Order no.	6850-9-			
LM-010	1			
155 mm (6")		1		
205 mm (8")		2		
305 mm (12")		3		
408 mm (16")		4		
508 mm (20")		5		
LS-011, length measuring system (steel)				1

LMS-180 Linear Motor Stage

Order no. 6850-9-

User Manual

Version: **00.004** Date: 21.04.2017

File name: FILE-001499283_0005_MAN_LMS-180_9_EN.DOCX Document ID:**DOC-000401795**

CONTENTS

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 LMS-180.
- 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 LMS-180 is a laboratory device as defined by DIN EN 61010. 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 LMS-180 is intended for advanced production and laser applications. It is driven by ironless linear motors. The LMS-180 can be mounted horizontally or vertically.

The intended use of the LMS-180 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 LMS-180.
- 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 process the signals from reference and limit switches, and from the incremental position encoder.

2.2 General Safety Instructions

The LMS-180 is built according to state-of-the-art technology and recognized safety standards. Improper use of the LMS-180 can result in personal injury and/or damage to the LMS-180.

1. Only use the LMS-180 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 LMS-180.

2.2.1 Organizational Measures

User Manual

- Always keep this user manual available when using the LMS-180. 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 LMS-180 after you have read and understood this user manual.

Personnel Qualification

The LMS-180 may only be started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

2.2.2 Measures during Installation

The LMS-180 may be damaged by excessively long screws and wrongly mounted parts.

- When mounting the LMS-180, make sure that the mounting screws do not interfere with the stage motion. The screw heads must not protrude from the countersunk holes.
- Note the depth of the mounting holes in the motion platform.
- Only use screws of the correct length for the respective mounting holes.
- Only mount the LMS-180 and the loads on the mounting fixtures (holes) intended for this purpose.
- The LMS-180 heats up during operation. High temperatures can influence your application.
- Install the LMS-180 so that your application is not affected by the dissipating heat.
- Cable extensions can affect the performance of the LMS-180 and damage the electronics.

- Only use genuine PI miCos parts to connect the LMS-180 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 LMS-180 into operation until it is fully mounted and connected.

Your system can be damaged by uncontrolled oscillation of the LMS-180. Noise generated during operation of the LMS-180 is a typical sign of oscillation.

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

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

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 allow the controller to disable evaluation of the limit switch signals.
- Check the function of the limit switches at about 10 % to 20 % of the maximum velocity.
- In the event of a malfunction of the limit switches, stop 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 LMS-180, 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.

1. During continuous operation at room temperature, do not exceed a maximum of 90 % of the control signal level.
2. 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 LMS-180 is precision adjusted.

- Do not loosen any sealed screws.

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

- Keep the motor of the LMS-180 free from lubricants.
- Keep the LMS-180 free of dirt and condensation.

3. UNPACKING

1. Unpack the LMS-180 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

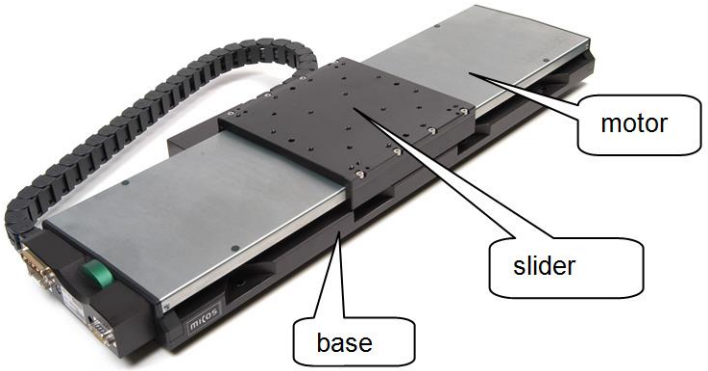
4.1 Features and Application Area

Our products are designed specifically for use in the laboratory.

4.2 Model Overview

Order no.	6850-9-			
LM-010	1			
155 mm (6")		1		
205 mm (8")		2		
305 mm (12")		3		
408 mm (16")		4		
508 mm (20")		5		
LS-011, length measuring system (steel)				1

4.3 Product View



4.4 Safety Instructions

WARNING

After removing the transport lock (if present), watch out for moving parts.

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

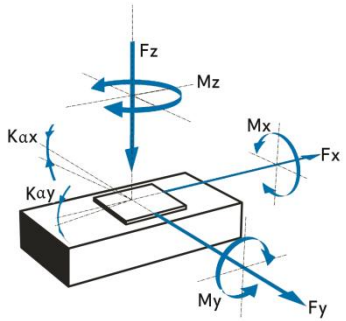
- Stage according to order.
- Mounting accessories (screws & pins) in fast-sealing bag.

4.6 Optional Accessories

For optional accessories, please ask our customer service department (chapter 9) for information on possible use of adapter plates.

4.7 Technical Features

4.7.1 Load Capacity Data



FACTS									
Load characteristics	Fx (N)	Fx Peak (N)	Fy (N)	Fz (N)	Mx (Nm)	My (Nm)	Mz (Nm)	Kax (µrad/Nm)	Kay (µrad/Nm)
LM-010	50	150	500	250	250	130	125	20	30

4.7.2 Motors

LMS-010

UM-9S linear motor

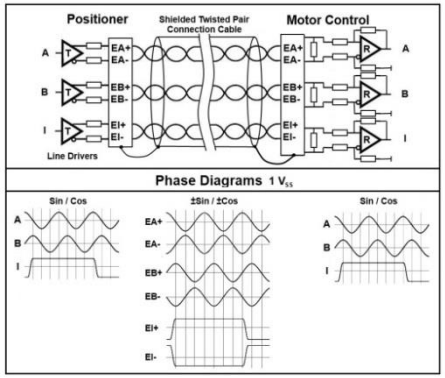
Motor type		UM-9S 3-phase U-shaped ironless motor
peak force	N	150
continues force	N	50
max. voltage	Vdc	300
force constant	N/Arms	19.9
motor constant	N/√W	8.4
peak current	Arms	7.5
continues current	Arms	3.2
back EMF, phase-phase	Vdc/m/s	16
resistance	Ω	1.8
inductance	mH	0.6
electrical time constant	ms	0.35
magnetic pitch	mm	30
coil weight	kg	0.240

4.7.3 Measuring System

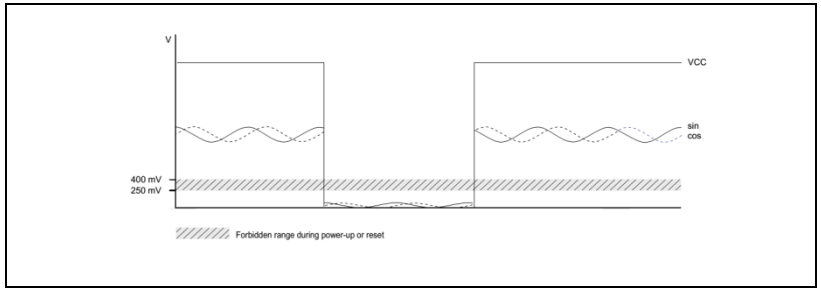
LS-011

Optical encoder, sin/cos signals

Encoder type		Linear incremental LIA-20
Grating period	µm	20
Signal period	µm	20
Grating material		Steel
Signal output		1 Vpp differential sin-cos signals
Channels		2+1 index
Supply voltage	VDC	5 +/- 10%
Current consumption, typical (Vcc = 5 V DC)	mA	<60
max. scanning frequency	KHz	< 500
Operating temperature	°C	0..55
Linear expansion coefficient		app. 10.5 e^{-6}
Absolute accuracy	µm	+/- 1
Index position		50 mm starting in the middle of travel
Connector		Sub-D (m), 9-pin



During the power-up procedure of the encoder system, the operating voltage and the level in the signal lines must be below 250 mV!
If the encoder is switched on at a residual voltage between 250 to 400 mV,
internal sensor parameter will not set correctly. This can lead to incorrect encoder signals.
This behavior has to be observed especially during reset routines of controllers

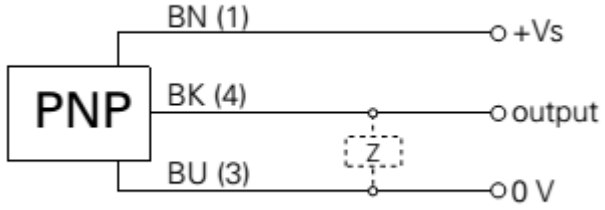


4.7.4 Limit Switch

ILS-020

Inductive limit switches

Supply voltage Vs	V	10-30
Supply current	mA	<12 mA
Output configuration		Open emitter
Max. source current	mA	<200
Max. switch voltage (resistive load)	VDC	30
Contact type		Normal closed
Output type		PNP
Operating temperature	°C	-25 to +75



4.7.5 Connector

ST

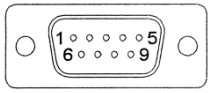
FM9W4 motor pin assignments with ILS limit switches

FM7W2	Function	
A1	U	motor phase U
A2	V	motor phase V
A3	W	motor phase W
A4	PE	
1	LVcc	Supply voltage limit switch
2	LE1	Limit reverse
3	nc	
4	LE2	Limit forward
5	LGND	GND supply limit switch

ST-001 Vpp

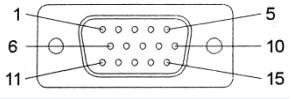
Linear encoder, Sub-D (m), 9-pin, 1Vpp pin assignment

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



Temperature sensor:

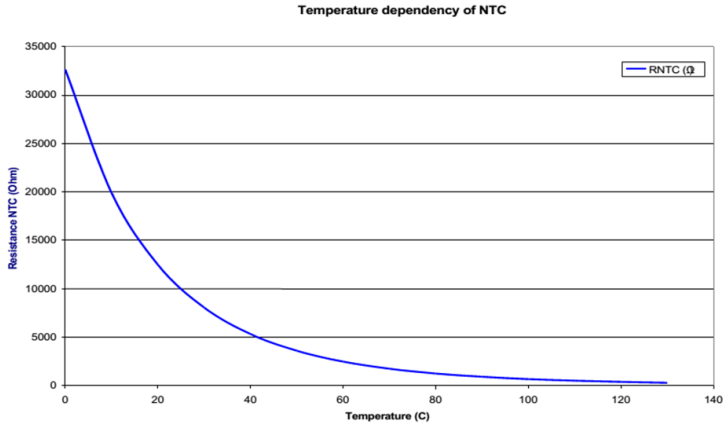
HD Sub-D (m), 15-pin	Function	
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11	PTC	
12	PTC	
13		
14	NTC	
15	NTC	



PTC behavior

Temperature	Resistance
Up to 20°C below critical temperature	< 250 Ω
Up to 5°C below critical temperature	< 550 Ω
Nominal switching resistance	***1000 Ω***
Above critical temperature	> 1330 Ω

NTC behavior



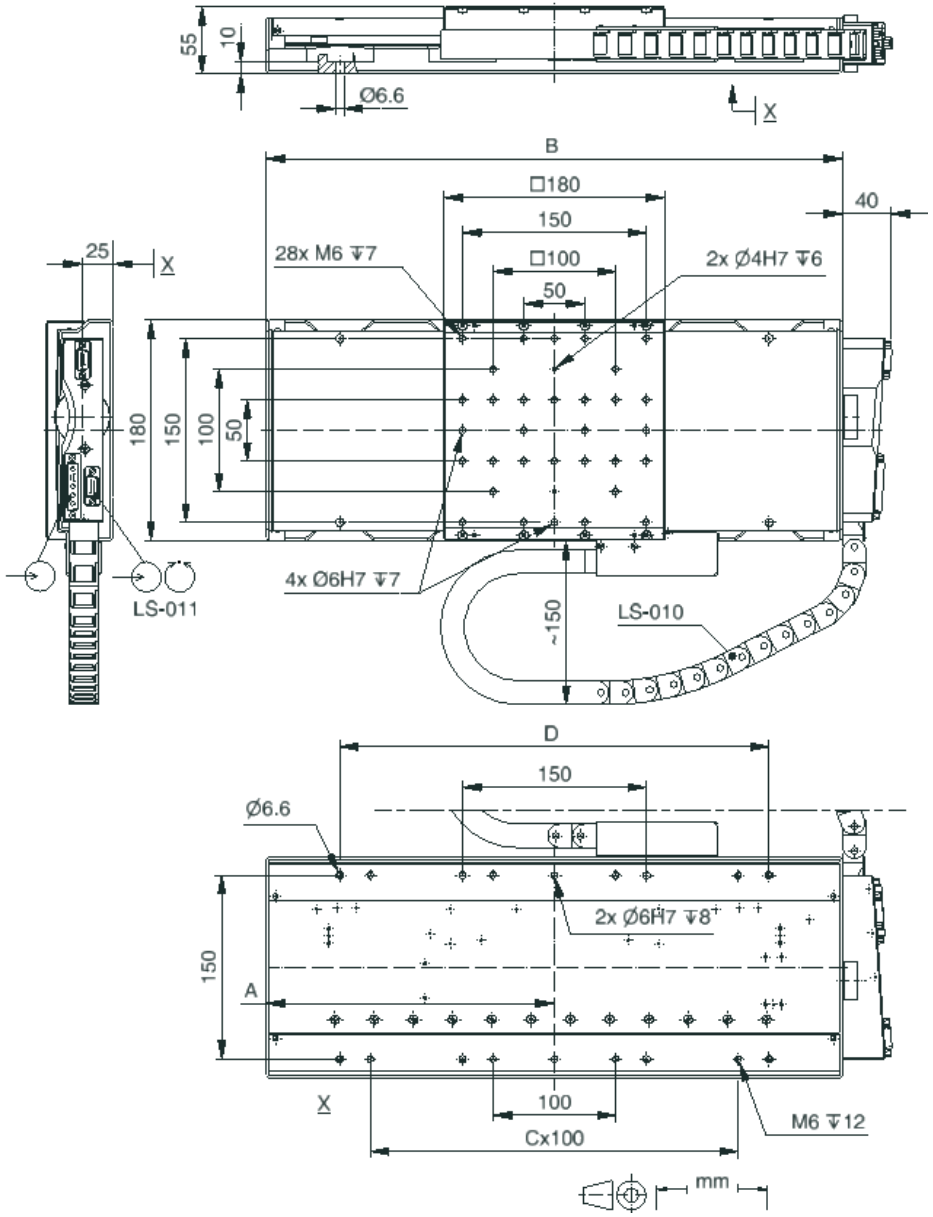
The following table with numerical values from NTC and former KTY

T (°C)	0	10	20	30	40	50	60	70	80	90	100	110	120	130
R_{NTC} (Ω)	32650	19900	12490	8057	5327	3603	2488	1752	1258	918	680	511	389	301
R_{KTY} (Ω)	815	886	961	1040	1123	1209	1300	1394	1492	1594	1700	1810	1923	2041

4.7.6 Technical Data

TECHNICAL DATA					
Travel range (mm)	155	205	305	408	508
Straightness / Flatness (µm)	± 2	± 3	± 4	± 5	± 6
Pitch angle (µrad)	± 40	± 50	± 60	± 70	± 80
Yaw angle (µrad)	± 50	± 50	50	± 50	± 50
Weight (kg)	10.2	10.4	11.5	12.8	14.2
Motor	LM-010				
Linear scale				LS-011	
Max. velocity (mm/sec)	500				
Typical resolution (µm)				0.04	
Calculated resolution (µm)				0.015	
Bidirectional repeatability (µm)				± 0.15	
Unidirectional repeatability (µm)				0.05	
Nominal current (A)	1.8				
Max. operating voltage (V)	60				
Accuracy	on request				
Velocity range (mm/sec)	0.001..500				
Material	Aluminum, black anodized				

Travel (mm)	155	205	305	408	508
A	235	260	310	360	410
B	470	520	620	720	820
C	3	3	5	5	5
D	350	350	450	550	650



4.8 Ambient Conditions

For indoor use only.

- The LMS-180 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 LMS-180 free of dirt, dust, and corrosive gases.

5. INSTALLATION

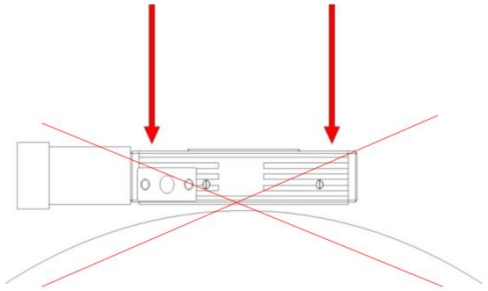
5.1 General Notes on Installation

Requirements

The axis must be screwed onto a surface with 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), **the flatness of the mounting surface must be better than 5 µm**. (Reference surface of PI miCos measuring granite is 3 µm).



5.2 Mounting the Stage

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").

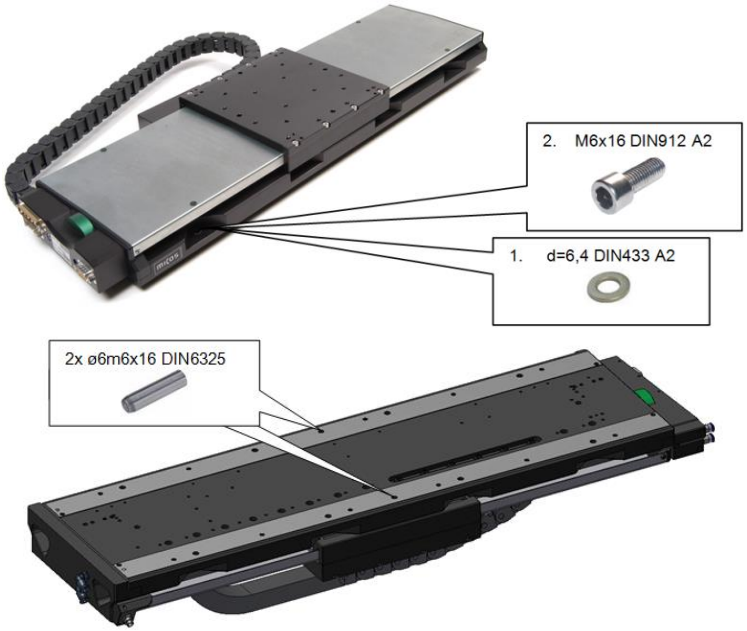
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

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

Mounting the LMS-180 on a Surface

1. Move the motion platform of the LMS-180 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. Mount the stage with the included screws.
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).

Mounting material

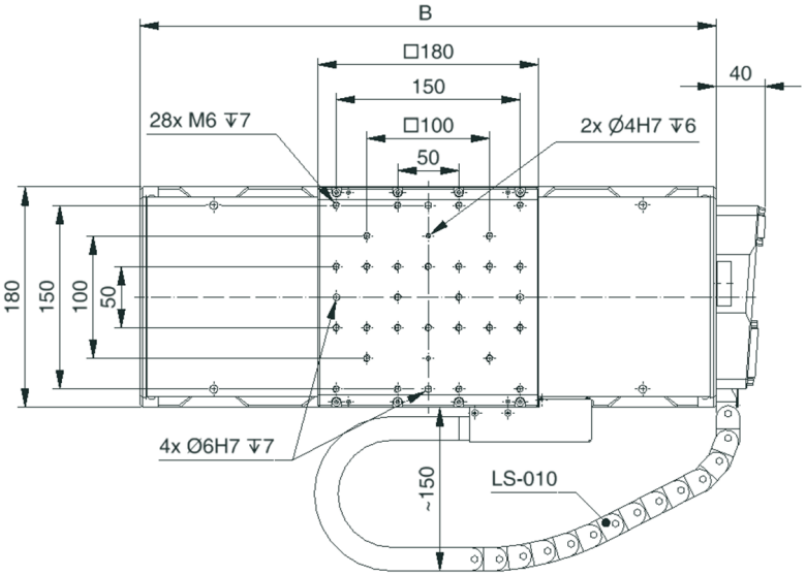
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

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 LMS-180 can be used for the additional part to be mounted.
- Affix the additional part with the corresponding screws.



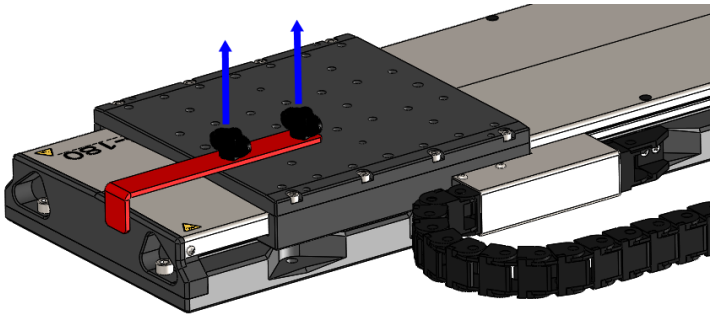
6. START-UP

6.1 General Notes on Start-Up

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

6.2 Removing the Transport Lock

This stage is locked for transport with a steel bracket and two knurled screws. This lock must be removed before start-up by loosening the 2 knurled nuts.



7. MAINTENANCE

Depending on the operating conditions and the period of use of the LMS-180, 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 LMS-180 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).

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 LMS-180 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