Order no.	6236-9-				
DC-B-032	1				
2Phase-045	3				
DC-B-033	4				
26 mm (1")		1			
52 mm (2")		2			
77 mm (3")		3			
102 mm (4")		4			
155 mm (6")		5			
190 mm		6			
255 mm (10")		7			
305 mm (12")		8			
Without LS-010			0		
LS-010, length measuring system (steel) (max. 155 mm)			1		
MLS-020, limit switch (mechanical)					0

LS-110 Linear Stage

Order no. 6236-9-

User manual

Version: 00.000 Date: 31.07.2015

PI micos

File name:FILE-001438011_0001_MAN_LS-110_9_EN.DOCX/.pdf Document-ID:DOC-000339522

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 LS-110.
- 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 LS-110 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 LS-110 is intended for positioning, adjusting and shifting of loads at various velocities. The LS-110 can be mounted horizontally or vertically.

The intended use of the LS-110 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-110.
- 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-110 is built according to state-of-the-art technology and recognized safety standards. Improper use of the LS-110 can result in personal injury and/or damage to the LS-110.

1. Only use the LS-100 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-100.

2.2.1 Organizational Measures

User manual

- Always keep this user manual available when using the LS-100. 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-100 after you have read and understood this user manual.

Personnel Qualification

The LS-100 may only be started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

2.2.2 Measures during Installation

The LS-100 may be damaged by excessively long screws and wrongly mounted parts.

- When mounting the LS-110, 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-110 and the loads on the mounting fixtures (holes) intended for this purpose.
- The LS-110 heats up during operation. High temperatures can influence your application.
- Install the LS-110 so that your application is not affected by the dissipating heat.
- Cable extensions can affect the performance of the LS-110 and damage the electronics.

- Only use genuine PI miCos parts to connect the LS-110 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-110 into operation until it is fully mounted and connected.

Your system can be damaged by uncontrolled oscillation of the LS-110. Noise generated during operation of the LS-110 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.
The stage can carry out unintentional motions when being connected to the controller for the first time. Defective software or wrong 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 during occurs operation of the LS-110, check the settings of the servo-control parameters of your controller.

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

- 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 LS-110 is precision adjusted.

- Do not loosen any sealed screws.

Dirt, oil, lubricants and condensation will render the motor/drive inoperable.
Keep the LS-110 free of dirt and condensation water.

3. UNPACKING

1. Unpack the LS-110 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 Ceramic 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

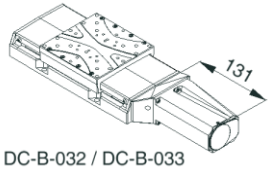
All specifications in this user manual only refer to the standard products that are included in the PI-miCos catalog. Any special features that are different, in particular special requests from customers, are supplied with the user manual as additional documentation in the form of "Technical Notes".

4. PRODUCT DESCRIPTION

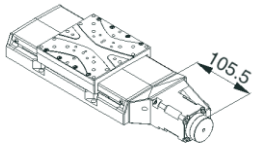
4.1 Features and Application Area

Our products are designed specifically for use in the laboratory.

4.2 Model Overview



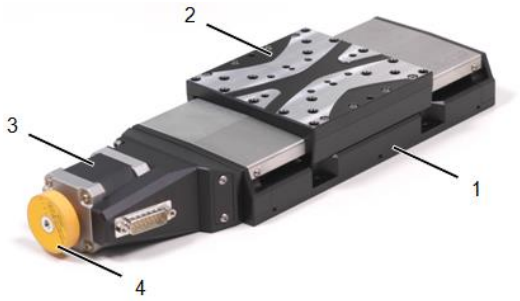
DC-B-032 / DC-B-033



2Phase-045

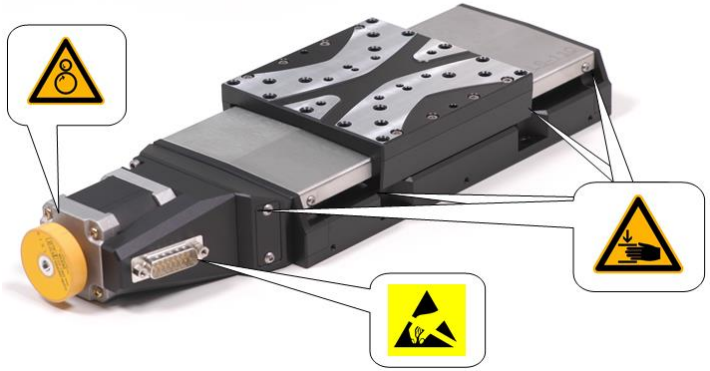
Order No.	6236-9-				
DC-B-032	1				
2Phase-045	3				
DC-B-033	4				
26 mm (1")		1			
52 mm (2")		2			
77 mm (3")		3			
102 mm (4")		4			
155 mm (6")		5			
190 mm		6			
255 mm (10")		7			
305 mm (12")		8			
			without LS-010		0
			LS-010, Linear steel scale (max 155 mm)		1
				MLS-020, Mechanical limit switches	0

4.3 Product View



1 Base
2 Slide
3 Motor
4 Damper

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.

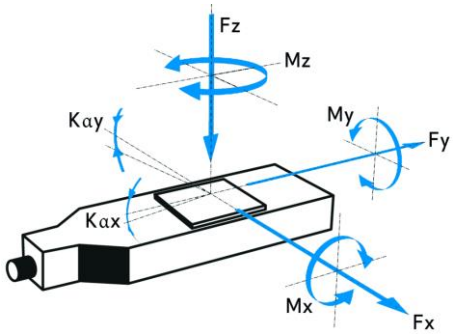
- Mounting accessories (screws & pins) in fast-sealing bag.

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	Fx(N)	Fy(N)	Fz(N)	Mx(Nm)	My(Nm)	Mz(Nm)	kax(µrad/Nm)	kay(µrad/Nm)
DC-B-032	50	80	100	30	60	33	50	40
2Phase-045	50	80	100	30	60	33	50	40
DC-B-033	50	80	100	30	60	33	50	40

4.7.2 Motors

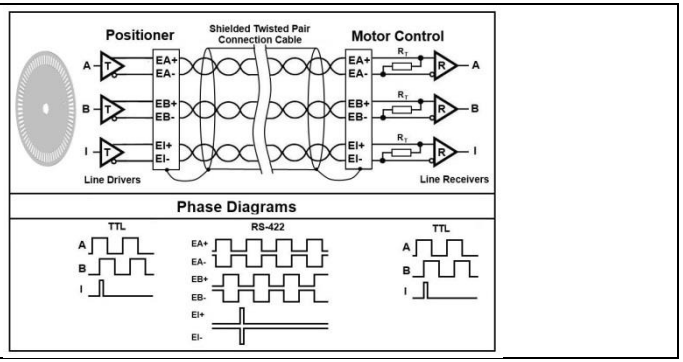
DC-B-032

Motor type		DC brush 3257-024 CR
Nominal voltage	V	24
Max. continuous current	A	2.3
Electrical resistance	Ω	1.63
Electrical inductance	mH	0.27
Torque constant	mNm/A	37.7
Velocity constant	rpm/V	253
n/M slope curve	rpm/mNm	10.9
No load velocity	rpm	5900
Max.continuous velocity at nominal torque	rpm	5210
Inertia	kgm^2	4.7E-6
Continuous torque	mNm	71
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
Code disc inertia	kgm2	0.5E-7
Operating temperature	°C	-40..100



2Phase-045

Motor type		PK-245-01B 2-phase bipolar half coil
Phase current	A	1.2
Step angle	°	1.8
Steps	n	200
Coil resistance	Ω	3.3
Coil inductance	mH	2.8
Holding torque	mNm	320
Inertia	kgm^2	6.8E-6
Weight	kg	0.35

DC-B-033

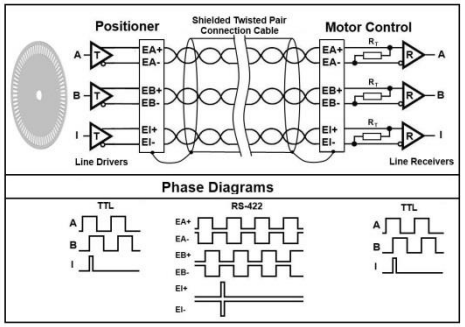
Motor type		DC brush 3257-024 CR
Nominal voltage	V	24
Max. continuous current	A	2.3
Electrical resistance	Ω	1.63
Electrical inductance	mH	0.27
Torque constant	mNm/A	37.7
Velocity constant	rpm/V	253
n/M slope curve	rpm/mNm	10.9
No load velocity	rpm	5900
Max.continuous velocity at nominal torque	rpm	5210
Inertia	kgm^2	5.1E-6
Continuous torque	mNm	71

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	kgm2	1E-7
Operating temperature	°C	-40..85

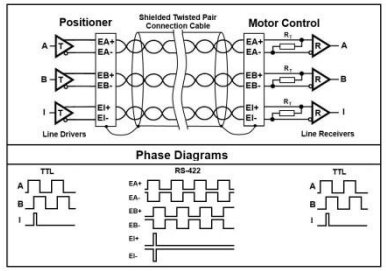


4.7.3 Measuring System

LS-010

Linear optical encoder RS-422 quadrature

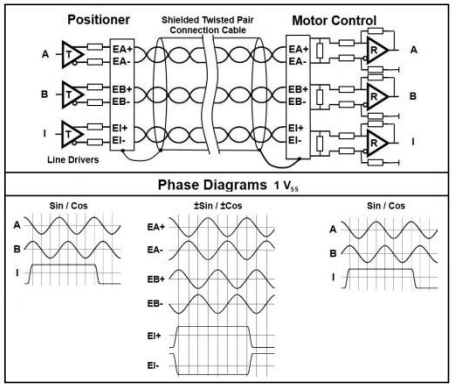
Encoder type		Linear incremental LIA-20
Quadrature counts per mm	n	20000
Resolution	nm	50
Grating period	µm	20
Grating material		Steel
Interpolator	n	Integrated 100 times
Signal output		RS-422 quadrature
Channels		2+1 index
Supply voltage	VDC	5 +/- 10%
Current consumption, Typical (Vcc = 5 V DC)	mA	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



LS-011

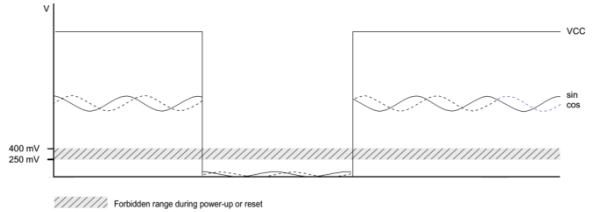
Optical encoder, sin/cos signals

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		Approx. 10.5 e^{-6}
Absolute accuracy	µm	+/- 1
Index position		50 mm starting in the middle of travel
Connector		Sub-D (m)



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 parameters are not set properly. This can lead to incorrect encoder signals.

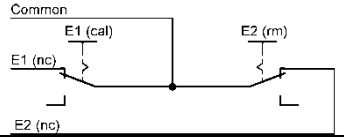
It is particularly important to observe this when resetting controllers!



4.7.4 Limit Switch

Mechanical limit switches

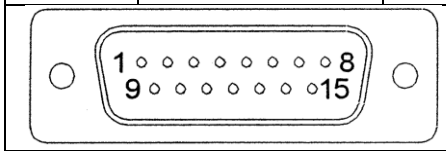
Max. voltage (resistive load)	V	30
Max. current (resistive load)	A	1
Contact type		Normal closed
Operations		>5x10^4
Operating temperature	°C	-40 to +85



4.7.5 Connector

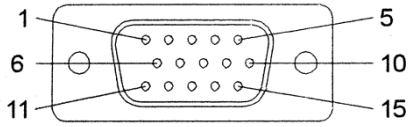
DC motor, Sub-D 15-pin with mechanical switches

Sub-D (m) 15-pin	Function	
1	EA+	Encoder channel A+
2	EB+	Encoder channel B+
3	EI+	Encoder channel I+
4	EGND	Supply encoder GND
6	M+	DC brush motor +
7	E2	Limit forward
8	COM	Limit common
9	EA-	Encoder channel A-
10	EB-	Encoder channel B-
11	EI-	Encoder channel I-
12	E5V	Encoder supply voltage
14	M-	DEI brush motor -
15	E1	Limit reverse



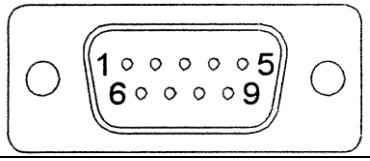
2SM motor, HD15 motor pinout with mechanical sensors

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	LE2	Limit forward
14	LE1	Limit reverse
15	LCOM	Limit common



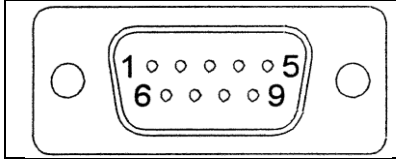
Linear encoder, Sub-D 9-pin, RS-422 pin assignment

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



Linear encoder, Sub-D 9-pin, sin/cos signal pin assignment

Sub-D (m) 9-pin	Function	
1	EA+	Encoder channel A+ (sin+)
2	EB+	Encoder channel B+ (cos+)
3	EI+	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	EI-	Encoder channel I- (Ref-)
9	nc	
Housing	Shield	Shield of encoder, read head



4.7.6 Technical Data

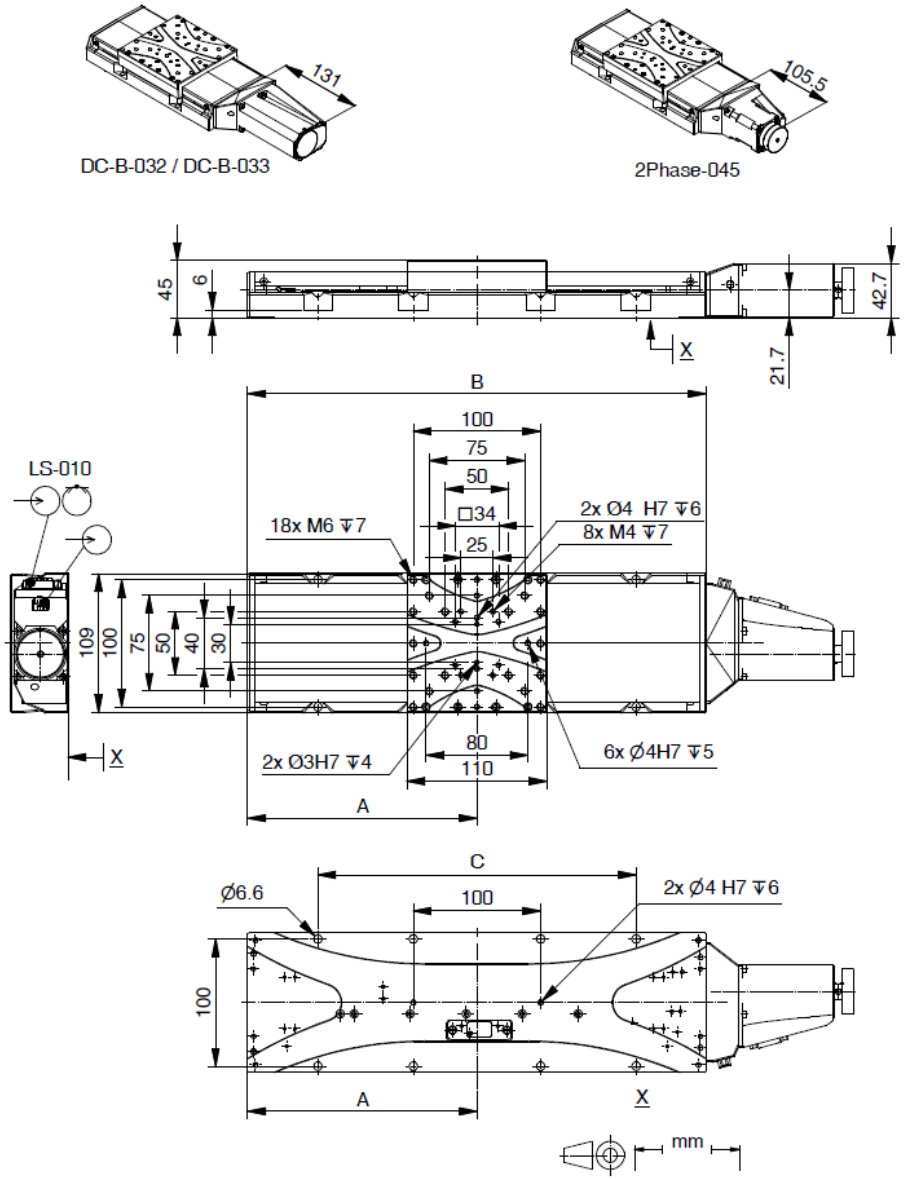
TECHNICAL DATA								
Travel range (mm)	26	52	77	102	155	190	255	305
Straightness / Flatness (µm)	± 1	± 1.5	± 2	± 2.5	± 3	± 3.5	± 4	± 5
Pitch (µrad)	± 30	± 40	± 50	± 60	± 70	± 80	± 90	± 100
Yaw (µm)	± 40	± 40	± 40	± 40	± 40	± 40	± 40	± 40
Weight (kg)	2.6	2.7	2.8	2.9	3.1	3.1	3.5	3.7

Motor (Pitch 2 mm)	DC-B-032	2Phase-045	DC-B-033	
Linear scale				LS-010
Speed max. (mm/sec)	90	45	90	
Resolution calculated (µm)	1 (RE)	10 (FS)	0.1 (RE)	0.05
Resolution typical (µm)	1	0.2	0.2	0.05
Bi-directional Repeatability (µm)	± 1	± 1	± 1	± 0.1
Uni-directional Repeatability (µm)	1	0.2	0.2	0.05
Nominal Current (A)	2.3	1.2	2.3	
Voltage Range (V)	24		24	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 90
Material	Aluminum, black anodized

Note: FS = full step, RE = rotary encoder

Travel(mm)	26	52	77	102	155	190	255	305
A	112.5	125	137.5	150	180	180	215	240
B	225	250	275	300	360	360	430	480
C	-	-		-	250	250	300	350



4.8 Ambient Conditions

For indoor use only.

- The LS-110 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-110 free of dirt, dust and corrosive gases.

5. INSTALLATION

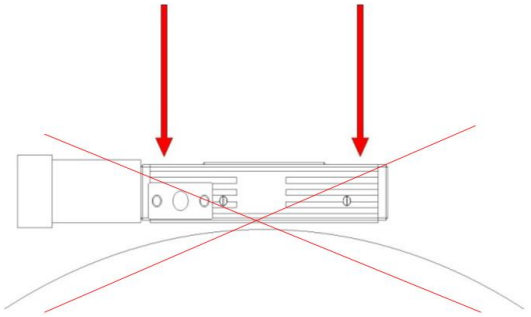
5.1 General Notes on Installation

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 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 "Scope of Delivery").

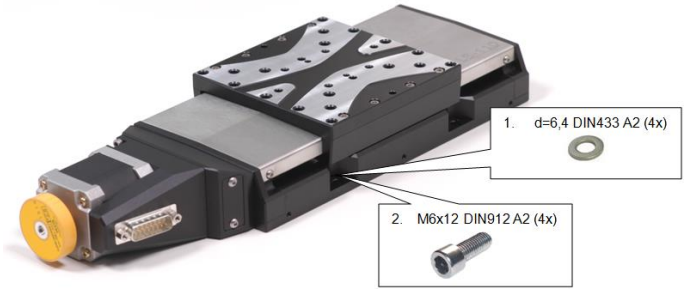
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

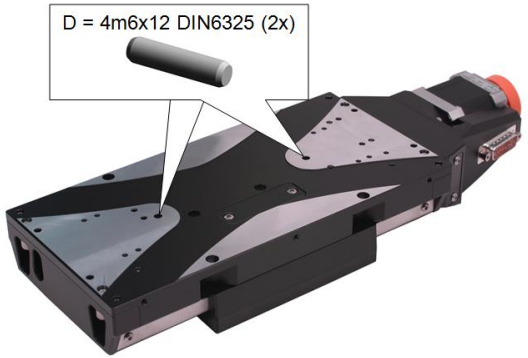
Tightening torques of the mounting screws to be used should not have values higher than the following:

- 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-110

1. Displace the moving platform of the LS-110 to the center position by hand until all of the countersunk holes in the base body required for mounting 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.





5.3 Affixing the Load

Prerequisite

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

Mounting material

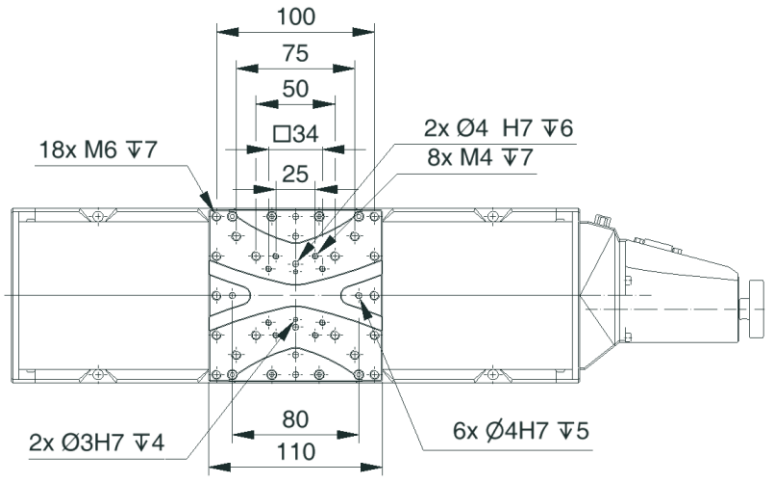
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

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

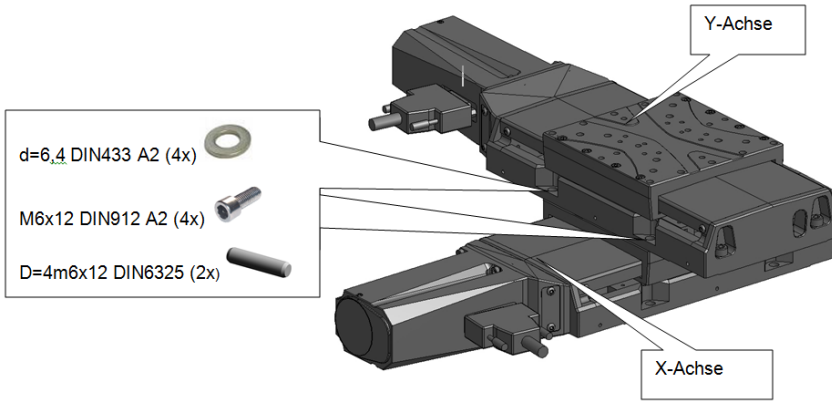
Mounting the Additional Part

- Select the mounting position so that the existing fixing holes in the slider of the LS-110 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-110 can be stacked to form an XY system as follows:



Prerequisite

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

Tools and accessories for combining two LS-110

- Use the mounting material supplied (for example, pins, screws and washers) with the LS-110 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-110, 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 you operate the translation stage continuously over a small travel range (less than 20 percent of the entire travel range), perform a

maintenance run every 5000 motion cycles across the entire travel range.

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-110 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.

7.1 Supplementary Information

7.1.1 Safety

- This positioning unit is a sensitive device and must be handled with care. Do not throw it or subject it to strong mechanical loading.
- Do not touch moving parts when the unit is in motion.
- Do not touch the spindle as this will shorten the lifetime of the unit.

7.1.2 Operational environment

- The unit is calibrated to an ambient temperature of 20°C+/-3°C
- Keep the surrounding atmosphere free of corrosive gases and humidity
- Protect against dirt falling from above
- Protect against dust
- Temperature range 20°C –40°C
- Relative humidity between 20-80%

7.1.3 Care and maintenance intervals

• Motor	*maintenance-free*
• Guidings	*maintenance-free*
• Ball screw drive	*maintenance-free*

Do not modify the positioning unit; do not make any mechanical changes without prior consultation with PImiCos personnel. If the positioning unit does not correspond to the prescribed specifications, contact PImiCos.

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).

Problem	Possible causes	Solution
Reduced positioning accuracy	Warped base body	Ø Mount the LS-110 on an even surface. The recommended evenness of the surface is 3 µm.
	When the LS-110 is mounted vertically: The load exceeds the self-locking of the drive.	Ø Do **not** exceed the maximum permissible load capacities
	Increased wear due to small motions over a long period of time	Ø Carry out a maintenance run over the entire travel range (chapter 7)

Functional impairment after system modification	Controller was replaced. LS-110 was replaced by another model.	Controller from PI: Ø Load the parameters from the stage database that correspond to the combination of controller and the LS-110 model. Controller from a third-party supplier: Ø Check the operating parameters.
Mechanical system does not move; no operating noise can be heard.	Controller and/or power supply are connected incorrectly or defective.	Ø Check all connecting cables. Ø Check the controller. Ø If present: Check the power supply of the stage.
Mechanical system does not move; no operating noise can be heard.	When a PI controller is used: There is a motion error of the axis.	Motion error = The difference between the current position and the commanded position exceeds the specified maximum value in closed-loop operation. For example, motion errors can be caused by malfunctions of the drive or the position sensor of the stage. 1. Read out the error code of the controller in the PC software. If there is a motion error, error code -1024 is output. 2. Check your system and make sure that all axes can be moved safely. 3. In the PC software, switch on the servo mode for the axis affected. For details, see the user manual of the controller.
	Moving platform has triggered the limit switch.	If you use a controller from PI: 1. In the PC software, switch on the servo mode of the axis affected. 2. In the PC software, command an axis motion away from the limit switch.
In the case of models with a stepper motor: The mechanical system does not move any more but produces an operating noise.	The motor is overloaded by an external load torque or the mass to be driven in the case of strong acceleration or deceleration.	The motor skips steps. The information on the current position is lost without the controller recognizing this state. Ø In the application, determine the maximum velocity for a stage with a stepper motor.

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

11. EU DECLARATION OF CONFORMITY

An EC Declaration of Conformity has been issued for the LS-110 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