PI

MP183E
L-738 / V-738 Precision XY Stage
User Manual

Version: 1.1.2   Date: 17-July-2019

This document describes the following precision XY stages with 102 mm x 102 mm travel range:

- **L-738.051100:**
  With stepper motor, without encoder
- **L-738.051111:**
  With stepper motor and linear encoder,
  sin/cos signal transmission
- **L-738.051112:**
  With stepper motor and linear encoder,
  A/B quadrature signal transmission
- **L-738.053111:**
  With DC motor and linear encoder,
  sin/cos signal transmission
- **L-738.053112:**
  With DC motor and linear encoder,
  A/B quadrature signal transmission
- **L-738.053132:**
  With DC motor and rotary encoder,
  A/B quadrature signal transmission
- **V-738.056111:**
  With linear motor and linear encoder,
  sin/cos signal transmission

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Subject to change without notice. This manual is superseded by any new release. The latest release is
available for download from our website (p. 5).

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-738 / V-738.

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. 5).

1.2 Symbols and Typographic Conventions

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

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.

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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

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
SMC Hydra motion controller	Hardware manual (SMC-Hydra CM TT.doc)
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
ACS SPiiPlusEC	ACS SPiiPlusEC Installation guide ACS SPiiPlusEC IMPU Only Installation guide
C-891 PIMag® motor controller	MS251E User manual
C-885/C-891.11C885	C885T0002 User manual C891T0005 User manual

2 Safety

2.1 Intended Use

The L-738 / V-738 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-738 / V-738 is intended for positioning, adjusting and shifting of loads on two axes at various velocities. The L-738 / V-738 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-738 / V-738 is only possible when completely mounted and connected and in a horizontal position.

The L-738 / V-738 must be operated with a suitable controller (p. 12). The controller is not included in the scope of delivery of the V-738.

2.2 General Safety Instructions

The L-738 / V-738 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-738 / V-738 may result in personal injury and/or damage to the V-738.

➢ Only use the L-738 / V-738 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. 33).

The operator is responsible for the correct installation and operation of the V-738.

2.3 Organizational Measures

User Manual

➢ Always keep this user manual available when using the V-738.
The latest versions of the user manuals are available on our website (p. 5) for download.

➢ Add all information from the manufacturer such as supplements or technical notes to the user manual.

➢ If you give the L-738 / V-738 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-738 / V-738 after you have read and understood this user manual.

Personnel Qualification

The L-738 / V-738 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 stages

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

L-738 / V-738	Drive type			Rotary encoder	Linear encoder	
	Stepper motor	DC motor	Linear motor	A/B quadrature	sin/cos*	A/B quadrature
L-738.051100	+					
L-738.051111	+				+	
L-738.051112	+					+
L-738.053111		+			+	
L-738.053112		+				+
L-738.053132		+		+		
V-738.056111			+		+	

* Separate sensor connection

Detailed model overview

Order number	Product description
L-738.051100	Precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, stepper motor
L-738.051111	Precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, stepper motor, incremental linear encoder with sin/cos signal transmission, 20 µm sensor signal period
L-738.051112	Precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, stepper motor, incremental linear encoder with A/B quadrature signal transmission, 10 nm sensor resolution
L-738.053111	Precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, DC motor, incremental linear encoder with sin/cos signal transmission, 20 µm sensor signal period

Order number	Product description
L-738.053112	Precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, DC motor, incremental linear encoder with A/B quadrature signal transmission, 10 nm sensor resolution
L-738.053132	Precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, DC motor, rotary encoder
V-738.056111	PIMag® precision XY stage, 380 mm × 380 mm width, 102 × 102 mm travel range, 150 × 150 mm clear aperture, ironless 3-phase linear motor, 48 V, incremental linear encoder with sin/cos signal transmission, 20 µm sensor signal period

3.2   Product View

3.2.1 Important Components
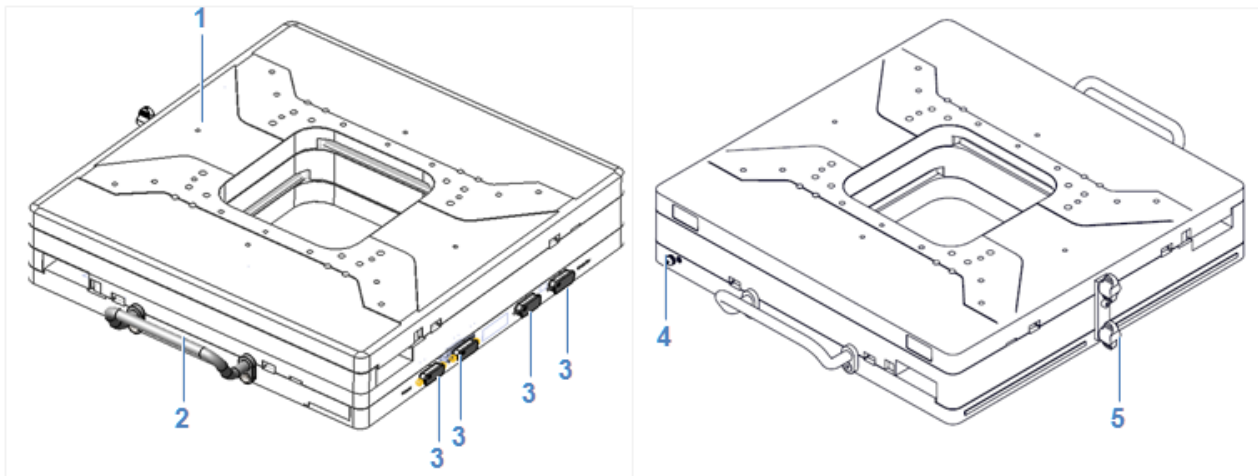
Figure 1: Important components

1   Platform
2   Handle
3   ESD protection caps / controller connectors
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. 46).

L-738.051111	L-738.051100
L-738.053111	L-738.051112
V-738.056111	L-738.053112
	L-738.053132
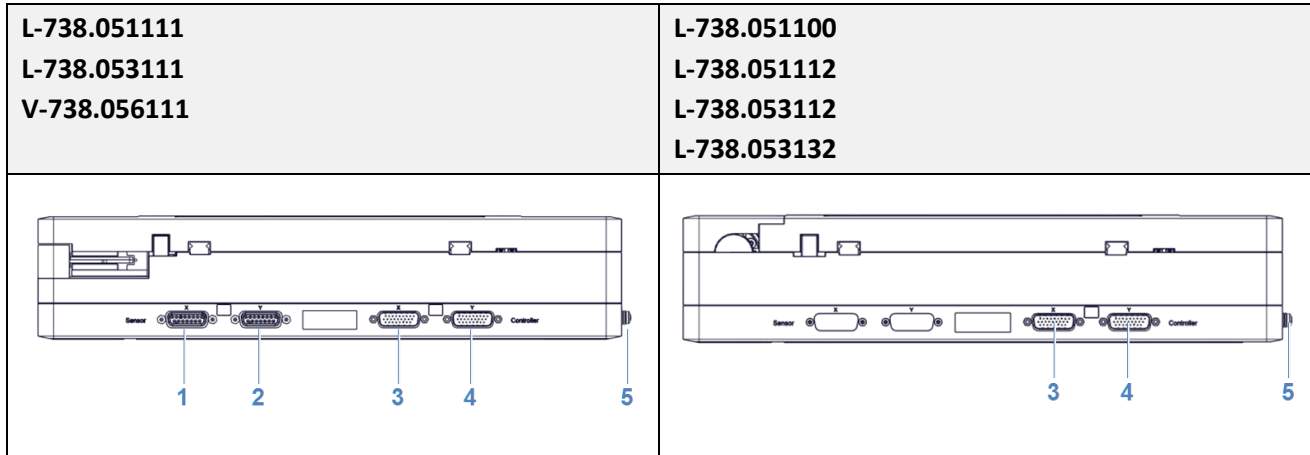
Pos.	Connection	L-738.051111 L-738.053111 V-731.056111	L-738.051100 L-738.051112 L-738.053112 L-738.053132
1	Sensor connection, X axis (D-Sub 15 panel plug)	+	
2	Sensor connection, Y axis (D-Sub 15 panel plug)	+	
3	Motor connection, X axis (HD D-Sub 26 panel plug)	+	+
4	Motor connection, Y axis (HD D-Sub 26 panel plug)	+	+
5	Protective earth connection (screw ISO 7045 M4x8)	+	+

3.3 Directions of Motion
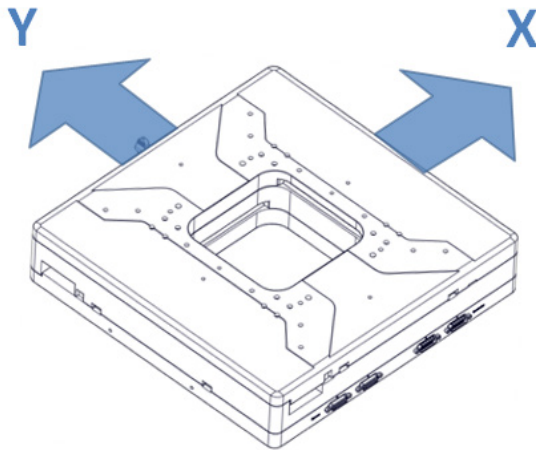
Figure 2: Direction of the motion of the platform

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

3.4 Product Labeling
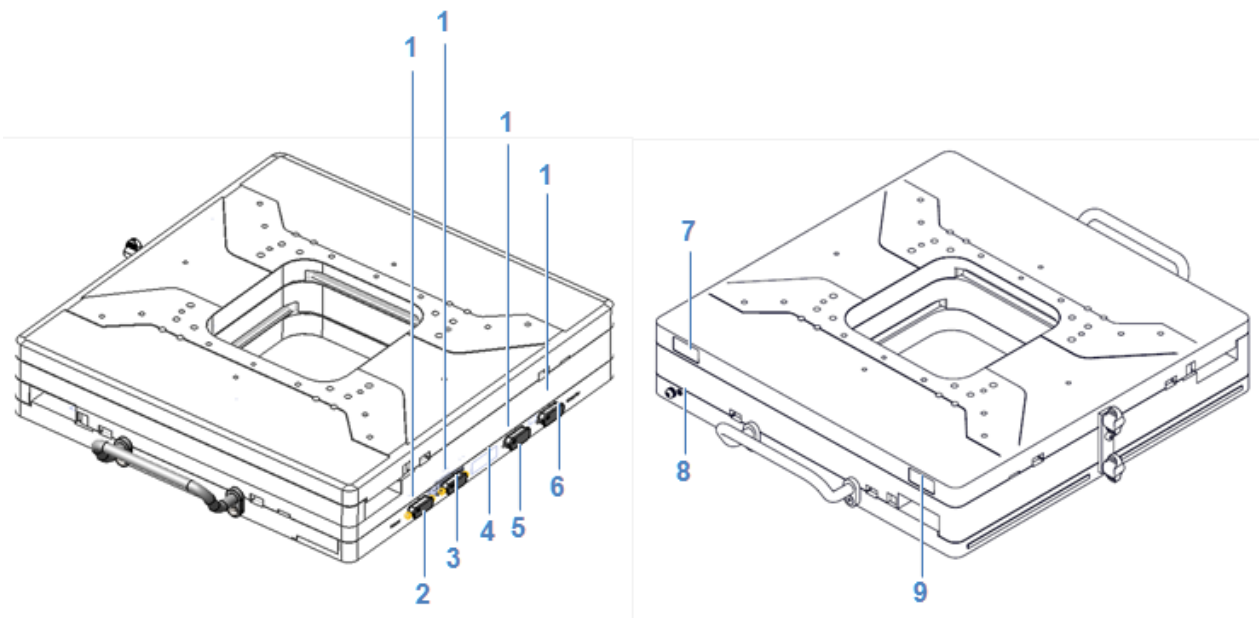
Figure 3: Product labeling (see following table)

Position	Labeling	Description
1	⚠️	Warning sign "Electrostatic sensitive devices"
2	Sensor X	Encoder connection, X axis
3	Sensor Y	Encoder connection, Y axis

Position	Labeling	Description
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	V-738. 056111	Complete product code (example)
4	CE	CE conformity mark
4	415002159	Serial number (example), individual for each V-738 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. 22)
9, 4	L-738 V-738	Product series

3.5   Scope of Delivery

Item number	Component
V-738	Stage according to order (p. 7)
	Motor cables and sensor cables according to the controller and stage ordered
MP146EK	Short instructions for stages with electric motors
6303500012	Mounting accessories: • 8 socket head screw, ISO 4762* M6x25 • 2 dowel pins, ISO 8734** - 4 m6 x 16

* Corresponds to DIN 912

** Corresponds to DIN 6325

3.6 Suitable Controllers

The L-738 / V-738 must be connected to a suitable controller. The following controllers from PI are suitable for the operation of the L-738 / V-738:

Models	Controller	Axes per controller (max.)	PC interface	Multiple controllers on the same PC
L-738.051100	C-663.12*	1	USB, RS-232, daisy chain network	Yes
	C-885 with C-663.12C885	20	USB, LAN	Yes
	SMC Hydra	2	RS-232, LAN	Yes
L-738.051111	SMC Hydra	2	RS-232, LAN	Yes
L-738.051112	C-663.12*	1	USB, RS-232, daisy chain network	Yes
	C-885 with C-663.12C885	20	USB, LAN	Yes
L-738.053111	C-885 with C-891.11C885	20	USB, LAN	Yes
	C-891*	1	RS-232, USB	Yes
	SMC Hydra	2	RS-232, LAN	Yes
L-738.053112 L-738.053132	C-863*	1	USB, RS-232, LAN	Yes
	C-884	4	RS-232, LAN	Yes
	C-885 with C-863.20C885	40	USB, LAN	Yes
V-738.056111	C-891*	1	RS-232, USB	Yes
	C-885 with C-891.11C885	20	USB, LAN	Yes
	SMC Hydra	2	RS-232, LAN	Yes

* 2 controllers are required for operation.

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

3.7 Technical Features

3.7.1 Encoder

The L-738.051111, L-738.051112, L-738.053111, L-738.053112, and V-738.056111 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.

Model L-738.053132 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. 37).

Model L-738.051100 does not have an encoder.

3.7.2 Limit Switches

The stage 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 stage runs into the hard stop.

See "Limit Switch Specifications" for more information (p. 43).

3.7.3 Reference Point Switch

The stage is equipped with a direction-sensing reference point switch (see "Reference Point Switch Specifications" (p. 43)).

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-738 / V-738 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-738 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.

NOTICE
Cable break! A cable break leads to failure of the stage. ➢ Install the stage so that the cable is not bent too strongly or crushed.

NOTICE
Heating up of the L-738 / V-738 during operation! The heat produced during operation of the L-738 / V-738 can affect your application. ➢ Install the L-738 / V-738 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 V-738. ➢ Do **not** loosen screws on the stage, except when removing the transport lock (p. 20). ➢ 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 stage 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 stage and the application, in accordance with the legal regulations.

5.2   Attaching the L-738 / V-738 to a Surface

NOTICE

Warping of the L-738 / V-738 due to mounting on uneven surfaces!
Mounting the L-738 / V-738 on an uneven surface can warp the V-738. Warping reduces the accuracy.

➢ Mount the L-738 / V-738 onto an even surface.
    The recommended flatness of the surface is ≤5 µm.

➢ For applications with large temperature changes:
    Only mount the L-738 / V-738 on surfaces that have the same or similar thermal expansion properties as the L-738 / V-738.

NOTICE

Damage to the V-738.056111 by impact of the platform with hard stops!
The V-738.056111 has a linear drive without self-locking. When the XY stage is tipped, the platform can hit the hard stops without braking.

➢ Only mount the V-738.056111 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. 17).

✓ 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. 44)):

– For mounting from above: 8 threaded holes M6 are provided.

– If you use locating pins to align the stage: Two locating holes Ø 4 mm 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-738 / V-738 (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. 11)

    – 8 socket head cap screws, ISO 4762 M6x25

    – 2 dowel pins, ISO 8734 - 4 m6 × 10, for use as locating pins

- Hex key AF 5
- Hex key AF 3

Mounting the stage onto a surface
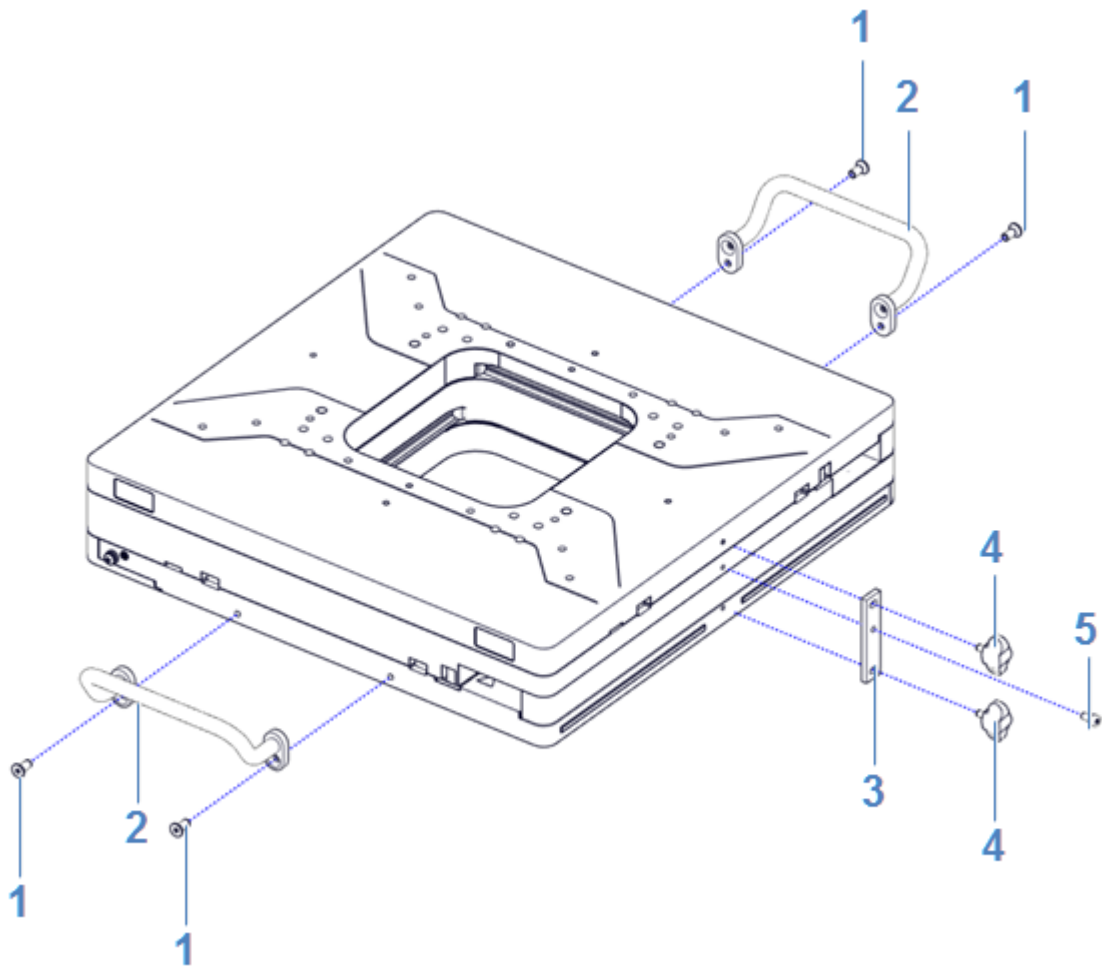
Figure 4: Remove the handle and the transport lock (similar illustration)

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: With the hex key AF 3, 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 stage:

    a) Insert the locating pins into the respective holes in the surface.

    b) Place the stage 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).
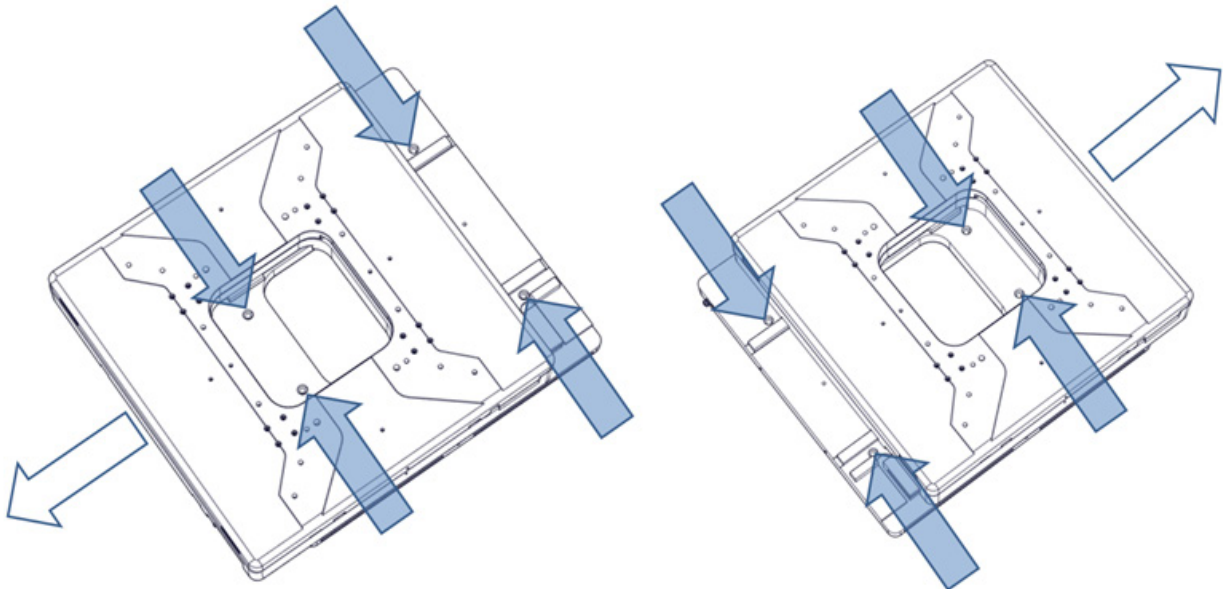
Figure 5:   Positions of the through-holes for mounting the stage (blue/dark arrows; move the platform for access, see light arrows)

It is possible to move the platform accordingly by hand.

5. Align the stage on the surface so that the corresponding mounting holes in the stage and the surface overlap.

6. Tighten all screws in the mounting holes selected. Pay attention to the permissible tightening torques (p. 49)

7. Repeat steps 4 to 6 for all remaining mounting holes.

8. Check that the stage is affixed firmly to the surface.

5.3   Connecting the L-738 / V-738 to the Protective Earth Conductor

> *INFORMATION*
>
> It is only necessary to connect the L-738 / V-738 to the protective earth conductor when both of the following conditions are met:
> - The load on the motion platform of the L-738 / V-738 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 motion 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-738 / V-738 (see also Figure 1, p. 8).
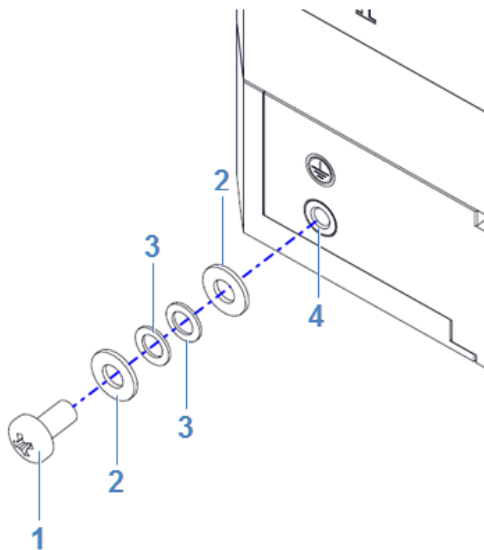
Figure 6: Protective earth connection set-up (explosive view)

1	Screw, M4x8, ISO 7045
2	Flat washer
3	Safety washer
4	M4 mounting hole
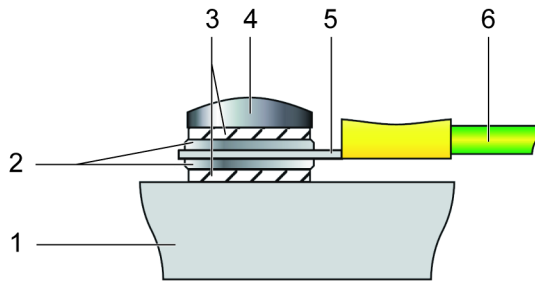
Figure 7: Mounting of the protective earth conductor (profile view)

1	Base body of the L-738 / V-738 (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. 17).

Tools and accessories

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

Connecting the L-738 / V-738 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 6).

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 7)

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-738 / V-738

NOTICE

Impermissibly high load on the stage!

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

➢ 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 motion platform (p. 37).

Requirements

✓ You have read and understood the general notes on installation (p. 17).

✓ You have mounted the stage properly onto a surface (p. 19).

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

✓ You have prepared the load so that it can be affixed to the mounting holes on the motion platform:

− The distance between the center of gravity of the load and the center of the motion platform is as small as possible in all directions.

− At least two points are provided for affixing the load to the motion 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 8734 - 6 m6 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 motion platform.

2. Align the load so that the selected mounting holes in the motion platform can be used to affix it.

3. Use the screws to affix the load to the selected mounting holes in the motion platform.

4. Check that the load is affixed firmly to the motion platform of the stage.

5.5 Connecting the L-738 / V-738 to a Controller

	NOTICE

Damage if an incorrect controller or motor cable is connected!

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

 ➢ Only connect the stage to a suitable controller (p. 12).

 ➢ To connect the stage to the controller, only use the cables provided with the stage.

Requirements

 ✓ You have read and understood the general notes on installation (p. 17).

 ✓ 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 from the scope of delivery of the stage (p. 11)

 ▪ Suitable tools for tightening the screws to the connections

Connecting the L-738 / V-738 to a Controller

1. Remove the ESD protection caps from all connections of the V-738.

2. Connect the L-738 / V-738 and the controller to each other by the provided cables.

   Use the integrated screws to secure the connections against accidental disconnection.

6 Start-Up

6.1 General Notes on Start-Up

DANGER

For V-738 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 stage 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 stage, the load to be moved, and the surroundings.

➢ Make sure that no collisions are possible between the stage, the load to be moved, and the surroundings in the motion range of the stage.
➢ 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.

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> ### *NOTICE*
>
> ⊘
>
> **Damage if an incorrect controller or motor cable is connected!**
>
> Connecting a stage to an unsuitable controller or using an unsuitable motor cable can cause damage to the stage or controller.
>
> ➢ Only connect a stage to a suitable controller.
>
> ➢ To connect the stage to the controller, only use a motor cable that is provided with the stage.

> ### *NOTICE*
>
> ⊘
>
> **Damage if an incorrect controller or motor cable is connected!**
>
> Connecting a stage to an unsuitable controller or using an unsuitable motor cable can cause damage to the stage or controller.
>
> ➢ Only connect a stage to a suitable controller (page 12).
>
> ➢ To connect the stage to the controller, only use the cables which were delivered with your order and your specific stage/controller-combination.

> ### *NOTICE*
>
> ⊘
>
> **Operating voltage excessively high or incorrectly connected!**
>
> Operating voltages that are excessively high or incorrectly connected can cause damage to the V-738.
>
> ➢ Do **not** exceed the operating voltage range that is specified for the V-738.
>
> ➢ Only operate the L-738 / V-738 when the operating voltage is properly connected.

> ### *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-738 / V-738 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 V-738, check whether a macro is defined as the start-up macro in the controller, and cancel the selection of the start-up macro if necessary.

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INFORMATION

The maximum velocity for an L-738.0511xx 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 point 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 point switch.

6.2 Starting Up the Stage

Requirements

✓ You have read and understood the general notes on start-up (p. 27).

✓ For starting up with a load or in a multi-axis system: You have properly installed the stage (p. 17).

✓ 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-738 / V-738 to the Controller" (p. 25) and the user manual of the controller).

Starting up the stage

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

   Configure the controller(s) during start-up using the PC software for the stage used (see user manual of the controller, and the PC software): Select the entry in the stage database that exactly matches the stage model used.

2. Start a few motion cycles for testing purposes (see user manual of the controller model).

6.2.1 L-738 / V-738 Entries in the Stage Database of PI

For PI controllers, you can select the connected stage from a stage 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.

PI

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 V-738.

➢ Do **not** loosen screws on the stage.
➢ Do **not** remove any caps other than the ESD protection.

7.2 Performing a Maintenance Run (L-738 Models)

Depending on the operating conditions and the period of use of the L-738, 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 stage 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. 35).

7.3 Cleaning the L-738 / V-738

Requirements

✓ You have disconnected the stage from the controller.

Cleaning the Stage

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

8   Troubleshooting

8.1   Possible Causes and Remedies

Problem	Possible causes	Solution
Reduced positioning accuracy	Warped base body	➢ Mount the L-738 / V-738 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. ▪ V-738 was replaced by another model.	➢ Load the parameters from the stage database that correspond to the combination of controller and the L-738 / V-738 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 stage.
For L-738.0511xx 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 stage 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. 35).

8.2   Manually Moving the Platform

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

The platform can be moved by hand without additional aid.

9   Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (mailto: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. 5) for download.

10 Technical Data

10.1 Specifications

The specified data applies to a temperature of **20 °C** (±3 °C) and **horizontal** installation.

10.1.1 Data Table

L 738.051100 / L 738.051111 / L 738.051112

	L 738.051100	L 738.051111	L 738.051112	Unit	Tolerance
Motion and positioning					
Active axes	X, Y	X, Y	X, Y		
Travel range	102 × 102	102 × 102	102 × 102	mm	
Integrated sensor	–	Incremental linear encoder with sin/cos signal transmission	Incremental linear encoder with A/B quadrature signal transmission		
Design resolution	10	0.001	0.01	µm	
Sensor signal period	–	20		µm	
Minimum incremental motion	0.2	0.05	0.05	µm	typ.
Unidirectional repeatability	0.2	0.05	0.05	µm	typ.
Bidirectional repeatability	±2	±0.5	±0.5	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Angular error xry (pitch)	±40	±40	±40	µrad	typ.
Angular error xrz (yaw)	±20	±20	±20	µrad	typ.
Angular error yrx (pitch)	±40	±40	±40	µrad	typ.
Angular error yrz (yaw)	±20	±20	±20	µrad	typ.
Straightness / flatness	±2	±2	±2	µm	typ.
Orthogonality	±96.963	±96.963	±96.963	µrad	typ.
Velocity	35	35	35	mm/s	max.
Reference and limit switches	optical	optical	optical		

	L 738.051100	L 738.051111	L 738.051112	Unit	Tolerance
Mechanical properties					
Load capacity	200	200	200	N	
Permissible torque in θX, θY	130	130	130	Nm	
Permissible torque in θZ	90	90	90	Nm	
Moved mass in X	13.8	13.8	13.8	kg	
Moved mass in Y	5.8	5.8	5.8	kg	
Overall mass	22	22	22	kg	
Guiding	Crossed roller guide with anti-creep system				
Drive properties					
Motor Type	2-phase stepper motor				
Step resolution	200			200	200
Operating voltage	24	24	24	V	nom.
	48	48	48	V	mx.
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Moved mass in X, unloaded	13.8	13.8	13.8	kg	±5 %
Moved mass in Y, unloaded	5.8	5.8	5.8	kg	±5 %
Humidity	20 … 90 % rel., not condensing				
Material	Aluminum, black anodized				
Connection	Motor/Sensor: 2 × HD D-Sub 26 (m)	Motor: 2 × HD D-Sub 26 (m)/ Sensor: 2 × D-Sub 15 (f)	Motor/Sensor: 2 × HD D-Sub 26 (m)		
Recommended controller	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	C-663.12 (single axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

L-738.053111 / L-738.053112 / L-738.053132

	L-738.053111	L-738.053112	L-738.053132	Unit	Tolerance
Motion and positioning					
Active axes	X, Y	X, Y	X, Y		
Travel range	102 × 102	102 × 102	102 × 102	mm	
Integrated sensor	Incremental linear encoder with sin/cos signal transmission	Incremental linear encoder with A/B quadrature signal transmission	Incremental rotary encoder		
Sensor resolution			20000	cts/rev	
Design resolution	0.001	0.01	0.1	µm	
Sensor signal period	20			µm	
Minimum incremental motion	0.1	0.1	0.4	µm	typ.
Unidirectional repeatability	0.1	0.1	0.4	µm	typ.
Bidirectional repeatability	±0.5	±0.5	±2	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Angular error xry (pitch)	±40	±40	±40	µrad	typ.
Angular error xrz (yaw)	±20	±20	±20	µrad	typ.
Angular error yrx (pitch)	±40	±40	±40	µrad	typ.
Angular error yrz (yaw)	±20	±20	±20	µrad	typ.
Straightness / flatness	±2	±2	±2	µm	typ.
Orthogonality	±96.963	±96.963	±96.963	µrad	typ.
Velocity	50	50	90	mm/s	max.
Reference and limit switches	optical	optical	optical		
Mechanical properties					
Drive screw type	Ball screw	Ball screw	Ball screw	mm	
Drive screw pitch	2	2	2		
Holding force, power off	20	20	20	N	typ.
Push/pull force Fx, Fy power on	100	100	100	N	max.
Load capacity	200	200	200	N	max.
Permissible torque Mx in θX, θY	130	130	130	Nm	max.
Permissible torque Mz in θZ	90	90	90	Nm	max.
Guiding	Recirculating ball bearing				
Mass	24	24	24	kg	±5 %
Moved mass in X, unloaded	14.6	14.6	14.6	kg	±5 %
Moved mass in Y, unloaded	5.8	5.8	5.8	kg	±5 %

	L-738.053111	**L-738.053112**	**L-738.053132**	**Unit**	**Tolerance**
Drive properties					
Motor type	DC motor				
Operating voltage	24	24	24	V	nom.
	48	48	48	V	max.
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized				
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)	2 × HD Sub-D 26 (m) (motor/sensor)	2 × HD Sub-D 26 (m) (motor/sensor)		
Recommended controller	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	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

V-738.096111

	V-738.096111	Unit	Tolerance
Motion and positioning			
Active axes	X, Y		
Travel range	102 × 102	mm	
Integrated sensor	Incremental linear encoder, sin/cos signal output		
Design resolution*	0.001	µm	
Sensor signal period	20	µm	
Minimum incremental motion	0.02	µm	typ.
Unidirectional repeatability	0.1	µm	typ.
Bidirectional repeatability	±0.25	µm	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±20	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±20	µrad	typ.
Straightness / flatness	±2	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	500	mm/s	max.
Acceleration in X, Y, without load	10	m/s²	max.
Reference and limit switches	Optical		
Mechanical properties			
Load capacity	100	N	max.
Permissible torque in θX, θY	130	Nm	max.
Permissible torque in θZ	90	Nm	max.
Guide	Recirculating ball bearing		
Drive properties			
Motor type	Ironless 3-phase linear motor		
Operating voltage	48	V	nom.
	48	V	max.
Peak force	200	N	max.
Nominal force	87	N	typ.
Peak current, effective	15	A	typ.
Nominal current, effective	4.4	A	typ.
Force constant, effective		N/A	typ.
Motor constant	71	N/√W	typ.
Electrical time constant	0.4	ms	

	V-738.096111	Unit	Tolerance
Resistance phase-phase	3.6	Ω	typ.
Inductance phase-phase	1.2	mH	typ.
Back EMF phase-phase	16	Vs/m	max.
Pole pitch N-N	30	mm	
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
Moved mass in X, unloaded	16.8	kg	±5 %
Moved mass in Y, unloaded	8	kg	±5 %
Overall mass	24	kg	±5 %
Connection	2 × HD D-Sub 26 (m) (motor) 2 × D-Sub 15 (f) (sensor)		
Recommended controller	SMC Hydra C-891 C-885 with C-891.11C885 Modular ACS controller		

10.1.2 Maximum Ratings

The L-738 / V-738 stages are designed for the following operating data. Except for V-738, not suitable for continous operation.

Maximum operating voltage
⚠
48 V

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed.

Area of application	For indoor use only
Maximum altitude	2000 m
Relative humidity	20% … 90%, not condensing
Storage temperature	10 °C to 50 °C
Transport temperature	10 °C to 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 Point 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 point switch: The signal level changes from 0 to +5 V when the reference point switch is passed.
Hysteresis	0.2 to 0,4 mm (when arriving from the positive or negative direction)

10.2   Dimensions

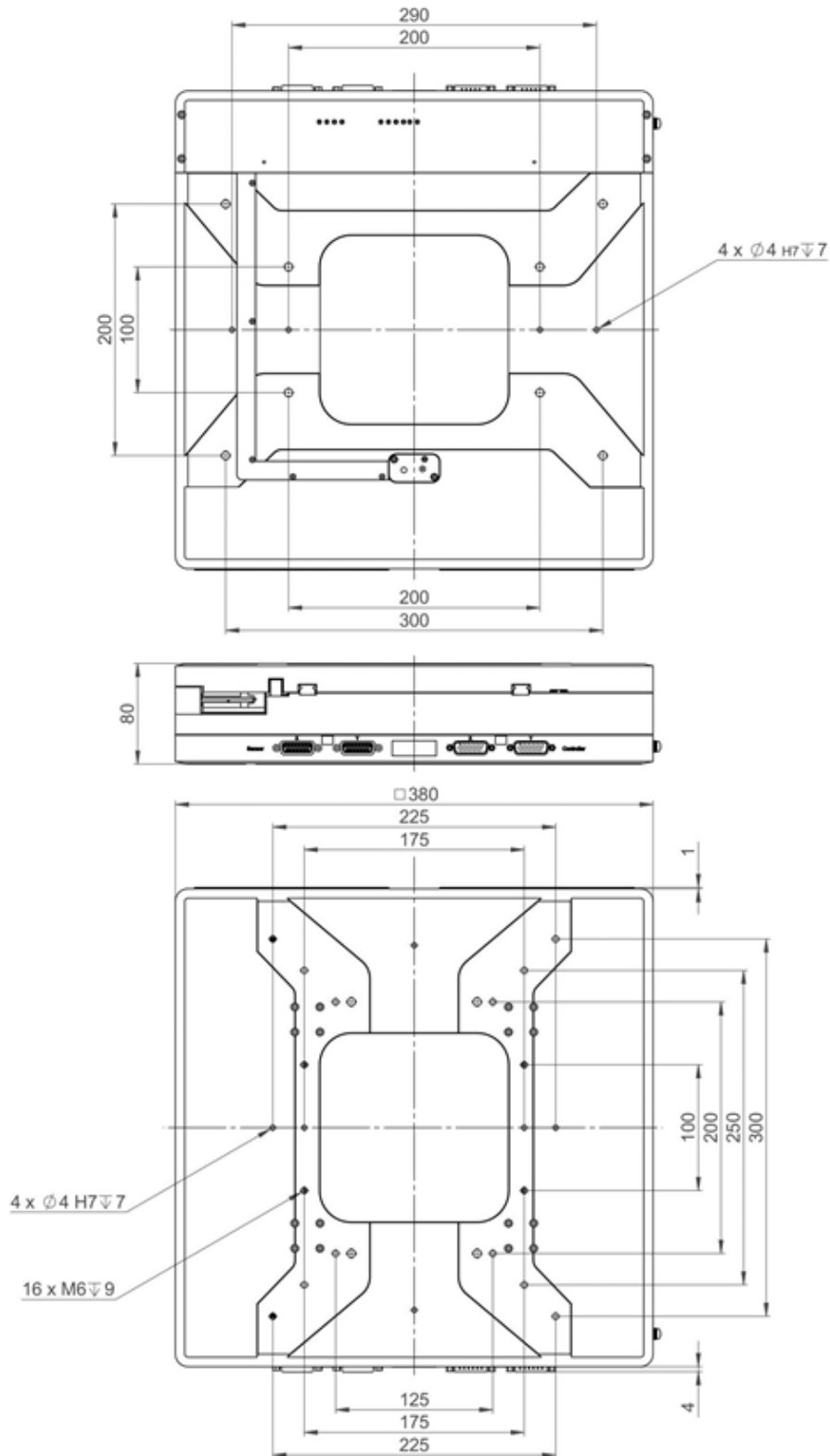Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.
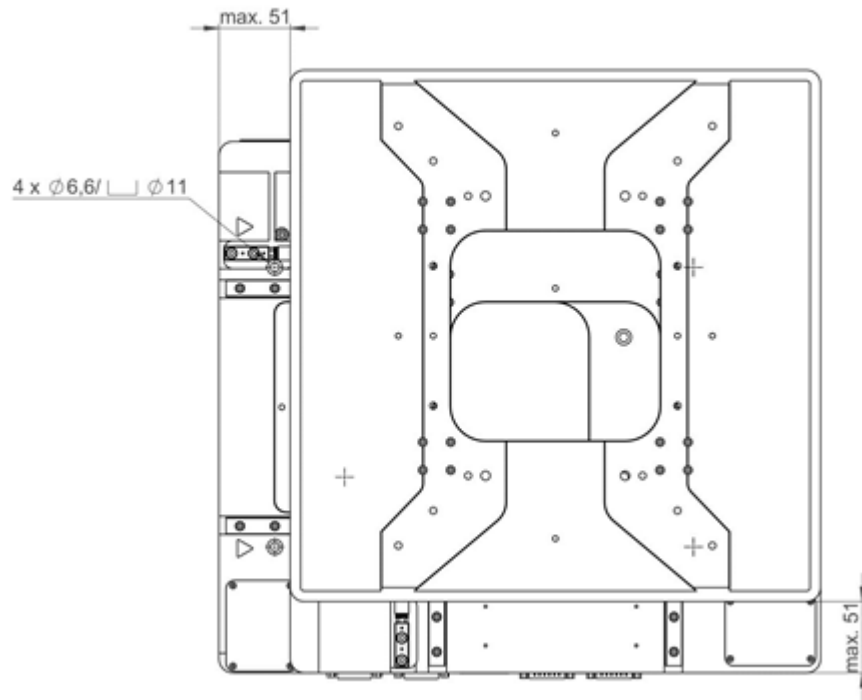
Figure 8: Dimensions; Platform in reference position

Figure 9: Dimensions; Platform moved out
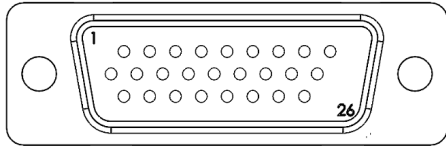
10.3 Pin Assignment

10.3.1 HD D-Sub 26 (Male)

Figure 10: HD D-Sub 26 panel plug

L 738.051100 / L 738.051111 / L 738.051112

Pin	Signal L-731.40SD / L-731.44SD	Signal L-731.4ASD	Direction
1	Motor A+	Motor + / Motor A+ / U	Input
2	Motor A+	Motor + / Motor A+ / U	Input
3	Motor A-	Motor - / Motor A- / V	Input
4	Motor A-	Motor - / Motor A- / V	Input
5	Motor B+	Motor B+ / W	Input
6	Motor B+	Motor B+ / W	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 (+5 V)	Output
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	-	-	-

PI

L-738.053111 / L-738.053112 / L-738.053132

Pin	Signal	Direction
1	Motor +	Input
2	Motor +	Input
3	Motor -	Input
4	Motor -	Input
5	-	-
6	-	-
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	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	Encoder Power 5 V DC	Input

V-738.056111

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

PI

10.3.2   D-Sub 15 (Female)
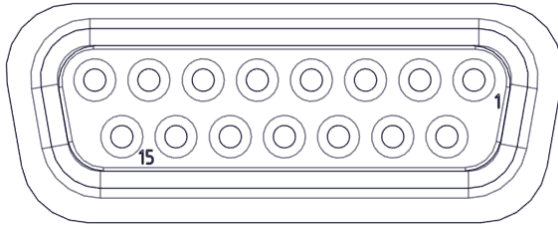
Figure 11: D-Sub 15 panel plug

Pin	Signal	Direction
1	Power 5 V DC	Input
2	Encoder GND	-
3	sin +	Output
4	sin -	Output
5	Temp GND	-
6	cos +	Output
7	cos -	Output
8	Limit neg.	Output
9	NTC	Output
10	REF +	Output
11	PTC	Output
12	REF -	Output
13	-	Output
14	GND	-
15	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

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12 EU Declaration of Conformity

An EU Declaration of Conformity has been issued for the L-738 / V-738 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