
Keysight Precision XYZ Stage

DS1010A Precision XYZ Stage

Notices

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Manual Part Number

DS1010-90002

Edition

Edition 1, January 2025

Published by:
Keysight Technologies
1400 Fountain Grove Parkway Santa
Rosa, CA 95403

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Where to Find the Latest Information

Documentation is updated periodically. For the latest information about these products, including instrument software upgrades, application information, and product information, browse to one of the following URLs, according to the name of your product:

<https://www.keysight.com/us/en/product/DS1010A/precision-xyz-stage.html>

To receive the latest updates by email, subscribe to Keysight Email Updates at the following URL:

<https://support.keysight.com>

Information on preventing instrument damage can be found at:

<https://www.keysight.com/find/PreventingInstrumentDamage>

Is your product software up-to-date?

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements. To search for software updates for your product, go to the Keysight Technical Support website at:

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Keysight complies with multinational regulations for the cybersecurity of its own products and is committed to providing information to assist you in protecting your products and solutions from external cyber threats. For more information, see:

<https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security.html>

Keysight also recommends that you secure your IT environments using appropriate third-party tools. For instruments that run the Microsoft Windows operating system, Keysight concurs with Microsoft's recommendations for ensuring that the instrument is protected:

- Get the latest critical Windows updates
- For network-connected instruments, use an Internet firewall (in Keysight instruments, Windows Firewalls enabled by default)
- For network-connected instruments, use up-to-date antivirus and anti-spyware software

Responsible Disclosure Program

Keysight recommends that security researchers share the details of any suspected vulnerabilities across any asset owned, controlled, or operated by Keysight (or that would reasonably impact the security of Keysight and our users) using this form:

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Manufacturer Address

Keysight Technologies Netherlands Riscure B.V.

Delftechpark 49

2628 XJ Delft, The Netherlands

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

Before operation, you should review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

General

WARNING

This product has been manufactured and tested according to international safety standards. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

WARNING

Use only the Keysight supplied power cord or cords with the same or better electrical rating.

Using other power cords may present a fire hazard or cause serious to deadly injury.

WARNING

Use only the Keysight supplied power supply.

Using other power supplies may present a fire hazard or cause serious to deadly injury.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

Do not Operate in Explosive Atmosphere




Do not operate the instrument in the presence of flammable gases or fumes.

Do not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Instrument Markings

Instrument Marking	Description
	The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.
	Direct Current
	Alternate Current

Specification

Environmental Specifications

Parameter	Description	Comment
Ambient operating temperature	10 – 30 °C	
Ambient non-operating temperature	-10 – 50 °C	
Humidity	< 90 %	Non-condensing
Operating altitude	Up to 2000 m	
Overvoltage category	II	
Pollution degree	2	For indoor use only

Electrical Specifications

For detailed power input ratings of this product please refer to the rating label placed on the product.

Electrical Specifications (AC Adaptors)

Parameter	Description	Comment
Line Voltage	100 – 240 V~	
Line Frequency	50 – 60 Hz	
Input Current	1.0 A max.	
Line Voltage Fluctuations	± 10 %	
Output Voltage	6 / 12 / 15 / 24 V ^{DC}	Depending on model
Output power	36 W max.	

Electrical Specifications (Keysight U8002A Power Supply)

If your product is delivered with a Keysight Technologies U8002A Power Supply, please also review the U8002A Power Supply and its manual for safety markings and instructions. You must also follow these to ensure safe operation and to maintain the instrument in safe condition.

Physical Specifications

The physical specification of the product, in detail the dimensions and the weight is documented in the specific User Manual delivered with your product.

Cleaning the instrument

WARNING

To prevent electrical shock, disconnect the instrument from mains before cleaning.

Use a dry cloth slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Connections to External Circuits

All external I/O connections are supplied by non-hazardous voltages supplied by circuits of limited energy.

WARNING

All external inputs connected to ports shall provide reinforced or double insulation against hazardous voltages for protection against electric shock and shall have voltage below 30 Vrms and 42.4 Vpeak or 60 VDC.

CAUTION

Connecting an instrument to voltages other than rated may introduce excessive voltage and damage the device. Excessive voltage can lead to thermal stress, breakdown of insulating materials, or direct electrical failure, necessitating repairs or replacements. Always refer to product model specifications to avoid such damage.

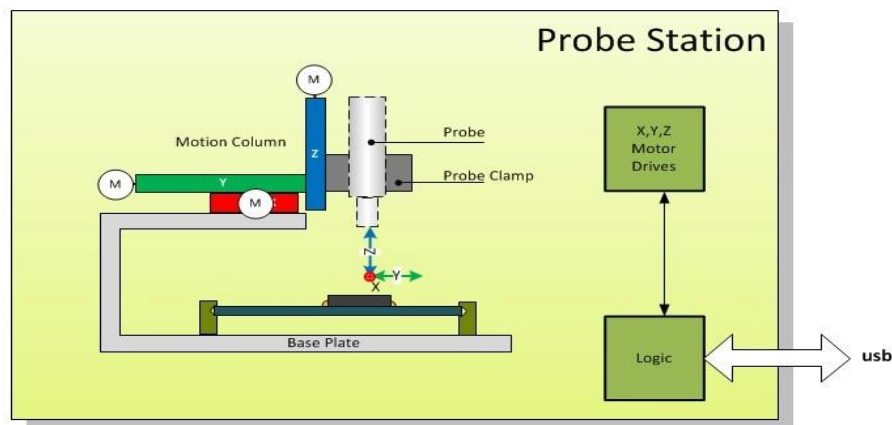
What It Does

The Precision XYZ Stage is a high precision probing workbench used in security evaluations.

It is capable of moving an EM-FI Transient Probe, Unidirectional Fault Injection Probe, or Compact Laser Microscope over the encapsulation of semiconductors chips and smart cards.

The Precision XYZ Stage is used with the EM-FI Transient Probe, Unidirectional Fault Injection Probe, or Compact Laser Station to detect and perturb cryptography related hotspots in a target.

Figure 1 Functional overview of the XYZ stage



The Precision XYZ Stage is an assembly of an XYZ-positioned column above a baseplate. The column has a socket to clamp cylindrical probes. The socket is replaceable to support other shaped probes.

The baseplate provides a grid of locations to fit mounting accessories. This enables robust positioning of diverse shapes of printed circuit boards, as well as Keysight product casings.

The Precision XYZ Stage is normally controlled by the Inspector application.

Homing

The Precision XYZ Stage is mounted with stop switches at the motor ends of its axis arms. They serve to provide mechanical position references to the Precision XYZ Stage system. With the reference position inputs, the Precision XYZ Stage controller can re-establish the absolute origin of the internal three-dimensional coordinate

system. The process of re-establishing the origin of the coordinate system by locating the stop switches is referred to as homing.

The homing feature is particularly useful when the user desires to reach one or several previously defined coordinates after a power cycle of the system. Power cycling the Precision XYZ Stage resets its internal coordinate position to (0, 0, 0), i.e. the coordinates of the origin, regardless of its actual position, rendering any coordinates recorded prior to the power cycling meaningless since the origin of the coordinate system has changed. Initiating the homing process after power cycling Precision XYZ Stage restores the origin of the coordinate system in a consistent fashion by making use of the mechanical position references.

In the “XYZ Device” tab of Acquisition2 or Perturbation2 modules of Inspector (version ≥ 2020.2), Precision XYZ Stage devices are automatically detected by Inspector, and upon detection the homing feature is enabled to the user.

NOTE

Homing the Precision XYZ Stage must be initiated manually by the user. As the process could provoke full-range movements of axis arms, we would like to ask the user to verify the clearances along the axis arm motion directions prior to the homing operation.

CAUTION

D O NOT start the homing process if any axis arm is located near the end of its drive shaft. Move the axis arm towards the motor end for five seconds if found in the mentioned state, then start the homing process.

How to Build a Setup

Fixing a target on the baseplate

The Precision XYZ Stage is supplied with three types of adjuster brackets to fix a target on the baseplate.

Figure 2 Adjuster brackets of type square (1), round (2), and support (3)

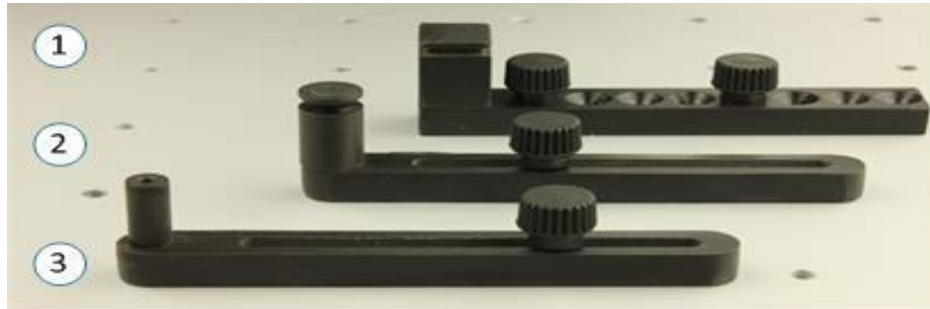


Figure 3 Close-up view on the usage of the different adjuster brackets



To create a good fixture, do the following:

1. Use two (or three) square adjuster brackets to create a fixed reference corner and fix each with two thumb screws.
2. Place the object against the reference corner.
3. Add remaining round adjuster brackets at opposite locations against the object and fix each of them with thumb screws as required.

Figure 4 Example of fixing a printed circuit board

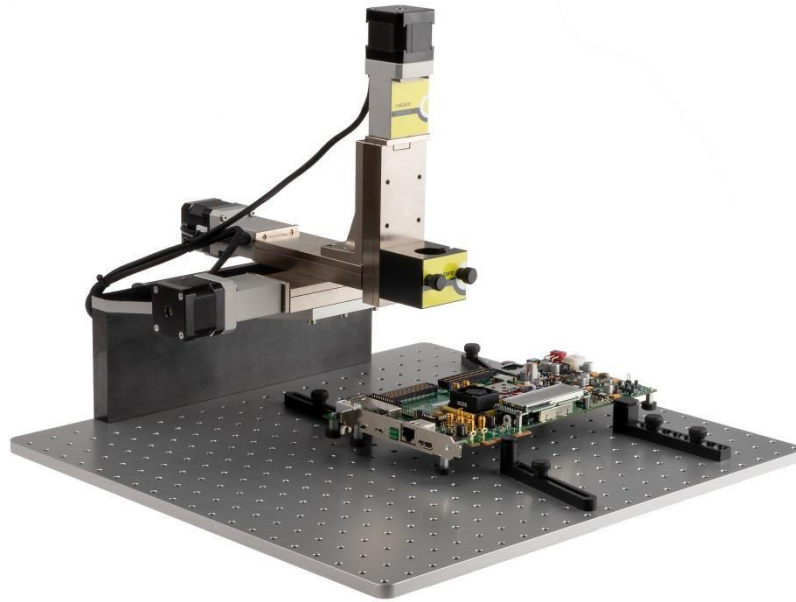
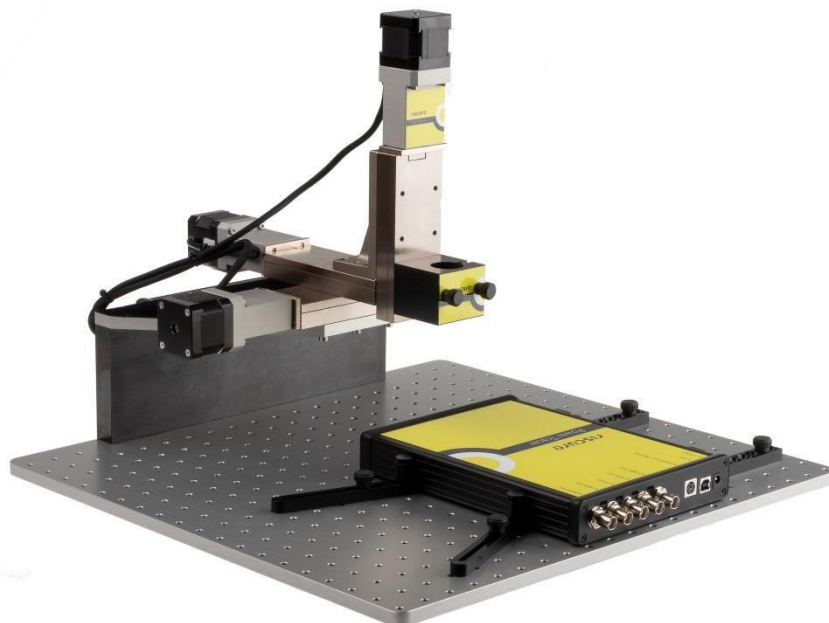


Figure 5 Example of fixing a Power Tracer



Attaching EM-FI Transient Probe or Unidirectional Fault Injection Probe

The Precision XYZ Stage has a clamp for attaching a cylindrical type of probe with an outer diameter of 25 mm. The EM-FI Transient Probe fits this probe clamp by default.

The Unidirectional Fault Injection Probe is too big for the probe clamp. It uses a clamp adapter fitted to its back panel which fits into the probe clamp.

Figure 6

The EM-FI Transient Probe in the probe clamp (a), the Unidirectional Fault Injection Probe (b), with the clamp adapter fitted (c)

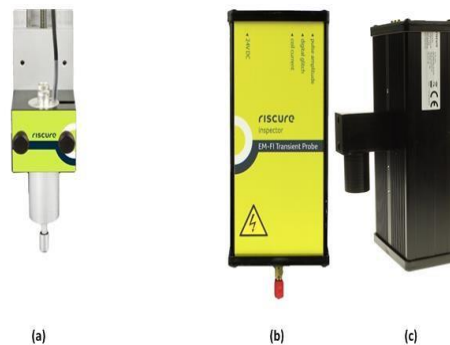
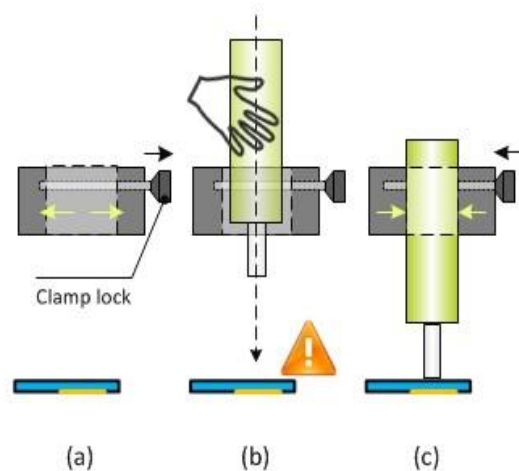


Figure 7

Close-up on fitting the probe into the probe clamp



To safely insert the probe, do the following (Figure 7):

1. Unscrew the clamp lock (a) to open the probe clamp.
2. Insert the probe (or clamp adapter) into the clamp (b) and gently lower it until the probe tip makes contact with the target surface.

3. Screw the clamp lock (c) to tighten the probe in the clamp.

Attaching Compact Laser Microscope

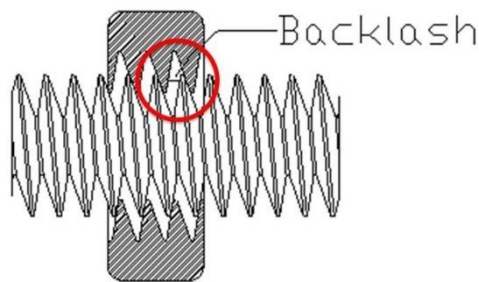
The Precision XYZ Stage has an interface block to mount Compact Laser Microscope. This interface block is part of the Compact Laser Microscope package and described in the User Manual of Compact Laser Microscope.

Stage backlash

Motor driven Precision XYZ Stage exhibit backlash. Backlash is caused by the space between driving screw and stage carriage, see [Figure 8](#).

Figure 8

Backlash between driving screw and stage carriage

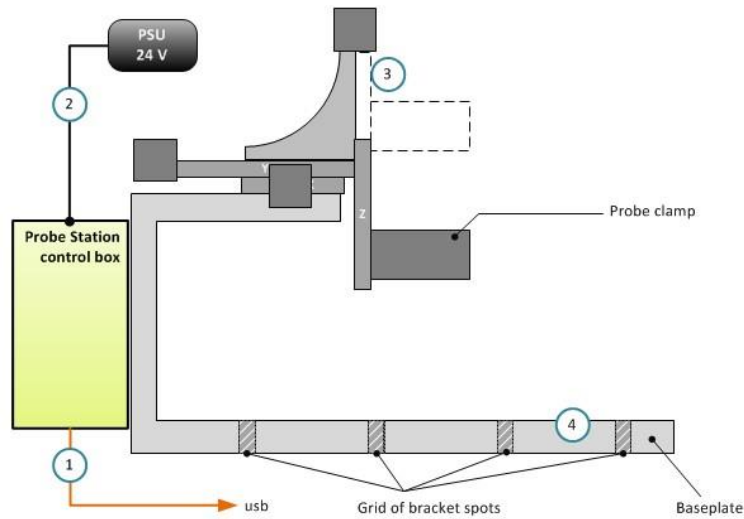


The effect of backlash can be avoided by moving stages always from a preferred direction towards target position. Inspector uses this technique for backlash compensation. Preferred directions are South, East, and Down. The inspector driver ends each movement by a movement in one of the preferred directions. If necessary, the stage moves at first too far in a non-preferred direction and returns to the target position in the preferred direction. EM Probe Station generations 1 - 4 show significantly more backlash compared to EM Probe Station 5. User needs to select EM Probe Station generation in configuration to set matching backlash compensation, see section "Device registration (Inspector)".

How to Connect a Setup

Preparation: Install the Inspector application on the computer.

Figure 9 Numbered steps to build a setup



4. Connect the Precision XYZ stage with the USB cable to the computer.
5. Connect the PSU to the Precision XYZ stage.
6. With Inspector, move the probe clamp into top position, to create free working space on the baseplate.

For information on moving the clamp, see “Is the Precision XYZ Stage responding to commands?”

7. Fix the target object on the baseplate using the adjuster brackets.

Device driver installation (Windows)

The Precision XYZ Stage requires the manual installation of an additional driver supplied with Inspector 4.8 or later.

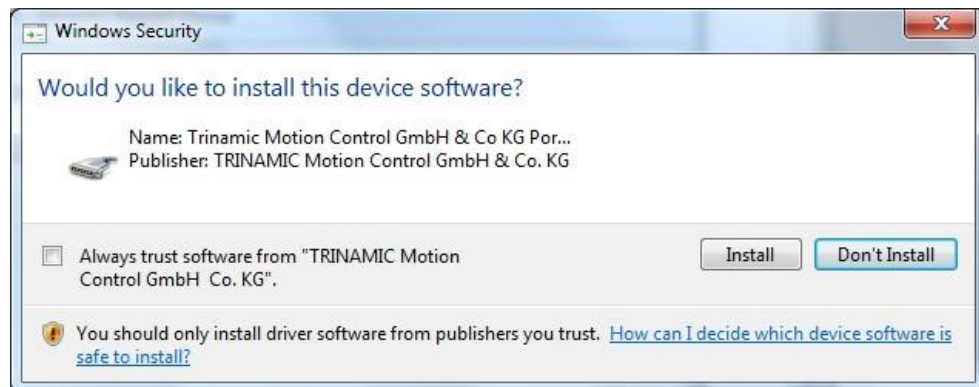
1. Open Window Device Manager.
2. Look for 'Trinamic Stepper Device'.



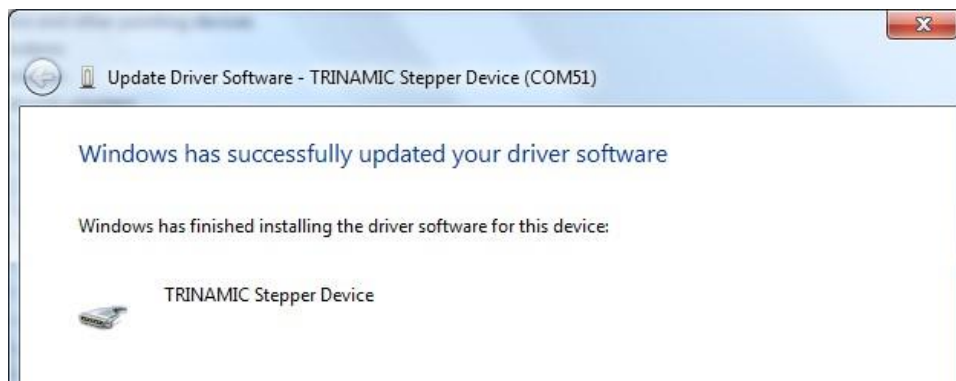
3. Open the Update Driver Software dialog for the item, and point the file browser to the following installation folder:

%ProgramFiles%\Inspector x.y\hardware\EMPS-Trinamic

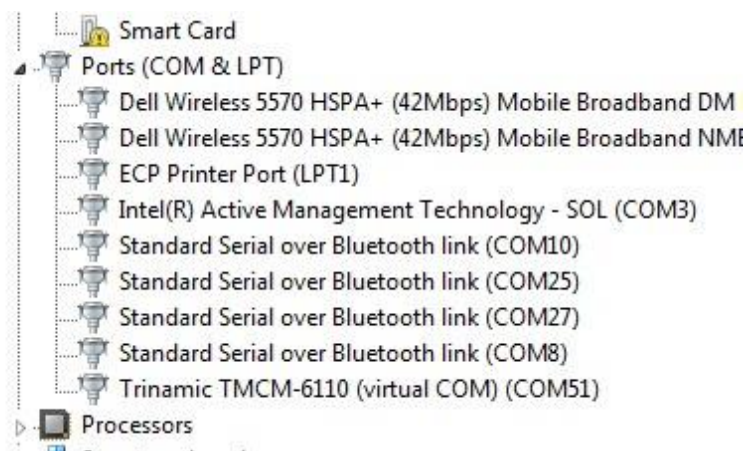
4. Press 'Install' on the following window.



Press Close to complete the driver software installation.



5. Windows will assign a COM port number to the XYZ stage.



CAUTION

This COM port number (Here: 51) is needed for device registration with the Inspector hardware manager.

NOTE

If the Precision XYZ Stage is reconnected to a different USB port on the computer, it will be assigned a different COM port by Windows.

To prevent manual updating of the Inspector hardware manager registration, always connect the Precision XYZ Stage to the same port.

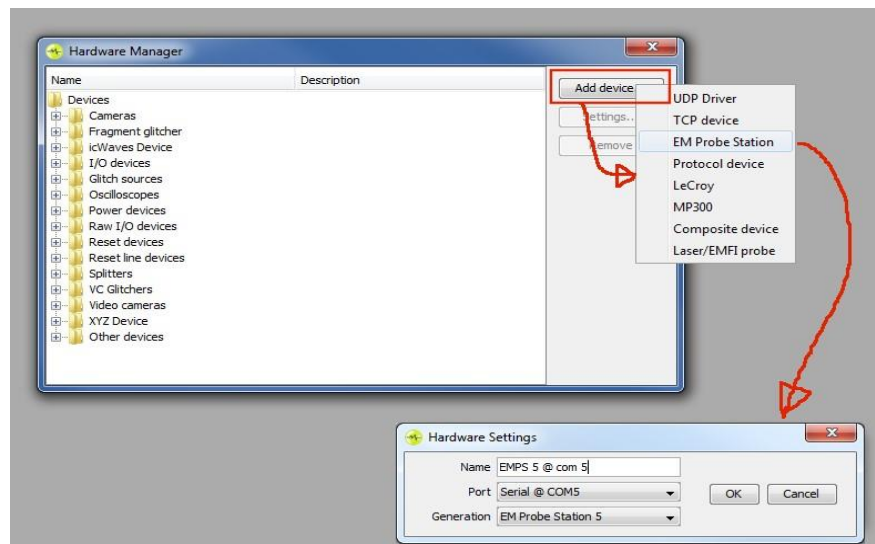
Device registration (Inspector)

The Probe Station requires a user defined identification in Inspector.

1. Open Inspector.
2. Go to menu item Tools >> Hardware Manager.
3. Press button Add device and select Precision XYZ Stage.
4. Enter a Name, for example EMPS 3 (USB).

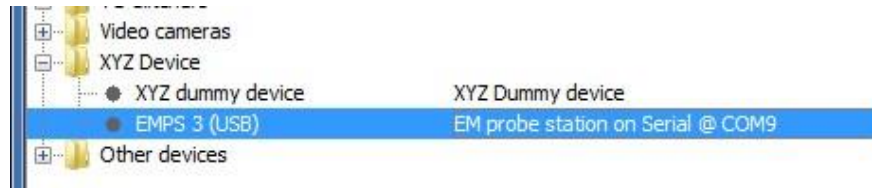
NOTE: A better naming structure uses the COM port x as assigned by Windows, for example "EMPS @ COM9". From the Port-list, select the serial device with the correct COM-port assigned by the Windows Device Manager.

5. Select Precision XYZ Stage generation to set matching backlash correction.



6. Press Ok to accept the values and close the dialog.

An entry will be added to group XYZ Device with the name just assigned.



Setup Maintenance

Maintenance

Backlash is described in section 'Stage backlash'. To minimize backlash of your setup, it is advised to perform maintenance for each 1000 hours of operation or for each quarter year, whichever comes first. The maintenance consists of backlash adjustment and lubrication. You may mark your maintenance on the maintenance stickers, which are part of the package. We suggest putting the sticker at the back of the Precision XYZ Stage.

Backlash adjustment

Backlash can be mechanically adjusted by tightening a backlash adjustment hex screw at each stage carriage next to the driving screw entrance, see [Figure 10](#).

The hex key for this screw is part of the Precision XYZ Stage package. Tightening this screw too much will lock the stage carriage. This is noticeable by:

- Stepper motor produces more noise when powered.
- Driving screw and stage carriage cannot move.

Figure 10 Backlash adjustment screw at stage carriage



When a stage carriage is locked, the backlash adjustment hex screw must be loosened by turning the screw counterclockwise over approximately 20°, just sufficient to unlock the stage carriage.

Lubrication

Lubrication lowers friction between driving screw and stage carriage. Please take following steps for each of the three axes:

- Unscrew and remove dust cover from driving screw.
- Lubricate driving screw with just a few drops of lubricant. The lubricant is part of the XYZ stage package.
- Place dust cover back and fix with screw.

How to Verify Your Setup

Perform the following checks in order:

1. Is the Precision XYZ Stage powered?
2. Is the Precision XYZ Stage recognized by the computer?
3. Is the Precision XYZ Stage responding to commands?

Please ensure that a check is successful, before proceeding to the next one. If not successful, refer to page 23 for solutions.

Is the Precision XYZ Stage powered?

There are no visible signs to verify if the Precision XYZ Stage is powered. When powered, a faint but audible high pitch sound (about 2 kHz @ 40 dB) can be heard from the control box, produced by the motor drive electronics.

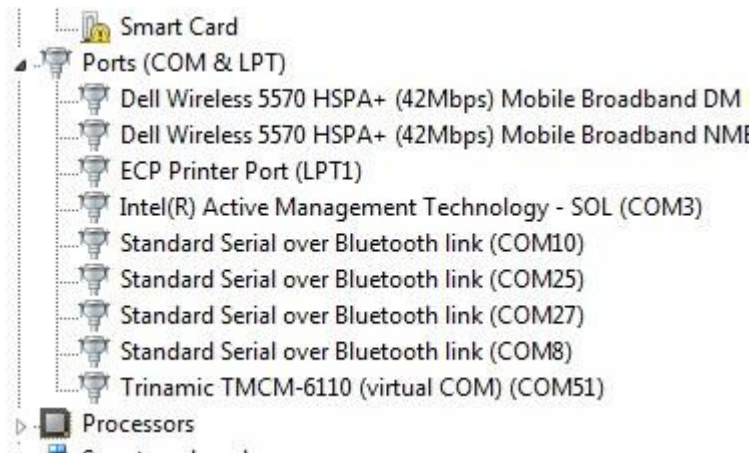
Is the Precision XYZ Stage stage recognized?

4. Open the Windows device manager.
5. If device 'TMCM-6110 (virtual COM)' is listed under Other devices, then the XYZ stage is not properly installed.



For a solution, see page 14 "Device driver installation (Windows)".

6. If device 'Trinamic TMCM-6110 (virtual COM)' is listed under Ports (COM & LPT) devices, then the Precision XYZ Stage is successfully recognized.



Is the Precision XYZ Stage responding to commands?

1. Open Inspector.

From the menu bar, go to: Perturbation >> Single XYZ >> Smartcard >> Protocol. (Inspector FI) or

— Acquisition >> XY Protocol. (Inspector SCA)

2. In the dialog, select tab:

— XYZ Device. (Inspector FI) or

— Measurement. (Inspector SCA)

3. In Device Selection, from Device list, select EMPS 3 (USB).

NOTE

The label 'EMPS 3 (USB)' is a custom, user defined label. If your Precision XYZ Stage is not in the device list, you must register it first with the Inspector Hardware Manager. See page 15.

1. (Optional, Inspector FI only) Set the Velocity slider to the right (maximum) value.

Press and hold the on-screen buttons N (North), E (East), S (South), W (West), U (Up), or D (Down). See [Figure 11](#). This activates the different motors. If the probe clamp can be moved in all directions, the Precision XYZ Stage successfully responds to commands.

Calibration

After each power-on, the position sensors of the Precision XYZ Stage must be calibrated.

Calibrating means defining the parameters of a plane which best describes the, possibly slanted, surface of the target. It is performed as follows: Move and lower the probe tip onto a Northwest corner using the Precision XYZ Stage control buttons.

1. Press button Record for Ref 1 (Inspector FI) or Set for Corner A (Inspector SCA).
2. Repeat steps 1 and 2 for the other corner(s), i.e. Ref 2 and Ref 3 (Inspector FI), or opposite corner B (Inspector SCA).

All position coordinates of the probe tip are now defined and displayed relative to this plane.

NOTE

The reference points, when projected on the XY plane, define an area ranging from Northwest (Xmin,Ymin) to Southeast (Xmax,Ymax).

When executing a scan with Inspector, the probe will move along tracks from West to East (X-axis) and is stepped into South direction (Y-axis).

The probe height (Z) is automatically adapted to the calibration plane.

Help and Troubleshooting

Common problems

Problem	Cause	Solution
Precision XYZ Stage is not working.	The Precision XYZ Stage is not powered	Cable not connected, or PSU is not powered.
The column is not moving.	The Precision XYZ Stage is not powered.	Verify connection of the power cord and the PSU cable.
	The velocity slider is set to the minimum value.	Set the slider to a higher value.
Precision XYZ Stage is not recognized by Inspector.	The Precision XYZ Stage USB drivers have not been registered successfully.	Manually add the Precision XYZ Stage USB drivers. Refer to Device driver installation (Windows).
Precision XYZ Stage is moving erratically.	By a power down of the computer with Inspector, the null position has been lost.	Use Inspector to recalibrate the current state of Precision XYZ Stage. (Refer to section Calibration).

Version differences

Version	Description
EM Probe Station 2	Platform + column with RS232 control.
EM Probe Station 3	Platform + column with USB control.
EM Probe Station 4	Platform + column with USB control + enhanced baseplate.
EM Probe Station 5	High precision EM Probe Stations, rigid platform and column with USB control and enhanced baseplate.
Precision XYZ Stage 5S	Inherit all characteristics of XYZ stage 5, plus stop switches for each axis.

Storage and travel

Securing the Precision XYZ stage for travel.

CAUTION

If the Precision XYZ Stage is going to be moved or packed up for travel, please move the column to the inward/blocked state on all axes to reduce the risk of damage when handled roughly.

Note that if the Precision XYZ Stage has been homed, power cycling the device is required before it allows the user to move the axis arms immediately next to the motor ends of the axes.

Still have questions?

1. Go to the Inspector Help menu and read detailed information on the Precision XYZ Stage.
2. Visit the Keysight Support Portal: <http://support.keysight.com>

Technical Specifications

Operational conditions

- Room temperature 20 .. 30 °C, (68 .. 86 °F), preferred.

CAUTION

Do not block the ventilation holes of the Probe Station. A blocked airflow may cause malfunction or breakdown.

NOTE

Maintain a stable and identical environment to reliably repeat tests.

NOTE

Turning OFF the Precision XYZ Stage is not required but recommended when not used for an extended time.

Power supply input

- 24 V DC, nominal load 1.1 A.
- Center-positive plug, inner-Ø 2.5 mm, outer-Ø 5.5 mm.

CAUTION

Use of a PSU other than supplied by Keysight is not supported. Power spikes may cause internal damage and loss of accuracy.

Platform control

- Motion range X/Y/Z: 50 mm.
- Full range traversal time: 22 s @ maximum velocity (min. step time).
- Homing reproducibility error: < 2µm.
- XYZ minimal step size: 0.3 µm.
- XYZ reproducibility error: < 2.0 µm with backlash compensation active.

Target fixture

- Fixation method: adjuster brackets, 3 types, thumb screws.
- Bracket spots: square grid, distance 23 mm, threaded holes M5.
- Baseplate: anodized aluminum 10 mm.

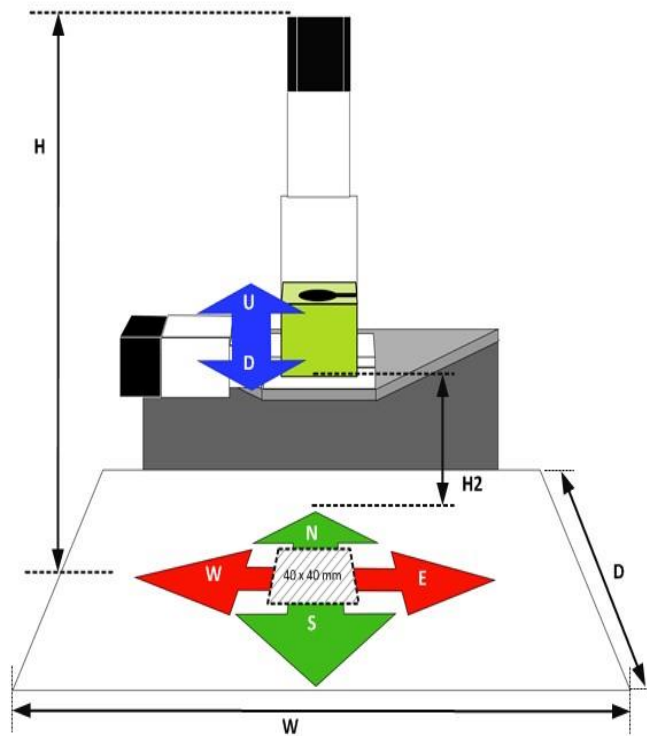
Probe fixture

- EM Probe and EM-FI Transient Probe clamp: cylindrical shape, diameter \varnothing 25 mm.
- Compact Laser Microscope: Black metal block as part of Compact Laser Microscope package.

Product case

- Dimensions (incl. column) (W x D x H): 476 x 445 x 320 [mm].
- Clamp height above plate (H2) range: 85 ... 125 mm.

Figure 11 Main dimensions and control directions of the Precision XYZ stage





Port	Label	Description
A1	USB	USB-B type port, USB 2.0 Communication link with a computer.
A2	24VDC	24 V DC Power supply input.
B1		Motor drive power lines for X, Y, and Z motor.



This information is subject to change
without notice

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Edition 1, January 2025

DS1010-90002

9924-01954.EN

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