID-chip”.
Response:	none
Notes:	E-135.601M reads the data from the ID-chips of the actuators at power-on or reboot. Some of these parameters are immediately overwritten with values from the nonvolatile memory of the E-135.601M. To make sure that the parameter values from the ID-chips are used, send the following command in a terminal, e.g. in the ***Command entry*** window of PIMikroMove, after each power-on or reboot: ➢ Read out the ID-chips again by sending `ZZZ 100 IDC` This way the parameter values are copied from the ID-chips to the volatile memory of the E-135.601M.

Parameters

Settings of the E-135.601M

Parameters define the behavior of the system and can be divided into the following categories:

- Protected parameters whose default settings cannot be changed
- Parameters that can be set by the user to adapt to the application

The write permission for the parameters is determined by command levels. The user can change parameters on command levels 0 and 1. On command levels 2 and 3, write access is only available to PI service personnel.

Every parameter is present in the volatile as well as in the nonvolatile memory of the E-135.601M. The values in the volatile memory determine the current behavior of the system.

The values of several parameters are stored on the ID-chip of the actuator. They are loaded to the volatile memory when the E-135.601M is switched on or rebooted. You cannot overwrite the parameters in the ID-chip (this can only be done by PI).

INFORMATION

E-135.601M reads the data from the ID-chips of the actuators at power-on or reboot. Some of these parameters are immediately overwritten with values from the nonvolatile memory of the E-135.601M. To make sure that the parameter values from the ID-chips are used, send the following command in a terminal, e.g. in the ***Command entry*** window of PIMikroMove, after each power-on or reboot:

➢ Read out the ID-chips again by sending `ZZZ 100 IDC`

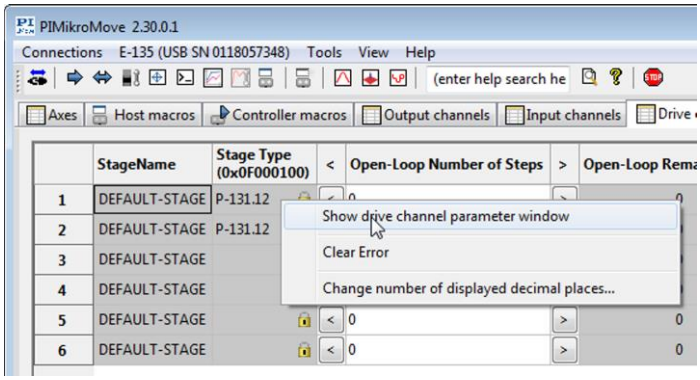
This way the parameter values are copied from the ID-chips to the volatile memory of the E-135.601M.

Refer to the table on p. 41 for parameter details.

Parameter Handling

To change parameter values, you can use the commands listed in "Commands for Parameters" (p. 40). But if you want to access the parameters in a more convenient way, use the ***Parameter Panel*** window of PIMikroMove.

1. Open the ***Parameter Panel***:
   a) Right-click the line of the actuator in the PIMikroMove main window.
   b) Select the ***Show drive channel parameter window*** entry.



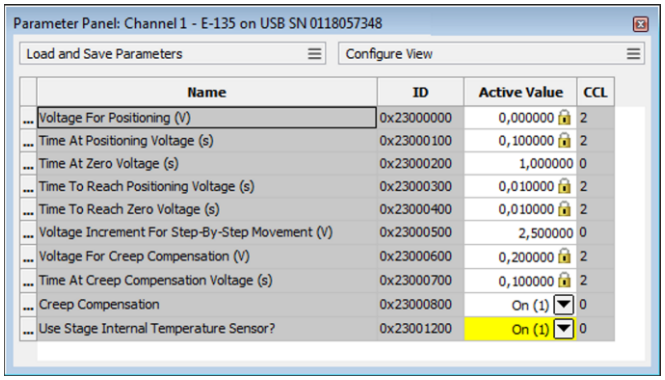
2. Enter new values for the parameters to be adapted:

   a) If the parameters to be changed are not included in the list, click on ***Configure View -> Show all***.

   b) Type the new parameter value into the corresponding input field in the ***Active Value*** column of the list.

      - If changing the parameter value requires command level 1, enter the password *advanced* when prompted to do so.

   c) Press the Enter key on the PC keyboard or click outside the input field with the mouse to transfer the parameter value to the volatile memory of the E-135.601M. Note: If a parameter value in the volatile memory (***Active Value*** column) is different to the parameter value in the nonvolatile memory (***Startup Value*** column), the line in the list is highlighted in color.



The ***CCL*** column of the ***Parameter Panel*** window shows the command level required for write access to the parameters.

INFORMATION

On command levels 2 and 3, write access is only available to PI service personnel.

➢ Contact the customer service department (p. 30) if there seem to be problems with parameters of command level 2 or higher.

Commands for Parameters

The following commands are available for parameters:

Command	Function
CCL	Change to a higher command level, e.g., to obtain write permission for particular parameters.
CCL?	Get active command level.
HPA?	Get a help string which contains all available parameters with short descriptions.
RPA	Copy a parameter value from the nonvolatile to the volatile memory.
SEP	Change parameters in the nonvolatile memory.
SEP?	Get parameter values from the nonvolatile memory.
SPA	Change parameters in the volatile memory.
SPA?	Get parameter values from the volatile memory.
WPA	Copy a current parameter value from the volatile to the nonvolatile memory.
ZZZ	Read parameter values from the ID-chips and copy them to the volatile memory.

Parameter Overview

The table below gives short descriptions of some parameters. The parameters stored in the ID-chip are marked in the "Description" column.

Parameter ID (hexa-decimal)	Data Type	Command Level for Write Access	Item Type	Parameter Name	Value Range	Description
0x3C	CHAR	0	Channel	Stage Name (max. 20 characters)	-	ID-chip Used by PIMikroMove for display purposes
0x57	FLOAT	0	Channel	Stage Temperature (deg C)	-	Temperature of the actuator If the actuator is equipped with a temperature sensor and parameter 0x23001200 has the value 1: The E-135.601M reads the sensor value when an adjustment is started (OSM, SVA, or POL commands are sent), provided that a period of at least 60 s has elapsed since the last reading.
0x100100B	INT	3	Channel	ID Chip Type	0=None 1=PI-AME 2=OneWire	Type of ID-chip of the connected actuator
0x7000601	CHAR	0	Channel	Axis Unit	-	ID-chip Used by PIMikroMove for display purposes

Parameter ID (hexa-decimal)	Data Type	Command Level for Write Access	Item Type	Parameter Name	Value Range	Description
0x9000000	FLOAT	1	Channel	Correction Factor For Expansion Without CC	0 to 5 default: 1.0	ID-chip Factor applied to the voltage amplitude. The factor is used if both conditions are fulfilled: ▪ A target is commanded with SVA. This target is in the lower half of the travel range (0 to < 50 %). ▪ Creep compensation is deactivated.
0x9000001	FLOAT	1	Channel	Correction Factor For Expansion With CC	0 to 5 default: 1.0	ID-chip Factor applied to the voltage amplitude. The factor is used if both conditions are fulfilled: ▪ A target is commanded with SVA. This target is in the lower half of the travel range (0 to < 50 %). ▪ Creep compensation is activated.
0x9000002	FLOAT	1	Channel	Correction Factor For Contraction Without CC	0 to 5 default: 1.0	ID-chip Factor applied to the voltage amplitude. The factor is used if both conditions are fulfilled: ▪ A target is commanded with SVA. This target is in the upper half of the travel range (50 to 100 %). ▪ Creep compensation is deactivated.
0x9000003	FLOAT	1	Channel	Correction Factor For Contraction With CC	0 to 5 default: 1.0	ID-chip Factor applied to the voltage amplitude. The factor is used if both conditions are fulfilled: ▪ A target is commanded with SVA. This target is in the upper half of the travel range (50 to 100 %). ▪ Creep compensation is activated.

Parameter ID (hexa-decimal)	Data Type	Command Level for Write Access	Item Type	Parameter Name	Value Range	Description
0xB00000A	FLOAT	2	System	Offset Of Amplifier		
0xB000003	FLOAT	2	System	Slew Rate Of Amplifier		
0xC000101	FLOAT	3	Channel	Measured Piezoelectric Capacity (µF)		ID-chip Value set by PI during calibration
0xC000105	FLOAT	2	Channel	Max. Expansion Voltage (V)	0 to 120 V Default: 120 V	ID-chip Max. voltage amplitude for expansion of the actuator. Used in the following cases: ▪ A specific target is commanded with SVA ▪ Expansion or contraction to the corresponding travel range limit is commanded with POL
0xC000106	FLOAT	1	Channel	Correction Factor Of CC Expansion	0 to 5 default: 1.0	ID-chip Factor applied to the amplitude of the creep compensation voltage. The factor is used if creep compensation is activated and actuator expansion has been commanded with SVA or OSM.
0xC000107	FLOAT	1	Channel	Correction Factor Of CC Contraction	0 to 5 default: 1.0	ID-chip Factor applied to the amplitude of the creep compensation voltage. The factor is used if creep compensation is activated and actuator contraction has been commanded with SVA or OSM.
0xC000500	FLOAT	3	Channel	Temperature At Range Determina-tion (deg C)		ID-chip Temperature during calibration at PI
0xC000501	FLOAT	3	Channel	Prestress At Range Determina-tion (N)		ID-chip Prestress during calibration at PI

Parameter ID (hexa-decimal)	Data Type	Command Level for Write Access	Item Type	Parameter Name	Value Range	Description
0xC000502	FLOAT	3	Channel	Position At Delivery (%)		ID-chip Position after calibration at PI
0xD000000	CHAR	2	System	Device S/N		Serial number of the E-135.601M
0xE000102	INT	0	Channel	Number Of Decimal Places		Number of decimal places for floating point numbers Only used for display purposes
0xE000200	FLOAT	3	System	Update Time (s)		Cycle time of the E-135.601M
0xF000100	CHAR	3	Channel	Stage Type		ID-chip
0xF000200	CHAR	3	Channel	Stage Serial Number		ID-chip
0xF000300	CHAR	3	Channel	Stage Assembly Date		ID-chip
0xF000600	INT	3	Channel	Stage HW Version		ID-chip
0x23000000	FLOAT	2	Channel	Voltage For Positioning (V)	-100 to 120 V	Used for step-by-step adjustment (OSM command). Is calculated by E-135.601M during the adjustment.
0x23000100	FLOAT	2	Channel	Time At Positioning Voltage (s)	0.5 ms to 60 s Default: 0.1 s	Used for step-by-step adjustment (OSM command).
0x23000200	FLOAT	0	Channel	Time At Zero Voltage (s)	0.5 ms to 60 s Default: 1 s	Used for step-by-step adjustment (OSM command). The time span specifies the length of the pause between the individual steps.
0x23000300	FLOAT	2	Channel	Time To Reach Positioning Voltage (s)	0.5 ms to 60 s Default: 0.01 s	Used for step-by-step adjustment (OSM command).
0x23000400	FLOAT	2	Channel	Time To Reach Zero Voltage (s)	0.5 ms to 60 s Default: 0.01 s	Used for step-by-step adjustment (OSM command).

Parameter ID (hexa-decimal)	Data Type	Command Level for Write Access	Item Type	Parameter Name	Value Range	Description
0x23000500	FLOAT	0	Channel	Voltage Increment For Step-By-Step Movement (V)	0 V to 120 V Default: 2.5 V	Used for step-by-step adjustment (OSM command). Voltage increase during adjustment. The greater the value, the larger the steps.
0x23000600	FLOAT	2	Channel	Voltage For Creep Compensa-tion (V)	-100 to 120 V	Used for step-by-step adjustment (OSM command), if creep compensation is activated. Is calculated by E-135.601M during the adjustment.
0x23000700	FLOAT	2	Channel	Time At Creep Compensa-tion Voltage (s)	0.5 ms to 60 s Default: 0.1 s	Used for step-by-step adjustment (OSM command), if creep compensation is activated.
0x23000800	INT	0	Channel	Creep Compensa-tion	0 = Off 1 = On default: 1	Creep compensation minimizes actuator creeping, but also reduces the available travel range.
0x23000900	FLOAT	3	Channel	Travel Range With Creep Compensa-tion ([Axis Unit])		ID-chip Travel range with creep compensation as measured by PI during calibration.
0x23000A00	FLOAT	3	Channel	Travel Range Without Creep Compensa-tion ([Axis Unit])		ID-chip Travel range without creep compensation as measured by PI during calibration.

Parameter ID (hexa-decimal)	Data Type	Command Level for Write Access	Item Type	Parameter Name	Value Range	Description
0x23001200	INT	0	Channel	Use Stage Internal Temperature Sensor?	0 = no 1 = yes	Determines if the E-135.601M reads the temperature sensor of the actuator. If the parameter value is 1, E-135.601M reads the sensor value when an adjustment is started (OSM, SVA, or POL commands are sent), provided that a period of at least 60 s has elapsed since the last reading. The read out value is written to parameter 0x57. If the connected actuator has a temperature sensor, it is used by default (0x23001200 is automatically set to 1) when the E-135.601M is switched on or rebooted.
0x23001300	INT	0	System	Shaping	0 = Off 1 = On default: 1	Polynomial-based shaping of the output voltage. The aim is a shock- and jerk-free adjustment of the actuator.

Technical Data

Data Table

	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 Sub-D 15 (f) Suitable connecting cables: E-815.AKx00
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
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	20 W
Mass	0.7 kg

Maximum Ratings

The E-135.601M drive electronics are designed for the following operating data:

Maximum operating voltage	Maximum Operating Frequency	Maximum power consumption
⚠	⚠	⚠
24 V	⎓	20 W

Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the E-135.601M drive electronics:

Area of application	For indoor use only
Maximum altitude	2000 m above msl
Air pressure	1100 hPa to 0.1 hPa
Relative humidity	Max. 80 % for temperatures to 31 °C, decreasing linearly to 50 % at 40 °C
Storage temperature	0 °C to 70 °C
Transport temperature	–25 °C to +85 °C
Overvoltage category	II
Protection class	I
Degree of pollution	2
Degree of protection according to IEC 60529	IP20

Dimensions

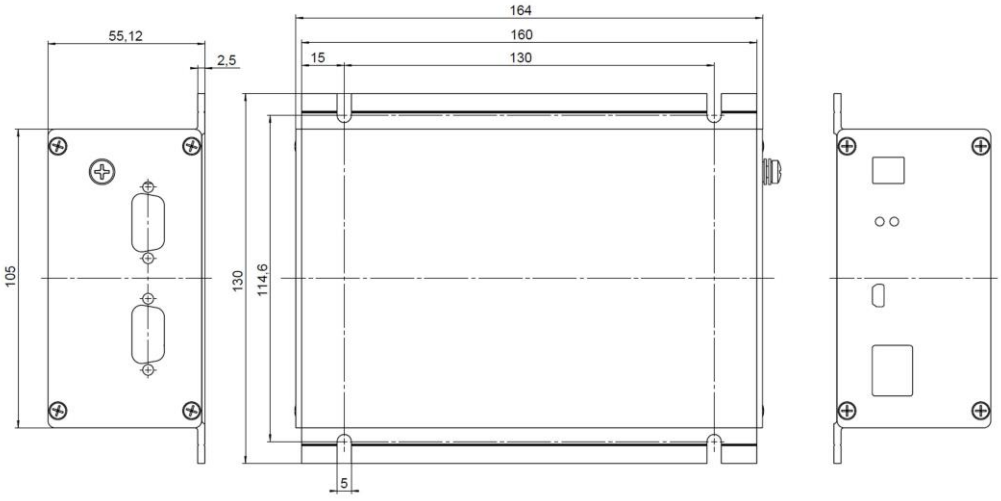


Figure 3: E-135.601M drive electronics, dimensions in mm

Pin Assignment

Figure 4: **PZT 1…3** and **PZT 4…6** HD Sub-D 15 (f) sockets on the E-135.601M drive electronics

Pin	Signal	Function	Direction
1	GND	Ground	GND
2	5 V	5 V supply voltage for the ID-chip and temperature sensor for actuator 1	Output
3	ID1	ID-chip and temperature sensor for actuator 1	Bidirectional
4	GND	Ground	GND
5	GND	Ground	GND
6	5 V	5 V supply voltage for the ID-chip and temperature sensor for actuator 0	Output
7	ID0	ID-chip and temperature sensor for actuator 0	Bidirectional
8	GND	Ground	GND
9	5 V	5 V supply voltage for the ID-chip and temperature sensor for actuator 2	Output
10	ID2	ID-chip and temperature sensor for actuator 2	Bidirectional
11	Piezo0	Piezo voltage for actuator 0	Output
12	GND	Ground	GND
13	Piezo1	Piezo voltage for actuator 1	Output
14	GND	Ground	GND
15	Piezo2	Piezo voltage for actuator 2	Output

Old Equipment Disposal

In accordance with EU law, electrical and electronic equipment may not be disposed of in EU member states via the municipal residual waste.

Dispose of your old equipment according to international, national, and local rules and regulations.

In order to fulfil the responsibility as the product manufacturer, Physik Instrumente (PI) GmbH & Co. KG undertakes environmentally correct disposal of all old PI equipment made available on the market after 13 August 2005 without charge.

Any old PI equipment can be sent free of charge to the following address:

Physik Instrumente (PI) GmbH & Co. KG

Auf der Roemerstrasse 1

76228 Karlsruhe, Germany

EU Declaration of Conformity

For the E-135.601M, an EU Declaration of Conformity has been issued in accordance with the following European directives:

Low Voltage Directive (LVD)

EMC Directive

RoHS Directive

The applied standards certifying the conformity are listed below.

Safety (LVD):	EN 61010-1
EMC:	EN 61326-1
RoHS:	EN 50581