**MP99E**

# M-683 Linear Stage

## User Manual

Version: 1.4.0 Date: 04.06.2014

**This document describes the following products:**

- **M-683.2U4**
  PILine® High-Speed Linear Stage, 50 mm, 6 N
- **M-683.2V4**
  PILine® High-Speed Linear Stage, 50 mm, 6 N, Vacuum Compatible to $10^{-6}$ hPa



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Germany: DE102004024656A1, DE102004044184B4, DE102004059429B4, DE102005010073A1, DE102005039357B4, DE102005039358A1, DE102006041017B4, DE102008012992A1, DE102008023478A1, DE102008058484A1, DE102010022812A1, DE102010047280A1, DE102010055848, DE102011075985A1, DE102011082200A1, DE102011087542B3, DE102011087542B3, DE102011087801B4, DE102011108175, DE102012201863B3, DE19522072C1, DE19938954A1

Europe: EP0789937B1 EP1210759B1, EP1267425B1, EP1581992B1, EP1656705B1, EP1747594B1, EP1812975B1, EP1861740B1, EP1915787B2, EP1938397B1, EP2095441B1, EP2130236B1, EP2153476B1, EP2164120B1, EP2258004B1, EP2608286A2

USA: US2010/0013353A1, US5872418A, US6765335B2, US6806620B1, US6806620B1, US7218031B2, US7598656B2, US7737605B2, US7795782B2, US7834518B2, US7973451B2, US8253304B2, US8344592B2, US8482185B2

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# 1 About this Document

## In this Chapter

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## 1.1 Goal and Target Audience of this User Manual

This manual contains information on the intended use of the M-683.

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 (p. 3) 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/Label | Meaning |
|---|---|
| 1.<br>2. | Action consisting of several steps whose sequential order must be observed |
| ➢ | 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) |
|  | Warning sign on the product which refers to detailed information in this manual. |

## 1.3 Definition

| Term | Explanation |
|---|---|
| Load capacity | Maximum load capacity in the vertical direction when the stage is mounted horizontally. The contact point of the load is in the center of the platform. |
| Linear encoder | The linear encoder is an incremental sensor for capturing changes in position. Signals from the sensor are used for axis position feedback. After switching on the controller a reference point definition must be performed before absolute target positions can be commanded and reached. |

## 1.4 Figures

For better understandability, the colors, proportions and degree of detail in illustrations can deviate from the actual circumstances. Photographic illustrations may also differ and must not be seen as guaranteed properties.

## 1.5 Other Applicable Documents

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

| Description | Document |
|---|---|
| C-867.160 PILine® controller | MS185E User Manual |
| C-867.260 PILine® controller | MS189E User Manual |
| C-867.OE PILine® controller | MS195E User Manual |
| M-110 Microtranslation Stage | MP41E User Manual |
| PIMikroMove | SM148E Software Manual |
| PILine® stages | MP121EK Short Instructions |

## 1.6 Downloading Manuals

***INFORMATION***

If a manual is missing on our website or if there are problems in downloading:

➢ Contact our customer service department (p. 47).

The current versions of the manuals are found on our website. For some products (e.g. Hexapod systems and electronics that are delivered with a CD), access to the manuals is password-protected. The password is stored on the CD.

## Download freely accessible manuals

1. Open the website **http://www.pi-portal.ws**.
2. Click ***Downloads***.
3. Click the corresponding category (e.g. ***M Hexapods / Micropositioning***)
4. Click the corresponding product code (e.g. ***M-683***).
5. Click ***Documents***.

   The available manuals are displayed.
6. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

## Download password-protected manuals

1. Carry out steps 1 to 5 of the download process for freely accessible manuals.
2. Insert the product CD in the PC drive.
3. Switch to the ***Manuals*** directory on the CD.
4. In the ***Manuals*** directory, open the Release News (file including ***releasenews*** in the file name).
5. Find the user name and password in the ***User login for software download*** section in the Release News.
6. In the ***User login*** area on the left margin in the website, enter the user name and the password in the corresponding fields.
7. Click ***Login***.

   The available manuals are displayed.
8. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

# 2 Safety

## In this Chapter

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General Safety Instructions ..... 5
Organizational Measures ..... 7
Measures for Handling Vacuum-Compatible Products ..... 7

## 2.1 Intended Use

The M-683 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.

In accordance with its design and realization, the M-683 is intended for single-axis positioning, adjusting and shifting of loads at different velocities in interval operation. The M-683 is **not** intended for applications in areas in which a failure would present severe risks to human beings or the environment.

The intended use of the M-683 is only possible when completely mounted and connected.

The M-683 uses PILine® ultrasonic piezo linear motors as a drive and must be operated with a suitable controller (p. 12). The controller is not included in the scope of delivery of the M-683.

## 2.2 General Safety Instructions

The M-683 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-683.

- Only use the M-683 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-683.

Piezomotors are driven by piezo actuators. After being disconnected from the electronics, piezo actuators can stay electrically charged for several hours. Temperature changes can also induce charges in piezo actuators. Touching charged parts of the M-683 can cause slight injuries from electric shock.

- Do **not** open the M-683.
- Do **not** touch the contacts in the connector of the M-683.

If a protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the M-683 in the case of malfunction or failure of the system. If touch voltages exist, touching the M-683 can result in minor injuries from electric shock.

- Connect the M-683 to a protective earth conductor (p. 19) before start-up.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e. g. in the case of modifications), reconnect the M-683 to the protective earth conductor before starting it up again.

Mechanical forces can damage or misalign the M-683.

- Avoid impacts that affect the M-683.
- Do **not** drop the M-683.
- Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 49).

## 2.3 Organizational Measures

### User manual

- Always keep this user manual available by the M-683.
  The latest versions of the user manuals are available for download (p. 3) 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-683 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-683 after having read and understood this user manual.

### Personnel qualification

The M-683 may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

## 2.4 Measures for Handling Vacuum-Compatible Products

When handling the vacuum version of the stage, attention must be paid to appropriate cleanliness. At PI, all parts are cleaned before assembly. During assembly and measurement, powder-free gloves are worn. Afterwards, the stage is cleaned once again by wiping and shrink-wrapped twice in vacuum-compatible film.

- Only touch the stage with powder-free gloves.
- If necessary, wipe the stage clean after unpacking.

# 3 Product Description

## In this Chapter

Model Overview ..... 9
Product View ..... 10
Product Labeling ..... 10
Scope of Delivery ..... 12
Suitable Controllers ..... 12
Accessories ..... 13
Technical Features ..... 13

## 3.1 Model Overview

The M-683 is available in the following versions:

| Model | Description |
|---|---|
| M-683.2U4 | PILine® high-speed linear stage, 50 mm, 6 N |
| M-683.2V4 | PILine® high-speed linear stage, 50 mm, 6 N, vacuum compatible to $10^{-6}$ hPa |

## 3.2 Product View


*Figure 1: M-683 product view*

*1 Cable for connection to the controller*
*2 Moving platform*
*3 Base body*
*x Positive direction of motion of the stage*

## 3.3 Product Labeling

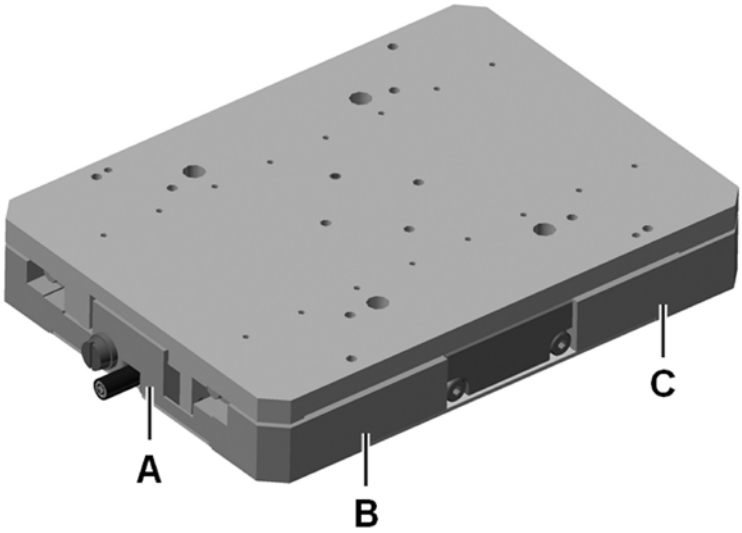



*Figure 2: M-683: Position of the product labeling (example view)*

| Position | Labeling | Description |
|---|---|---|
| A |  | Symbol for the protective earth conductor, marks the protective earth connection of the M-683 |
| A |  | Old equipment disposal (p. 61) |
| B |  | CE conformity mark |
| C |  | Warning sign "Observe manual!" |
| C |  | Manufacturer's logo |
| C | M-683.2U4 | Product name (example), the places after the point refer to the model |
| C | WWW.PI.WS | Manufacturer's address (website) |
| C | 114000939 | Serial number (example), individual for each M-683<br>Meaning of the places (counting from left):<br>1 = internal information<br>2 and 3 = manufacturing year<br>4 to 9 = consecutive numbers |
| C | Country of origin: Germany | Country of origin |

## 3.4 Scope of Delivery

| Item ID | Components |
|---|---|
| M-683.2U4<br>or<br>M-683.2V4 | PILine® high-speed linear stage, 50 mm, 6 N<br><br>PILine® high-speed linear stage, 50 mm, 6 N, vacuum compatible to $10^{-6}$ hPa, including:<br>▪ C-815.VF vacuum feedthrough, Sub-D 15-pin (m/f)<br>▪ K030B0420 extension cable for PILine®, MDR14 to Sub-D 15-pin, 1.5 m, on the air side<br>▪ C815T0003 Technical Note for C-815.VF |
| 000036450 | M4 screw set for protective earth, consisting of:<br>▪ 1 M4x8 flat-head screw with cross recess, ISO 7045<br>▪ 2 safety washers<br>▪ 2 flat washers |
| 000026699 | Screw set:<br>▪ 6 M3x16 socket-head cap screws ISO 4762<br>▪ 1 Allen wrench |
| MP121EK | Short instructions for PILine® stages |

## 3.5 Suitable Controllers

| Order Number | Description |
|---|---|
| C-867.160 | Piezomotor controller / driver, networkable, 1 channel, for PILine® systems |
| C-867.260 | Piezomotor controller with drive electronics, 2 channels, for PILine® systems |
| C-867.OE | OEM driver / controller card for PILine® ultrasonic motors, 1 channel |

➢ To order, contact our customer service department (p. 47).

## 3.6 Accessories

| Order Number | Description |
|---|---|
| M-110.05 | ▪ Adapter bracket for vertical mounting of M-110 series stages on M-683 stages<br>▪ 4 hex-head cap screws M3x5 (ISO 4762)<br>▪ 1 Allen wrench |
| M-663.AB | ▪ Adapter box, MDR to 15-pin Sub-D, for PILine® stages with long cables<br>▪ M663T0015 Technical Note for adapter box |
| Extension cables for use with the M-663.AB adapter box: | |
| M-663.A01<br>M-663.A03<br>M-663.A05 | Extension cable for PILine®, MDR to 15-pin Sub-D, 1 m<br>Extension cable for PILine®, MDR to 15-pin Sub-D, 3 m<br>Extension cable for PILine®, MDR to 15-pin Sub-D, 5 m<br>Longer cables available on request. |

➢ To order, contact our customer service department (p. 47).

## 3.7 Technical Features

### 3.7.1 Linear Encoder

The M-683 is equipped with an optical linear encoder. For the resolution, refer to the table in the "Specifications" section (p. 49).

Optical linear encoders measure the actual position directly (direct metrology). Therefore, errors occurring in the drivetrain, such as nonlinearity, backlash or elastic deformation, cannot influence the measurement of the position.

### 3.7.2 Limit Switches

The M-683 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 stage runs into the hard stop.

See "Limit Switch Specifications" (p. 50) for more information.

### 3.7.3 Reference Point Switch

The M-683 is equipped with a direction-sensing reference point switch, which is located at about the midpoint of the travel range. This sensor transmits a TTL signal that indicates whether the stage is on the positive or negative side of the reference point switch.

See the controller user manual and/or associated software manuals for the commands which make use of the reference point signal.

For more information, see "Reference Point Switch Specifications" (p. 50).

# 4 Unpacking

***INFORMATION***

When handling the vacuum version of the stage, attention must be paid to appropriate cleanliness. At PI, all parts are cleaned before assembly. During assembly and measurement, powder-free gloves are worn. Afterwards, the stage is cleaned once again by wiping and shrink-wrapped twice in vacuum-compatible film.

- Only touch the stage with powder-free gloves.
- If necessary, wipe the stage clean after unpacking.

1. Unpack the M-683 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

## In this Chapter

General Notes on Installation ..... 17
Connecting the M-683 to the Protective Earth Conductor ..... 19
Mounting the M-683 on a Surface ..... 21
Affixing the Load to the M-683 ..... 23
Setting Up a Multi-Axis System ..... 25
Connecting the Vacuum Version to the Controller ..... 32
Connecting the Extension Cable ..... 34

## 5.1 General Notes on Installation

***CAUTION***

**Dangerous voltage and residual charge on piezo actuators!**

Piezomotors are driven by piezo actuators. After being disconnected from the electronics, piezo actuators can stay electrically charged for several hours. Temperature changes can also induce charges in piezo actuators. Touching or short-circuiting the contacts in the connector of the M-683 can lead to minor injuries from electric shock.

- Do **not** touch the contacts in the connector of the M-683.

***NOTICE***

**Lubricants, dirt, condensation!**

Dirt, oil, lubricants and condensation will render the motor/drive inoperable.

- Ensure that the piezomotors of the M-683 do not come into contact with lubricants.
- Keep the M-683 free from dirt and condensation.

**NOTICE**

**Heating up of the M-683 during operation!**

The heat produced during operation of the M-683 can affect your application.

- ➢ Install the M-683 so that your application is not affected by the dissipating heat.

**NOTICE**

**Unsuitable cables!**

Unsuitable cables can cause damage to the controller and can affect the performance of the M-683.

- ➢ Only use original PI parts to connect the M-683 to the controller.
- ➢ If you need longer cables, use the M-663.AB adapter box and an extension cable from PI (p. 34).

**INFORMATION**

For the reproducibility of the positioning to be optimal, all components must be affixed with zero-backlash.

- ➢ Make sure that stage and load are affixed with zero-backlash.

- ➢ If possible, perform a simulation of the stage motions with a mounted load or suitable calculations in order to identify collisions or unfavorable center of gravity constellations.
- ➢ If necessary, take suitable constructive measures to avoid collisions and instabilities in the overall system.
- ➢ Avoid or mark danger zones that result from the installation of the stage and the application, in accordance with the legal regulations.

For more information about operational conditions, refer to the "Motor Power" section (p. 53).

## 5.2 Connecting the M-683 to the Protective Earth Conductor

***INFORMATION***

The supplied M4 screw on the protective earth connection is only for protecting the thread.

- Use the supplied M4 screw set (p. 12) for protective earth to mount the protective earth conductor.

***INFORMATION***

- Observe the applicable standards for mounting the protective earth conductor.

An M4 hole is located on the M-683 next to the cable exit, for connecting the protective earth conductor. In the following figure, this hole is marked with the symbol for the protective earth conductor ⏚.

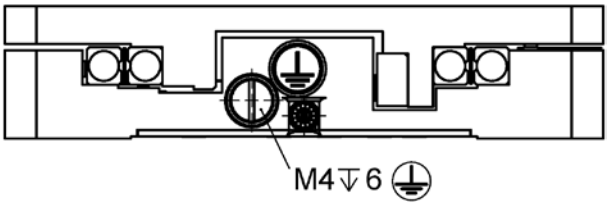



*Figure 3: M4 threaded hole for fastening the protective earth conductor*

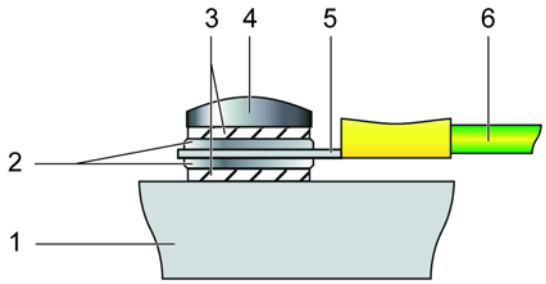



*Figure 4: Mounting of the protective earth conductor (profile view)*

*1 Base body of the M-683*
*2 Flat washer*
*3 Safety washer*
*4 Screw*
*5 Cable lug*
*6 Protective earth conductor*

## Prerequisite

- ✓ You have read and understood the General Notes on Installation (p. 17).
- ✓ The M-683 is **not** connected to the controller.

## Tools and accessories

- Suitable protective earth conductor: Cross-sectional area of the cable ≥0.75 $mm^2$
- Supplied M4 screw set for protective earth (p. 12) for mounting a protective earth conductor
- Suitable screwdriver

## Connecting the M-683 to the protective earth conductor

1. If necessary, fasten a suitable cable lug to the protective earth conductor.
2. Fasten the cable lug of the protective earth conductor using the M4 screw on the protective earth connection of the M-683 as shown in the profile view.
3. Tighten the M4 screw with a torque of 1.2 Nm to 1.5 Nm.
4. Make sure that the contact resistance at all connection points relevant for mounting the protective earth conductor is <0.1 Ω at 25 A.

## 5.3 Mounting the M-683 on a Surface

***NOTICE***

**Protruding screw heads!**

Protruding screw heads can damage the M-683.

- ➢ Ensure that the screw heads do not protrude from counter-sunk holes so that they do not interfere with the stage motion.

***NOTICE***

**Warping of the base body!**

Incorrect mounting can warp the base body. Warping of the base body will increase wear and reduce accuracy.

- ➢ Mount the M-683 on an even surface. The recommended evenness of the surface is 10 µm.
- ➢ For applications with great temperature changes:
  Only fasten the M-683 to surfaces that have the same or similar thermal expansion properties as the M-683 (e.g. surfaces made of aluminum).

***INFORMATION***

The positive direction of motion is away from the cable exit side.

*Figure 5: M-683: Two of four counter-sunk holes in the base body (see arrows)*

## Prerequisite

- ✓ You have read and understood the General Notes on Installation (p. 17).
- ✓ You have provided a suitable surface (for the required position and depth of the holes for accommodating the screws, see "Dimensions", p. 57).
  - Four M3 holes are present.
  - The evenness of the surface is ≤10 µm.
  - For applications with great temperature changes: The surface should have the same or similar thermal expansion properties as the M-683 (e.g. surface made of aluminum).
- ✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.
- ✓ The M-683 is **not** connected to the controller.

## Tools and accessories

- Mounting accessories in the scope of delivery (p. 12):
  - 4 M3x16 screws
  - Allen wrench

### Mounting the M-683 on a surface

1. Manually displace the moving platform of the M-683 until two of the four counter-sunk holes in the base body are accessible (see figure).
2. Align the M-683 on the surface so that the corresponding holes in the M-683 and surface overlap.
3. Mount the M-683 with two screws.
4. Ensure that the screw heads do not protrude from the counter-sunk mounting holes.
5. Manually displace the moving platform of the M-683 until the other two counter-sunk holes in the base body are accessible.
6. Mount the M-683 with two screws.
7. Ensure that the screw heads do not protrude from the counter-sunk mounting holes.
8. Check that the M-683 fits on the surface without backlash.

## 5.4 Affixing the Load to the M-683

***NOTICE***

**Impermissibly high forces and torques!**

Impermissibly high forces and torques that are applied to the moving platform can damage the stage.

- ➢ For affixing type and mass of the load, observe the maximum permissible forces according to the specifications (p. 49).
- ➢ When the motion axis of the stage is oriented vertically, ensure that the installed load is lower than the holding force of the drive (see "Data Table" (p. 49) and "Influence of Downtimes on the Static Holding Force", p. 56).
- ➢ Avoid tilting torques at the moving platform.

**NOTICE**

**Screws that are too long!**

The M-683 can be damaged by screws that are too long.

- ➢ Note the depth of the mounting holes in the moving platform (p. 57).
- ➢ Only use screws of the correct length for the respective mounting holes.

**INFORMATION**

With a vertically oriented motion axis, the M-683 can reliably move a maximum load of 150 g without gravity compensation. The velocity is correspondingly reduced; see "Velocity and Dynamic Force" (p. 54).

For operating M-683 with a vertically oriented motion axis and load >150 g:

- ➢ Mount a suitable gravity compensation. Contact our customer service department (p. 47) for details on gravity compensation.

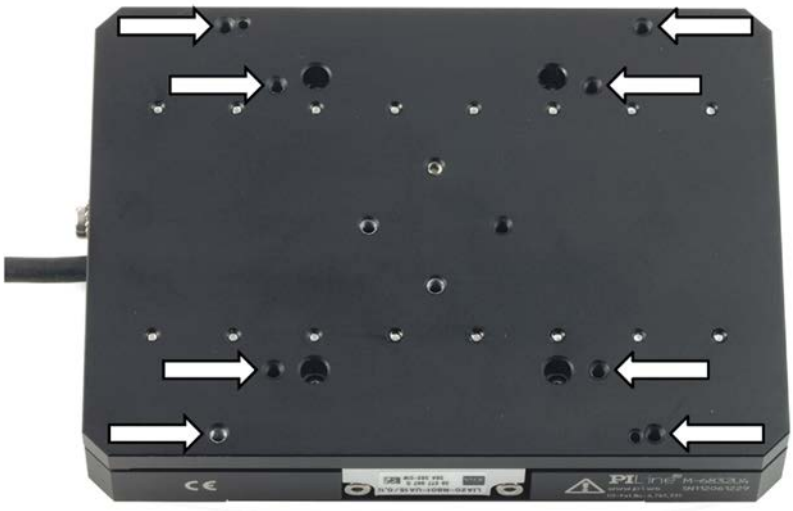


*Figure 6: M-683: Threaded holes for mounting a load (see arrows)*

### Prerequisite

- ✓ You have read and understood the General Notes on Installation (p. 17).
- ✓ You have properly mounted the M-683 on a surface (p. 21).
- ✓ The M-683 is **not** connected to the controller.
- ✓ You have prepared the load so that it can be affixed to the mounting holes on the moving platform:
  - The distance between the center of gravity of the load and the center of the moving platform is as small as possible in all directions.
  - At least three points are provided for affixing the load on the moving platform.

### Tools and accessories

- At least three M3 screws of suitable length (p. 57)
- Suitable tools for fastening the screws

### Affixing the load

1. Align the load on the M-683 so that the mounting holes in the load and the moving platform overlap.
2. Affix the load with at least three screws.
3. Check that the load fits on the moving platform of the M-683 without backlash.

## 5.5 Setting Up a Multi-Axis System

The M-683 can be used in multi-axis systems.

Typical combinations:

- XY system (p. 27) as a stacked system
- Z system (p. 30) with micro-translation stage of the M-110 series

➢ For combination possibilities with other stages, contact our customer service department (p. 47).

### 5.5.1 General Information on Setting Up a Multi-Axis System

**NOTICE**

**Impermissibly high forces and torques!**

Impermissibly high forces and torques that are applied to the moving platforms of the stages in a multi-axis system can damage the stages.

- Include the masses of the moved stages and the mounting adapters (p. 13) in the calculation of the load to be moved.
- For the mounting type and mass of the load, observe the maximum permissible forces according to the specifications for the individual stages.
- Avoid tilting torques on the moving platforms: Make sure that the distance between the center of gravity of the load and the center of the moving platform is as small as possible in all directions for the individual stages.
- When the motion axis of the stage is oriented vertically, ensure that the installed load is lower than the holding force of the drive.

**NOTICE**

**Screws that are too long!**

Screws that are inserted too deeply can damage the lower stage.

- Observe the depth of the mounting holes in the moving platform of the lower stage.
- Only use screws of the correct length for the respective mounting holes.

- Only install and operate the multi-axis system after you have read and understood the user manuals of all components of the multi-axis system.
- If you require special mounting adapters, contact our customer service department (p. 47).

## 5.5.2 Setting Up an XY System

Two linear positioning stages can be stacked to form an XY system as shown below:

- Combination of two M-683
- Affixing an M-110 micro-translation stage to an M-683

### Prerequisite

✓ You have read and understood the General Notes on Installation (p. 17).

✓ You have read and understood the general notes on setting up a multi-axis system (p. 26).

### Tools and accessories for combining two M-683 stages

- Mounting accessories in the scope of delivery (p. 12):
  - 4 M3x16 screws
  - Allen wrench
- Optional: 2 locating pins (Ø 2 mm H7, length: 10 mm) according to DIN EN ISO 13337 for easy alignment of the stages, not in the scope of delivery

### Affixing an M-683 to an M-683

*Figure 7: Combination of two M-683 stages as a stacked XY system*

*Figure 8: Holes to be used for screws (white arrows) and locating pins (gray arrows) in the lower M-683*

1. If you use locating pins: Introduce the locating pins into the two holes in the moving platform of the lower M-683 (see gray arrows in the figure).
2. Rotate the upper M-683 by 90° and position it on the lower M-683. For a different orientation of the cable exit, it is possible to rotate the stage by 180°.

   If you use locating pins:

   – Make sure that the locating pins are introduced into the corresponding holes in the bottom side of the base body of the upper M-683.
3. Affix the upper M-683 to the lower M-683 using the screws and the relevant threaded holes (see white arrows in the figure). Proceed as when mounting the stage on a surface (p. 21).

## Tools and accessories for affixing the M-110 to the M-683

- Screws and tools for affixing the M-110 (see M-110 User Manual)

## Affixing the M-110 to the M-683

*Figure 9: M-683: Threaded holes for affixing the M-110 (white circles)*

1. Rotate the M-110 by 90° and position it on the M-683. It is possible to rotate the M-110 again by 180° for a different orientation of its cable exit.
2. Affix the M-110 to the M-683 using the relevant threaded holes (see white circles in the figure) in the M-683. Follow the instructions given in the M-110 User Manual.

### 5.5.3 Setting Up a Z System

To form a Z system, an M-110 microtranslation stage is affixed to an M-683 using an adapter bracket.

***NOTICE***

**Malfunction with unsealed threaded hole!**

A threaded pin is located in one of the holes of the moving platform of the M-683. If the threaded pin is removed, incident light can trigger the reference point switch of the M-683 and cause a malfunction.

- ➢ Only remove the threaded pin from the moving platform of the M-683 if this is necessary for mounting an adapter bracket.
- ➢ After removing the threaded pin, make sure that the corresponding hole is suitably closed.

***INFORMATION***

You can also affix the adapter bracket to the M-683 offset in 90° steps.

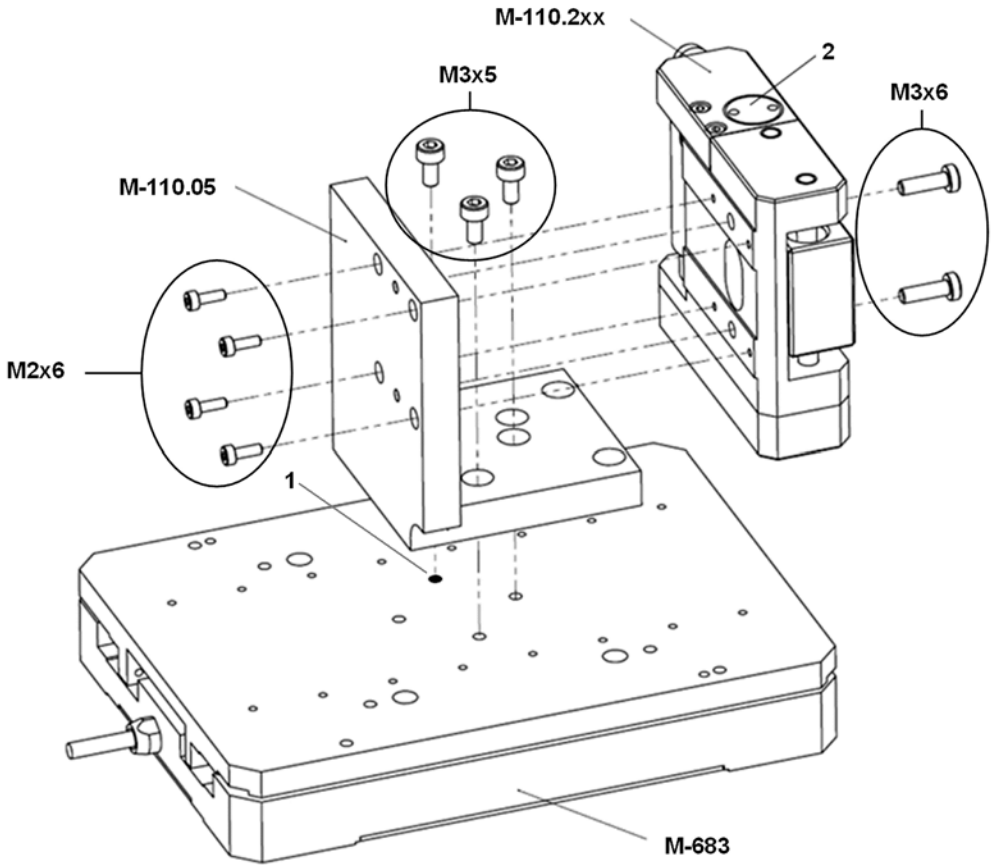



*Figure 10: M-683, M-110.05 bracket and M-110*

*1 Threaded pin in the moving platform of the M-683*
*2 Cover of the spindle bearing on the M-110*

## Prerequisite

- ✓ You have read and understood the General Notes on Installation (p. 17).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 26).

### Tools and accessories

- M-110.05 adapter bracket and supplied screws (p. 13).
- Screws and tools for affixing the M-110 (see M-110 User Manual)
- Allen wrench AF 1.5 for removing the threaded pin from the moving platform of the M-683 (see figure)
- Optional: Four M2x6 hex-head cap screws (not in the scope of delivery)

### Setting up a Z system

1. Remove the threaded pin (1) from the moving platform of the M-683 (see figure).
2. Affix the M-110.05 adapter bracket to the M-683 using three M3x5 hex-head cap screws (see figure).
3. Align the M-110 so that the cover of the spindle bearing (2) is on the top, see figure (the cable exit of the M-110 is then on the top as well).
4. Affix the M-110 to the adapter bracket. Use either two of the M3x6 screws supplied with the M-110 or four M2x6 screws (see figure).

## 5.6 Connecting the Vacuum Version to the Controller

For the vacuum version of the M-683, it is necessary to install a vacuum feedthrough (p. 12).

### Prerequisites

- ✓ You have read and understood the General Notes on Installation (p. 17).
- ✓ The controller is **switched off**.
- ✓ You have connected the M-683 to the protective earth conductor (p. 19).
- ✓ You have read and understood the C815T0003 Technical Note for the C-815.VF vacuum feedthrough.

## Tools and accessories

- C-815.VF vacuum feedthrough, Sub-D 15 (p. 12)
- K030B0420 extension cable for PILine®, MDR14 to Sub-D 15, 1.5 m, on the air side (p. 12)
- Suitable tools for installing the vacuum feedthrough

## Installing the vacuum feedthrough

1. Find the dimensions of the vacuum feedthrough in the C815T0003 Technical Note (see "shell size 2").
2. Provide the vacuum chamber with a suitable opening.
3. Install the vacuum feedthrough so that the Sub-D 15 (f) socket is in the vacuum chamber.

## Connecting the vacuum version to the controller

➢ Connect the M-683 ("stage"), vacuum feedthrough and controller as shown in the connection diagram below.

– Observe the assignment that is given by the labeling on the sockets, connectors and cables.

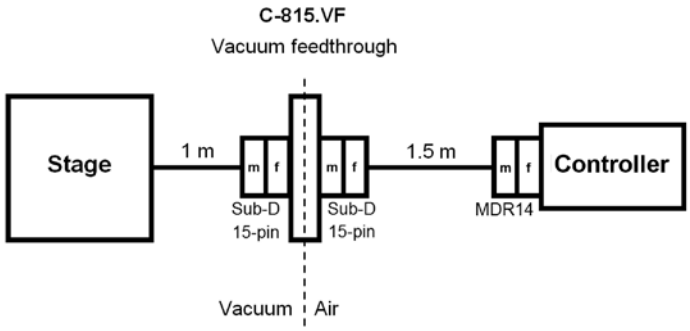



*Figure 11: Connection of the vacuum version to the controller*

# 5.7 Connecting the Extension Cable

## Prerequisites

- ✓ You have read and understood the General Notes on Installation (p. 17).
- ✓ The controller is **switched off**.
- ✓ You have connected the M-683 to the protective earth conductor (p. 19).
- ✓ For vacuum versions:
  The C-815.VF vacuum feedthrough is installed (p. 32).

## Tools and accessories

- M-663.AB adapter box*, MDR14 to Sub-D 15-pin, for PILine® stages with long cable
- Extension cable* for PILine®, MDR14 to Sub-D 15-pin, 1 to 5 m, on the air side

*Not in the scope of delivery; see "Accessories" (p. 13).

## Connecting the extension cable

➢ Connect the M-683 ("stage") and controller via the adapter box and the extension cable as shown in the respective connection diagram.

  – Observe the assignment that is given by the labeling on the sockets, connectors and cables.

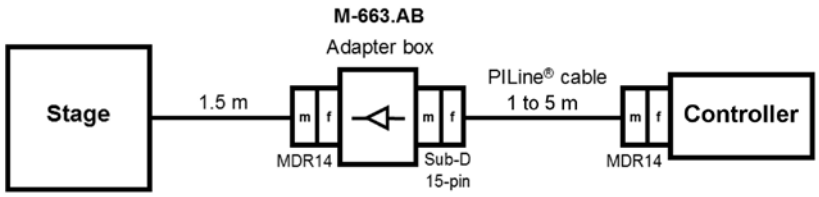



*Figure 12: Connection of an extension cable to the standard version of the M-683*

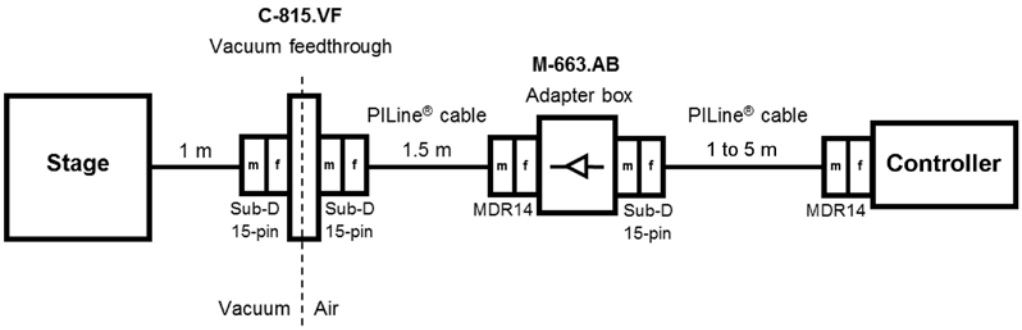



*Figure 13: Connection of an extension cable to the vacuum version of the M-683*

# 6 Start-Up and Operation

## In this Chapter

General Notes on Start-Up and Operation ..... 37
Starting Up the M-683 with the C-867 Controller ..... 41

## 6.1 General Notes on Start-Up and Operation

***CAUTION***

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

If a protective earth conductor is not or not properly connected, dangerous touch voltages can occur on the M-683 in the case of malfunction or failure of the system. If touch voltages exist, touching the M-683 can result in minor injuries from electric shock.

- Connect the M-683 to a protective earth conductor (p. 19) before start-up.
- Do **not** remove the protective earth conductor during operation.
- If the protective earth conductor has to be removed temporarily (e. g. in the case of modifications), reconnect the M-683 to the protective earth conductor before starting it up again.

***NOTICE***

**Damage if an incorrect controller is connected!**

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

- Only connect a stage with PILine® ultrasonic piezomotors to a PILine® controller (p. 12).

**NOTICE**

**Operating voltage too high or incorrectly connected!**

Operating voltages that are too high or incorrectly connected can cause damage to the M-683.

- Only operate the M-683 with controllers/drivers and original accessories from PI.
- Do **not** exceed the operating voltage range (p. 51) for which the M-683 is specified.
- Only operate the M-683 when the operating voltage is properly connected; see "Pin Assignment" (p. 59).

**NOTICE**

**Unintentional motions!**

When the M-683 is being connected to the controller, it can carry out unintentional motions. Defective software or wrong operation of the software can also result in unintentional motions.

- Do not place any objects in areas where they can get caught by moving parts.
- Before connecting the M-683, check whether a macro is defined as the start-up macro in the controller, and cancel the selection of the start-up macro if necessary.

**NOTICE**

**Damage from collisions!**

Collisions can damage the stage, the load to be moved and the environment.

- Make sure that no collisions are possible between the stage, the load to be moved and the environment in the motion range of the stage.
- Do not place any objects in areas where they can get caught by moving parts.
- Stop the motion immediately if a controller malfunction occurs.
- If possible, adapt the travel range limits of your mechanical system in the software that you use for commanding the motion.

**NOTICE**

**Uncontrolled oscillation!**

Your application can be damaged by uncontrolled oscillation of the M-683.
If you encounter noise during operation:

- ➢ Immediately switch off the servo-control system of the affected axes.
- ➢ Check the settings of the servo-control parameters.

**NOTICE**

**Collision of the moving platform with the hard stop!**

The collision of the moving platform of the M-683 with the hard stop can lead to damage or considerable wear on the M-683.

- ➢ Prevent motions in open-loop operation.
- ➢ If motions in open-loop operation are necessary with the C-867 controller:
  - – Set the control value with the `SMO` command so that the axis moves with low velocity.
  - – Stop the axis in time. For this purpose, use the `#24`, `STP` or `HLT` command, or set the control value to zero with the `SMO` command.
- ➢ Ensure that the end of the travel range is approached at low velocity.
- ➢ Only make changes to the velocity, acceleration, deceleration and load in small steps.
- ➢ Do **not** deactivate the limit switches in the software.
- ➢ Test limit switch operation at low velocities only.
- ➢ In the event of a malfunction of the limit switches, stop the motion immediately.

**NOTICE**

**Overheating during continuous operation!**

The highest dynamic force and holding force are achieved at maximum motor power; however, the M-683 may overheat during continuous operation.

- ➢ Observe the recommended motor power depending on the duty cycle and the ambient temperature (p. 55).

**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.
- ➢ Determine the maximum velocity for your application.
- ➢ Observe the information in the "Motor Power" section (p. 53).

***INFORMATION***

Although in theory the M-683 operates quietly, noise levels of up to 50 dB (A) are possible during operation. The ultrasonic drive of the M-683 can also generate higher noise levels at frequencies between 100 and 500 kHz.

***INFORMATION***

The positive direction of motion is away from the cable exit side.

***INFORMATION***

The repeatability of the positioning is only ensured when the reference point switch is always approached from the same side. Controllers from PI fulfill this requirement as a result of the automatic direction sensing for reference moves to the reference switch.

***INFORMATION***

For maximum force generation, a run-in procedure is necessary during the start-up of the M-683 and after longer downtimes; see also "Influence of Downtimes on the Static Holding Force" (p. 56). After run-in, the M-683 will generate its maximum dynamic force.

- ➢ For run-in, command a few motion cycles at low velocity over the entire travel range.

For more information about operational conditions, refer to the "Motor Power" section (p. 53).

## 6.2 Starting Up the M-683 with the C-867 Controller

**NOTICE**

**Incorrect parameter settings!**

When using the software which is included in the scope of delivery of the C-867 controller, the operating parameters of the M-683 can be loaded from a stage database. The stage *PIStages2.dat* database contains the default parameter values of your stage for performing initial test motions during start-up. Depending on the application, using the default parameter values (e. g. for P-term, I-term, D-term, acceleration and velocity) can, however, cause damage to the stage, especially when operated with heavy loads.

- ➢ If possible: Perform the first start-up without a load.
- ➢ Always install the latest version of the *PIStages2.dat* stage database on your PC.

For start-up with a load:

- ➢ Before start-up, make sure that the M-683 has been properly installed (p. 17).
- ➢ For optimum performance of the moving axis, adjust the operating parameters of the C-867 (e. g. P-term, I-term, D-term, acceleration, velocity; see C-867 User Manual).
- ➢ Save the new parameter values for future use in a stage database on the PC or in the non-volatile memory of the controller (see C-867 User Manual and PIMikroMove User Manual).

### Prerequisites

- ✓ You have read and understood the General Notes on Start-Up and Operation (p. 37).
- ✓ You have read and understood the user manual of the C-867 piezomotor controller/driver.
- ✓ In the case of start-up with a load: The M-683 has been properly installed (p. 17).
- ✓ The C-867 piezomotor controller/driver and the required software have been installed. All connections on the C-867 have been established (see C-867 User Manual).

### Starting up the M-683 with the C-867 controller

- Start up the axis (see C-867 User Manual).
  The start-up involves the following steps:
  - Selecting the stage type
  - Defining the reference point of the axis
  - Commanding initial motions in closed-loop operation for testing and for run-in of the mechanical system

  The description in the C-867 User Manual assumes that you perform these steps using PIMikroMove.

# 7 Maintenance

## In this Chapter

General Notes on Maintenance ..... 43
Performing a Maintenance Run ..... 43
Cleaning the M-683 ..... 44

## 7.1 General Notes on Maintenance

***NOTICE***

**Damage due to improper maintenance!**

Improper maintenance can result in the failure of the M-683.

- Only loosen screws according to the instructions in this manual.
- Ensure that the piezomotors of the M-683 do not come into contact with lubricants.

## 7.2 Performing a Maintenance Run

Depending on the operating conditions and the period of use of the M-683, the following maintenance measures are required:

### Maintenance run

The maintenance run is performed to distribute the existing lubricant on the guidings of the M-683.

- To evenly distribute the existing lubricant on the stage guidings, perform a maintenance run across the entire travel range after 500 hours of operation, or after 1 year at the latest.
- If you move the M-683 continuously over a small working range (<20 % of the entire travel range) in industrial operation, perform a maintenance run across the entire travel range every 5000 motion cycles.

### Lubrication

Under laboratory conditions, the guidings of the M-683 only need to be lubricated in exceptional cases. For continuous industrial use, the lubrication intervals must be defined individually.

- Do not lubricate the guidings of the M-683 without consulting our customer service department (p. 47).
- To lubricate the guidings, follow the instructions given in the maintenance manual which you can obtain from our customer service department.
- Ensure that the piezomotors of the M-683 do not come into contact with lubricants.

## 7.3 Cleaning the M-683

### Prerequisites

- ✓ You have disconnected the stage from the controller.

### Cleaning the stage

- Do **not** use any organic solvents.

Only when the stage is **not** used in vacuum:

- When necessary, clean the surfaces of the stage with a cloth slightly dampened with a mild cleanser or disinfectant.

Only when the stage is used in vacuum:

- Only touch the stage with powder-free gloves.
- If necessary, wipe the stage clean.

# 8 Troubleshooting

| Problem | Possible Causes | Solution |
|---|---|---|
| Noise during operation | Uncontrolled oscillation of the M-683 | ➢ Immediately switch off the servo-control system of the affected axes.<br>➢ Check the settings of the servo-control parameters. |
| stage positions inaccurately | Settling window around the target position is too large | ➢ Reduce the settling window by changing the parameter values for the settling window limits on the controller. See the controller user manual (p. 3) for details. |
| Reaching the target position takes too long | Settling window around the target position is too small | ➢ Enlarge the settling window by changing the parameter values for the settling window limits on the controller. See the controller user manual (p. 3) for details. |
| Increased wear | Warped base body | ➢ Mount the M-683 on an even surface. The recommended evenness of the surface is 10 µm.<br>➢ For applications with great temperature changes:<br>Only mount the M-683 on surfaces that have the same or similar thermal expansion properties as the M-683 (e.g. surfaces made of aluminum). |
| Reduced accuracy | | |

| Problem | Possible Causes | Solution |
|---|---|---|
| With a vertically oriented motion axis: No or limited motion | Excessive load | ➢ Reduce the load to a maximum of 150 g.<br>For operating M-683 with a vertically oriented motion axis and load >150 g:<br>➢ Mount a suitable gravity compensation. Contact our customer service department (p. 47) for details on gravity compensation. |

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 47).

# 9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an e-mail (info@pi.ws).

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 (p. 3) on our website.

# 10 Technical Data

## In this Chapter

Specifications ..... 49
Ambient Conditions and Classifications ..... 52
Motor Power ..... 53
Dimensions ..... 57
Pin Assignment ..... 59

## 10.1 Specifications

### 10.1.1 Data Table

| | M-683.2U4 | Unit | Tolerance |
|---|---|---|---|
| Active axes | X | | |
| **Motion and positioning** | | | |
| Travel range | 50 | mm | |
| Integrated sensor | Linear encoder | | |
| Sensor resolution | 0.1 | µm | |
| Min. incremental motion | 0.3 | µm | typ. |
| Bidirectional repeatability | ±1 | µm | typ. |
| Unidirectional repeatability | 0.2 | µm | typ. |
| Pitch | ±150 | µrad | typ. |
| Yaw | ±50 | µrad | typ. |
| Velocity | 350 | mm/s | max. |
| Reference point switch repeatability | ±1 | µm | typ. |
| **Mechanical properties** | | | |
| Guiding | Crossed-roller bearings | | |
| Load capacity | 50 | N | max. |
| Push / pull force | 6 | N | max. |
| Holding force | 6 | N | max. |
| **Drive properties** | | | |
| Motor type | PILine® U-164 (dual motor) | | |
| Reference point switch | Optical | | |
| Limit switches | Hall-effect | | |

| | M-683.2U4 | Unit | Tolerance |
|---|---|---|---|
| **Miscellaneous** | | | |
| Operating temperature range | 0 to 50 | °C | |
| Material | Al (black anodized) | | |
| Dimensions | 130 mm × 95 mm × 21 mm | | |
| Mass | 0.65 | kg | ±5 % |
| Cable length | 1.5 | m | ±10 mm |
| Connector | MDR, 14-pin | | |
| Recommended controller | C-867 PILine® controller incl. driver | | |

M-683.2V4: Delivery includes 1 m cable (vacuum), feedthrough and 1.5 m cable (air). Specifications for vacuum versions can differ.

Ask about custom designs!

## 10.1.2 Limit Switch Specifications

| | |
|---|---|
| Type | Magnetic (Hall-effect) sensor |
| Supply voltage | +5 V/GND, supply via the motor connector |
| Signal output | TTL level |
| Signal logic | Active high. When the limit switch is passed, the signal level changes:<br>– Normal motor operation: low (0 V)<br>– Limit switch reached: high (+5 V) |

## 10.1.3 Reference Point Switch Specifications

| | |
|---|---|
| Type | Optical sensor |
| Supply voltage | +5 V/GND, supply via the motor connector |
| Signal output | TTL level |
| Signal logic | Direction sensing by means of different signal levels on the left and right side of the reference point switch: The signal level changes from 0 to +5 V when the reference point switch is passed. |
| Hysteresis | 0.2 to 0.4mm (when approaching from the positive or negative direction) |

### 10.1.4 Maximum Ratings

M-683 stages are designed for the following parameters:

| Device | Maximum Operating Voltage  | Operating Frequency  | Maximum Power Consumption  |
|---|---|---|---|
| M-683.2U4<br>M-683.2V4 | 200 $V_{pp}$ or 71 $V_{rms}$ | 152 to 165 kHz | 15 W |

### 10.1.5 Specifications for Vacuum-Compatible Versions

The following vacuum-compatible components are used for the M-683.2V4:

| Component | Material |
|---|---|
| Mechanical parts | Aluminum (blank), aluminum (anodized, black, matt), steel, ceramic (PIC181, $Al_2O_3$) |
| Cables | FEP; ribbon cable (FFC) from Axon Kabel GmbH |
| Shrink tubing | PVDF (Kynar) |
| Connector | ZF5-06-01 connector from Samtec |
| Insulation | KU-THE-150 |
| Lubricant | Molykote HP-300 |
| Sealant | Scotch Weld |
| Adhesives | Epo-Tek 353 ND, Delo Duopox AD895 |

Bakeout temperature: 80°C (176°F)

Bakeout time: 3 hours

## 10.2 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the M-683:

| | |
|---|---|
| Area of application | For indoor use only |
| Maximum altitude | 2000 m |
| Air pressure | 1100 hPa to 0.1 hPa<br>(corresponds to roughly 825 torr to 0.075 torr) |
| Relative humidity | Highest relative humidity 80 % for temperatures up to 31 °C<br>Decreasing linearly to 50 % relative humidity at 40 °C |
| Operating temperature | 0°C to 50°C |
| Storage temperature | -20 °C to 75 °C |
| Transport temperature | -20 °C to 75 °C |
| Overvoltage category | II |
| Protection class | I |
| Degree of pollution | 1 |
| Degree of protection according to IEC 60529 | IP20 |

# 10.3 Motor Power

## 10.3.1 Motor Power and Operating Voltage

The following table shows the relationship between the operating voltage and the motor power of the M-683. The operating voltage is output by the C-867 controller and depends on the actual control value. The polarity sign of the control value determines the direction of motion.

| Motor Power | Operating Voltage | Corresponding Control Value on the C-867* |
|---|---|---|
| 0 % | 0 $V_{pp}$ | 0 |
| 25 % | 50 $V_{pp}$ | 8192 or -8192 |
| 50 % | 100 $V_{pp}$ | 16384 or -16384 |
| 75 % | 150 $V_{pp}$ | 24575 or -24575 |
| 100 % | 200 $V_{pp}$ | 32767 or -32767 |

* Generated in closed-loop operation via the control algorithm or set in open-loop operation via the `SMO` command

***INFORMATION***

The control value and thus the output operating voltage are limited by the C-867 controller with the ***Maximum Motor Output*** parameter (ID 0x9). When you load the operating parameters of the M-683 from the *PIStages2.dat* stage database, this parameter is set to a suitable value.

You can check the control value of the C-867 as follows:

- Get the current control value with the `SMO?` command.
- Record the control value during the motion with the data recorder (as "motor output").

For further information, see the user manual of the controller (p. 12) used to operate the M-683.

## 10.3.2 Velocity and Dynamic Force

To estimate the velocity and dynamic for of the M-683 at different motor output levels, refer to the following graph.

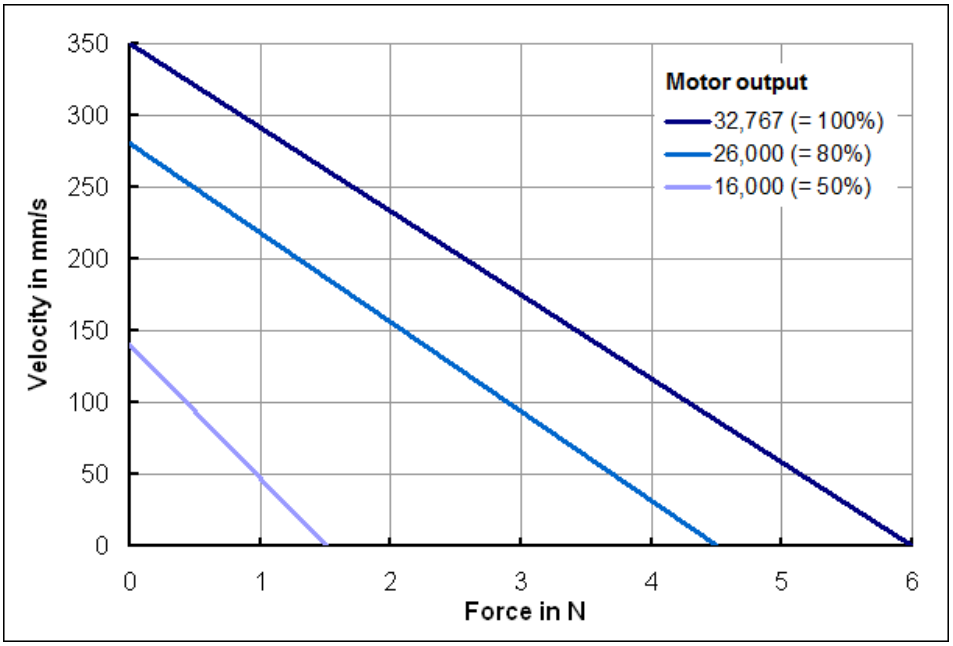



*Figure 14: Velocity of the M-683 vs. dynamic force (push/pull force) at various levels of the control signal*

### 10.3.3 Motor Power and Lifetime

Motor power, duty cycle and ambient temperature influence the lifetime of the stage. In order to prevent overheating and high wear, the motor power and the duty cycle should not exceed the limits given in the following graph in continuous operation. A load cycle corresponds to a positioning run and includes the acceleration, motion, deceleration as well as downtime (break). The motor should only sporadically be operated at peak power; the peak power serves as a control reserve.

***INFORMATION***

In a vacuum, there is no heat dissipation via convection.

➢ Operate the vacuum version of the M-683 with a 20% lower motor power than given in the graph, or reduce the duty cycle.

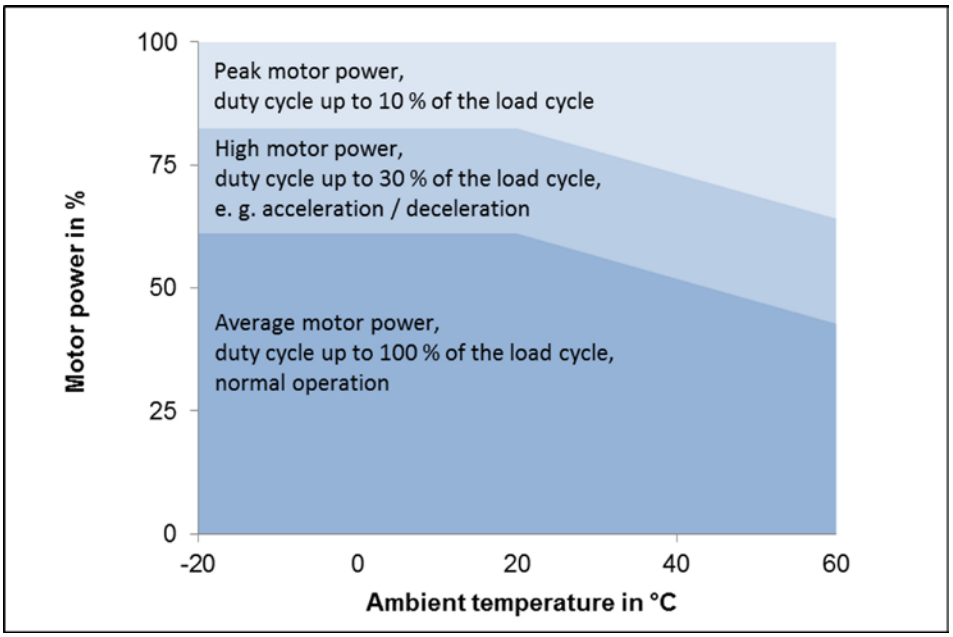



*Figure 15: M-683: Recommended duty cycle and motor power depending on the ambient temperature*

## 10.3.4 Influence of Downtimes on the Static Holding Force

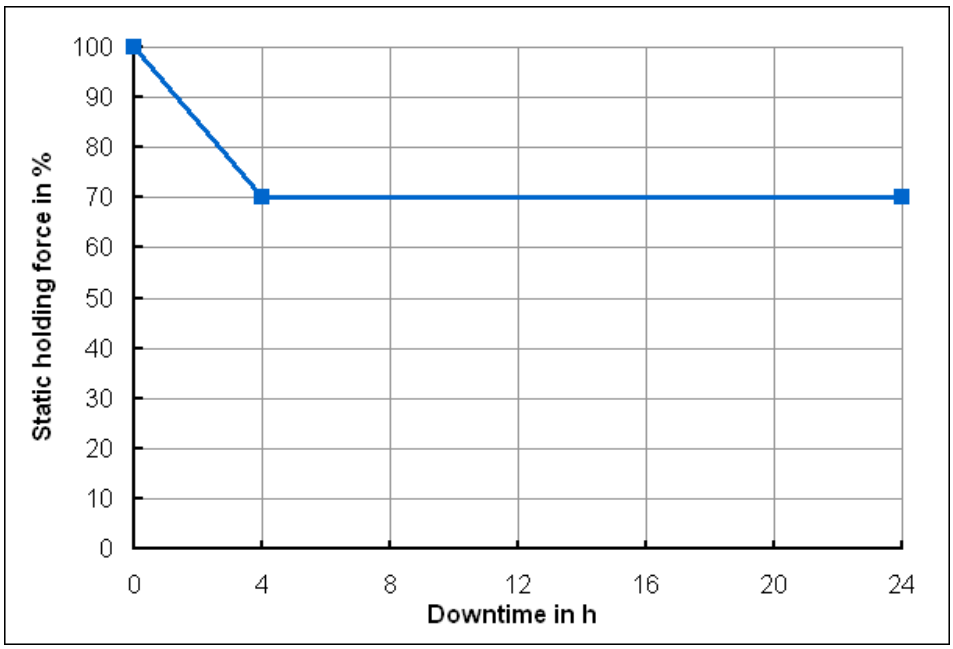



*Figure 16: Static holding force of the M-683 depending on the downtime of the motor*

## 10.4 Dimensions

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

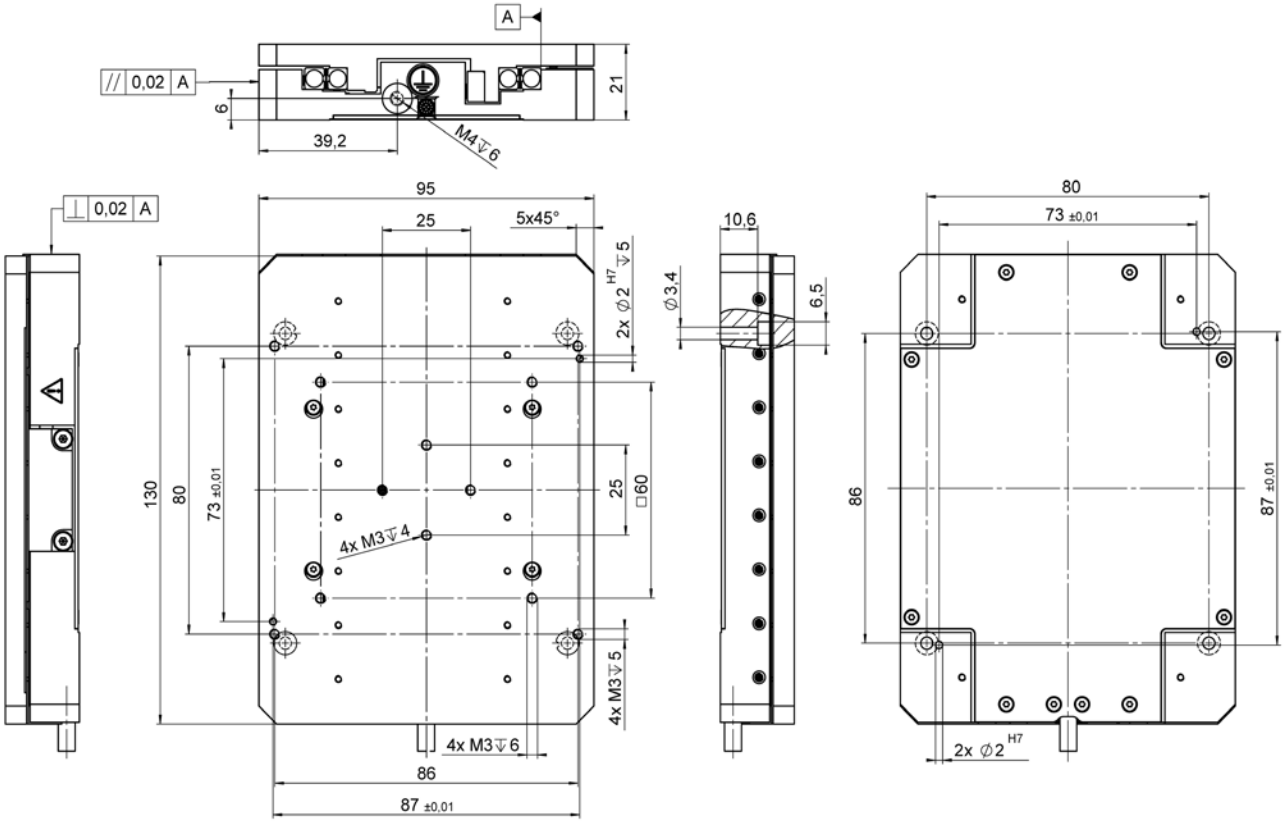



*Figure 17: M-683*

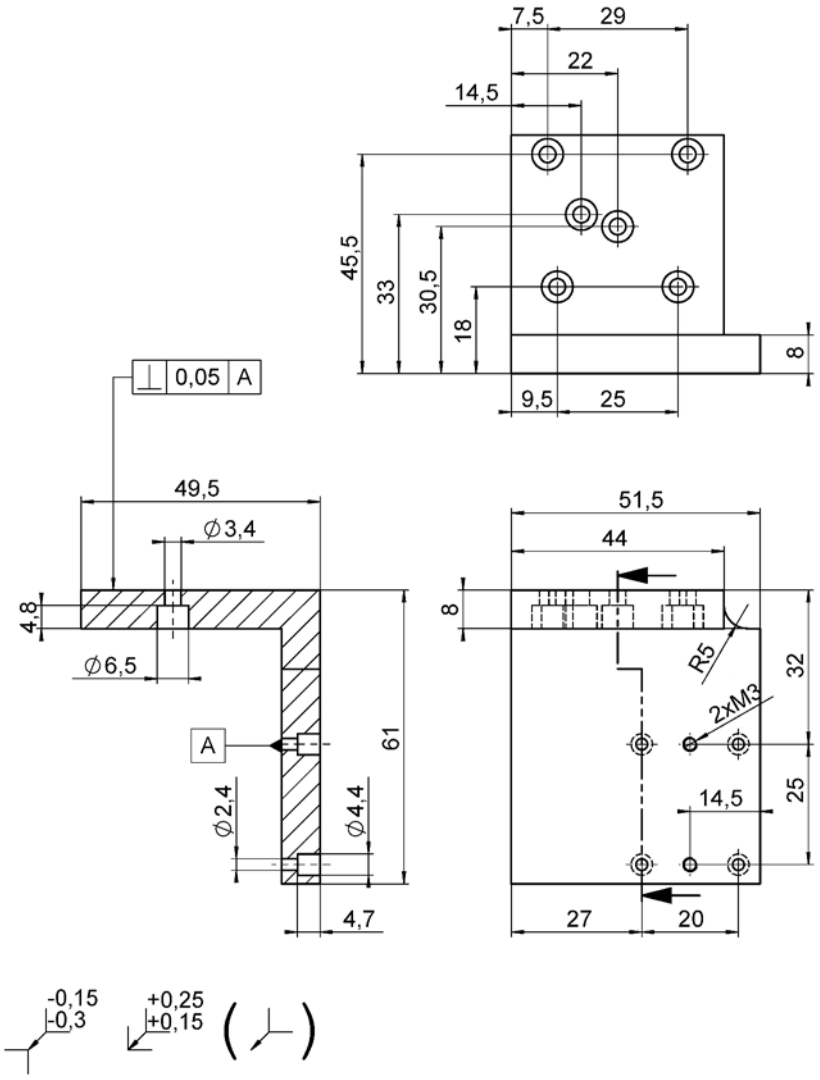



*Figure 18: M-110.05 adapter bracket*

## 10.5 Pin Assignment

### Connector: MDR14, N10214-52B2VC (3M)

All models (p. 9) except for the vacuum versions are equipped with this connector.

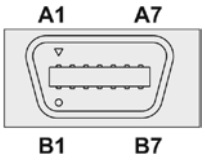



*Figure 19: Front view of the MDR14 connector*

| Pin | Signal | Function |
|---|---|---|
| A1 | GND | 0 V |
| A2 | PSWITCH | Output: Positive-end limit switch, active-high |
| A3 | NSWITCH | Output: Negative-end limit switch, active-high |
| A4 | REFSWITCH | Output: Reference point switch |
| A5 | NC | Not connected |
| A6 | VDD | Input: +5 V |
| A7 | USM_P1 | Input: Piezo 71 VAC (RMS) |
| B1 | USM_P2 | Input: Piezo 71 VAC (RMS) |
| B2 | USM_P3 | Input: Piezo 71 VAC (RMS) |
| B3 | ENCA+ | Output: Encoder channel A, RS-422 |
| B4 | ENCA- | Output: Encoder channel A (inverted), RS-422 |
| B5 | ENCB+ | Output: Encoder channel B, RS-422 |
| B6 | ENCB- | Output: Encoder channel B (inverted), RS-422 |
| B7 | NC | Not connected |

## Connector: Sub-D 15 (m)

All vacuum versions (p. 9) are equipped with this connector.

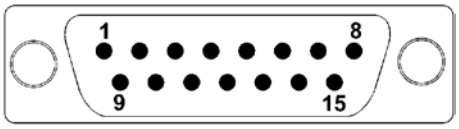



*Figure 20: Front view of the Sub-D 15 connector*

| Pin | Signal | Function |
|---|---|---|
| 1 | NC | Not connected |
| 2 | USM_P1 | Input: Piezo 71 VAC (RMS) |
| 3 | USM_P2 | Input: Piezo 71 VAC (RMS) |
| 4 | VDD | Input: +5 V |
| 5 | PSWITCH | Output: Positive-end limit switch, active-high |
| 6 | GND | 0 V |
| 7 | ENCA- | Output: Encoder channel A (inverted), RS-422 |
| 8 | ENCB- | Output: Encoder channel B (inverted), RS-422 |
| 9 | NC | Not connected |
| 10 | GND | 0 V |
| 11 | USM_P3 | Input: Piezo 71 VAC (RMS) |
| 12 | NSWITCH | Output: Negative-end limit switch, active-high |
| 13 | REFSWITCH | Output: Reference point switch |
| 14 | ENCA+ | Output: Encoder channel A, RS-422 |
| 15 | ENCB+ | Output: Encoder channel B, RS-422 |

# 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.

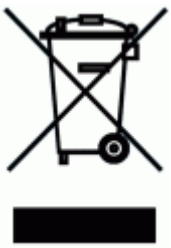
To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG ensures environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

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 Declaration of Conformity

PI

## Declaration of Conformity

according to DIN EN ISO/IEC 17050-1:2005

**Manufacturer:** **Physik Instrumente (PI) GmbH & Co. KG**

**Manufacturer's Address:** Auf der Roemerstrasse 1
D-76228 Karlsruhe,
Germany

CE

**The manufacturer hereby declares that the product**

Product Name: **PILine® High-Speed Linear Stage**

Model Numbers: **M-683**

Product Options: **all**

complies with all relevant provisions of the **Machinery Directive (2006/42/EC)**.
Furthermore, it complies with all provisions of the **EMC Directive (2004/108/EC)** as well as the **RoHS Directive (2011/65/EC)**.

**The applied standards certifying the conformity are listed below.**

***Safety of Machinery:*** EN 12100:2010

***Electrical Safety:*** EN 61010-1:2010

***Electromagnetic Emission:*** EN 61000-6-3:2007, EN 55011:2009

***Electromagnetic Immunity:*** EN 61000-6-1:2007

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

December 11, 2012
Karlsruhe, Germany

Norbert Ludwig
Managing Director

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