MP158E

L-731 / V-731 Precision XY Positioner

User Manual

Version: 1.2.0 Date: 2024-01-18

This document describes the following precision XY positioners with 205 mm x 205 mm travel range:

- L-731.40SD:
  with stepper motor, without encoder
- L-731.4ASD:
  with stepper motor and linear encoder,
  sin/cos signal transmission
- L-731.44SD:
  with stepper motor and linear encoder,
  A/B quadrature signal transmission
- L-731.093132:
  with DC motor and rotary encoder
- L-731.093111:
  with DC motor and linear encoder,
  sin/cos signal transmission
- L-731. 093112:
  with DC motor and linear encoder,
  A/B quadrature signal transmission
- V-731.096111:
  with linear motor and linear encoder,
  sin/cos signal transmission

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Contents

1 About this Document

1.1 Objective and Target Group of this User Manual

This user manual contains the necessary information on the intended use of the L-731 / V-731.

Basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures is assumed.

The latest versions of the user manuals are available for download on our website (p. 6).

1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

DANGER

Imminently hazardous situation

If not avoided, the hazardous situation will result in death or serious injury.

➢ Actions to take to avoid the situation

CAUTION

Dangerous situation

If not avoided, the dangerous situation will result in minor injury.

➢ Actions to take to avoid the risk.

NOTICE

Dangerous situation

If not avoided, the dangerous situation will result in damage to equipment.

➢ Actions to take to avoid the risk.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol / Label	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant
▪	Lists
p. 5	Cross-reference to page 5
RS-232	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning sign affixed to the product that refers to detailed information in this manual.

1.3 Pictures

For better understandability, the colors, proportions and degree of detail in illustrations can deviate from the actual circumstances. Photographic illustrations may also differ and must not be seen as guaranteed properties.

1.4 Other Applicable Documents

INFORMATION

Current versions of manuals and data sheets can be downloadedfrom our web site www.pi.ws.

The devices and software tools from PI that are mentioned in this documentation are described in separate manuals.

Product	Document
Positioners with electric motors	MP146EK Short instructions for positioners with electric motors
Positioners with PIMag® drives	MP163EK Short instructions for positioners with PIMag® drives
C-663.12 Stepper Motor Controller	MS241E User Manual
C-863.11 DC Motor Controller	MS205E User Manual
C-863 DC Motor Controller	MS249E User Manual
C-884 DC Motor Controller	MS243E User Manual
SMC Hydra motion controller	Hardware Manual

Product	Document
ACS SPiiPlusEC	ACS SpiiPlusEC Installation Guide ACS SpiiPlusEC IMPU Only Installation Guide
C-891 PIMag® Motion Controller	MS251E User Manual
C-885/C-891.11C885	C885T0002 User Manual C891T0005 User Manual

1.5 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

➢ Contact our customer service department (p. 43).

1. Open the website **www.pi.ws**.
2. Search the website for the product number (e.g., L-731).
3. Click the corresponding product to open the product detail page.
4. Click ***Downloads***.

   The manuals are shown under ***Documentation***.
5. Click the desired manual and fill out the inquiry form.

   The download link will then be sent to the email address entered.

2 Safety

2.1 Intended Use

The L-731 / V-731 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 L-731 / V-731 is intended for positioning, adjusting and shifting of loads on two axes at various velocities. The L-731 / V-731 is **not** intended for applications in areas, in which a failure would present severe risks to human beings or the environment.

The intended use of the L-731 / V-731 is only possible when completely mounted and connected and in a horizontal position.

The L-731 / V-731 must be operated with a suitable controller (p. 14). The controller is not included in the scope of delivery of the L-731 / V-731.

2.2 General Safety Instructions

The L-731 / V-731 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-731 / V-731 may result in personal injury and/or damage to the L-731 / V-731.

- Only use the L-731 / V-731 for its intended purpose, and only use it if it is in good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety (p. 41).

The operator is responsible for the correct installation and operation of the L-731 / V-731.

2.3 Organizational Measures

User Manual

- Always keep this user manual available when using the L-731 / V-731.
  The latest versions of the user manuals are available on our website (p. 6) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the L-731 / V-731 to other users, also include this user manual as well as all other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in damage to equipment.
- Only install and operate the L-731 / V-731 after you have read and understood this user manual.

Personnel Qualification

The L-731 / V-731 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

3 Product Description

3.1 Model Overview

Classification of the positioners

All models are precision XY positioners with linear positioner with crossed roller bearings. They differ with respect to the drive type and encoder equipment.

L-731 / V-731	Drive type			Linear encoder: Signal transmission	
	Stepper motor	DC motor	Linear motor	sin/cos*	A/B quadrature
L-731.40SD	+				
L-731.4ASD	+			+	
L-731.44SD	+				+
L-731.093132		+			
L-731.093111		+		+	
L-731.093112		+			+
V-731.096111			+	+	

* Separate sensor connection

Detailed model overview

Order number	Product name
L-731.40SD	Precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, 2-phase stepper motor
L-731.4ASD	Precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, 2-phase stepper motor, linear encoder with sin/cos signal transmission
L-731.44SD	Precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, 2-phase stepper motor, linear encoder with A/B quadrature signal transmission
L-731.093132	Precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, DC motor, rotary encoder
L-731.093111	Precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, DC motor, linear encoder with sin/cos signal transmission

Order number	Product name
L-731.093112	Precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, DC motor, linear encoder with A/B quadrature signal transmission
V-731.096111	High-precision XY positioner, 310 mm × 310 mm width, 205 mm × 205 mm travel range, linear motor, linear encoder with sin/cos signal transmission

➢ For further technical data, see the specifications. (p. 49).

3.2 Product View

3.2.1 Mechanical Parts and Protective Earth Connection

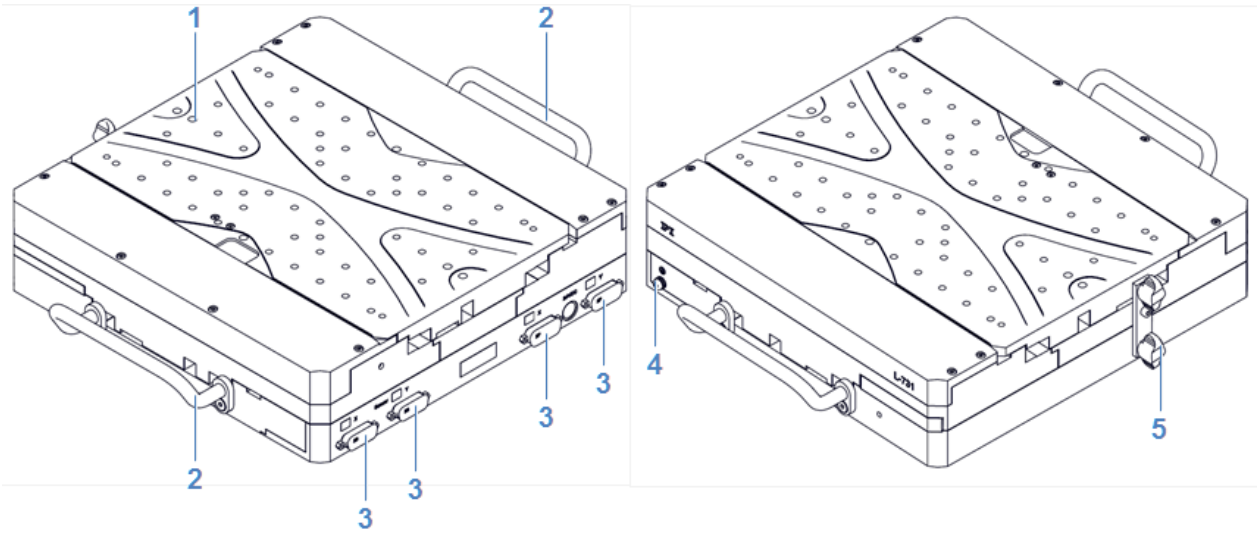
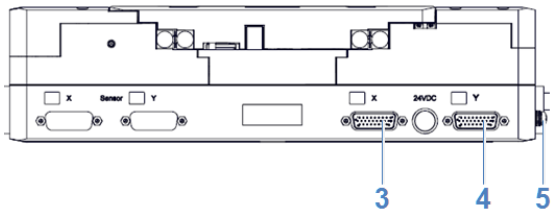
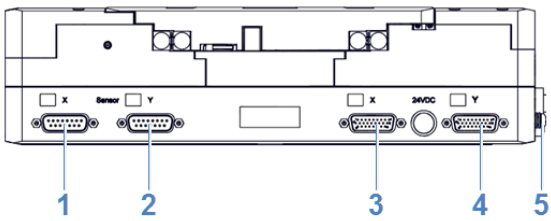


Figure 1: Parts

1 Platform
2 Handle
3 ESD protection
4 Protective earth connection
5 Transport lock

3.2.2 Electrical Connections

Connection type and assignments depend on the model (for pin assignment, see p. 56).

L-731.40SD **L-731.44SD** **L-731.093112** **L-731.093132**	**L-731.4ASD** **L-731.093111** **V-731.096111**
	

Pos.	Connection	L-731		V-731
		.40SD .44SD .093112 .093132	.4ASD .093111	.096111
1	Sensor connection, X axis (D-Sub 15 panel plug)		+	+
2	Sensor connection, Y axis (D-Sub 15 panel plug)		+	+
3	Motor connection, X axis (HD D-Sub 26 panel plug)	+	+	+
4	Motor connection, Y axis (HD D-Sub 26 panel plug)	+	+	+
5	Protective earth connection (screw ISO 7045, M4x8)	+	+	+

3.3 Direction of Motion

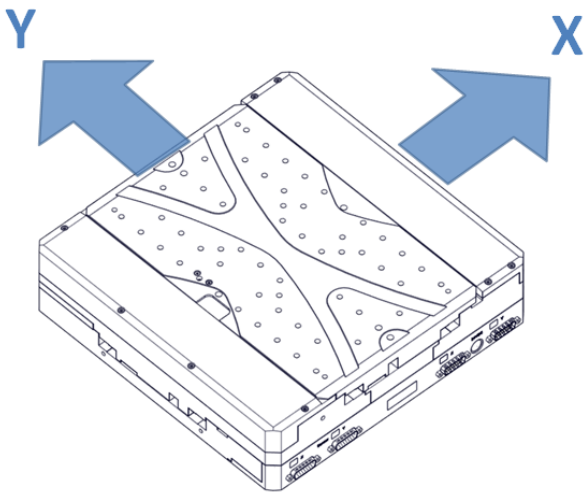
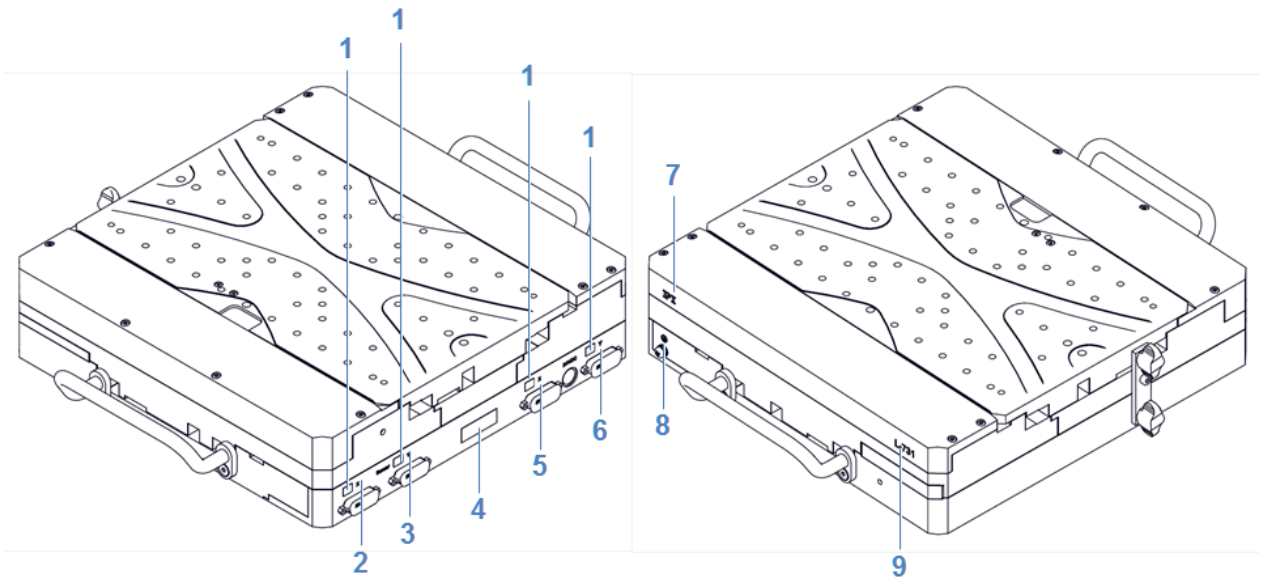


Figure 2: Direction of the motion of the platform

X, Y (arrow direction:) Direction of motion on positive command

3.4 Product Labeling



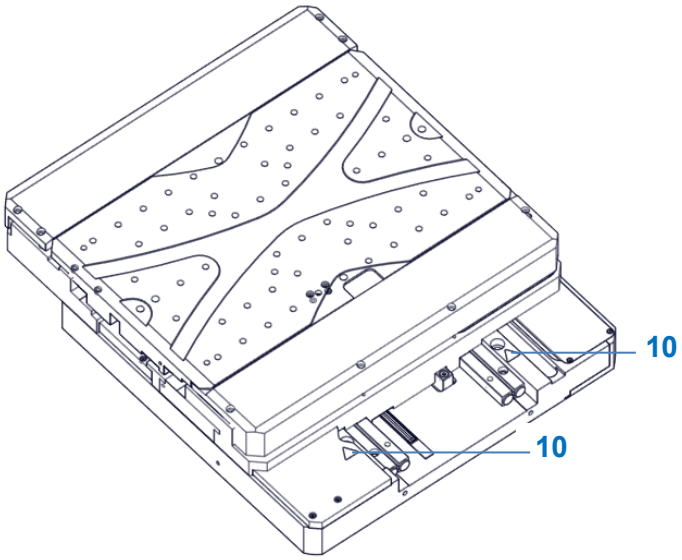


Figure 3: Product labeling (see following table)

Position	Labeling	Description
1		Warning symbol "Electrostatic sensitive devices"
2	Sensor X	Encoder connection, X axis
3	Sensor Y	Encoder connection, Y axis
4		Warning sign "Observe manual!"
4		Old equipment disposal
4	Country of origin: Germany	Country of origin
4	WWW.PI.WS	Manufacturer's address (website)
4	L-731.4ASD	Complete product code (example)
4	CE	CE conformity mark
4	415002159	Serial number (example), individual for each L-731 / V-731 Meaning of the places (counting from left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive numbers
5	X	Motor connection, X axis
6	Y	Motor connection, Y axis
7, 4	PI	Manufacturer's logo
8		Protective earth conductor connection (p. 24)
9, 4	L-731 / V-731	Product series
10		Warning symbol”Risk of crushing”

3.5 Scope of Delivery

Item number	Component
L-731.xxxxxx or V-731.xxxxxx	Positioner according to order (p. 9)
MP146EK MP163EK	Short instructions for positioners with electric motors Short instructions for positioners with PIMag® drives
6303500012	Mounting accessories: • 4 socket head screw, ISO 4762* M6x35 • 2 dowel pins, ISO 2338** - 6 h8 x 16

* Corresponds to DIN 912

** Corresponds to DIN 7

3.6 Suitable Controllers

	C-663.12*	SMC Hydra	C-863.12*	C-891*	C-884	C-885 with C-663. 12C885	C-885 with C-891. 11C885	C-885 with C-863. 20C885	Modular ACS controller
Motion axes per controller (max.)	1	2	1	1	6	20	20	40	
PC interfaces	USB, RS-232, daisy chain network	RS-232, LAN	USB, RS-232, LAN	RS-232, LAN	RS-232, LAN	USB, LAN	USB, LAN	USB, LAN	USB, LAN
Multiple controllers on the same PC	+	+	+	+	+	+	+	+	+
L-731.40SD	+	+				+			+
L-731.44SD	+	+				+			+
L-731.4ASD		+							+
L-731.093111		+	+	+			+		+
L-731.093112			+		+			+	+
L-731.093132			+		+			+	+
V-731.096111		+		+			+		+

* 2 controllers of this type are required for operation.

PC software is in the scope of delivery of the controllers from PI. The operation of the controllers is described in the corresponding user manuals.

Please note that the cables for connecting the L-731 / V-731 to the electronics must also be ordered separately.

➢ To order, contact our customer service department (p. 43).

3.7 Technical Features

3.7.1 Encoder

The L-731.4ASD, L-731.44SD, L-731.093111, L-731.093112, and V-731.096111 models are equipped with an optical linear encoder. Optical linear encoders measure the actual position directly (direct metrology). Errors occurring in the drive, such as nonlinearity, backlash or elastic deformations cannot influence the measurement of the position.

The L-731.093132 model is equipped with an optical rotary encoder. A rotary encoder is implemented at a rotating point in the drivetrain, e.g., the motor shaft.

Refer to the table in the "Specifications" section for the encoder resolution (p. 45).

The L-731.40SD model does not have an encoder.

3.7.2 Limit Switches

The positioner is equipped with optical limit switches.

Each limit switch sends its signal to the controller on a dedicated line. The controller then stops the motion. If the controller does not stop the motion in time, the positioner runs into the hard stop.

See "Limit Switch Specifications" for more information (p. 52).

3.7.3 Reference Switch

The positioner is equipped with a direction-sensing reference switch (see "Reference Switch Specifications" (p. 52)).

The commands that use the reference signal are described in the user manual of the controller and/or in the corresponding software manuals.

4 Unpacking

1. Unpack the L-731 / V-731 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 immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installation

5.1 General Notes on Installation

DANGER

For V-731 models: Magnetic fields!

Magnetic fields may damage or interfere with sensitive devices and objects (e. g. **cardiac pacemakers**, EC-cards, magnetic data carriers). **The fields are also effective when the positioner is not connected to the controller/electric power.**

Loose magnetizable objects (e.g. made of iron, steel) may be attracted and cause damages. The corresponding pull might not be manually compensated.

- If applicable, note the usual precautions for applying pacemakers.
- Remove loose magnetizable objects and sensitive devices from the installation site.
- Ensure that hazardous areas are marked correspondingly and that the usual precautions are applied.
- Keep sufficient distance from the positioner.
- Apply corresponding precautions also for storage and transport of the positioner.

CAUTION

Risk of crushing by moving parts!

There is a risk of minor injury from crushing between the moving parts of the positioner or the load and a fixed part or obstacle.

- Use protective structures to keep limbs away from areas in which they could be caught by moving parts.
- Observe the safety distances in accordance with DIN EN ISO 13857 when installing protective structures.

NOTICE

Cable break!

A cable break leads to failure of the positioner.

- Install the positioner so that the cable is not bent too strongly or crushed.

NOTICE

Heating up of the L-731 / V-731 during operation!

The heat produced during operation of the L-731 / V-731 can affect your application.

- Install the L-731 / V-731 so that the application is not impaired by the dissipated heat.

NOTICE

Damage due to removed caps or screws!

Removing caps and screws can lead to contamination and failure of the L-731 / V-731.

- Do **not** loosen screws on the positioner, except when removing the transport lock (p. 22).
- Do **not** remove any caps other than the ESD protection.
- Remove the ESD protection only when connecting to the controller.

INFORMATION

For optimal repeatability, all components must be connected firmly together.

- If possible, simulate the positioner motions with a mounted load or make suitable calculations to detect collisions or unfavorable center of gravity constellations.
- If necessary, take suitable constructive measures to avoid collisions and instability in the overall system.
- Avoid or mark danger zones that result from the installation of the positioner and the application, in accordance with the legal regulations.

5.2 Attaching the L-731 / V-731 to a Surface

NOTICE

Warping of the L-731 / V-731 due to mounting on uneven surfaces!

Mounting the L-731 / V-731 on an uneven surface can warp the L-731 / V-731. Warping reduces the accuracy.

- Mount the L-731 / V-731 onto an even surface. The recommended flatness of the surface is ≤5 µm.
- For applications with large temperature changes:
  Only mount the L-731 / V-731 on surfaces that have the same or similar thermal expansion properties as the L-731 / V-731.

NOTICE

Damage to the V-731 by impact of the platform with hard stops!

The V-731 has a linear drive without self-locking. When the XY positioner is tipped, the platform can hit the hard stops without braking.

- Only mount the V-731 onto absolutely horizontal surfaces.
- Remove the transport lock just before mounting onto the surface.

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ You have provided a suitable surface (for the required position and depth of the holes for accommodating the screws and locating pins, see "Dimensions" (p. 54)):
  - For mounting from above: 4 threaded holes M6 are provided.
  - If you use locating pins to align the positioner: Two 6 mm Ø locating holes are present.
  - The flatness of the surface is ≤5 µm.
  - For applications with large temperature changes: The surface should have the same or similar thermal expansion properties as the L-731 / V-731 (e.g., surface made of aluminum).
- ✓ You have accounted for the space required to route cables without bending and according to regulations.

Tools and accessories

- Mounting accessories; in the scope of delivery (p. 14)
  - 4 socket head cap screws, ISO 4762 M6x35
  - 2 dowel pins, ISO 2338 - 6 h8 × 10, for use as locating pins
- Allen wrench AF 5
- Hex key, AF 3

Mounting the positioner onto a surface

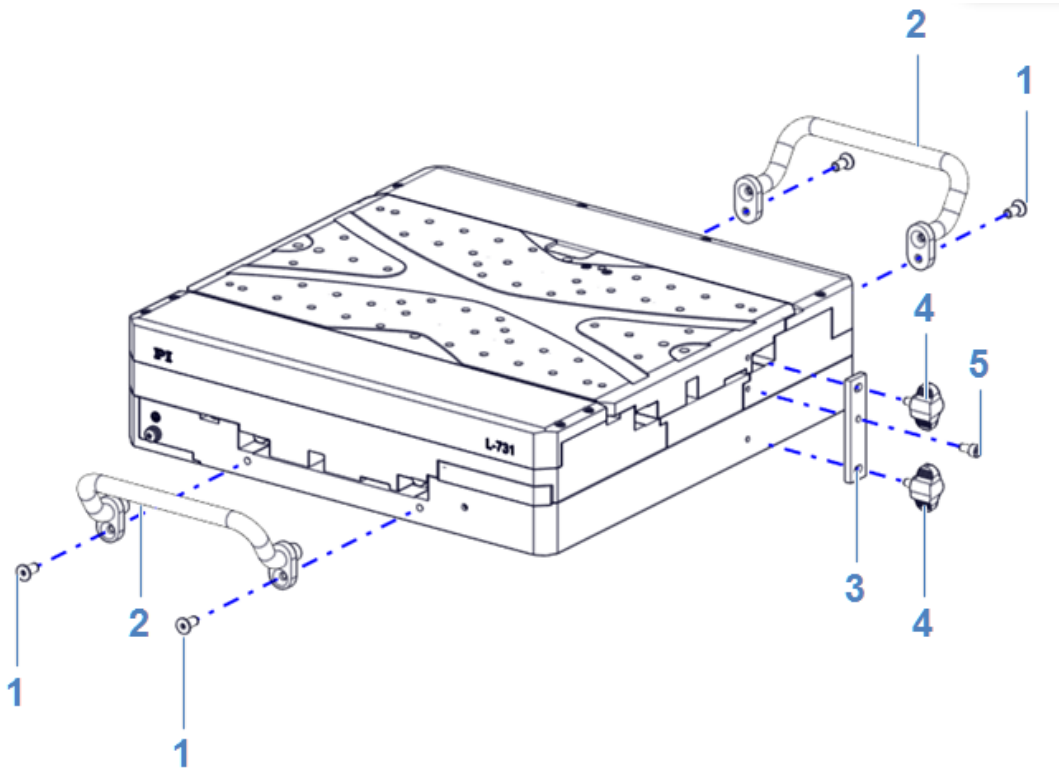


Figure 4: Remove the handle and the transport lock

1 Screw for the handle
2 Handle
3 Perforated plate for the transport lock
4 Wing screw for the transport lock
5 Screw for the transport lock

1. Remove both handles: Loosen the screws for the handles (see figure above).
2. Remove the screw and both wing screws of the transport lock (see figure above).
3. If you use locating pins to align the positioner:

a) Insert the locating pins into the respective holes in the surface.
b) Place the positioner on the surface so that the locating pins are inserted into the corresponding locating holes on the other side.

4. Move the platform in the X direction so that two of the fixing holes (through-holes) become accessible (see figure below).

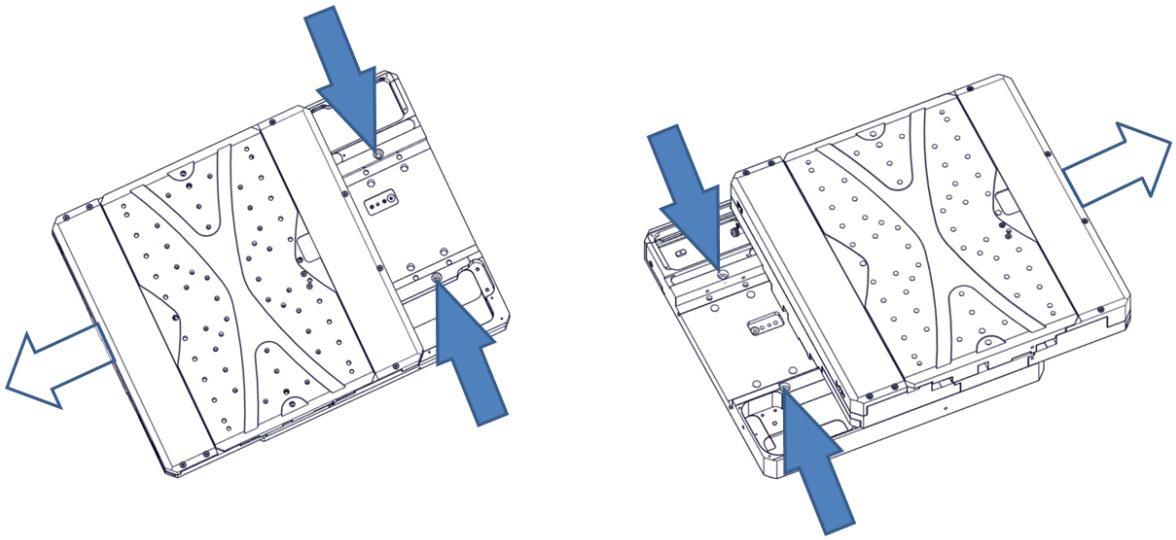


Figure 5: Position of the through-holes for mounting the positioner (schematic)

It is possible to move the platform accordingly.
Alternatively, to move the platform via a spindle:

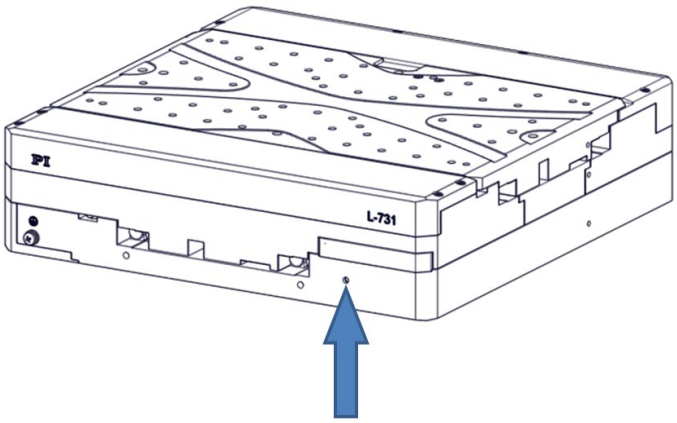


Figure 6: Position of the drive screw access

a) Insert a hex key AF3 into the drive screw access until you sense a mechanical resistance.
b) Turn the hex key clockwise or counterclockwise to move the platform in the positive or negative X direction.

5. Align the positioner on the surface so that the corresponding mounting holes in the positioner and the surface overlap.
6. Tighten all screws in the mounting holes selected. Pay attention to the permissible tightening torques (p. 60)
7. Repeat steps 4 to 6 for all remaining mounting holes.
8. Check that the positioner is affixed firmly to the surface.

5.3 Connecting the L-731 / V-731 to the Protective Earth Conductor

INFORMATION

It is only necessary to connect the L-731 / V-731 to the protective earth conductor when both of the following conditions are met:

- The load on the platform of the L-731 / V-731 must be connected to the protective earth conductor, but it is not possible to connect the protective earth conductor directly to the load.
- The load and the platform are connected conductively to each other.

INFORMATION

➢ Observe the applicable standards for connecting the protective earth conductor.

A protective earth connection is located on front side of the L-731 / V-731 (see also Figure 1, p.10).

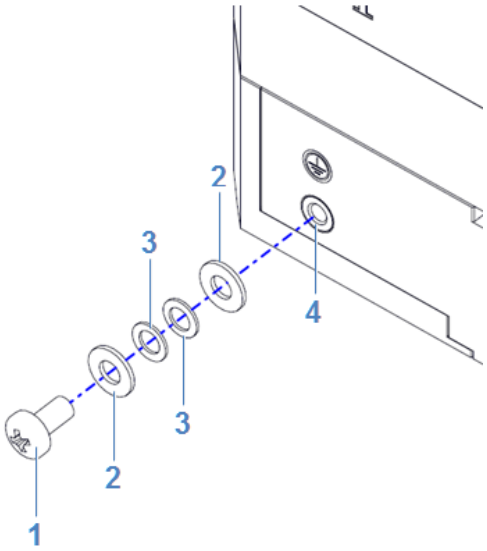


Figure 7: Protective earth connection set-up (explosive view)

1 Screw, M4x8, ISO 7045
2 Flat washer
3 Safety washer
4 M4 mounting hole

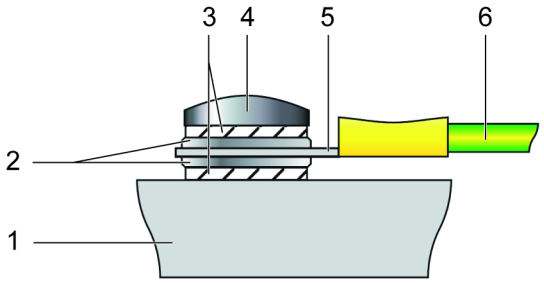


Figure 8: Mounting of the protective earth conductor (profile view)

1 Base body of the L-731 / V-731 (front side)
2 Flat washer
3 Safety washer
4 Screw, M4x8, ISO 7045
5 Cable lug
6 Protective earth conductor

Requirements

✓ You have read and understood the general notes on installation (p. 19).

Tools and accessories

- Suitable protective earth conductor: Cross-sectional area of the cable ≥ 0.75 mm^2
- PH1 screwdriver or similar tool

Connecting the L-731 / V-731 to the protective earth conductor

1. If necessary, attach a suitable cable lug to the protective earth conductor.
2. Remove the screw and the safety and flat washers of the protective earth connection (p. Figure 7).
3. Tighten the screw (together with the safety and flat washers) to affix the cable lug of the protective earth conductor to the protective earth connection (p. Figure 8)
4. Tighten the screw with a torque of 1.2 Nm to 1.5 Nm.
5. Make sure that the contact resistance at all connection points relevant for mounting the protective earth conductor is <0.1 Ω at 25 A.

5.4 Affixing the Load to the L-731 / V-731

NOTICE

Impermissibly high load on the positioner!

An impermissible high load impairs the motion of the platform and can damage the positioner.

➢ When considering the mass and mounting method of the load, pay attention to the specified maximum permissible forces, that are permitted to act on the platform (p. 49).

Requirements

✓ You have read and understood the general notes on installation (p. 19).

✓ You have mounted the positioner properly onto a surface (p. 20).

✓ The positioner is **not** connected to the controller.

✓ You have prepared the load so that it can be affixed to the mounting holes on the platform (p.55):

- The distance between the center of gravity of the load and the center of the platform is as small as possible in all directions.
- At least two points are provided for affixing the load to the platform (ideally: three attachment points).

Tools and accessories

- At least 2 M6 screws of suitable length
- Suitable tool for tightening the screws.
- Optional: Dowel pins, ISO 2338 - 6 h8 x 16 (locating pins)

Affixing the load

1. If you use locating pins for aligning the load: Insert the locating pins into the holes provided in the platform (p.55).
2. Align the load so that the selected mounting holes in the platform can be used to affix it.
3. Use the screws to affix the load to the selected mounting holes in the platform.
4. Check that the load is affixed firmly to the platform of the positioner.

5.5 Connecting the L-731 / V-731 to a Controller

NOTICE

Damage if an incorrect controller or motor cable is connected!

Connecting a positioner to an unsuitable controller or using an unsuitable motor cable can cause damage to the positioner or controller.

- ➢ Only connect the positioner to a suitable controller (p. 14).
- ➢ To connect the positioner to the controller, only use a motor cable that is suitable for the controller.
- ➢ For inquiries refer to the customer service (p. 43).

Please note that the cables for connecting the L-731 / V-731 to the electronics must also be ordered separately.

- ➢ To order, refer to the customer service (p. 43).

Requirements

- ✓ You have read and understood the general notes on installation (p. 19).
- ✓ You have installed the controller.
- ✓ You have read and understood the user manual of the controller.
- ✓ The controller is switched off.

Tools and accessories

- Cable
- Suitable tools for tightening the screws to the connections

Connecting the L-731 / V-731 to a Controller

1. Remove the ESD protection from all connections of the L-731 / V-731.
2. Connect the L-731 / V-731 and the controller to each other:
3. Use the integrated screws to secure the connections against accidental disconnection.

6 Startup

6.1 General Notes on Startup

DANGER

For V-731 models: Magnetic fields!

Magnetic fields may damage or interfere with sensitive devices and objects (e. g. **cardiac pacemakers**, EC-cards, magnetic data carriers). **The fields are also effective when the positioner is not connected to the controller/electric power.**

Loose magnetizable objects (e.g. made of iron, steel) may be attracted and cause damages. The corresponding pull might not be manually compensated.

- If applicable, note the usual precautions for applying pacemakers.
- Remove loose magnetizable objects and sensitive devices from the installation site.
- Ensure that hazardous areas are marked correspondingly and that the usual precautions are applied.
- Keep sufficient distance from the positioner.
- Apply corresponding precautions also for storage and transport of the positioner.

CAUTION

Risk of crushing by moving parts!

There is a risk of minor injury from crushing between the moving parts of the positioner or the load and a fixed part or obstacle.

- Use protective structures to keep limbs away from areas in which they could be caught by moving parts.
- Observe the safety distances in accordance with DIN EN ISO 13857 when installing protective structures.

NOTICE

Damage due to collisions!

Collisions can damage the positioner, the load to be moved, and the surroundings.

- Make sure that no collisions are possible between the positioner, the load to be moved, and the surroundings in the motion range of the positioner.
- Do not place any objects in areas where they can be caught by moving parts.
- Stop the motion immediately if a controller malfunction occurs.
- If possible, adapt the travel range limits of your mechanical system in the software that you use for commanding the motion.

NOTICE

Damage if an incorrect controller or motor cable is connected!

Connecting a positioner to an unsuitable controller or using an unsuitable motor cable can cause damage to the positioner or controller.

- Only connect a positioner to a suitable controller (page 14).
- To connect the positioner to the controller, only use a motor cable that is suitable for the controller.
- For inquiries and orders refer to the customer service (p. 43).

NOTICE

Operating voltage excessively high or incorrectly connected!

Operating voltages that are excessively high or incorrectly connected can cause damage to the L-731 / V-731.

- Do **not** exceed the operating voltage range (p. 52) that is specified for the L-731 / V-731.
- Only operate the L-731 / V-731 when the operating voltage is properly connected; see "Pin Assignment" (p. 55).

NOTICE

Damage or considerable wear due to high accelerations!

High accelerations can cause damage to or considerable wear on the mechanical system.

- Stop the motion immediately if a controller malfunction occurs.
- Ensure that the end of the travel range is approached at low velocity.
- Determine the maximum velocity for your application.

NOTICE

Unintentional motions!

Unintentional motion of the L-731 / V-731 is possible when it is connected to the controller. Defective software or incorrect operation of the software can also result in unintentional motion.

- Do not place any objects in areas where they can be caught by moving parts.
- Before connecting the L-731 / V-731, check whether a macro is defined as the startup macro in the controller, and cancel the selection of the startup macro if necessary.

INFORMATION

The maximum velocity for an L-731.4xSD should be determined in the application. If the commanded velocity is too high, the stepper motor might stop without the controller detecting this state.

INFORMATION

The repeatability of the positioning is only ensured when the reference switch is always approached from the same side. Controllers from PI fulfill this requirement as a result of the automatic direction sensing for reference moves to the reference switch.

6.2 Starting Up the Positioner

Requirements

- ✓ You have read and understood the general notes on startup (p. 29).
- ✓ For starting up with a load or in a multi-axis system: You have properly installed the positioner (p. 19).
- ✓ You have read and understood the user manual of the controller used.
- ✓ You have read and understood the manual of the PC software used.
- ✓ The controller and the required PC software have been installed. All connections on the controller have been set up (see "Connecting the L-731 / V-731 to the Controller" (p. 27) and the user manual of the controller).

Starting up the positioner

1. Start up the controller(s) (see user manual of the controller).

   Configure the controller(s) during startup using the PC software for the positioner used (see user manual of the controller, and the PC software): Select the entry in the positioner database that exactly matches the positioner model used.
2. Start a few motion cycles for testing purposes (see user manual of the controller model).

6.2.1 L-731 / V-731 Entries in the Positioner Database of PI

For PI controllers, you can select the connected positioner from a positioner database in the corresponding PC software. The appropriate operating parameters are thus loaded to the controller. You can find a detailed description in the user manual for the controller or in the manual for the PC software used.

7 Maintenance

7.1 General Notes on Maintenance

NOTICE

Damage due to improper maintenance!

Removing caps and screws can lead to contamination and failure of the L-731 / V-731.

- Do **not** loosen screws on the positioner.
- Do **not** remove any caps other than the ESD protection.

7.2 Performing a Maintenance Run (L-731 Models)

Depending on the operating conditions and the period of use of the L-731, the following maintenance measures are required:

Maintenance Run

The maintenance run serves to distribute the existing lubricant.

- After 500 operating hours or at least after 1 year, perform a maintenance run over the entire travel range, in order for the lubricant present to be evenly distributed.
- If the L-731 is to be operated continuously in an industrial environment over a small travel range (<20 % of the entire travel range), perform a maintenance run across the entire travel range every 5000 motion cycles.

Lubrication

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

- If you have any questions, contact our customer service department (p. 43).

7.3 Cleaning the L-731 / V-731

Requirements

- ✓ You have disconnected the positioner from the controller.

Cleaning the Positioner

- If necessary, clean the surfaces of the positioner with a cloth that is dampened with a mild cleanser or disinfectant.

7.4 Packing, Transporting, Storing, Returning

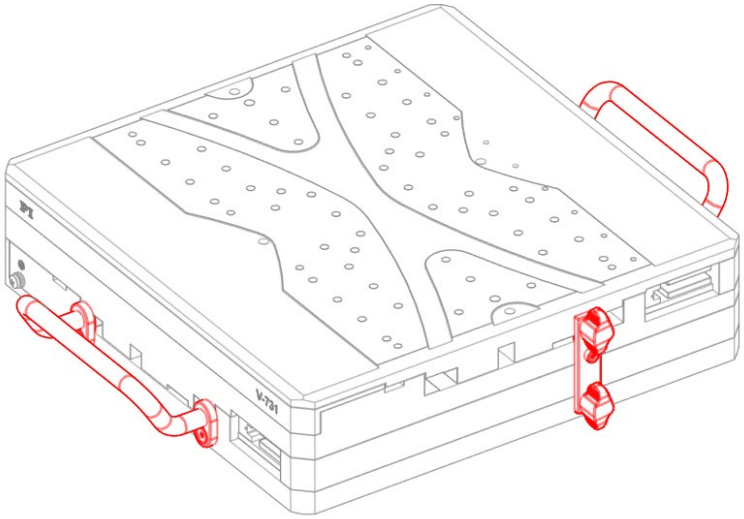
HINWEIS

For positioners of the V-7xx series: Possible damage after disassembly due to missing or incomplete transport lock

In contrast to the L-7xx series models, the moving components of the cross table can be moved very easily for V-7xx series models, even after disconnection from the controller. If the base body is tilted accordingly, undesirably high accelerations and decelerations of these components as well as collisions can occur and cause damage to the device. This is prevented by installing appropriate components to secure the device during transport.

If you wish to detach the device from its mounting surface:

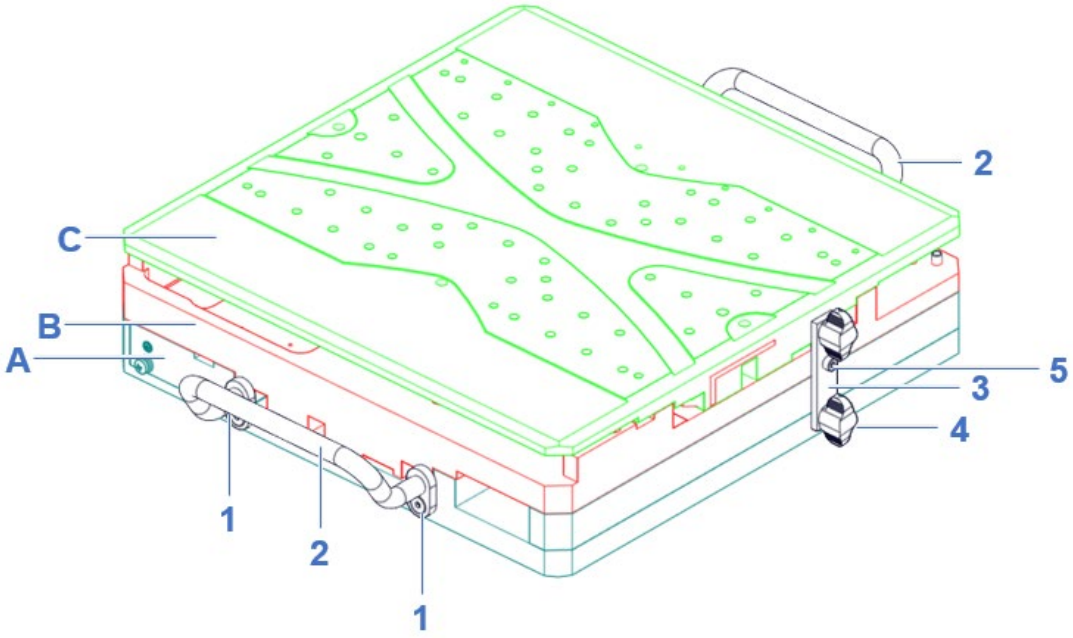
➢ After uninstalling the device: Ensure that all components of the transport lock are fitted before the device is moved from its horizontal position. Follow the instructions below.



INFORMATION

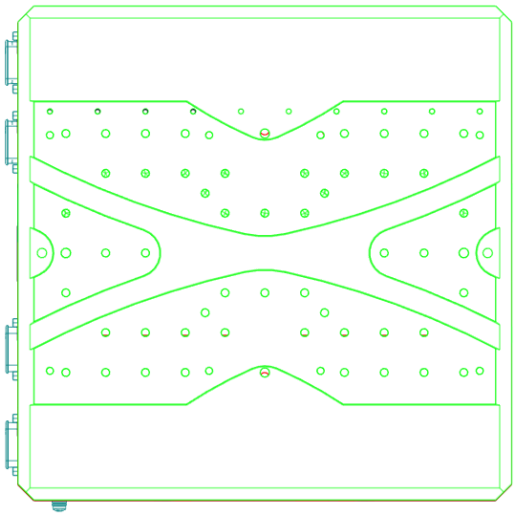
If the positioner is not to be used for a longer period of time, we recommend storing it in its original packaging if possible (delivery condition). To do this, the platform must be in the reference position (X = 0, Y = 0).

7.4.1 Designations of Relevant Components



A	Base body
B	X component
C	Platform / Y component
1	Mounting screw for carrying handle / X-lock (example, 4 in total)
2	Carrying handle / X-lock (example, 2 in total)
3	Y-lock
4	Wing screw for Y lock (example, 2 in total)
5	Hex socket screw for Y-lock

7.4.2 Move to Reference Position



INFORMATION

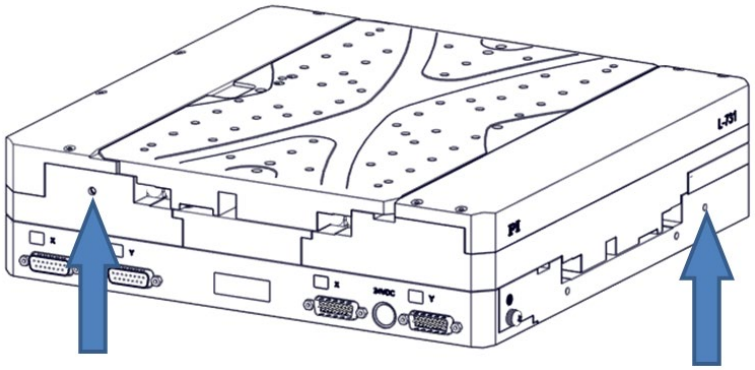
In contrast to the L-7xx series models, the moving components of the cross table can be moved very easily by hand (see below).

Procedure for Models L-7xx (also applicable for V-7xx models)

1. Establish (or keep,repectively) the connection to the controller.
2. Using the motion control software, command the platform to the position X = 0 and Y = 0.

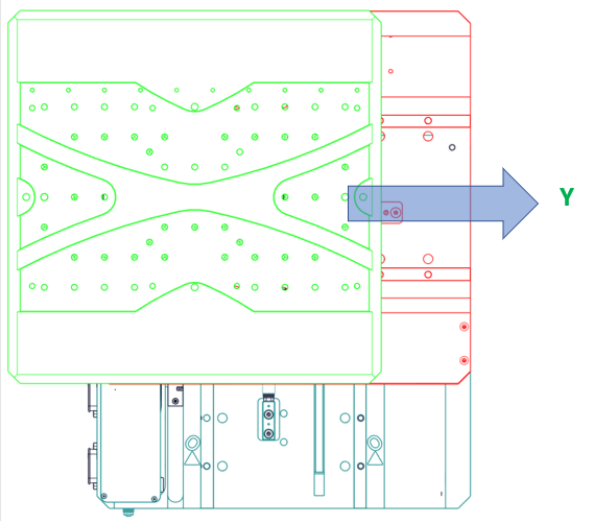
Manual Procedure for Models L-7xx

Alternatively, move the platform manually (using a hex key for spindle access) to the reference positions for X and Y that are shown in the next section (corresponding the positioning for V-7xx). For instructions, refer to the section “Attaching the L-731 / V-731 to a Surface” (p. 20)

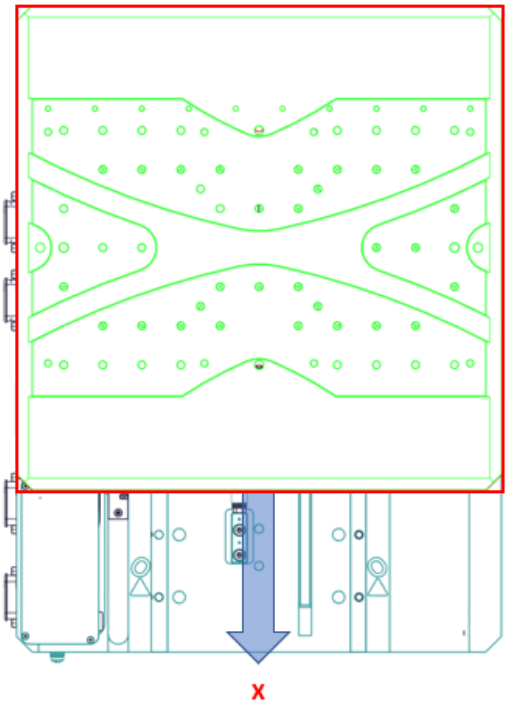


Manual motion of the platform for models V-7xx

1. Move the platform / Y-component in Y-direction so that it covers the X-component completely.



2. Move the X-component in X-direction so that it covers the base body completely.

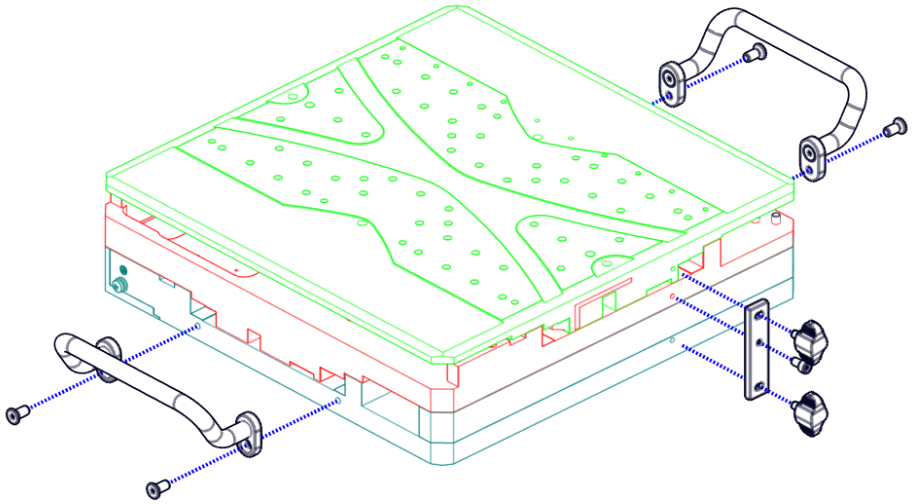


7.4.3 Securing the positioner mechanically

Required tools and material

- 2 handles, X-lock, Wing screws and hex screws provided with the postioner (previously removed according to section “Attaching the L-731 / V-731 to a Surface” (p. 20)
- Hex key AF 3 mm or compliant tool

Mount the two handles and the X-lock



1. Place one of the two handles on the base body so that the corresponding mounting holes in the handle and in the base body overlap.
2. In the mounting holes for the X-lock, insert the screws and tighten them with a torque of **max. 3 Nm**.
3. Repeat step 1 and step 2 correspondingly for the remaining handle.
4. Place the Y-lock on the base body, X and Y components so that the intended mounting holes overlap.
5. In the outer mounting holes for the Y-lock, insert the wing screws and tighten them with a torque of max. **1.5 Nm**.
6. In the middle mounting hole for the Y-lock, insert the hex-socket screw and it with a torque of max. **1.5 Nm**.
7. Check the firm mechanical connection of the locks.

7.4.4 Packing

Pack the device according to the delivery state.

INFORMATION

- Store the device in a dry and normal temperature environment, if possible, in the original packaging.

7.4.5 Returning the Device

1. Contact our customer service department before returning the product (service@pi.de).
2. if not already done: Remove the device completely from the installation site. When loosening the mounting screws, proceed in reverse order as described in section "Fastening the L 731 / V 731 to a base" (page 18). Disconnect the electrical connections to the controller and, if necessary, to the protective earth (PE).
3. Ensure that the positioner is properly secured (see section "Securing the positioner mechanically", p. 35)
4. If possible, use the original packaging.

8 Troubleshooting

8.1 Possible Causes and Remedies

Problem	Possible causes	Solution
Reduced positioning accuracy	Warped base body	➢ Mount the L-731 / V-731 onto an even surface. The recommended flatness of the surface is ≤ 5 µm.
	Increased wear due to small motions over a long period of time	➢ Carry out a maintenance run over the entire travel range.
Functional impairment after system modification	▪ Controller was replaced. ▪ L-731 / V-731 was replaced by another model.	➢ Load the parameters from the positioner database that correspond to the combination of controller and the L-731 / V-731 model.
Mechanical system does not move; no operating noise can be heard.	Controller not correctly connected or defective.	➢ Check all connecting cables. ➢ Check the controller. ➢ If necessary, check the power supply of the positioner.
For L-731.4xSD models: Actual position deviates from the displayed position.	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 detecting the state. ➢ Determine the maximum velocity for a positioner with a stepper motor in the application. ➢ Start a new reference move.

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 (p. 43).

8.2 Manually Moving the Platform

INFORMATION

It is necessary to repeat the reference move after moving manually and connecting to the controller.

V-731: The platform can be easily moved by hand without aid.

L-731: The platform can be moved with more force by hand without aid. Alternatively, the spindle can be used to move the platform without damaging the drive.

This can be necessary when the platform is stuck at the beginning or the end of the travel range (has reached the hard stop).

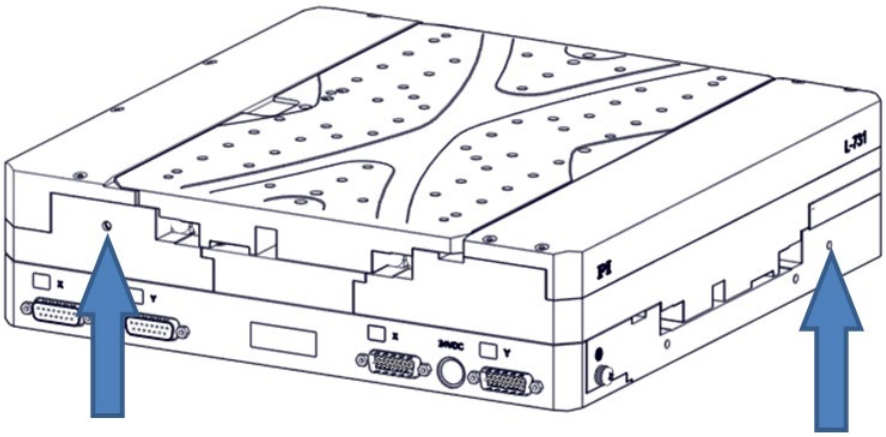


Figure 9: Position of the spindle accesses for the Y direction (left arrow) and X direction (right arrow)

Requirements

The positioner is **not** connected to the controller.

Tools and accessories

Hex key AF 3

Manually moving the platform

- Insert the hex key into the corresponding spindle access.
- Turn the hex key as far as necessary:
  - Clockwise rotation: Platform moves in a positive direction
  - Counterclockwise rotation: Platform moves in a negative direction

9 Customer Service

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

- If you have questions concerning your system, have the following information ready:
  - Product and serial numbers of all products in the system
  - Firmware version of the controller (if present)
  - Version of the driver or the software (if present)
  - Operating system on the PC (if present)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

The latest versions of the user manuals are available on our website (p. 6) for download.

10 Specifications

10.1 Technical Data

10.1.1 Data Table

The specified data applies to a temperature of **20 °C** (±3 °C) and **horizontal** installation.
You can download current versions of data sheets from our web site www.pi.ws.

L-731

Stages with DC motor					
Motion	**L-731.093111 / L-731.093112 / L-731.093132**			**Unit**	**Tolerance**
Active axes	X, Y				
Travel range	205 × 205			mm	
Angular error xry (pitch)	±75			µrad	Typ.
Angular error xrz (yaw)	±30			µrad	Typ.
Angular error yrx (pitch)	±75			µrad	Typ.
Angular error yrz (yaw)	±30			µrad	Typ.
Straightness / flatness	±2			µm	Typ.
Orthogonality	±96.963			µrad	Typ.
Velocity	L-731.093111 / L-731.093112: 50 L-731.093132: 90			mm/s	Max.

Positioning	L-731.093111	L-731.093112	L-731.093132	Unit	Tolerance
Integrated sensor	Incremental linear encoder				
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL		
Design resolution	0.001	0.01	0.1	µm	
Sensor resolution rotary encoder	–	–	20000	Cts./rev.	
Minimum incremental motion	0.1	0.5	0.8	µm	Typ.
Unidirectional repeatability	0.1	0.5	0.8	µm	Typ.
Bidirectional repeatability	±0.5	±0.5	±2.5	µm	Typ.

Positioning	L-731.093111	L-731.093112	L-731.093132	Unit	Tolerance
Reference switch repeatability	<1	<1	<1	µm	Typ.
Reference and limit switches	Forked photoelectric sensor, N/C contact, 5V, NPN				

Mechanical properties	L-731.093xxx	Unit	Tolerance
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Push/pull force F_X, F_Y power on	100	N	Max.
Load capacity	200	N	Max.
Permissible torque M_X in θ_X	125	Nm	Max.
Permissible torque M_Y in θ_Y	125	Nm	Max.
Permissible torque M_z in θ_Z	125	Nm	Max.

Drive properties	L-731.093xxx	Unit	Tolerance
Motor type	DC motor		
Operating voltage, nominal	24	V	Nom.
Operating voltage, max.	48	V	Max.

Miscellaneous	L-731.093111	L-731.093112 / L-731.093132	Unit	Tolerance
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	16	16	kg	±5 %
Moved mass in X, unloaded	12	12	kg	±5 %
Moved mass in Y, unloaded	3.5	3.5	kg	±5 %

Miscellaneous	L-731.093111	L-731.093112 / L-731.093132	Unit	Tolerance
Connector	2 × HD D-sub 26 (m) (motor) 2 × D-sub 15 (f) (sensor)	2 × HD D-sub 26 (m) (motor/sensor)		
Recommended controllers/drivers	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.11C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

Stages with stepper motor					
Motion	**L-731.40SD / L-731.44SD / L-731.4ASD**			**Unit**	**Tolerance**
Active axes	X, Y				
Travel range	205 × 205			mm	
Angular error xry (pitch)	±75			µrad	Typ.
Angular error xrz (yaw)	±30			µrad	Typ.
Angular error yrx (pitch)	±75			µrad	Typ.
Angular error yrz (yaw)	±30			µrad	Typ.
Straightness / flatness	±2			µm	Typ.
Orthogonality	±96.963			µrad	Typ.
Velocity	45			mm/s	Max.

Positioning	**L-731.40SD**	**L-731.44SD**	**L-731.4ASD**	**Unit**	**Tolerance**
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	A/B quadrature, TTL	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	10.0	0.01	0.001	µm	
Minimum incremental motion	1	0.05	0.05	µm	Typ.
Unidirectional repeatability	1	0.05	0.05	µm	Typ.
Bidirectional repeatability	±2.5	±0.5	±0.5	µm	Typ.
Reference and limit switches	Forked photoelectric sensor, N/C contact, 5V, NPN				

Mechanical properties	**L-731.4xSD**	**Unit**	**Tolerance**
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Push/pull force F_X, F_Y power on	100	N	Max.
Load capacity	200	N	Max.
Permissible torque M_X in θ_X	125	Nm	Max.

Mechanical properties	L-731.4xSD	Unit	Tolerance
Permissible torque M_Y in θ_Y	125	Nm	Max.
Permissible torque M_z in θ_Z	125	Nm	Max.

Drive properties	L-731.4xSD	Unit	Tolerance
Motor type	Stepper motor, 2-phase		
Operating voltage, nominal	24	V	Nom.
Operating voltage, max.	48	V	Max.
Stepper motor	200	Full steps/ rev.	

Miscellaneous	L-731.40SD / L-731.44SD	L-731.4ASD	Unit	Tolerance
Operating temperature range	5 to 40	5 to 40	C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	15.5	15.5	kg	±5 %
Moved mass in X, unloaded	12	12	kg	±5 %
Moved mass in Y, unloaded	3.5	3.5	kg	±5 %
Connector	L-731.40SD: 2 × HD D-sub 26 (m) (motor) L-731.44SD: 2 × HD D-sub 26 (m) (motor/sensor)	2 × HD D-sub 26 (m) (motor) 2 × D-sub 15 (f) (sensor)		
Recommended controllers/drivers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	SMC Hydra (double axis) ACS modular controller		

V 731

Motion and positioning	V-731.096111	Unit	Tolerance
Active axes	X, Y		
Travel range	205 × 205	mm	
Integrated sensor	Incremental linear encoder		
Design resolution	0.001	µm	
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period		
Minimum incremental motion	0.02	µm	Typ.
Unidirectional repeatability	0.1	µm	Typ.
Bidirectional repeatability	±0.25	µm	Typ.
Angular error xry (pitch)	±75	µrad	Typ.
Angular error xrz (yaw)	±30	µrad	Typ.
Angular error yrx (pitch)	±75	µrad	Typ.
Angular error yrz (yaw)	±30	µrad	Typ.
Orthogonality	±96.963	µrad	Typ.
Straightness / flatness	±2	µm	Typ.
Velocity	200	mm/s	Max.
Acceleration in X, without load	5	m/s^2	Max.
Acceleration in Y, without load	15	m/s^2	Max.
Reference and limit switches	Forked photoelectric sensor, N/C contact, 5V, NPN		

Mechanical properties	V-731.096111	Unit	Tolerance
Load capacity	50	N	Max.
Permissible torque in θ_X, θ_Y	125	Nm	Max.
Permissible torque in θ_Z	125	Nm	Max.
Guide	Crossed roller guide with anti-creep system		

Drive properties	V-731.096111	Unit	Tolerance
Motor type	Ironless 3-phase linear motor		
Operating voltage, nominal	48	V	Nom.
Operating voltage, max.	48	V	Max.
Peak force	80	N	Max.
Nominal force	29	N	Typ.
Peak current, RMS	5	A	Typ.
Nominal current, RMS	1.5	A	Typ.
Force constant, RMS	19.9	N/A	Typ.
Motor constant	4.89	N/√W	Typ.
Electrical time constant	0.4	ms	
Resistance phase-phase	11	Ω	Typ.
Inductance phase-phase	3.6	mH	Typ.
Back EMF phase-phase	16	Vs/m	Max.
Pole pitch N-N	30	mm	

Miscellaneous	V-731.096111	Unit	Tolerance
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
Moved mass in X	15.4	kg	±5 %
Moved mass in Y	5.6	kg	±5 %
Overall mass	19.4	kg	±5 %
MTBF	20000	h	
Connector	2 × HD D-sub 26 (m) (motor) 2 × D-sub 15 (f) (sensor)		
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.11C885 (up to 20 axes) ACS modular controller		

10.1.2 Maximum Ratings

The L-731 / V-731 positioners are designed for the following operating data:

Model	Maximum operating voltage ⚠	Operating frequency ⚠	Maximum power consumption* ⚠
L 731.093111 L 731.093112 L 731.093132	48 V	0 Hz	60 W
L-731.4xSD	48 V	0 Hz	5 W
V-731.096111	48 V	0 Hz	3 W

* per axis

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the L-731 / V-731:

Area of application	For indoor use only
Maximum altitude	2000 m
Relative humidity	20% … 90%, not condensing
Storage temperature	10 °C … 50 °C
Transport temperature	10 °C … 50 °C
Supply fluctuations	Max. ±10 % of the nominal voltage
Degree of pollution	2
Degree of protection according to IEC 60529	IP00

10.1.4 Limit Switch Specifications

Type	Optical sensor
Supply voltage	+5 V/GND, supplied via the motor connector
Signal output	Open Collector
Signal logic	The signal level changes when passing the limit switch. The signal logic is active high. That means: ▪ Normal motor operation: low (0 V) ▪ Limit switch reached: high (+5 V)

10.1.5 Reference Switch Specifications

Type	Optical sensor
Supply voltage	+5 V/GND, supplied by the motor controller through the motor connector.
Signal output	Open Collector
Signal logic	Direction sensing by means of different signal levels on the left and right side of the reference switch: The signal level changes from 0 to +5 V when the reference switch is passed.
Hysteresis	0.2 … 0.4 mm (when arriving from the positive or negative direction)

10.2 Dimensions

10.2.1 L-731 / V-731 Positioners

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

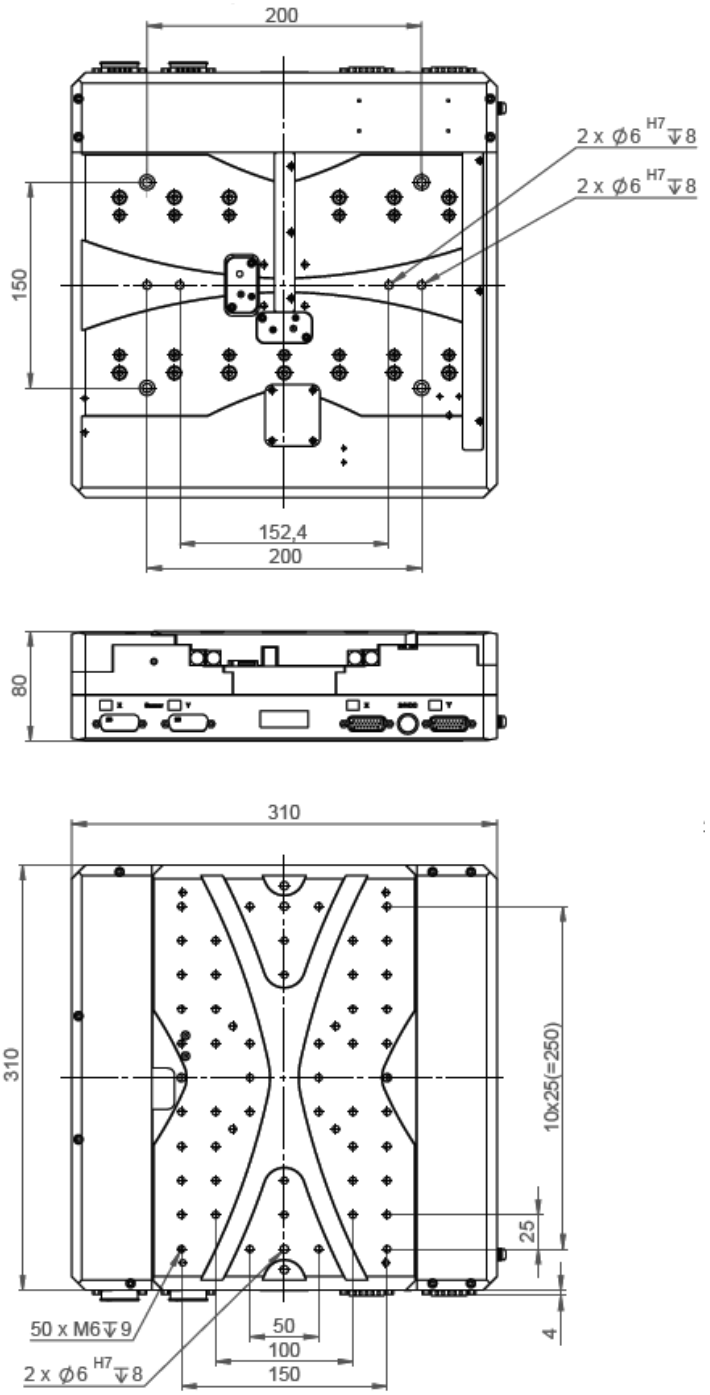


Figure 10: Dimensions; platform in reference position

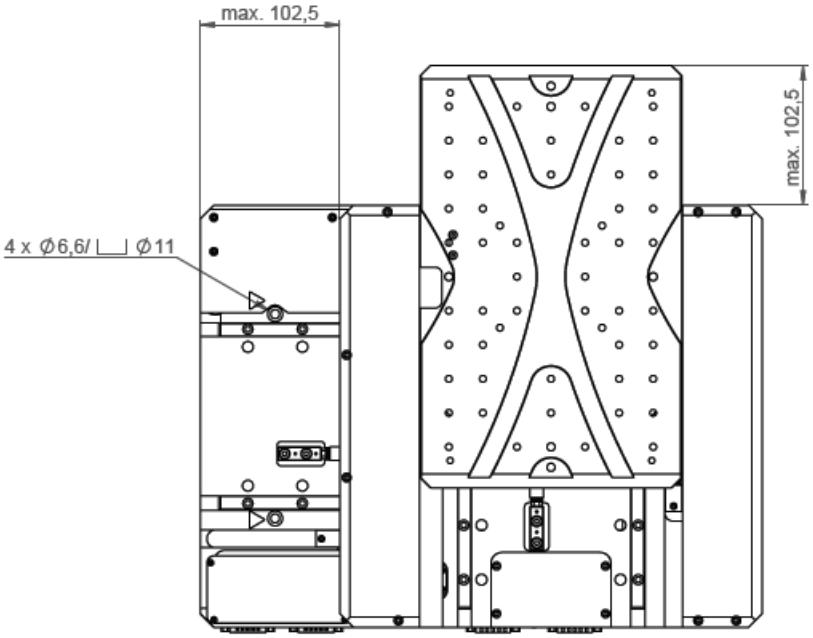


Figure 11: Dimensions; platform moved out

10.2.2 Hole Pattern of the Platform

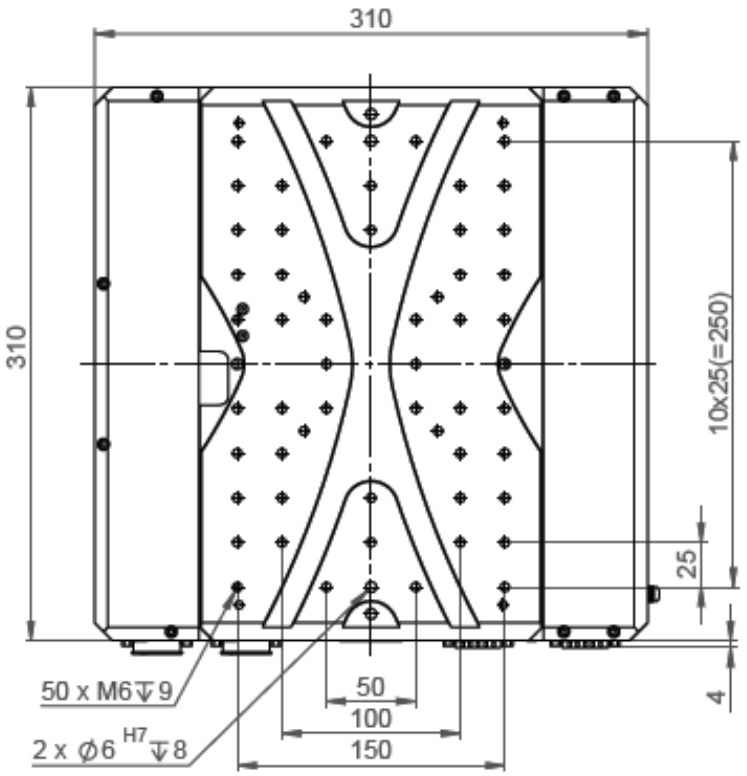


Figure 12: Hole pattern

10.3 Pin Assignment

10.3.1 HD D-Sub 26 (m)

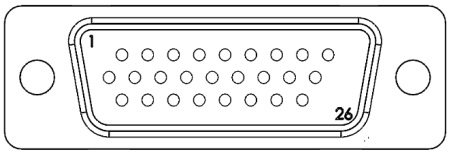


Figure 13: HD D-Sub 26 panel plug

L 731.0931xx

Pin	L-731.093132	L-731.093111	L-731.093112	Direction
1	Motor +	Motor +	Motor +	Input
2	Motor +	Motor +	Motor +	Input
3	Motor -	Motor -	Motor -	Input
4	Motor -	Motor -	Motor -	Input
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-
9	-	-	-	-
10	REF	REF	REF	Output
11	Limit neg.	Limit neg.	Limit neg.	Output
12	Limit pos.	Limit pos.	Limit pos.	Output
13	-	-	-	-
14	-	-	-	-
15	-	-	-	-
16	-	-	-	-
17	ID I/O	ID I/O	ID I/O	Bidirectional
18	Limit Power & Encoder (+5 V)	Limit Power (+5 V)	Limit Power & Encoder (+5 V)	Input
19	Encoder A+	-	Encoder A+	Output
20	Encoder A-	-	Encoder A-	Output
21	Encoder B+	-	Encoder B+	Output
22	Encoder B-	-	Encoder B-	Output
23	Encoder C+	-	Encoder C+	Output
24	Encoder C-	-	Encoder C-	Output
25	GND	GND	GND	-
26	-	-	-	-

L-731.4xSD

Pin	L-731.40SD / L-731.4ASD	L-731.44SD	Direction
1	Motor A+	Motor A+	Input
2	Motor A+	Motor A+	Input
3	Motor A-	Motor A-	Input
4	Motor A-	Motor A-	Input
5	Motor B+	Motor B+	Input
6	Motor B+	Motor B+	Input
7	Motor B-	Motor B-	Input
8	Motor B-	Motor B-	Input
9	-	-	-
10	REF	REF	Output
11	Limit neg.	Limit neg.	Output
12	Limit pos.	Limit pos.	Output
13	-	-	-
14	-	-	-
15	-	-	-
16	-	-	-
17	ID I/O	ID I/O	Bidirectional
18	Limit Power (+5 V)	Limit Power & Encoder (+5 V)	Output
19	-	Encoder A+	Output
20	-	Encoder A-	Output
21	-	Encoder B+	Output
22	-	Encoder B-	Output
23	-	Encoder C+	Output
24	-	Encoder C-	Output
25	GND	GND	-
26	-	-	-

V-731

Pin	V-731.096111	Direction
1	Motor U / Phase 1	Input
2	Motor U / Phase 1	Input
3	Motor V / Phase 2	Input
4	Motor V / Phase 2	Input
5	Motor W Phase 3	Input
6	Motor W / Phase 3	Input
7	-	-
8	-	-
9	-	-
10	REF	Output
11	Limit neg.	Output
12	Limit pos.	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID I/O	Bidirectional
18	Limit Power (+5 V)	Input
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	GND	-
26	-	

10.3.2 D-Sub 15 (m)

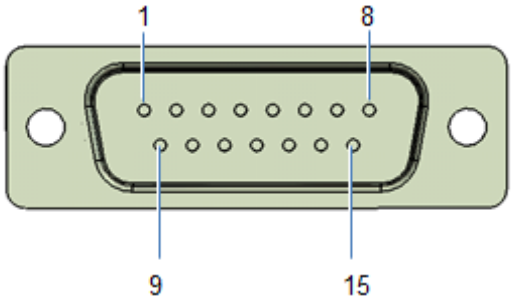


Figure 14: D-Sub 15 panel plug

Pin	L-731.093111	L-731.4ASD	V-731.096111	Direction
1	Encoder Power 5V DC	Encoder Power 5V DC	Encoder Power 5V DC	Input
2	Encoder GND	Encoder GND	AGND	-
3	sin +	sin +	sin +	Output
4	sin -	sin -	sin -	Output
5	-	-	-	-
6	cos +	cos +	cos +	Output
7	cos -	cos -	cos -	Output
8	Limit neg.	Limit neg.	Limit neg.	Output
9	-	-	NTC	Output
10	REF +	REF +	REF +	Output
11	-	-	PTC	Output
12	REF -	REF -	REF -	Output
13	-	-	-	Output
14	GND	GND	GND	-
15	Limit pos.	Limit pos.	Limit pos.	Output

10.4 Tightening Torque for Screws, ISO 4762 - A2

The following tightening torques for screws according to ISO4762 (corresponds to DIN 912) - A2 may not be exceeded.

Value	Maximum tightening torque
M3	1.5 Nm
M4	2 Nm
M5	2.5 Nm
M6	3 Nm

11 Old Equipment Disposal

In accordance with EU law, electrical and electronic equipment may not be disposed of in EU member states 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

12 EU Declaration of Conformity

An EU Declaration of Conformity has been issued for the L-731 / V-731 in accordance with the following European directives:

- EMC Directive
- RoHS Directive

The applied standards certifying the conformity are listed below.

- EMC: EN 61326-1
- Safety: EN 61010-1
- RoHS: EN 50581 or EN IEC 63000