

Order no.	6560-9-	1	
DC-B-082		1	↓
2Phase-070		2	
without AE-060		0	
AE-060, angular scale		1	

WT-120 Goniometer  
Order no. 6560-9-

User Manual  
Version: **00.000**

Date: 10.08.2016



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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download (<http://www.pimicos.com>).

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Document

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## CONTENTS

### 1. ABOUT THIS DOCUMENT

- 1.1 Objective and Target Group of this User Manual
- 1.2 Symbols and Typographic Conventions
- 1.3 Other Applicable Documents

### 2. SAFETY

- 2.1 Intended Use
- 2.2 General Safety Instructions
  - 2.2.1 Organizational Measures
  - 2.2.2 Measures during Installation
  - 2.2.3 Measures during Start-Up
  - 2.2.4 Measures during Operation
  - 2.2.5 Measures during Maintenance

### 3. UNPACKING

### 4. PRODUCT DESCRIPTION

- 4.1 Features and Application Area
- 4.2 Model Overview
- 4.3 Product View
- 4.4 Safety Instructions
- 4.5 Scope of Delivery
- 4.6 Optional Accessories

### 4.7 Technical Features

- 4.7.1 Load Capacity Data
- 4.7.2 Motors
- 4.7.3 Measuring System
- 4.7.4 Limit Switch
- 4.7.5 Connector
- 4.7.6 Technical Data

### 4.8 Ambient Conditions

### 5. INSTALLATION

- 5.1 General Notes on Installation
- 5.2 Mounting the goniometer
- 5.3 Mounting the Load
- 5.4 Mounting with WT-90

### 6. START-UP

- 6.1 General Notes on Start-Up

### 7. MAINTENANCE

### 8. TROUBLESHOOTING

### 9. CUSTOMER SERVICE

### 10. OLD EQUIPMENT DISPOSAL

### 11. EU DECLARATION OF CONFORMITY

### 1. ABOUT THIS DOCUMENT

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".

#### 1.1 Objective and Target Group of this User Manual

- This user manual contains all information required for the intended use of the WT-120.
- 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 miCos 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 WT-120 is a laboratory device as defined by DIN EN 61010. It is intended for indoor use and use in an environment that is free of dirt, oil, and lubricants.

In accordance with its design, the WT-120 is intended for single-axis positioning, adjusting and rotation of loads around an axis at various velocities. The WT-120 can be mounted horizontally or vertically.

The intended use of the WT-120 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 WT-120.
- 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 those from the incremental position encoder.

## 2.2 General Safety Instructions

The WT-120 is built according to state-of-the-art technology and recognized safety standards. Improper use of the WT-120 may result in personal injury and/or damage to the E-120.

1. Only use the WT-120 for its intended purpose, and only use it if it is in good working order.
2. Read the user manual.
3. Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the WT-120.

### 2.2.1 Organizational Measures

#### User Manual

- Always keep this user manual available when using the WT-120. 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 WT-120 after you have read and understood this user manual.

#### Personnel Qualification

The WT-120 may only be started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

### 2.2.2 Measures during Installation

The WT-120 may be damaged by excessively long screws and wrongly mounted parts.

- When mounting the WT-120, make sure that the mounting screws do not interfere with the stage motion. The screw heads must not protrude from the countersunk holes.
- Only use screws of the correct length for the respective mounting holes.
- When mounting the WT-120, observe the depth of the mounting holes in the motion platform.
- Only mount the WT-120 and the loads on the mounting fixtures (holes) intended for this purpose.
- The WT-120 heats up during operation. High temperatures can influence your application.
- Install the WT-120 so that your application is not affected by the dissipating heat.
- Cable extensions can affect the performance of the WT-120 and damage the electronics.
- Only use genuine PI miCos parts to connect the WT-120 to the electronic equipment.
- Do not use cable extensions. If you need longer cables, use cable extensions from PI miCos.
- Avoid shorting the piezo voltage lines since this can damage the electronics.

### 2.2.3 Measures during Start-Up

Do not put your WT-120 into operation until it is fully mounted and connected.

Your system can be damaged by uncontrolled oscillation of the WT-120. Noise generated during operation of the WT-120 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 goniometers can accelerate rapidly and generate high forces which can cause injury or damage to equipment.

Unintentional motion of the goniometer 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.

Collision of a part in motion at the end of the travel range and high accelerations can cause damage to or wear on the mechanical system.

- Ensure that the automatic limit switch halt is supported by the controller, or that it is activated in the controller.
- Do not disable the evaluation of the limit switch signals by the controller.
- Check the functioning of the limit switches at velocities between 10 % and 20 % of the maximum velocity.
- In the event of a malfunction of the limit switches, stop the motion immediately.
- Ensure that the end of the travel range is approached at low velocity.

Set the control signal so that the moving part does not stop abruptly or try to continue motion at the end of the travel range.

- Determine the maximum velocity for your application.

### 2.2.4 Measures during Operation

- If noise occurs during operation of the WT-120, check the settings of the servo-control parameters of your controller.

Highest dynamic force and holding force are achieved at a control signal level of 100 %; however, during continuous operation the motor/drive may overheat.

- During continuous operation at room temperature, do not exceed a maximum of 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 WT-120 is precision adjusted.

- Do not loosen any sealed screws.

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

- Keep the piezo motor of the WT-120 free from lubricants.
- Keep the WT-120 free of dirt and condensation.

### 3. UNPACKING

1. 1. Unpack the WT-120 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

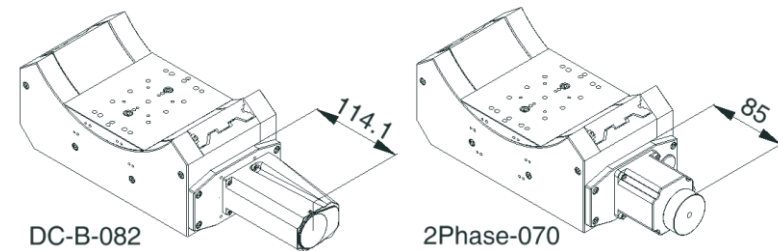
All specifications in this user manual refer only to the standard products that are included in the PI miCos catalog. Any special features that are different, in particular special requests from customers, are supplied with the user manual as additional documentation in the form of "Technical Notes".

### 4. PRODUCT DESCRIPTION

#### 4.1 Features and Application Area

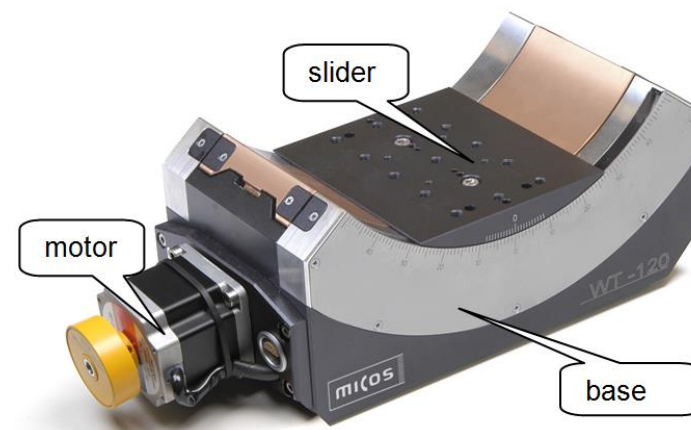
Our products are designed specifically for use in the laboratory.

#### 4.2 Model Overview



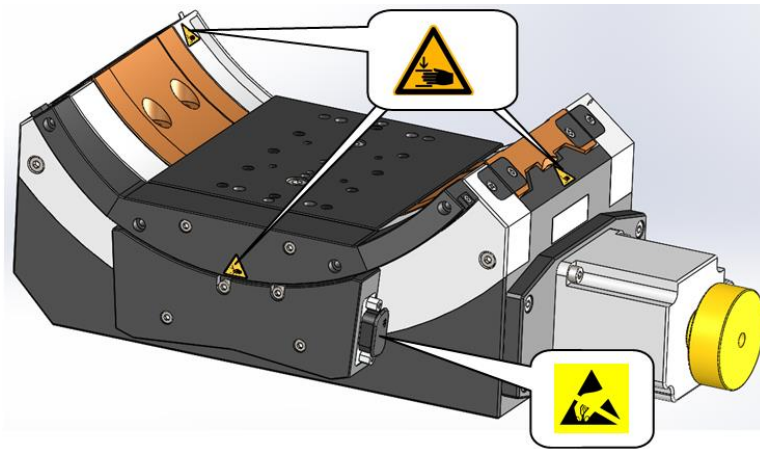
Order no.	6560-9-	1	
DC-B-082		1	J
2Phase-070		2	
without AE-060		0	
AE-060, angular scale		1	

#### 4.3 Product View



## 8 WT-120 Goniometer

### 4.4 Safety Instructions



#### ! 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 squeezing or crushing by moving sliders at the places illustrated.

#### ! 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

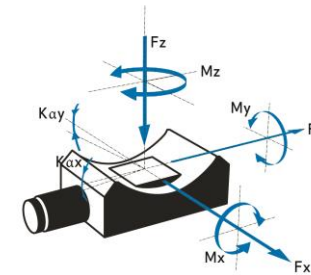
- Goniometer according to order.
- Mounting accessories (screws & pins) in fast-sealing bag.

### 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)	Fy (N)	Fz (N)	Mx (Nm)	My (Nm)	Mz (Nm)	Kax (μrad/Nm)	Kay (μrad/Nm)
DC-B-082	90	90	200	8	25	25	15	15
2Phase-070	90	90	200	8	25	25	15	15



4.7.2 Motors

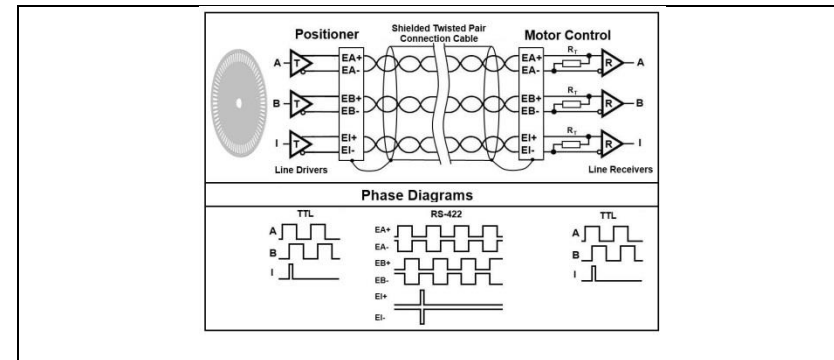
DC-B-082

Motor type		DC brush RE-040
Nominal voltage	V	48
Max. continuous current	A	3.12
Electrical resistance	$\Omega$	1.16
Electrical inductance	mH	0.329
Torque constant	mNm/A	60.3
Velocity constant	rpm/V	158
n/M slope curve	rpm/mNm	3.04
no load velocity at 48 V	rpm	7580
Max. continuous velocity at nominal torque	rpm	
Inertia	kgm <sup>2</sup>	13.8E-6
Continuous torque	mNm	184
Rotary encoder		RE-015 RS422 2-channel + index
Encoder increments (quad counts)	n	20000

RE-015

Rotary optical encoder RS-422 quadrature

Encoder type		RMHF rotary optical encoder
Quadrature counts per revolution	n	20000
Signal output		RS-422
Channels		2 + index
Supply voltage	VDC	4.5..5.5
Current consumption, typical (Vcc = 5 V DC)	mA	35
Frequency range	KHz	1000
Code disc inertia	kgm <sup>2</sup>	1E-7
Operating temperature	°C	-40..85



2Phase-070

Motor type		2-phase bipolar parallel PK-266-E2.0B
Phase current	A	2
Step angle	°	1.8
Steps	n	200
Coil resistance	$\Omega$	0.9
Coil inductance	mH	2.5
Holding torque	mNm	1170
Inertia	kgm <sup>2</sup>	30E-6
weight	kg	0.7

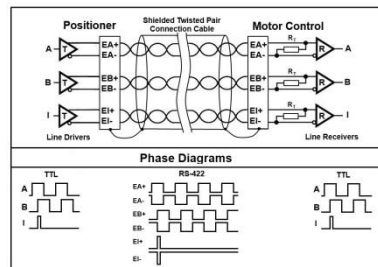
## 10 WT-120 Goniometer

### 4.7.3 Measuring System

#### AE-060 WT-120

Angular optical encoder RS-422 quadrature

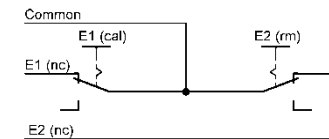
Encoder type		Angular incremental RGH-24
Quadrature counts per 360°	n	4140619
Resolution	deg	8.694352221e-5
Grating period	µm	20
Grating material		Steel
Interpolator	n	Integrated 25 times
Signal output		RS-422 quadrature
Channels		2+1 index
Supply voltage	VDC	5 +/- 10%
Current consumption, typical (Vcc = 5 V DC)	mA	<150
Frequency range, Counter capability	MHz	1
Operating temperature	°C	0..55
Absolute accuracy	deg	<+/- 0.01
Index	deg	middle of travel
Connector		Sub-D (m), 9-pin



### 4.7.4 Limit Switch

#### Mechanical limit switches

Max. voltage (resistive load)	V	30
Max. current (resistive load)	A	1
Contact type		Normal closed
Max. switch voltage (resistive load)	VDC	3-24
Operations		>5x10 <sup>4</sup>
Operating temperature	°C	-40 to +85

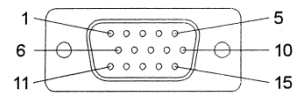


4.7.5 Connector

**ST-050**

DC motor, HD Sub-D (m), 15-pin assignment with mechanical switches

HD Sub-D (m), 15-pin	Function	
1	EA+	Encoder channel A+
2	EB+	Encoder channel B+
3	EC+	Encoder channel I+
4	EGND	Supply encoder GND
5	nc	
6	EA-	Encoder channel A-
7	EB-	Encoder channel B-
8	EC-	Encoder channel I-
9	E5V	Encoder supply voltage
10	nc	
11	M+	DC brush motor +
12	M-	DC brush motor -
13	LE2	Limit forward
14	LE1	Limit reverse
15	LCOM	Limit common

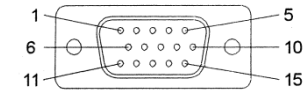


**ST-010**

2SM motor HD Sub-D (m), 15-pin with mechanical sensors

HD Sub-D (m), 15-pin	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	

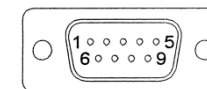
10	nc	
11	nc	
12	nc	
13	LE2	Limit forward
14	LE1	Limit reverse
15	LCOM	Limit common



**ST-001**

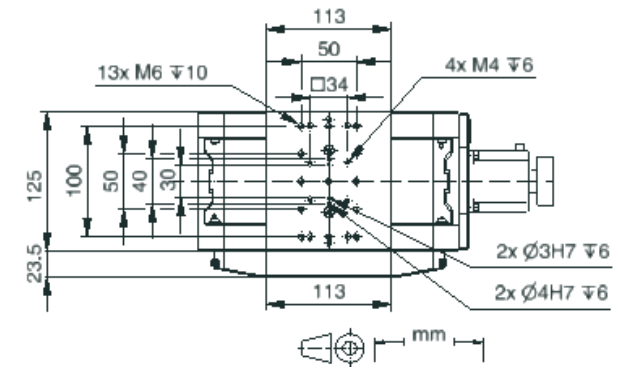
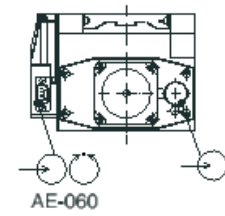
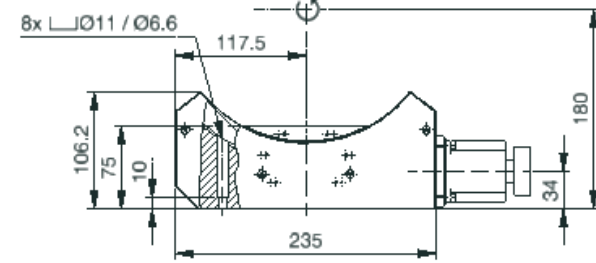
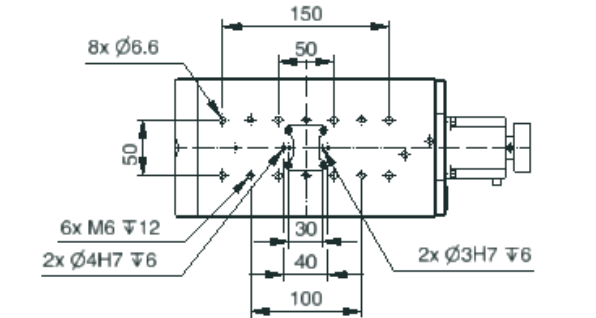
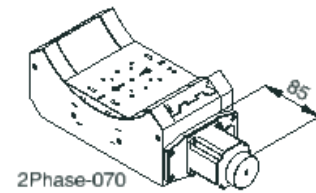
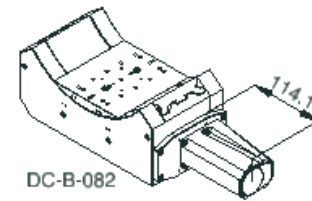
Linear encoder, Sub-D (m), 9-pin, RS-422 pin assignment

Sub-D (m), 9-pin	Function	
1	EA+	Encoder channel A+
2	EB+	Encoder channel B+
3	EC+	Encoder channel I+
4	EGND	Supply encoder GND
5	E5V	Encoder supply
6	EA-	Encoder channel A-
7	EB-	Encoder channel B-
8	EC-	Encoder channel I-
9	nc	
Housing	Shield	Shield of encoder, read head



4.7.6 Technical Data

TECHNICAL DATA			
Travel range (°)	90		
Wobble (bearings) (μrad)	± 125		
Weight (kg)	11.5		
Motor	DC-B-082	2Phase-070	
Linear scale			AE-060
Max. velocity (°/sec)	30	25	
Calculated resolution (°)	0.0001 (RE)	0.01 (FS)	8.7E-05
Typical resolution (°)	0.004	0.004	0.001
Bidirectional repeatability (°)	± 0.02	± 0.02	± 0.001
Unidirectional repeatability (°)	0.005	0.005	0.001
Nominal current (A)	3.33	2	
Max. operating voltage (V)	48	<100	
Warm gear reduction	180 : 1		
Accuracy	on request		
Velocity range (°/sec)	0.001..30		
Material	Aluminum, black anodized, stainless steel, red brass, hardened steel		



#### 4.8 Ambient Conditions

For indoor use only.

- The WT-120 was calibrated at an ambient temperature of 20 °C (+/- 3 °C).
- The permissible operating temperature is between 20 °C and 40 °C.
- The permissible relative humidity is between 20% and 80%.
- Always keep the WT-120 free of dirt, dust, and corrosive gases.

## 5. INSTALLATION

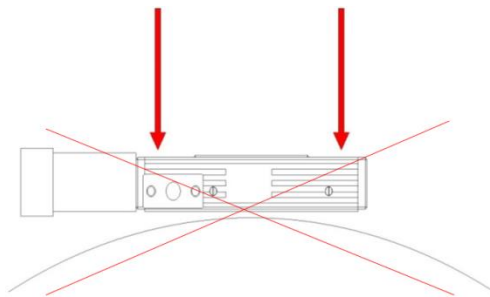
### 5.1 General Notes on Installation

#### Requirements

The goniometer must be screwed onto a surface with a flatness 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](http://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 goniometer

#### Requirements

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 "Scope of Delivery").

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

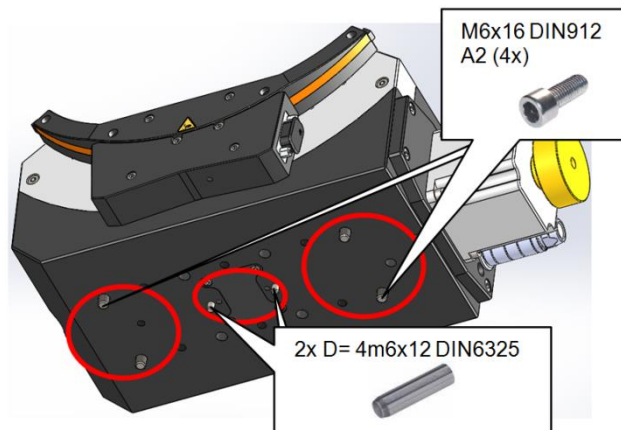
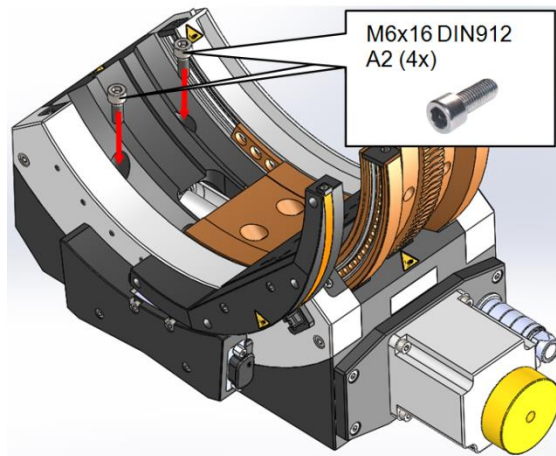
Tightening torques of the mounting screws to be used should not have values higher than the following:

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

## 14 WT-120 Goniometer

### Mounting the WT-120

1. Move the motion platform of the WT-120 to the center position by hand until all of the countersunk holes in the base body required for mounting are accessible (see following illustration).
2. Affix the stage with the screws supplied.
3. Make sure that the screw heads do not protrude from the countersunk holes.



### 5.3 Mounting the Load

#### Requirements

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

The load must have an evenness better than 5  $\mu\text{m}$ .

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.

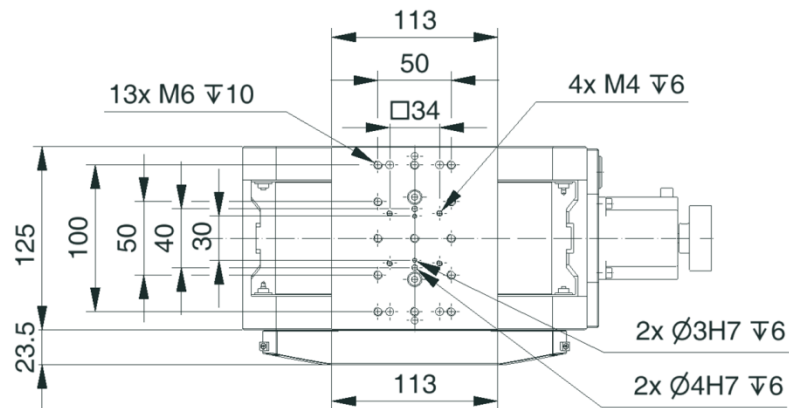
#### Mounting material

- 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:

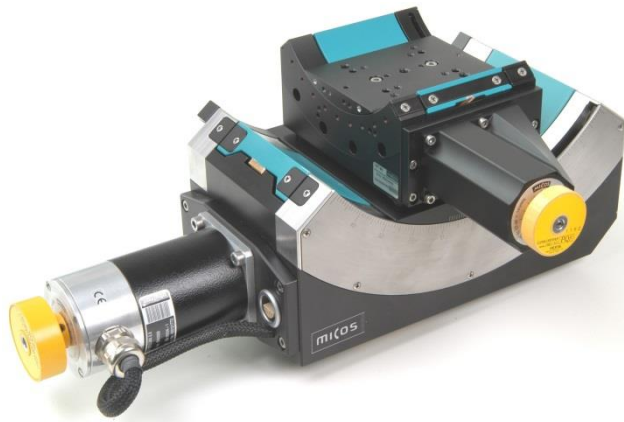
- M3 DIN 912 1.5 Nm
- M4 DIN 912 2.0 Nm
- M5 DIN 912 2.5 Nm
- M6 DIN 912 3.0 Nm

### Mounting the Additional Part



- Select the mounting position so that the existing fixing holes in the slider of the WT-120 can be used for the additional part to be mounted.
- Affix the additional part with the corresponding screws.

### 5.4 Mounting with WT-90



## 6. START-UP

### 6.1 General Notes on Start-Up

This goniometer 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 WT-120, the following maintenance measures are required:

### Maintenance Run

The maintenance run is performed to redistribute the existing lubricant on the guidings of the stage.

- To evenly distribute the existing lubricant on the stage guides, perform a maintenance run across the entire travel range after 500 hours of operation, or after 1 year at the latest.
- If the stage is to be operated continuously in an industrial environment over a small travel (less than 20 percent of the entire travel range), perform a maintenance run across the entire travel range every 5000 motion cycles.

### Lubrication

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

- Do not lubricate the guidings of the WT-120 without consulting our customer service department (see chapter 9).
- To lubricate the guidings, follow the instructions specified 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 miCos sales engineer or send us and email ([info@pimicos.com](mailto:info@pimicos.com)).

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 EQUIPMENT 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 miCos GmbH  
Freiburger Strasse 30  
79427 Eschbach, Germany  
(<http://www.pimicos.com>)



## 11. EU Declaration of Conformity

An EU Declaration of Conformity has been issued for the WT-120 in accordance with the following European directives:

2014/30/EU, 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