| Order no. | 6443-9- | | 0 | 0 |
|---|---|---|---|---|
| DC | | 1 | | |
| SM | | 2 | | |

# DT-80 Rotation Stage

Order no. 6443-9-

# User Manual

Version: **00.004** Date: 19.07.2019

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CONTENTS

# 1. ABOUT THIS DOCUMENT

All specifications in this user manual refer only to the standard products that are included in the PI catalog. Any special features that are different, in particular special requests from customers, are supplied with the user manual as additional documentation in the form of "Technical Notes".

## 1.1 Objective and Target Group of this User Manual

- This user manual contains all information required for the intended use of the DT-80.
- Basic knowledge on servo systems, motion control concepts and applicable safety measures is assumed.
- The latest version of the user manual and answers to any questions can be obtained from our customer service department (see chapter 9)

## 1.2 Symbols and Typographic Conventions

The symbols and typographic conventions used in this manual have the following meanings:

NOTICE

Dangerous situation!
If not avoided, the dangerous situation will result in death, injuries or damage to the equipment
-> Actions to take to avoid the situation

NOTICE

Information for easier handling, tricks, tips, etc.

## 1.3 Other Applicable Documents

All products and programs from PI mentioned in this documentation are described in separate user manuals.
The latest versions of the user manuals can be obtained from our customer service department (see chapter 9).

# 2. SAFETY

## 2.1 Intended Use

The DT-80 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment which is free of dirt, oil, and lubricants.

In accordance with its design, the DT-80 is intended for single-axis positioning, adjusting and rotation of loads around an axis at various velocities. The DT-80 can be mounted horizontally or vertically.

The intended use of the DT-80 is only possible in conjunction with suitable electronics. The following options are available:

1. Drive electronics and controller with suitable software
2. Combination device with suitable software

- The electronics are not included in the scope of delivery of the DT-80.
- The electronics must provide the required voltages. To ensure proper performance of the servo-control system, the electronics must be able to read out and further process the signals from the reference switch as well as the those from the incremental position encoder.

## 2.2 General Safety Instructions

The DT-80 is built according to state-of-the-art technology and recognized safety standards. Improper use of the DT-80 may result in personal injury and/or damage to the DT-80.

Only use the DT-80 for its intended purpose, and only use it if it is in 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 DT-80.

### 2.2.1 Organizational Measures

**User Manual**

- Always keep this user manual available when using the DT-80. If the user manual is lost or damaged, contact our customer service department (see chapter 10).
- Add all information from the manufacturer such as supplements or technical notes to the user manual.

- Only use the device on the basis of the complete user manual. If your user manual is incomplete and is therefore missing important information, serious or fatal injury as well as damage to the equipment can result.
- Only install and operate the DT-80 after you have read and understood this user manual.

**Personnel Qualification**

The DT-80 may only be started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

### 2.2.2 Measures during Installation

The DT-80 may be damaged by excessively long screws and wrongly mounted parts.

- Only use screws of the correct length for the respective mounting holes.
- Only mount the DT-80 and the loads on the mounting fixtures (holes) intended for this purpose.
- The DT-80 heats up during operation. High temperatures can influence your application.
- Install the DT-80 so that your application is not affected by the dissipating heat.
- Cable extensions can affect the performance of the DT-80 and damage the electronics.
- Only use genuine PI miCos parts to connect the DT-80 to the electronic equipment.
- Do not use cable extensions. If you need longer cables, use cable extensions from PI miCos.
- Avoid short circuiting the lines for motor voltages since this can damage the electronics.

### 2.2.3 Measures during Start-Up

Do not put your DT-80 into operation until it is fully mounted and connected.

Your system can be damaged by uncontrolled oscillation of the DT-80. Noise generated during operation of the DT-85 is a typical sign of oscillation.

Immediately switch off the servo-control system of the affected rotational axis.

- Check the settings of the servo-control parameters.

Moving parts attached to devices with motorized rotation stages can accelerate rapidly and generate high forces which can cause injury or damage to equipment.

Unintentional motion of the rotation stage is possible when it is connected to the controller for the first time. Defective software or incorrect operation of the software can also result in unintentional motions.

- Do not place any objects in areas where they can be caught by moving parts.

Set the control signal so that the moving part does not stop abruptly or try to continue motion.

- Determine the maximum velocity for your application.

### 2.2.4 Measures during Operation

- If noise during occurs during operation of the DT-80, check the settings of the servo-control parameters of your controller.

- During continuous operation at room temperature, do not exceed 90 % of the control signal level.
- For continuous operation at other temperatures, observe the maximum permissible duty cycle in relation to the ambient temperature or contact our customer service department for more information (see chapter 9).

### 2.2.5 Measures during Maintenance

The DT-80 is precision adjusted.

- Do not loosen any sealed screws.

Dirt, oil, lubricants and condensation will render the motor/drive inoperable. Keep the DT-80 free of dirt and condensation.

## 3. UNPACKING

1. Unpack the DT-80 with care.
2. Compare the contents with the items listed in the contract and the packing list.
3. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI miCos immediately.
4. Keep all packaging materials in case the product needs to be returned.

**WARNING**

Risk of suffocation for children. Keep the packaging foil away from children.
Dispose of packaging materials according to environmental regulations.

**NOTICE**

All specifications in this user manual refer only to the standard products that are included in the PI-miCos catalog. Any special features that are different, in particular special requests from customers, are supplied with the user manual as additional documentation in the form of "Technical Notes".

# 4. PRODUCT DESCRIPTION

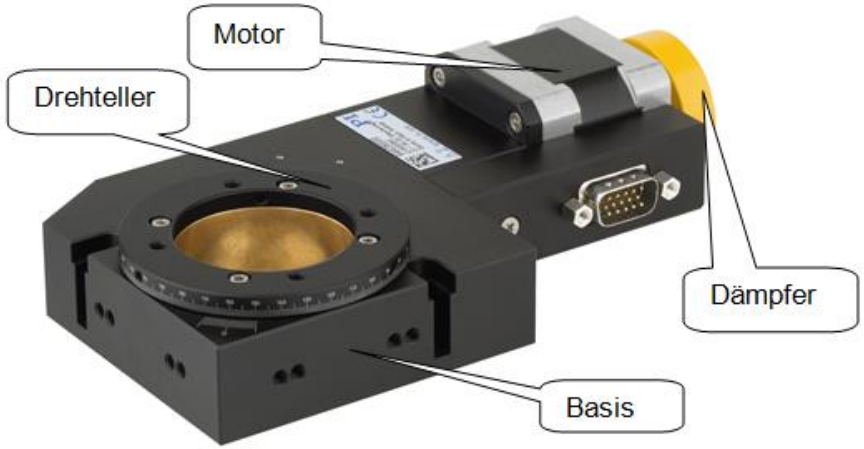
## 4.1 Features and Application Area

Our products are designed specifically for use in the laboratory.

## 4.2 Model Overview

| Order no. | 6443-9- | | 0 | 0 |
|---|---|---|---|---|
| DC | | 1 | | |
| SM | | 2 | | |

## 4.3 Product View




## 4.4 Safety Instructions

**NOTICE**

Modifications and servicing on this axis may only be carried out by the manufacturer or persons authorized by the manufacturer. The manufacturer is not liable for damage caused by unauthorized tampering. Unauthorized tampering invalidates the guarantee.

**NOTICE**

Protect the product against mechanical damage (knocking, shock, ...).
Never start up an axis if you suspect it to be damaged or broken.
Do not disconnect or connect connectors when voltage is present.

**WARNING**

Risk of catching by rotating parts such as couplers and ball screws

**WARNING**

It is recommended that all persons entrusted with working with this product and who therefore come into contact with areas marked by the ESD warning symbol, are given training and a comprehensive explanation of the ESD warning symbol with respect to the ESD precautions.

## 4.5 Scope of Delivery

- Rotation stage according to order.
- Mounting accessories (screws & pins) in fast-sealing bag.

## 4.6 Optional Accessories

Obtain more information on optional accessories from our customer service department (chapter 9).

## 4.7 Technical Features

### 4.7.1 Load Capacity Data

FACTS

| Load characteristics | Fx(N) | Fz(N) | Mx(Nm) | Mz(Nm) | kax(µrad/Nm) |
|---|---|---|---|---|---|
| DC | 10 | 20 | 5 | 0.1 | 150 |
| SM | 10 | 20 | 5 | 0.1 | 150 |

### 4.7.2 Motors

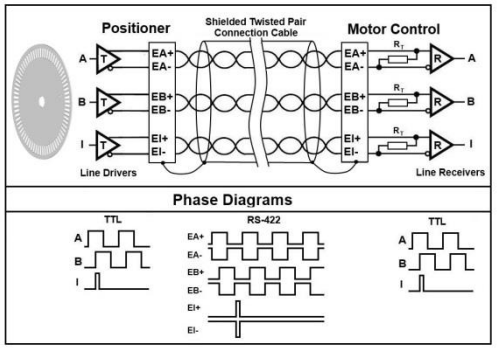
**DC**

| | | |
|---|---|---|
| Motor type | | DC brush, 3242-024 CR |
| Nominal voltage | V | 24 |
| Max. continuous current | A | 1.3 |
| Electrical resistance | Ω | 5.0 |
| Electrical inductance | mH | 0.54 |
| Torque constant | mNm/A | 41.3 |
| Velocity constant | rpm/V | 231 |
| n/M slope curve | rpm/mNm | 28 |
| No load velocity | rpm | 5300 |
| Max.continuous velocity at nominal torque | rpm | 3690 |
| Inertia | $kgm^2$ | 2.66 E-6 |
| Continuous torque | mNm | 41 |
| Rotary encoder | | RE-010 RS422 2-channel + index |
| Encoder increments (quad counts) | n | 2000 |

**RE-010**

Rotary optical encoder, RS-422 quadrature

| | | |
|---|---|---|
| Encoder type | | HEDL rotary optical encoder |
| Quadrature counts per revolution | n | 2000 |
| Signal output | | RS-422 |
| Channels | | 2 + index |
| Supply voltage | VDC | 4.5..5.5 |
| Current consumption, Typical (Vcc = 5 V DC) | mA | 57 |
| Frequency range | KHz | 100 |
| Inertia of code disc | kgm2 | 0.5E-7 |
| Operating temperature | °C | -40..100 |



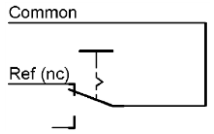
**SM**

| | | |
|---|---|---|
| Motor type | | 2 phase bipolar SH4118M1804 |
| Phase current | A | 1.8 |
| Step angle | ° | 1.8 ° |
| Steps | n | 200 |
| Coil resistance | Ω | 1.1 |
| Coil inductance | mH | 1.85 |
| Holding torque | mNm | 280 |
| Inertia | $kgm^2$ | 5.7 E-6 |
| Weight | kg | 0.24 |

### 4.7.3 Limit Switch

**Mechanical limit switches**

| | | |
|---|---|---|
| Supply Voltage | VDC | < 30 |
| Contact type | | normally closed |

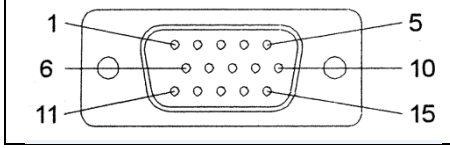



LRef: limit reference signal

### 4.7.4 Connector

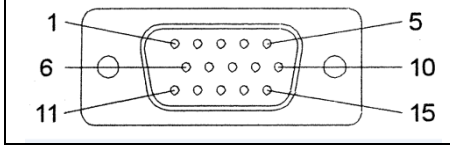
**DC motor, HD15 motor pin assignment with mechanical switches**

| HD15m | Function | |
|---|---|---|
| 1 | EA+ | Encoder channel A+ |
| 2 | EB+ | Encoder channel B+ |
| 3 | EI+ | Encoder channel I+ |
| 4 | EGND | Supply encoder GND |
| 5 | nc | |
| 6 | EA- | Encoder channel A- |
| 7 | EB- | Encoder channel B- |
| 8 | EI- | Encoder channel I- |
| 9 | E5V | Encoder supply voltage |
| 10 | nc | |
| 11 | M+ | DC brush motor + |
| 12 | M- | DC brush motor - |
| 13 | LCOM | Limit common |
| 14 | LRef | Limit Switch reference signal |
| 15 | LCOM | Limit common |



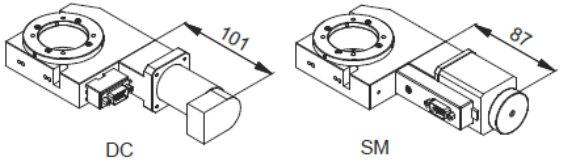

**2SM motor, HD15 motor pin assignment with mechanical sensors**

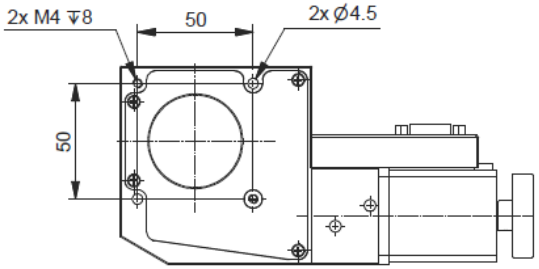
| HD15m | Function | |
|---|---|---|
| 1 | MA+ | Motor phase A+ |
| 2 | MA- | Motor phase A- |
| 3 | nc | |
| 4 | nc | |
| 5 | MB+ | Motor phase B+ |
| 6 | MB- | Motor phase B- |
| 7 | nc | |
| 8 | nc | |
| 9 | nc | |
| 10 | nc | |
| 11 | nc | |
| 12 | nc | |
| 13 | nc | |
| 14 | LRef | Limit Switch reference signal |
| 15 | LCOM | Limit common |

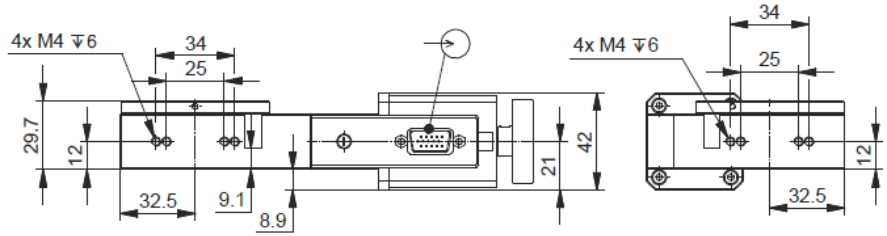


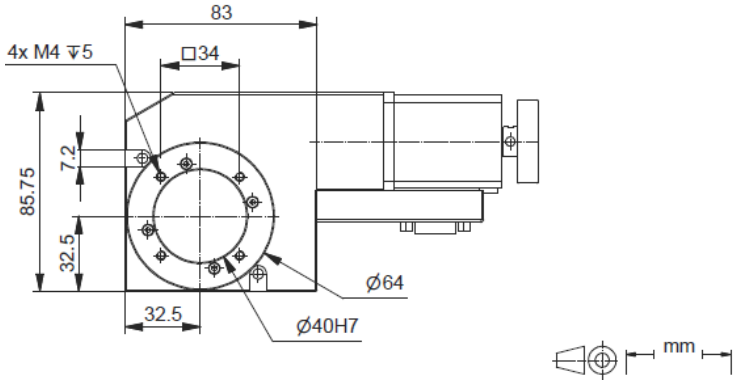
### 4.7.5 Technical Data

| Technical Data | | | |
|---|---|---|---|
| Travel range (°) | 360 endless | | |
| Pitch angle (µrad) | ± 30 | | |
| Evenness (µm) | ± 30 | | |
| Yaw angle (µrad) | ± 100 | | |
| Weight (kg) | 0.8 | | |
| Motor | DC | SM | |
| (°) | 1 | 1 | |
| Max. velocity (°/sec) | 40 | 30 | |
| Typical resolution (°) | 0.004 | 0.004 | |
| Calculated resolution (°) | RE0.001 | 0.01 (FS) | |
| Bidirectional repeatability (°) | ± 0.2 | ± 0.2 | |
| Unidirectional repeatability (°) | 0.01 | 0.01 | |
| Nominal current (A) | 1.17 | 1.8 | |
| Max. operating voltage (V) | 24 | <100 | |
| Translation | 180 : 1 | | |
| Accuracy | on request | | |
| Velocity range (°/sec) | 0.001..40 | | |
| Material | Al (black anodized) | | |



### 4.8 Ambient Conditions

For indoor use only.

- The DT-80 was calibrated at an ambient temperature of 20 °C (+/- 3 °C).
- The permissible operating temperature is between +5 °C and +40 °C.
- The permissible relative humidity is between 20% and 80%.
- Always keep the DT-80 free of dirt, dust, and corrosive gases.

# 5. INSTALLATION

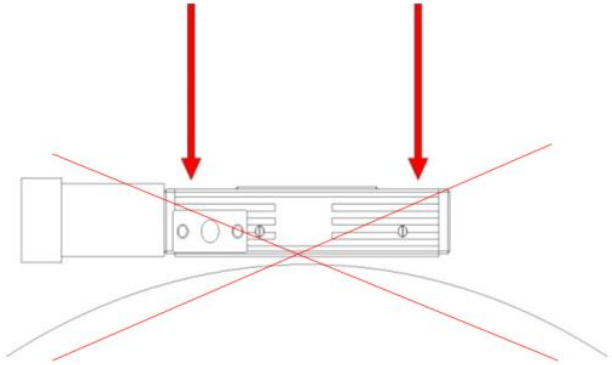
## 5.1 General Notes on Installation

**Prerequisite**

The axis must be screwed onto a surface with an evenness better than 5 µm.

It is necessary to make sure that no dust, dirt or other foreign bodies are between the surface and the axis, otherwise the properties of the axis can be impaired by mechanical tension.

To guarantee the prescribed specifications (see Internet www.pimicos.com), the evenness of the mounting surface must be better than 5 µm. (Reference surface of PI miCos measuring granite is 3 µm).



## 5.2 Mounting the Rotation Stage

**Prerequisite**

You have read and understood the general notes on installation (see chapter 5.1).

**Mounting material**

Screws, pins, and auxiliary material or tools supplied (see chapter 4.5.0 "Scope of Delivery").

- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

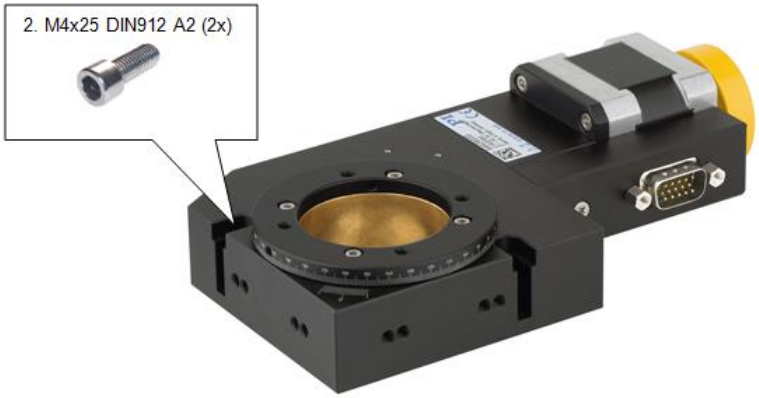
Tightening torques of the mounting screws to be used should not have values higher than the following:

- M3 DIN 912 1.5 Nm
- M4 DIN 912 2.0 Nm
- M5 DIN 912 2.5 Nm
- M6 DIN 912 3.0 Nm

**Mounting the DT-80**

Mount the rotation stage with the screws supplied.

Make sure that the screw heads do not protrude from the countersunk holes.



### 5.3 Affixing the Load

**Prerequisite**

You have read and understood the general notes on installation (see chapter 5.1).

The load must have an evenness better than 5 µm.

It is necessary to make sure that no dust, dirt or other foreign bodies are between the load and the axis, otherwise the properties of the axis can be impaired by mechanical tension.

**Mounting material**

- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

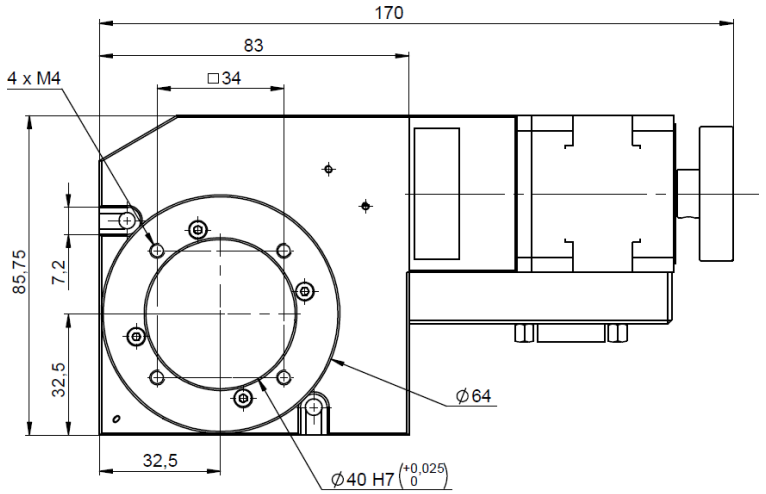
Tightening torques of the mounting screws to be used should not have values higher than the following:

- M3 DIN 912 1.5 Nm
- M4 DIN 912 2.0 Nm
- M5 DIN 912 2.5 Nm
- M6 DIN 912 3.0 Nm

**Mounting the Additional Part**

Select the mounting position so that the existing fixing holes in the slider of the DT-80 can be used for the additional part to be affixed.

Affix the additional part using the corresponding screws and lock the rotary plate first so that torque acts on the worm gear translation.




## 6. START-UP

### 6.1 General Notes on Start-Up

This rotation stage must be started up with a suitable cable and the associated controllers.

# 7. MAINTENANCE

Depending on the operating conditions and the period of use of the DT-80, the following maintenance measures are required:

**Maintenance run**

The maintenance run serves to distribute the existing lubricant.

- To evenly distribute the existing lubricant on the stage guidings, perform a maintenance run over one complete rotation after 500 hours of operation, or after 1 year at the latest.
- If the the rotation stage is operated frequently and its motion is over a small rotation range (less than 70°), perform a maintenance run over one complete rotation after 5,000 motion cycles.

**Lubrication**

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

- Do not lubricate the DT-80 without consulting our customer service department (see chapter 9).
- To lubricate, follow the instructions in the maintenance manual, which you can obtain from our customer service department.

# 8. TROUBLESHOOTING

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 (see chapter 9).

# 9. CUSTOMER SERVICE

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

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

1. Product codes and serial numbers of all products in the system
2. Current firmware of the controller (if present)
3. Software version of the driver or the user software (if present)
4. User operating system (if present)

## 10. OLD PRODUCT DISPOSAL

In accordance with EU directive 2002/96/EC (WEEE), as of 13 August 2005, electrical and electronic equipment may not be disposed of in the member states of the EU via the municipal residual waste.

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

In order to fulfil the responsibility as the product manufacturer, PI miCos GmbH undertakes environmentally correct disposal of all old PI miCos equipment made available on the market after 13 August 2005 without charge.

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

PI GmbH
Freiburger Strasse 30
D-79427 Eschbach, Germany

## 11. EU DECLARATION OF CONFORMITY

An EC Declaration of Conformity has been issued for the DT-80 in accordance with the following European directives:

2004/108/EC, EMC Directive
2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

EMC: EN 61326-1:2013
Safety: EN 61010-1:2010
DIN EN ISO 12100:2010
RoHS: EN 50581:2012