

MP102E M-230 Linear Actuators User Manual

Version: 1.2

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This document describes the following linear actuators with limit switches:

- **M-230.10**
DC Drive, 10 mm Travel Range,
High-Resolution
- **M-230.25**
DC Drive, 25 mm Travel Range,
High-Resolution
- **M-230.10S**
Stepper Motor Drive, 10 mm Travel Range,
High-Resolution
- **M-230.25S**
Stepper Motor Drive, 25 mm Travel Range,
High-Resolution



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Original instructions

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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download on our website.

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1 About this Document

1.1 Goal and Target Audience of this User Manual

This manual contains information on the intended use of the M-230.

It assumes that the reader has a fundamental understanding of basic servo systems as well as motion control concepts and applicable safety procedures.

The latest versions of the user manuals are available for download on our website.

1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

CAUTION



Dangerous situation

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

- Actions to take to avoid the situation.

NOTICE



Dangerous situation

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

- Actions to take to avoid the situation.

INFORMATION

Information for easier handling, tricks, tips, etc.

| Symbol | Meaning |
|--------|--|
| 1. | Action consisting of several steps whose sequential order must be observed |
| 2. | |

| Symbol | Meaning |
|---------------|---|
| ➤ | Action consisting of one or several steps whose sequential order is irrelevant |
| ▪ | List item |
| p. 5 | Cross-reference to page 5 |
| RS-232 | Labeling of an operating element on the product (example: socket of the RS-232 interface) |

1.3 Other Applicable Documents

The devices and software tools which are mentioned in this documentation are described in their own manuals.

| Product | Document |
|---------------------|---------------------------------------|
| Linear actuators | MP122EK Short Instructions |
| Suitable Controller | User manual of the applied controller |

2 Safety

2.1 Intended Use

The M-230 is a laboratory device as defined by DIN EN 61010-1. It is intended to be used in interior spaces and in an environment which is free of dirt, oil, and lubricants.

Based on its design and realization, the M-230 is intended for positioning, adjusting and shifting loads in one axis at various velocities.

The intended use of the M-230 is only possible when installed and with a suitable controller (p. 11). The controller is not included in the scope of delivery of the M-230.

2.2 General Safety Instructions

The M-230 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the M-230.

- Only use the M-230 for its intended purpose, and only use it if it is in a good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the M-230.

2.2.1 Organizational Measures

User manual

- Always keep this user manual available by the M-230.
The latest versions of the user manuals are available for download on our website.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.

- If you pass the M-230 on to other users, also turn over this user manual as well as 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 property damage.
- Only install and operate the M-230 after having read and understood this user manual.

Personnel qualification

The M-230 may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

2.2.2 Safety Measures during Installation

A cable break leads to a failure of the linear actuator.

- Install the linear actuator so that the cable is not bent or squeezed too severely during operation.

Lateral forces that affect the pusher of the linear actuator increase the friction on the internal drive components. Increased friction impairs the motion of the pusher and increases wear on the drive components.

- Avoid lateral forces on the tip and on the pusher of the M-230.

The motion of the pusher can be hindered by a mounting nut that has been tightened too strongly. This reduces the positioning accuracy.

- Tighten the mounting nut to a maximum torque of 1.7 Nm.

The heat produced during operation of the M-230 can affect your application.

- Install the M-230 so that your application is not affected by the dissipating heat.

2.2.3 Safety Measures during Start-Up

A motorized linear actuator can generate powerful forces depending on the gear ratio.

Connecting a linear actuator to an unsuitable controller can cause damage to the linear actuator or controller.

- Connect a linear actuator with DC motor to a DC motor controller only.
- Connect a linear actuator with stepper motor to a stepper motor controller only.

Faulty motor controllers can cause unintentional motor motion and run the M-230 into the hard stop.

The linear actuator can perform an unintentional motion when connecting it to the motor controller.

- Do not place any objects in areas where they can get caught by moving parts.
- Keep your fingers at a safe distance from the motion range of the M-230.

The collision of moving parts with the hard stop (end of travel range), as well as high acceleration, can cause damage to, or considerable wear on the mechanical system.

- In the event of a malfunction of the motor controller, stop the motion immediately.
- Ensure that the end of the travel range is approached at low velocity.
- Set your control signal so that the moving part does not stop abruptly or try to continue moving at the end of the travel range.
- Determine the maximum velocity for your application.
- Ensure that the automatic limit switch halt is supported by the controller, or that it is activated in the controller.

2.2.4 Safety Measures during Operation

For models with DC motors:

Unsuitable settings made to the servo-control parameters can impair the performance of the M-230. The consequences of this can be expressed as follows:

- Oscillations
- Imprecise approach of the position

- Settling time is too long
- If the performance of the M-230 is not satisfactory, check the settings for the servo-control parameters of your controller.

2.2.5 Safety Measures During Maintenance

The M-230 is precisely aligned.

- Do not loosen any sealed screw.

3 Product Description

3.1 System Overview

The following figure shows an overview of the total system.

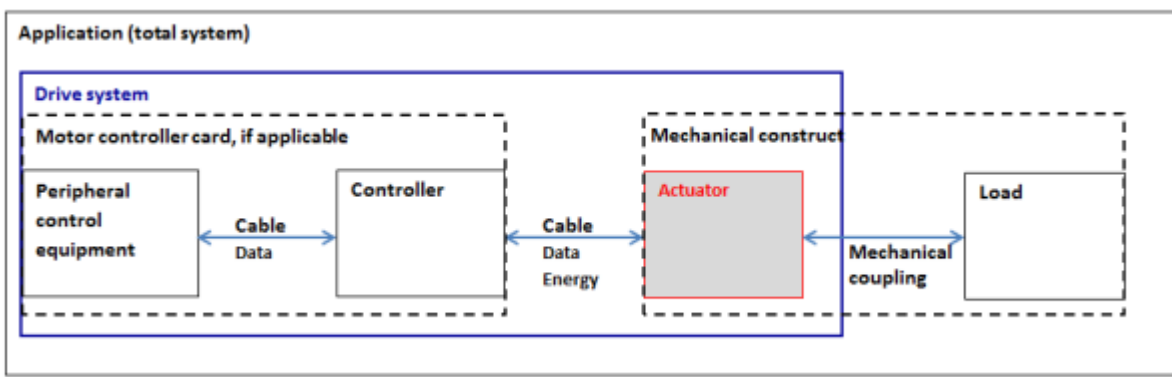


Figure 1: Overall system, overview

To operate the actuator in your application, the following components are necessary:

| Component | Task | Supplied by or available from PI |
|------------------------------|---|---|
| Peripheral control equipment | Loads configurations and control commands to the controller (e.g. PC in connection with PC software). | PC software (e.g. PIMikroMove) included in the scope of delivery of PI controllers. |
| Controller | Controls the motions of the actuator. | Stand-alone device or motor controller card (PC add-on card). Available separately, see section "Suitable Controllers" (p. 11). |
| Actuator | Produces the motions of the part to be driven or the load in your application. | Here: linear actuator, type M-230. Present product. |

| Component | Task | Supplied by or available from PI |
|----------------------|---|--|
| Cables | <ul style="list-style-type: none"> ▪ Peripheral control equipment to controller: Ensures the data communication. ▪ Controller to actuator: Ensures the data communication and the power source of the actuator. | <ul style="list-style-type: none"> ▪ Transmission cable between PC and controller. Included in the scope of delivery of PI controllers. ▪ Transmission cable between controller and actuator: Part of the actuator or included in the scope of delivery of the piezo actuator. |
| Mechanical structure | Ensures among other things the secure fixation of the actuator and thus a high repeatability. | Only mounting nut (for mechanical connection) included in the scope of delivery of the actuator. |
| Mechanical coupling | Establishes the connection between the actuator and the load (pusher with a separate tip, depending on the model). | Also in case exchangeable parts can be used, all options are included in the scope of delivery of the actuator (e.g. tips). |
| Load | Part to be driven. This is to be moved in your application. | - |

If a motor controller card is used, the "controller" component and the connection between the peripheral control equipment and the controller ("cable") are physically inside of the PC.

3.2 Features and Applications

The motorized precision drives of the M-230 series are linear actuators with travel ranges of 10 mm and 25 mm. Using a preloaded DC gear motor with a high-resolution rotary encoder and an extremely low-friction and zero-backlash design, they achieve minimum incremental motions of 50 nm. A design with a stepper motor is also on offer.

Integrated limit and reference point switches, plus line drivers enable the simple installation in automation solutions and protect the mechanical system of the actuator.

3.3 Model Overview

There are six standard versions of the M-230. All models are high-resolution linear actuators with a limit switch. They differ in terms of:

- Drive type
- Travel range

| Model | Travel range | | Drive Type | |
|------------------|--------------|-------|-------------|---------------|
| | 10 mm | 25 mm | DC gearhead | Stepper motor |
| M-230.10 | + | | + | |
| M-230.10S | + | | | + |
| M-230.10V | + | | + | |
| M-230.25 | | + | + | |

- For further technical data, see the specifications (p. 33).

PI also produces custom designs upon request. Custom designs can differ from the described standard products in respect to dimensions, characteristics or other technical data.

- If necessary, contact our customer service department (p. 31) directly.

3.4 Product View

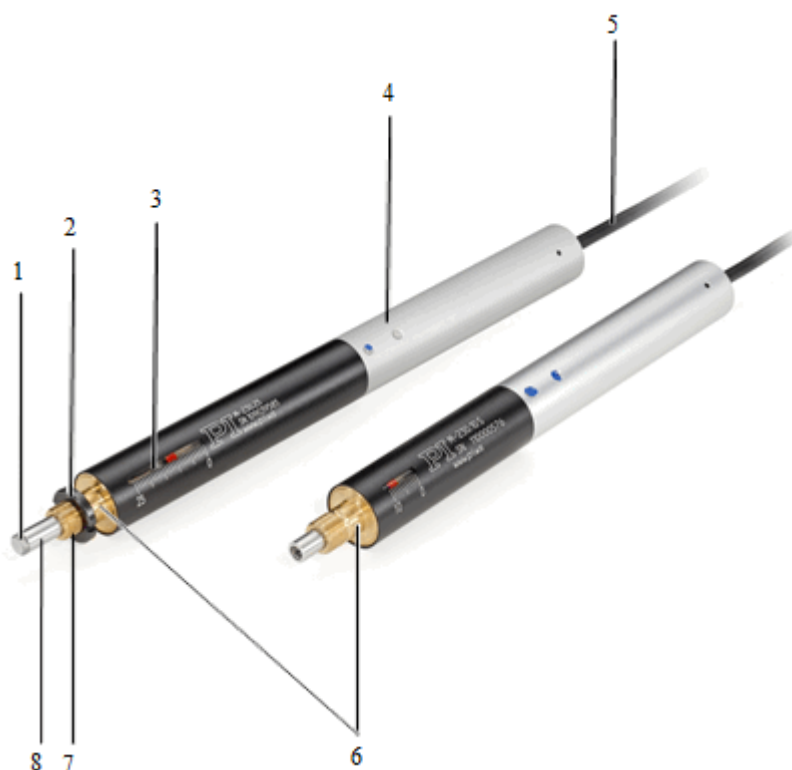


Figure 2: Product view: M-230 with 25 mm (left) and 10 mm (right) travel range

- 1 Tip, replaceable (here: flat)
- 2 Mounting nut for clamp connection
- 3 Window with position display
- 4 Sleeve
- 5 Cable for connecting to the controller
- 6 Mounting shaft
- 7 Thread for mounting nut
- 8 Pusher, non-rotating

3.5 Scope of Delivery

| Order Number | Items |
|--------------|---|
| M-230 | Linear actuator according to order (p. 9), with flat tip (assembled on delivery), spherical tip and hook wrench |
| MP122EK | Short instructions |

3.6 Suitable Controllers

The M-230 must be connected to a suitable controller (see Data Table, p. 33).

The required PC software is included in the scope of delivery of the controllers from PI. The operation of the controllers is described in the corresponding user manuals.

3.7 Accessories

| Order Number | Description |
|--------------|---|
| C-842.AP1 | Adapter box PWM analog to operate M-230 linear actuators with PWM signals |

To order, contact our customer service department (p. 31).

3.8 Technical Features

3.8.1 Rotary Encoder

The models with DC motors are equipped with a rotary encoder. A rotary encoder, also called an incremental or incremental rotary encoder, is implemented at a rotating point in the drivetrain, e.g. the motor shaft. To determine the relative position, the controller counts the encoder signals, the so-called impulses.

3.8.2 Limit Switches

The M-230 is equipped with non-contact, Hall-effect limit switches.

Each limit switch sends an overtravel signal on a dedicated line to the controller. The controller then stops the motion. If the controller does not stop the motion in time, the linear actuator runs into the hard stop.

See "Limit Switch Specifications" (p. 35) for more information.

3.8.3 Reference Point Switch

The M-230 is equipped with a reference point switch, which is located at about the midpoint of the travel range. The reference point switch transmits an index pulse (TTL) when being passed.

In order to use the reference point switch signal for reference moves, the controller must support the reference signal type "index pulse" (see user manual of the controller).

For more information, see "Reference Point Switch Specifications" (p. 35).

4 Unpacking

1. Unpack the M-230 with care.
2. Compare the contents against the items covered by the contract and against the packing list.
3. Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installation

5.1 General Notes on Installation

NOTICE

**Cable break!**

A cable break leads to a failure of the linear actuator.

- Install the linear actuator so that the cable is not bent or squeezed too severely during operation.

NOTICE

**Increased friction!**

Lateral forces that affect the pusher of the linear actuator increase the friction on the internal drive components. Increased friction impairs the motion of the pusher and increases wear on the drive components.

- Avoid lateral forces on the tip and on the pusher of the M-230.

NOTICE

**Heating up of the M-230 during operation!**

The heat produced during operation of the M-230 can affect your application.

- Install the M-230 so that your application is not affected by the dissipating heat.

INFORMATION

Models with DC gear motors are equipped with integrated signal drivers for cable lengths ≤ 10 m between the linear actuator and the motor controller.

5.2 Changing the Tip

INFORMATION

The supplied tips make it possible to realize different mechanical connections to a load:

- A flat tip allows a wide-area connection to a load.
- A spherical tip allows a punctiform connection to a load.

To achieve optimum repeatability:

- Use a tip.

Make sure that the selected tip is completely screwed in and does not have any backlash.

The tip is used to establish contact with the load. A flat tip is delivered pre-assembled; a spherical tip is also provided.

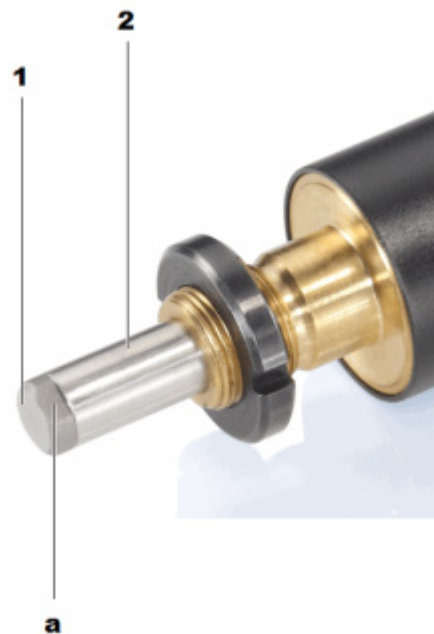


Figure 3: Mounted tip (flat)

- 1 (Flat) tip with
(a) wrench flat
- 2 Pusher

Prerequisites

- ✓ You have read and understood the General Notes on Installation (p. 15).
- ✓ You have made the M-230 accessible for changing the tip.
- ✓ The pusher is extended so far that you can comfortably reach the tip. In the delivery condition, the pusher is extended far enough.

Tools and accessories

- Supplied tip
- Open-end wrench SW 5

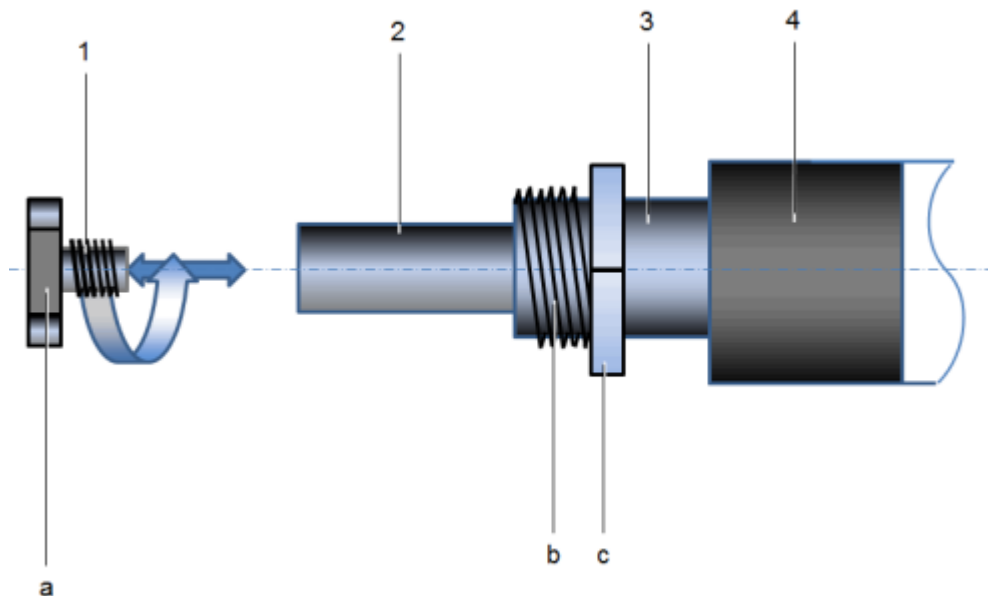


Figure 4: Changing the tip, schematic

- 1 (Flat) tip with
(a) wrench flat
- 2 Pusher, non-rotating
- 3 Mounting shaft with
(b) thread (for clamp connection, 3/8-40)
(c) mounting nut
- 4 Sleeve

Changing the tip

1. Manually unscrew the tip to be replaced from the pusher of the M-230. If this is not successful, use an AF 5 open-end wrench.
2. Manually screw the new end into the pusher of the M-230.

5.3 Providing a Suitable Mechanical Mounting and Installation Environment

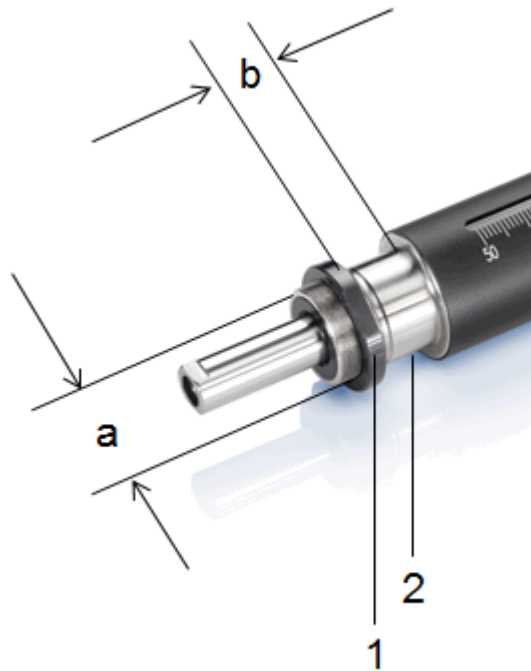


Figure 5: Relevant components and dimensions for installation in the mechanical mounting (schematic)

- 1 Mounting nut, 3/8 inch
- 2 Mounting shaft with
 - (a) diameter: 19 mm
 - (b) clamping width: 7 mm to 11 mm usable

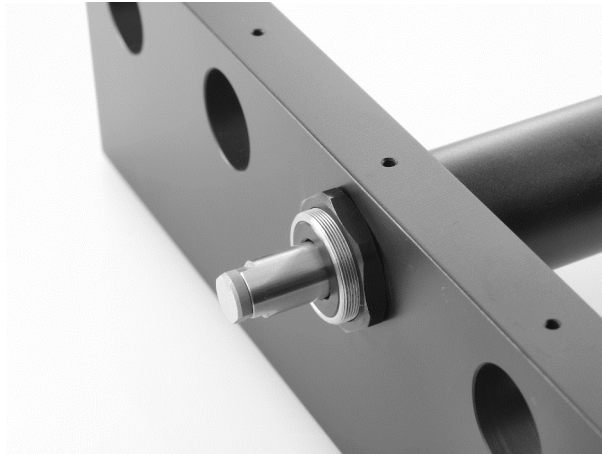


Figure 6: Example for the installation of a mike actuator (here: an M-235)

A suitable mechanical mounting and installation environment are necessary for the proper use of the actuator.

- Make sure that the following conditions have been met:
 - Material and statics of the mounting are designed so that the static and dynamic forces that occur can be safely and continuously managed.
 - The dimensions of the mounting are adapted to the dimensions of the actuator (see above figures and dimensions (p. 36)).
 - The intended motions of the pusher and the load must not be inhibited by the dimensions of the installation environment.
- Take into account the following specifications as well when planning the application and installing the actuator:
 - Dimensions of the selected tip (see Dimensions (p. 36))
 - Travel range: maximum 10 mm (M-230.10x models) or 25 mm (M-230.25xmodels)
 - Space requirements for a kink-free and proper guiding of the connection cable and additional motor cables
 - Length of the connection cable (approx. 0.5 m) and additional motor cables (3 m or 10 m)
 - Position of the position display of the actuator when it is to be read during operation.
- If the limit switches of the actuator cannot be reached with the planned minimum and maximum displacements: Make sure that the actuator and the load **only move within the planned range**. Suitable measures:

- Corresponding programming of the controller
- Emergency off switch
- Automatic shutdown systems
- Avoid or label danger areas that result from the installation of the actuator and from use, in accordance with the legal regulations (e.g. risk of crushing in the case of heavy moving loads, fast actuator motions and/or high drive torques).

The complete dimensions of the actuator and relevant individual parts can be found in the figures in the section Dimensions (p. 36).

5.4 Installing the Linear Actuator in a Mechanical Mounting

NOTICE



Incorrect tightening torque of the mounting nut!

The motion of the pusher can be hindered by a mounting nut that has been tightened too strongly. This reduces the positioning accuracy.

- Tighten the mounting nut to a maximum torque of 1.7 Nm.

INFORMATION

To achieve an optimum repeatability, the mounting shaft must not have any backlash.

- During mounting, make sure that there is a faultless connection between the actuator and the mechanical mounting.

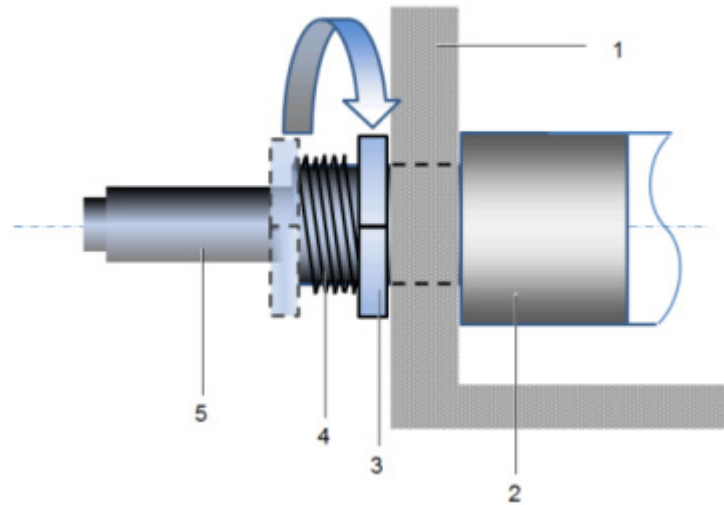


Figure 7: Clamp connection (schematic)

- 1 Mechanical mounting
- 2 Sleeve
- 3 Mounting nut, 3/8 inch
- 4 Mounting shaft with thread
- 5 Pusher with tip (flat)

We recommend installing the actuator in the mechanical mounting with a clamp connection. The following instructions refer to this case.

Prerequisites

- ✓ You have read and understood the General Notes on Installation (p. 15).
- ✓ You have provided your application with a suitable mounting for the mounting shaft of the actuator.

Tools and accessories

- Supplied hook wrench (p. 11)

Installing the actuator

1. Loosen the mounting nut on the mounting shaft of the actuator.
2. Position the actuator in the mounting of your application.
3. If necessary, stick a suitable flat washer or a suitable spring washer on the mounting shaft.
4. Manually screw the mounting nut into the thread of the mounting shaft with a few rotations.

5. To clamp the actuator in the mounting, tighten the mounting nut using the supplied hook wrench until you feel a resistance. The torque must **not** exceed 1.7 Nm!
6. Check that the actuator is correctly fitted in the mounting.

6 Start-Up

6.1 General Notes on Start-Up

CAUTION



Unintentional motion of the linear actuator while connecting it to the motor controller!

- Do not place any objects in areas where they can get caught by moving parts.
- Keep your fingers at a safe distance from the motion range of the linear actuator.

NOTICE



Damage if a wrong motor controller is connected!

Connecting a linear actuator to an unsuitable controller can cause damage to the linear actuator or controller.

- Connect a linear actuator with DC motor to a DC motor controller only.
- Connect a linear actuator with stepper motor to a stepper motor controller only.

NOTICE



Damage due to the pusher crashing into the hard stop!

When the limit switches are deactivated, the motion of the pusher is aborted by the hard stop and the M-230 can be damaged.

- Do **not** deactivate the limit switches in the software.
- Test limit switch operation at low velocities only.

NOTICE**Damage or considerable wear from high accelerations!**

High accelerations can cause damage to or considerable wear on the mechanical system.

- Stop the motion immediately if a controller malfunction occurs.
- Ensure that the end of the travel range is approached at low velocity.
- Set your control signal so that the moving part does not stop abruptly or try to continue moving at the end of the travel range.
- Determine the maximum velocity for your application.

NOTICE**Damage from unsuitable controllers and PC software!**

Unsuitable controllers and PC software can cause damage to the actuator.

- If you use controllers and software from other manufacturers, **before** starting up the actuator, check the technical data to make sure that they are suitable!

INFORMATION

The maximum velocity for a linear actuator with a stepper motor should be determined in the application. If the commanded velocity is too high, the stepper motor might stop without the controller detecting this condition.

INFORMATION

For models with DC motors:

Unsuitable settings made to the servo-control parameters can impair the performance of the M-230. The consequences of this can be expressed as follows:

- Oscillations
- Imprecise approach of the position
- Settling time is too long
- If the performance of the M-230 is not satisfactory, check the settings for the servo-control parameters of your controller.

INFORMATION

Moving the pusher outwards corresponds to the positive direction of motion.

6.2 Starting Up the Actuator

In the following, a PC with PC software is used as the peripheral control equipment of the controller.

Prerequisites

- ✓ You have read and understood the General Notes on Start-Up (p. 23).
- ✓ You have correctly installed the actuator (p. 15).
- ✓ You have read and understood the user manual of the used controller.
- ✓ You have read and understood the manual of the used PC software.

Accessories

- Suitable controller (p. 11) - motor controller card for PC installation or stand-alone device incl. connection cable to PC.
- PC
- PC software for the controller (for PI controllers: included in their scope of delivery)
- If necessary, suitable motor cable from PI, e.g.:
 - Motor cable C-815.38, 3 m, D-Sub 15 (m/f),
 - Motor cable C-815.83, 10 m, D-Sub 15 (m/f)

Starting up the actuator

1. If you use a motor controller card (e.g. C-843 from PI), make sure that it is properly installed or install it (see the user manual of the motor controller card).
2. If suitable and current PC software for the controller is not on your PC yet, install the PC software (see the user manual of the controller or the software).
3. If you do **not** use a motor controller card, connect the PC with the external controller using a suitable cable.
For PI products: the cable required for this is included in the scope of delivery.

4. Connect the actuator with the controller:
 - a) Determine the minimum necessary cable length between the actuator and the controller.
 - b) Connect the connector of the connection cable with the Sub-D socket of the controller or a corresponding adapter (according to the determined length, see above) either directly or by interposing an additional motor cable.
 - c) Secure all connections with the integrated screws against accidental disconnection.
 - d) Remove or label resulting danger areas in accordance with the valid legal regulations and directives.
5. Start up the controller (see user manual of the controller).
6. Configure the controller using the PC software for the used actuator (see the user manual of the controller and the PC software):
 - If you use a PI controller: select the entry in the stage database that precisely matches the actuator version used, see the list of available entries (p. 26).
 - If you use a controller from another manufacturer: Enter the parameters in the corresponding PC software that precisely match the actuator version used.
7. Start a few motion cycles for testing purposes (see user manual of the controller).

6.2.1 M-230 Entries in the Stage Database of PI

For motor controllers from PI you can select the connected linear actuator from a stage database in the respective PC software. The appropriate operating parameters are thus loaded into the motor controller. You can find a detailed description in the user manual for the motor controller or in the manual for the PC software used.

7 Maintenance

7.1 General Notes on Maintenance

NOTICE



Damage due to improper maintenance!

The M-230 can become misaligned as a result of improper maintenance.

- Do not loosen any sealed screws.

7.2 Lubricating the M-230

Depending on the operational conditions and the period of use of the linear actuator, the following maintenance measures are required.

Spreading lubricant

- If you operate the M-230 continuously on a small travel range (<20% of the entire travel range), perform a maintenance run every 2000 motion cycles across the entire travel range.

Lubrication

Under laboratory conditions, the linear actuator needs extra lubrication in exceptional cases only. For continuous industrial use the lubrication intervals must be defined individually.

- Do not lubricate the M-230 without consulting our customer service department (p. 31).
- To lubricate, follow the instructions given in the maintenance manual which you can obtain from our customer service department.

7.3 Cleaning the M-230

Prerequisites

- ✓ You have disconnected the linear actuator from the controller.

Cleaning the linear actuator

- Do **not** use any organic solvents.
- When necessary, clean the surfaces of the linear actuator with a cloth slightly dampened with a mild cleanser or disinfectant.

8 Troubleshooting

| Problem | Possible Causes | Solution |
|--|--|--|
| Reduced positioning accuracy | Mounting nut is fastened too tight | ➤ Tighten the mounting nut to a maximum torque of 1.7 Nm. |
| Functional impairment after system modification | <ul style="list-style-type: none"> ▪ Motor controller has been replaced ▪ M-230 has been replaced with another model | <p>Motor controllers from PI:</p> <ul style="list-style-type: none"> ➤ Load the parameters from the stage database that correspond to the combination of motor controller and M-230 model (p. 25). <p>Motor controller from a third-party supplier:</p> <ul style="list-style-type: none"> ➤ Check the operating parameters. |
| The mechanical system does not move | The cable is not connected correctly or is faulty | ➤ Check the connector cable. |
| | Lateral forces are affecting the pusher | <p>Lateral forces increase the friction on the internal drive components.</p> <ul style="list-style-type: none"> ➤ Avoid lateral forces on the tip and on the pusher of the M-230. |
| The mechanical system does not move, but generates operating noise | Values for the velocity, acceleration and/or load are too high | <ul style="list-style-type: none"> ➤ Reduce the velocity. ➤ Reduce the acceleration. ➤ Reduce the load on the mechanical system. |

| Problem | Possible Causes | Solution |
|---|--|---|
| The mechanical system did not stop in time and ran into the hard stop | <ul style="list-style-type: none">▪ Velocity is too high (see Limit Switches p. 11)▪ Limit switch is defective▪ Motor controller ignores the limit switch signal | <ol style="list-style-type: none">1. Stop the motor.2. Command the mechanical system away from the hard stop.3. Check the settings of the motor controller for the limit switch processing. |

If the problem that occurred with your system is not listed in the table above or it cannot be solved as described, contact our customer service department (p. 31).

9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an e-mail (<mailto:service@pi.de>).

If you have questions concerning your system, have the following information ready:

- Product codes and serial numbers of all products in the system
- Firmware version of the controller (if present)
- Version of the driver or the software (if present)
- Operating system on the PC (if present)

The latest versions of the user manuals are available for download on our website.

10 Technical Data

10.1 Specifications

10.1.1 Data Table

| | M-230.10 / M-230.25 | M-230.10S / M-230.25S | Unit | Tolerance |
|--------------------------------|----------------------------|------------------------------|-------------|------------------|
| Motion and positioning | M-230.10 / M-230.25 | M-230.10S / M-230.25S | Unit | Tolerance |
| Travel range | 10 / 25 | 10 / 25 | mm | |
| Integrated sensor | Rotary encoder | - | | |
| Sensor resolution | 2048 | - | cts./rev. | |
| Design resolution | 0.0046 | 0.037 | µm | typ. |
| Minimum incremental motion | 0.05 | 0.1 | µm | typ. |
| Backlash | 2 | 2 | µm | typ. |
| Unidirectional repeatability | ±0.1 | ±0.1 | µm | typ. |
| Velocity | 0.8 | 1.2 | mm/s | max. |
| Reference switch repeatability | 1 | 1 | µm | typ. |
| Mechanical properties | M-230.10 / M-230.25 | M-230.10S / M-230.25S | Unit | Tolerance |
| Drive screw | Leadscrew | Leadscrew | | |
| Thread pitch | 0.4 | 0.4 | mm | |
| Gear ratio | 42.92063:1 | 28.444444:1 | | |
| Motor resolution | - | 384 ⁽¹⁾ | steps/rev. | |
| Push/pull force | 70 | 45 ⁽²⁾ | N | max. |
| Permissible lateral force | 30 / 20 | 30 / 20 | N | max. |

| | M-230.10 / M-230.25 | M-230.10S / M-230.25S | Unit | Tolerance |
|---------------------------------|--|--|--------------------|--------------------|
| Drive properties | M-230.10 / M-230.25 | M-230.10S / M-230.25S | Unit | Tolerance |
| Motor type | DC gear motor | 2-phase stepper motor ⁽¹⁾ | | |
| Operating voltage | 0 to ± 12 | 24 | V | |
| Motor power | 1.78 | - | W | nominal |
| Reference and limit switches | Hall effect | Hall effect | | |
| Miscellaneous | M-230.10 / M-230.25 | M-230.10S / M-230.25S | Unit | Tolerance |
| Operating temperature range | -20 to 65 | -20 to 65 | $^{\circ}\text{C}$ | |
| Material | Anodized aluminum, chrome steel, brass | Anodized aluminum, chrome steel, brass | | |
| Mass | 0.3 / 0.35 | 0.3 / 0.35 | kg | $\pm 5\%$ |
| Cable length | 0.5 | 0.5 | m | $\pm 10\text{ mm}$ |
| Connector | D-sub 15 (m), incl. encoder driver | D-sub 15 (m) | | |
| Recommended controllers/drivers | C-863 C-884 | C-663 | | |

(1) Max. 0.25 A/phase, 24 full steps/rev., motor resolution with C-663 stepper motor controller.

(2) At a velocity to 1 mm/s.

10.1.2 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the M-230:

| | |
|---|---|
| Area of application | For indoor use only |
| Maximum altitude | 2000 m |
| Relative humidity | Highest relative humidity 80% for temperatures up to 31 $^{\circ}\text{C}$ Decreasing linearly to 50% relative humidity at 40 $^{\circ}\text{C}$ |
| Storage temperature | 0 $^{\circ}\text{C}$ to 80 $^{\circ}\text{C}$ |
| Transport temperature | 0 $^{\circ}\text{C}$ to 80 $^{\circ}\text{C}$ |
| Supply fluctuations | Not more than $\pm 10\%$ of the nominal voltage |
| Degree of pollution | 2 |
| Degree of protection according to IEC 60529 | IP40 |

10.1.3 Limit Switch Specifications

| | |
|----------------|---|
| Type | Magnetic (Hall-effect) sensor |
| Supply voltage | +5 V/ground |
| Signal output | TTL level |
| Signal logic | <p>The signal level changes when passing the limit switch. The signal logic depends on the model type:</p> <ul style="list-style-type: none"> ▪ Models with DC motor: active high. That means: <ul style="list-style-type: none"> – Normal motor operation: low (0 V) – Limit switch reached: high (+5 V) ▪ Models with stepper motor: active low. That means: <ul style="list-style-type: none"> – Normal motor operation: high (+5 V) – Limit switch reached: low (0 V) |

10.1.4 Reference Point Switch Specifications

| | |
|----------------|--|
| Type | Magnetic (Hall-effect) sensor |
| Supply voltage | +5 V/GND |
| Signal output | TTL level |
| Signal logic | Index pulse when passing the reference point switch. |

10.2 Dimensions

10.2.1 M-230.10, M-230.10S

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

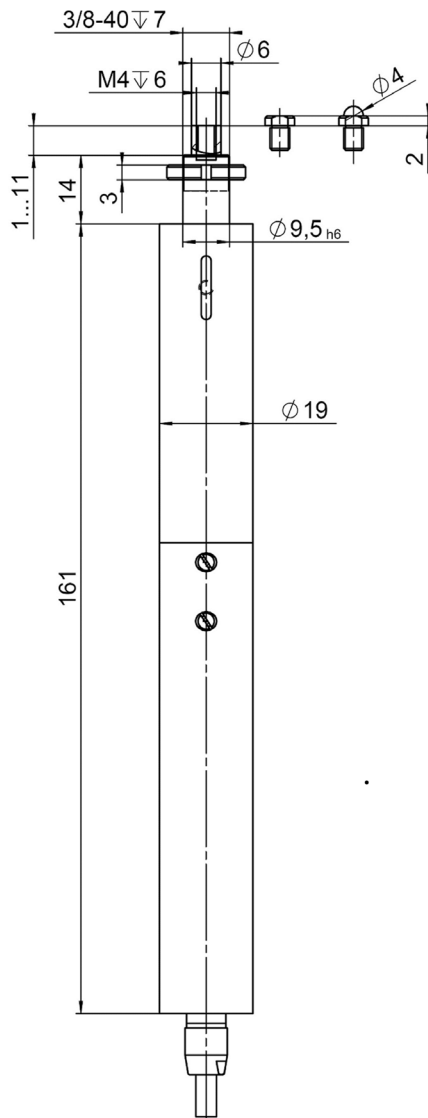


Figure 8: M-230.10, M-230.10S and M-230.10V, dimensions in mm

10.2.2 M-230.25, M-230.25S

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

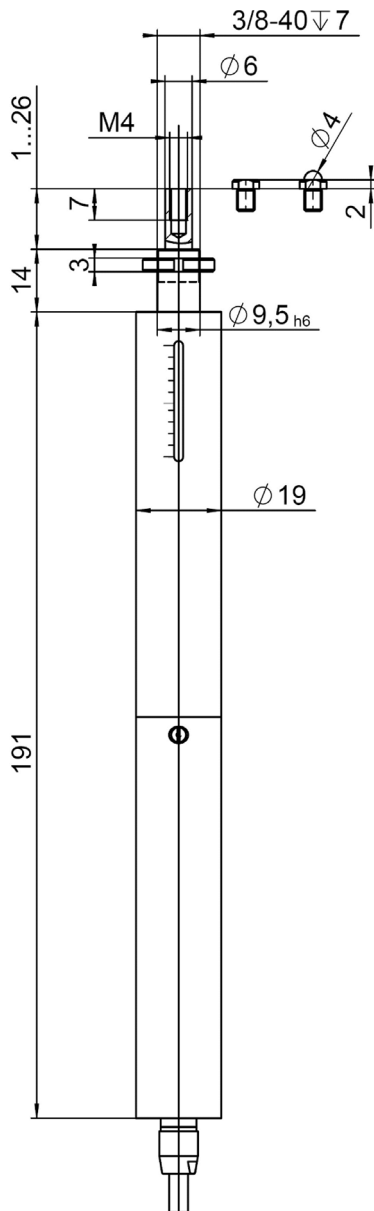


Figure 9: M-230.25, M-230.25S and M-230.25V, dimensions in mm

10.2.3 Tips

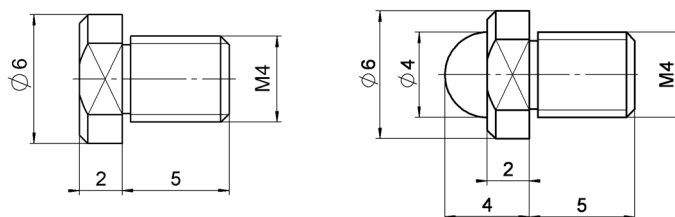


Figure 10: Flat tip (left) and spherical tip (right), dimensions in mm

10.3 Pin Assignment

10.3.1 Models with DC Gear Motor

Connector: Sub-D 15-pin (m)

| Pin no. | Function |
|---------|--|
| 1 | Internal |
| 9 | Input: Motor (-) |
| 2 | Input: Motor (+) |
| 10 | Internal |
| 3 | Internal |
| 11 | Internal |
| 4 | Input: +5 V supply from controller |
| 12 | Output: Limit switch signal, negative side |
| 5 | Output: Limit switch signal, positive side |
| 13 | Output: Reference point switch signal |
| 6 | GND (limit switch and logic) |
| 14 | Output: Encoder A (+) |
| 7 | Output: Encoder A (-) |
| 15 | Output: Encoder B (+) |
| 8 | Output: Encoder B (-) |

10.3.2 Models with Stepper Motor

Connector: Sub-D 15-pin (m)

| Pin no. | Function |
|---------|--|
| 1 | Input: Phase 1a |
| 9 | Input: Phase 1b |
| 2 | Input: Phase 2a |
| 10 | Input: Phase 2b |
| 3 | Not connected |
| 11 | Not connected |
| 4 | Not connected |
| 12 | Not connected |
| 5 | Not connected |
| 13 | Not connected |
| 6 | Input: +5 V supply from controller |
| 14 | Output: Limit switch signal, positive side |
| 7 | GND |
| 15 | Output: Reference point switch signal |
| 8 | Output: Limit switch signal, negative side |

11 Old Equipment Disposal

In accordance with the applicable EU law, electrical and electronic equipment may not be disposed of with unsorted municipal wastes in the member states of the EU.

When disposing of your old equipment, observe the international, national and local rules and regulations.

To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG ensures environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

If you have old PI equipment, you can send it postage-free to the following address:

Physik Instrumente (PI) GmbH & Co. KG
Auf der Römerstr. 1
D-76228 Karlsruhe, Germany



12 EC Declaration of Conformity

PI

Declaration of Conformity

according to DIN EN ISO/IEC 17050-1

Manufacturer: Physik Instrumente (PI)
GmbH & Co. KG
**Manufacturer's
Address:** Auf der Roemerstraße 1
D-76228 Karlsruhe,
Germany



The manufacturer hereby declares that the product

Product Name: **Precision Linear Actuator**

Model Numbers: **M-230**

Product Options: **all**

complies with all relevant provisions of the **Machinery Directive (2006/42/EC)**.
Furthermore, it complies with all provisions of the **Low Voltage Directive (2006/95/EC)** and the **EMC Directive (2004/108/EC)**.

The applied standards certifying the conformity are listed below.

Safety of Machinery: EN 12100-1, EN-12100-2


Safety (Low Voltage Directive): EN 61010-1

Electromagnetic Emission: EN 61000-6-3, EN 55011

Electromagnetic Immunity: EN 61000-6-1

The person authorized to compile the technical file is: Wolfgang Schobel
Address: see manufacturer's address

April 06, 2011
Karlsruhe, Germany


Dr. Karl Spanner
President

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