

Order no.	6240-9-		
DC-B-040	1	↓	
2Phase-052	2		
155 mm (6")	1		
205 mm (8")	2		
305 mm (12")	3		
508 mm (20")	5		
Without LS-010	0		
LS-010, length measuring system (steel)	1		

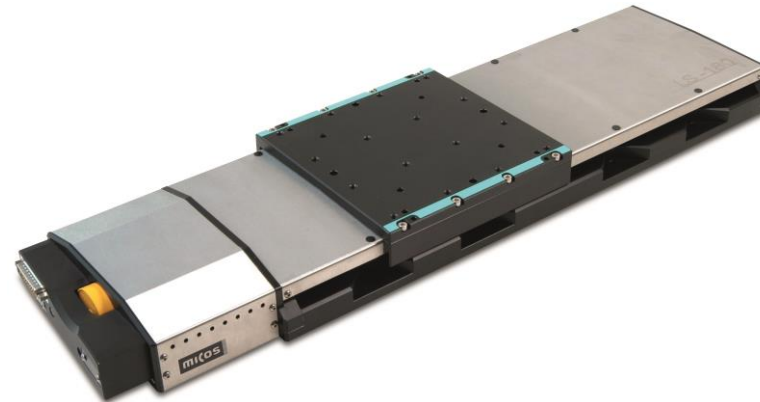
LS-180 Linear Stage

Order no. 6240-9-

User Manual

Version: **00.003**

Date: 20.04.2017



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 This manual is superseded by any new release.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

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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 LS-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:



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



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 LS-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 LS-180 is intended for positioning, adjusting and shifting of loads at various velocities. The LS-180 can be mounted horizontally or vertically.

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

1. Only use the LS-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 LS-180.

2.2.1 Organizational Measures

User Manual

- Always keep this user manual available when using the LS-180. If the user manual is lost or damaged, contact our customer service department (see chapter 9.).
- 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 LS-180 after you have read and understood this user manual.

Personnel Qualification

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

2.2.2 Measures during Installation

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

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

Your system can be damaged by uncontrolled oscillation of the LS-180. Noise generated during operation of the LS-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 disable the evaluation of the limit switch signals by the controller.
- 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 LS-180, check the settings of the servo-control parameters of your controller.

Highest dynamic force and holding force are achieved at a control signal input 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 Safety Measures during Maintenance

The LS-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 LS-180 free from lubricants.
- Keep the LS-180 free of dirt and condensation.

3. UNPACKING

1. Unpack the LS-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

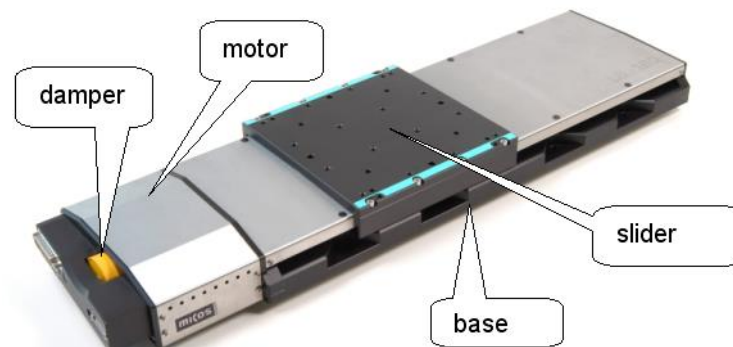
4.1 Features and Application Area

Our products are designed specifically for use in the laboratory.

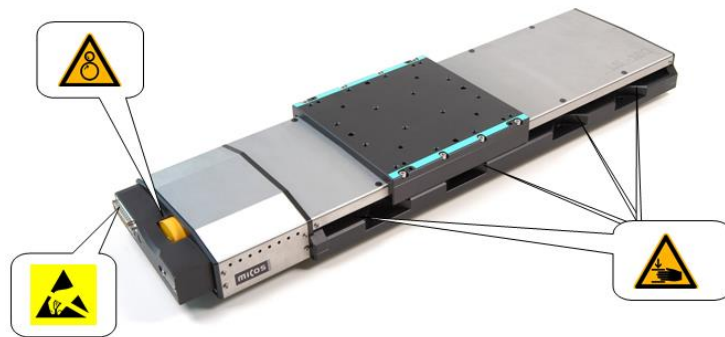
4.2 Model Overview


Order no.	6240-9-		
DC-B-040		1	}
2Phase-052		2	
155 mm (6")		1	
205 mm (8")		2	
305 mm (12")		3	
508 mm (20")		5	
Without LS-010		0	}
LS-010, 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 catching by rotating parts such as couplers and ball screws

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

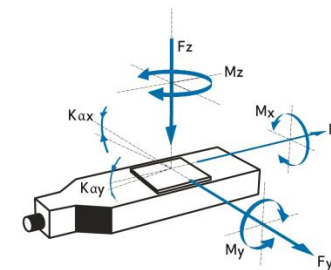
1. Stage according to order.
 - Mounting accessories (screws & pins) in fast-sealing bag.

4.6 Optional Accessories

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

4.7 Technical Features

4.7.1 Load Capacity Data



FACTS								
Load characteristics	F _x (N)	F _y (N)	F _z (N)	M _x (Nm)	M _y (Nm)	M _z (Nm)	k _{ax} (μrad/Nm)	k _{ay} (μrad/Nm)
DC-B-040	200	500	1000	250	132	125	20	30
2Phase-052	250	500	1000	250	132	125	20	30

4.7.2 Motors

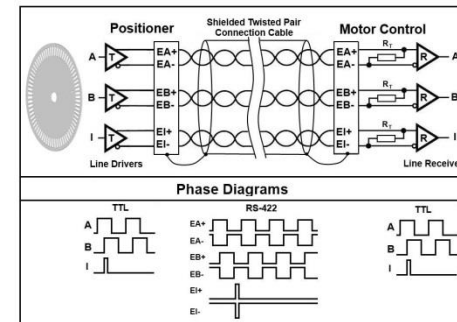
DC-B-040

Motor type		DC brush 3863-024 C
Nominal voltage	V	24
Max. continuous current	A	4
Electrical resistance	Ω	0.64
Electrical inductance	mH	0.180
Torque constant	mNm/A	39.8
Velocity constant	rpm/V	240
n/M slope curve	rpm/mNm	3.9
No load velocity	rpm	5800
Max. continuous velocity at nominal torque	rpm	5510
Inertia	kgm ²	12.0E-6
Continuous torque	mNm	129
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
		2 + index
Supply voltage	VDC	4.5..5.5
Current consumption, Typical (V _{cc} = 5 V DC)	mA	35
Frequency range	KHz	1000
Code disc inertia	kgm ²	1E-7
Operating temperature	°C	-40..85



2Phase-052

Motor type		PK-258-02B 2-phase bipolar half coil
Phase current	A	2
Step angle	°	1.8
Steps	n	200
Coil resistance	Ω	2.4
Coil inductance	mH	2.87
Holding torque	mNm	1200
Inertia	kgm ²	42E-6
Weight	kg	0.89

4.7.3 Measuring System

LS-010

Linear optical encoder RS-422 quadrature

Encoder type		Linear incremental LIA-20
Quadrature counts per mm	n	20000
Resolution	nm	50
Grating period	µm	20
Grating material		Steel
Interpolator	n	Integrated 100 times
Signal output		RS-422 quadrature
Channels		2+1 index
Supply voltage	VDC	5 +/- 10%
Current consumption, Typical (Vcc = 5 V DC)	mA	<200
Frequency range, Counter capability	MHz	8
Operating temperature	°C	0..55
Linear expansion coefficient		Approx. 10.5 e-6
Absolute accuracy	µm	+/- 1
Index position		50 mm starting in the middle of travel
Connector		Sub-D (m)

The diagram illustrates the LS-010 encoder's internal structure and signal outputs. It shows a 'Positioner' section with line drivers (A, B, I) and line receivers (EA+, EA-, EB+, EB-, EI+, EI-). A 'Motor Control' section shows the corresponding motor control signals (A, B, I) and their receivers (EA+, EA-, EB+, EB-, EI+, EI-). A 'Shielded Twisted Pair Connection Cable' connects the two sections. Below, 'Phase Diagrams' show the timing relationships for TTL signals (A, B, I) and RS-422 signals (EA+, EA-, EB+, EB-, EI+, EI-).

4.7.4 Limit Switch

ILS-020 Inductive Limit Switch

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

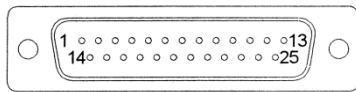
The circuit diagram shows a PNP transistor output stage. The emitter is connected to terminal BN (1) and +Vs. The collector is connected to terminal BK (4) and the output terminal. The base is connected to terminal BU (3) and 0V. A dashed box around the base-emitter junction indicates the inductive load.

4.7.5 Connector

DC brush motor Sub-D (m), 25-pin

Motor pin assignments with inductive limit switches

Sub-D (m), 25-pin	Function	
1	M+	DC brush motor +
2		
3	M-	DC brush motor -
4		
5	nc	
6		
7	nc	
8		
9	EA+	Encoder channel A+
10	EB+	Encoder channel B+
11	EC+	Encoder channel I+
12	EGND	Supply encoder GND
13	E5V	Encoder supply voltage
14	LE2	Limit forward
15	LE1	Limit reverse
16	nc	
17	nc	
18	LVcc	Supply sensor limit
19	nc	
20	LGND	GND supply sensor limit
21	nc	
22	EA-	Encoder channel A-
23	EB-	Encoder channel B-
24	EC-	Encoder channel I-
25	nc	

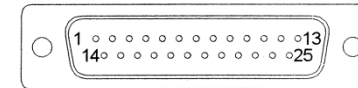


2SM Motor Sub-D (m), 25-pin

Motor pin assignments with inductive limit switches

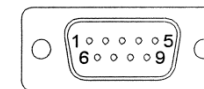
Sub-D (m), 25-pin	Function	
1	MA+	Motor phase A+
2		
3	MA-	Motor phase A-
4		
5	MB+	Motor phase B+

6		
7	MB-	Motor phase B-
8		
9	nc	
10	nc	
11	nc	
12	nc	
13	nc	
14	LE2	Limit forward
15	LE1	Limit reverse
16	nc	
17	nc	
18	LGND	GND supply sensor limit
19	nc	
20	LVcc	Supply sensor limit
21	nc	
22	nc	
23	nc	
24	nc	
25	nc	



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

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



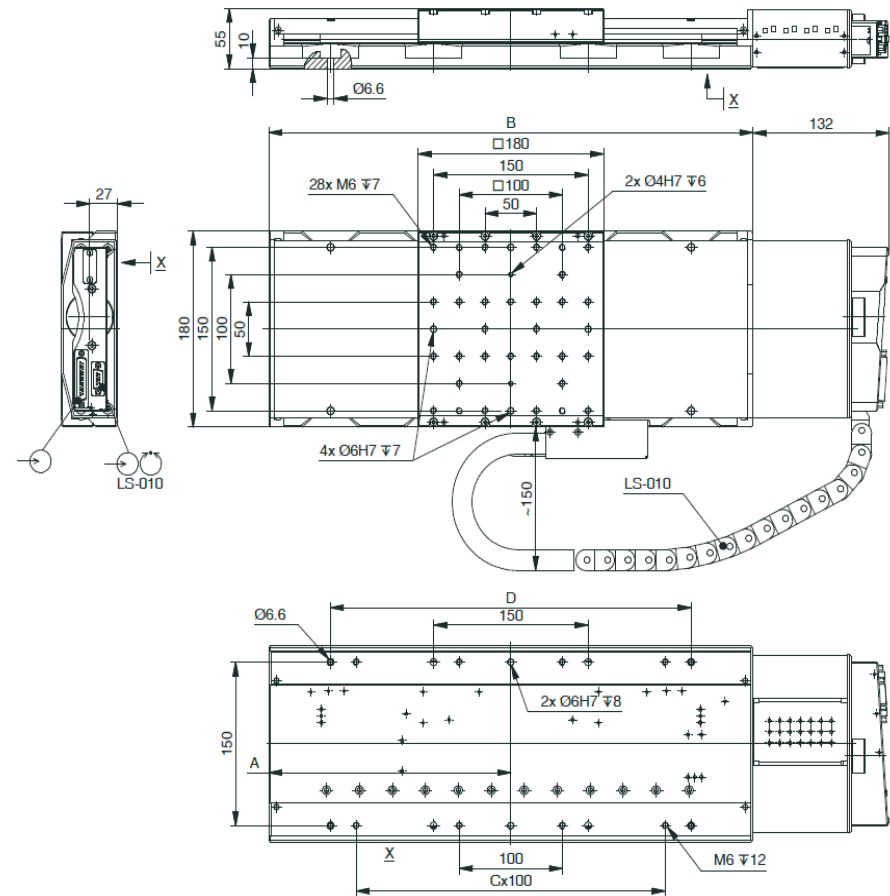
12 LS-180 Linear Stage

4.7.6 Technical Data

TECHNICAL DATA

Travel range (mm)	155	205	305	508
Straightness / Evenness (μm)	± 2	± 3	± 4	± 6
Pitch angle (μrad)	± 40	± 50	± 60	± 80
Yaw angle (μrad)	± 50	± 50	± 50	± 50
Weight (kg)	8.4	8.8	9.6	10.8
Motor	DC-B-040	2Phase-052		
Pitch (mm)	5	5	LS-010	
Max. velocity (mm/sec)	200	75		
Typical resolution (μm)	0.5	0.5	0.05	
Calculated resolution (μm)	0.25(RE)	25(FS)	0.05	
Bidirectional repeatability (μm)	± 2.5	± 2.5	± 0.1	
Unidirectional repeatability (μm)	0.5	0.5	0.05	
Nominal current (A)	3.8	2		
Max. operating voltage (V)	24	<200		
Accuracy	on request			
Velocity range (mm/sec)	0.001..200			
Material	Al (black anodized)			

Travel (mm)	155	205	305	408	508	610
A	235	260	310	360	410	460
B	470	520	620	720	820	920
C	3	3	5	5	5	7
D	350	350	450	550	650	750



4.8 Ambient Conditions

For indoor use only.

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

5. INSTALLATION

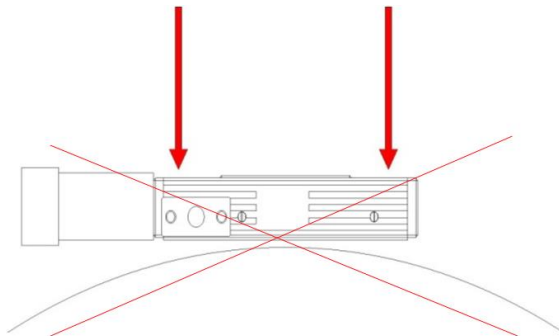
5.1 General Notes on Installation

Requirement

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 Stage

Requirement

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”).

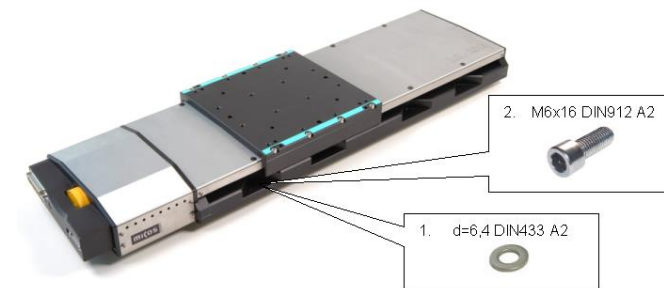
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

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

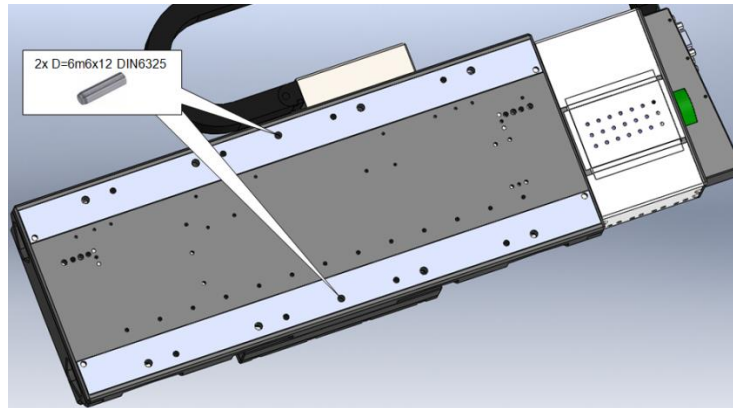
- M3 DIN 912 1.5 Nm
- M4 DIN 912 2.0 Nm
- M5 DIN 912 2.5 Nm
- M6 DIN 912 3.0 Nm

Mounting the LS-180

1. Displace the moving platform of the LS-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 screws supplied.
3. Make sure that the screw heads do not protrude from the countersunk holes.



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5.3 Affixing the Load

Requirement

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

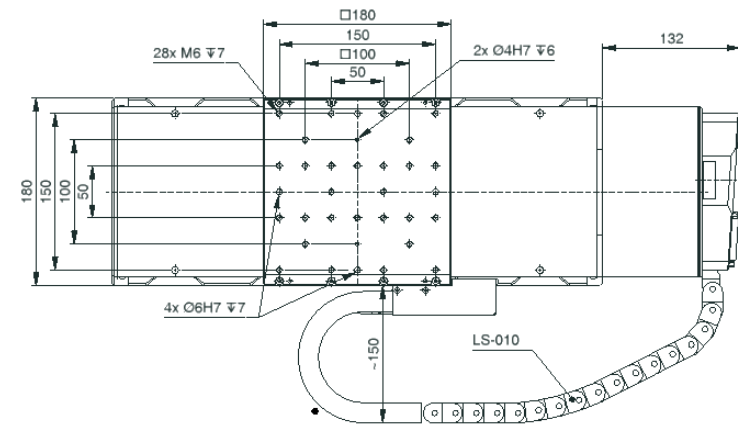
Tightening torques of the mounting screws to be used should not have values higher than the following:

- 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 DT-180 can be used for the additional part to be affixed.

Mount the additional part with the corresponding screws.



5.4 Setting up an XY System

Two LS-180 can be stacked to form an XY system.

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

Tools and Accessories for Combining Two LS-180

- Use the mounting material supplied (for example, pins, screws and washers) with the LS-180 to carry out XY mounting.
- The mounting procedure is described in chapter 5.2.0.
- Special adapter plates are not required for the standard axes.
- To prevent too much negative influence on the travel behavior of the Y axis, the shortest possible travel range should be selected. In extreme Y-axis positions, an adapter plate is used to allow sufficient space for stiffening.

6. START-UP

6.1 General Notes on Start-Up

This 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 LS-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 guidings, 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 LS-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 an 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 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 EC Declaration of Conformity has been issued for the LS-180 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 12100:2011
RoHS: EN 50581:2012