XYZ stage 5S

Quick Start Guide

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The information contained in this document is subject to change without notice.

The Probe Station must be used according to the Probe Station user guide. Any operation related to maintenance, repair or calibration must be carried out by qualified personnel. Consequently, in case of failure, contact Riscure to find out about the procedure to follow.

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Manufactured by

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What is in the box

The box contains the XYZ stage and all accessories to connect it to a computer and to fix targets.

Box content checklist

Quantity [1]	Description	Photo	Identifier [2]
1	XYZ stage		EMPS5S
1	Set of fixing accessories: 4 x Adjuster Bracket Square 4 x Adjuster Bracket Round 1 x Adjuster Bracket Support 15 x Thumb Screw M5 x12		FXACCS
1	Power supply: 1 x unit, 24 V DC, input 100 V - 240 V, AC 50 - 60 Hz 1 x power cable	Country specific	PSU
1	Communication cable:: USB-A – USB-B male	USB-B USB-A	USB
1	Lubricant for driving screw		

Quantity [1]	Description	Photo	Identifier [2]
5	Maintenance schedule stickers for screw lubrication		
1	Hex key 1.5mm for spindle adjustment		
1	Hex key 2.0mm for removing dust cover		
	This "XYZ stage 5S- Quick Start Guide"		

[1] Quantity of items registered in the package

[2] Identifier used in references in this document.

What does it do

The XYZ stage is a high precision probing workbench used in security evaluations. It is capable of moving an EM Probe, EM-FI Transient Probe or Compact Laser Microscope over the encapsulation of semiconductors chips and smart cards.

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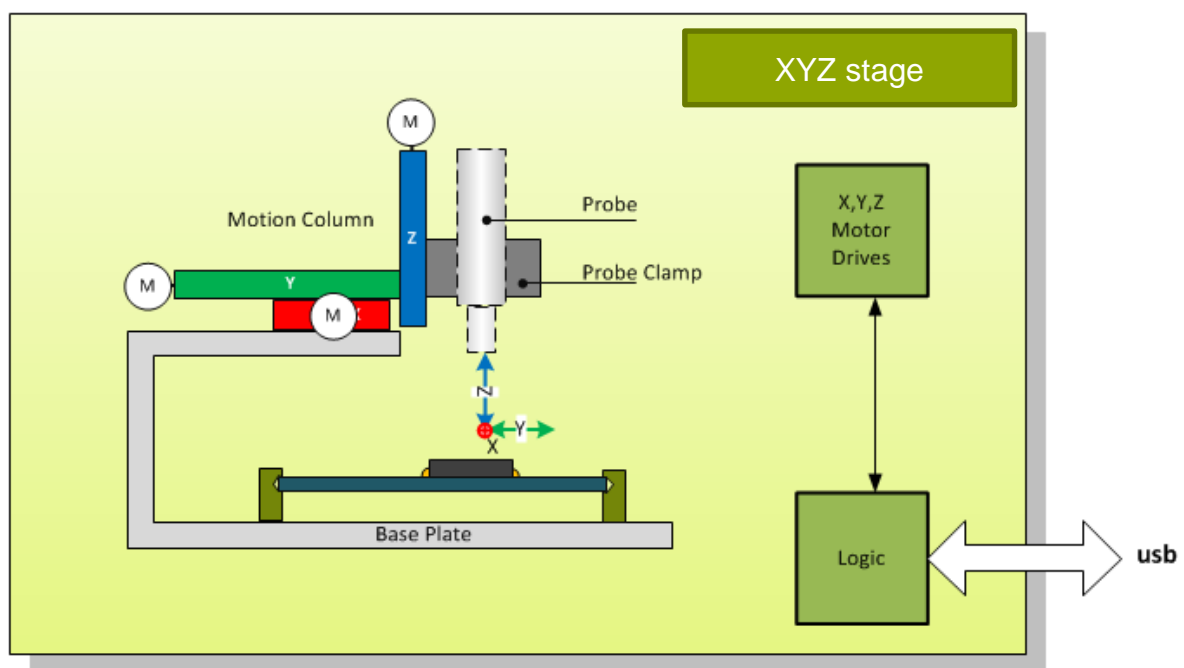

Figure 1 Functional overview of the XYZ stage .

The 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 a robust positioning of diverse shapes of printed circuit boards as well as Riscure product casings.

The XYZ stage is normally controlled by the Inspector application.

Homing

The XYZ stage 5S is mounted with stop switches at the motor ends of its axis arms. They serve to provide mechanical position references to the XYZ stage system. With the reference position inputs, the XYZ stage system controller can re-establish the absolute origin of the internal 3-dimensional coordinate system. The process of re-establishing the origin of the coordinate system by locating the stop switches is referred 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 XYZ stage resets its internal coordinate position to (0, 0, 0), i.e. the coordinates of the origin, regardless 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 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), XYZ stage 5S devices are automatically detected by Inspector, and upon detection the homing feature is enabled to the user.

Homing the 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.

DO 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 5 seconds if found in the mentioned state, then start the homing process.

How to build a setup

Fixing a target on the baseplate

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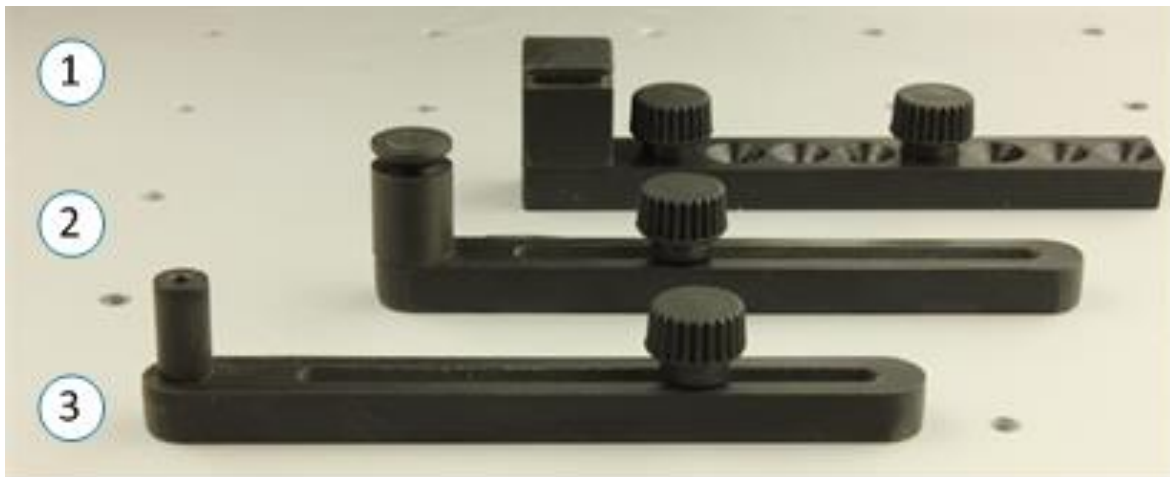

Figure 2 Adjuster brackets of type square (1), round (2) and support (3).

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.
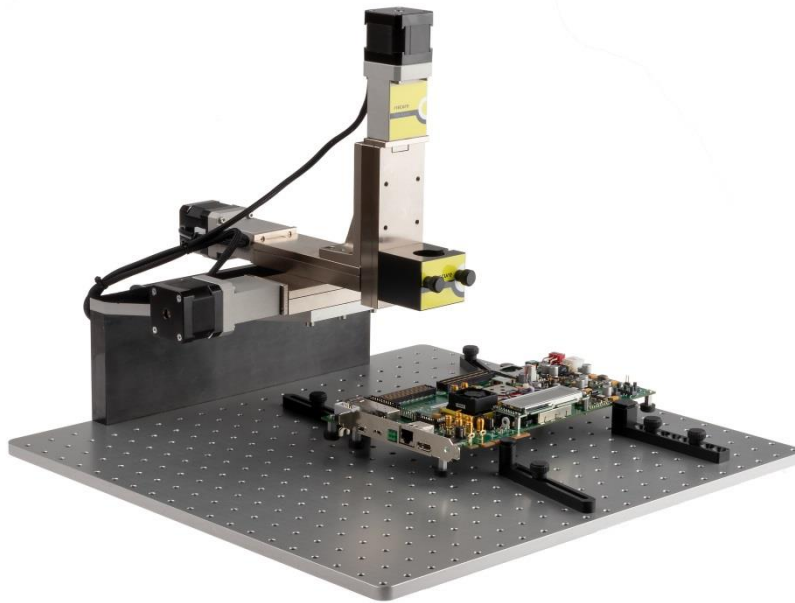
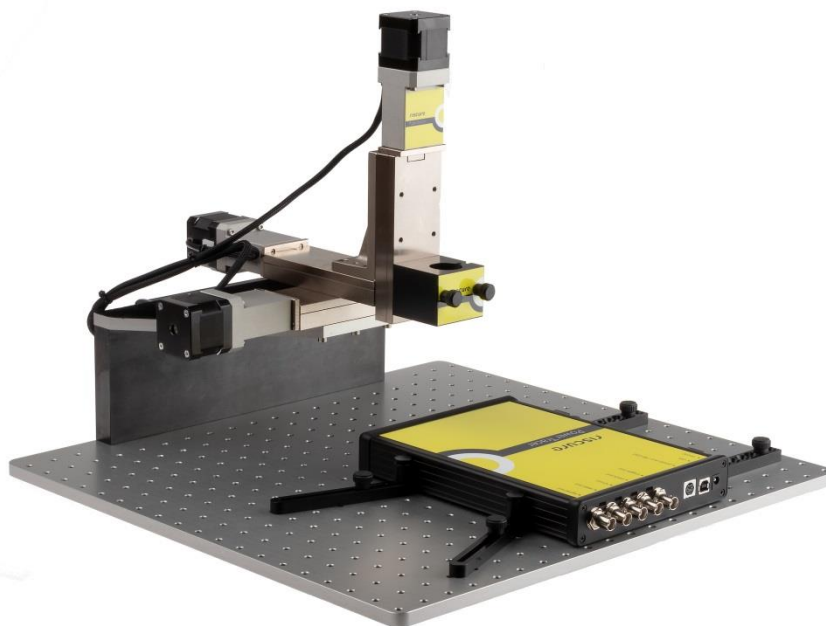*Figure 4 Example of fixing a printed circuit board.*

Figure 5 Example of fixing a Power Tracer.

Attaching EM Probe or EM-FI Transient Probe

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

The EM-FI Transient Probe is too big for the probe clamp. It uses a clamp adapter fitted to its back panel which fits into the probe clamp.
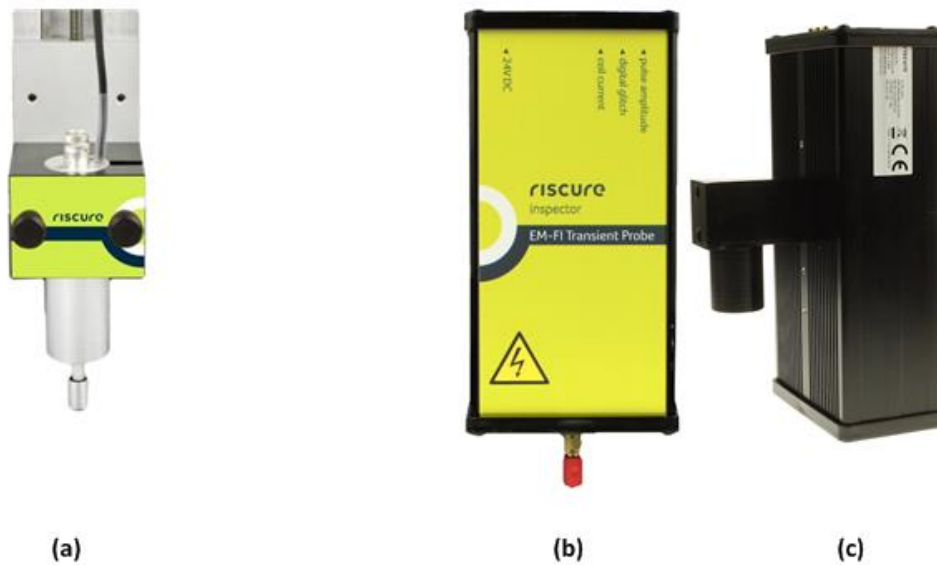

(a)　　　　　　　　(b)　　　　　(c)

Figure 6 The EM Probe in the probe clamp (a), and the EM-FI Transient Probe (b) with the clamp adapter fitted (c).

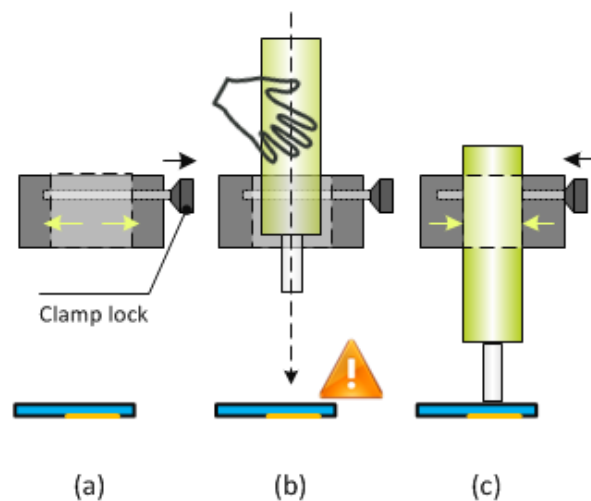

Clamp lock

(a)　　　　　(b)　　　　　(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 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 Quick Start Guide of Compact Laser Microscope.

Stage backlash

Motor driven XYZ stage exhibit backlash. Backlash is caused by the space between driving screw and stage carriage, see Figure 8.
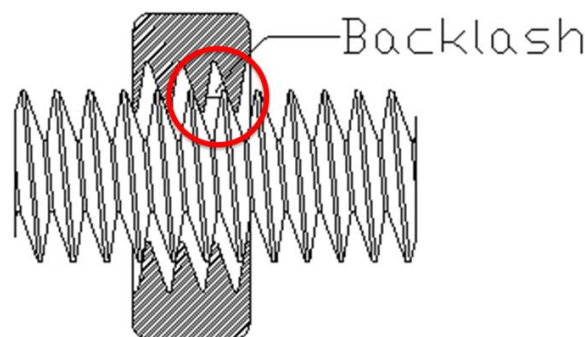

Figure 8 Backlash between driving screw and stage carriage.

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 generation 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.
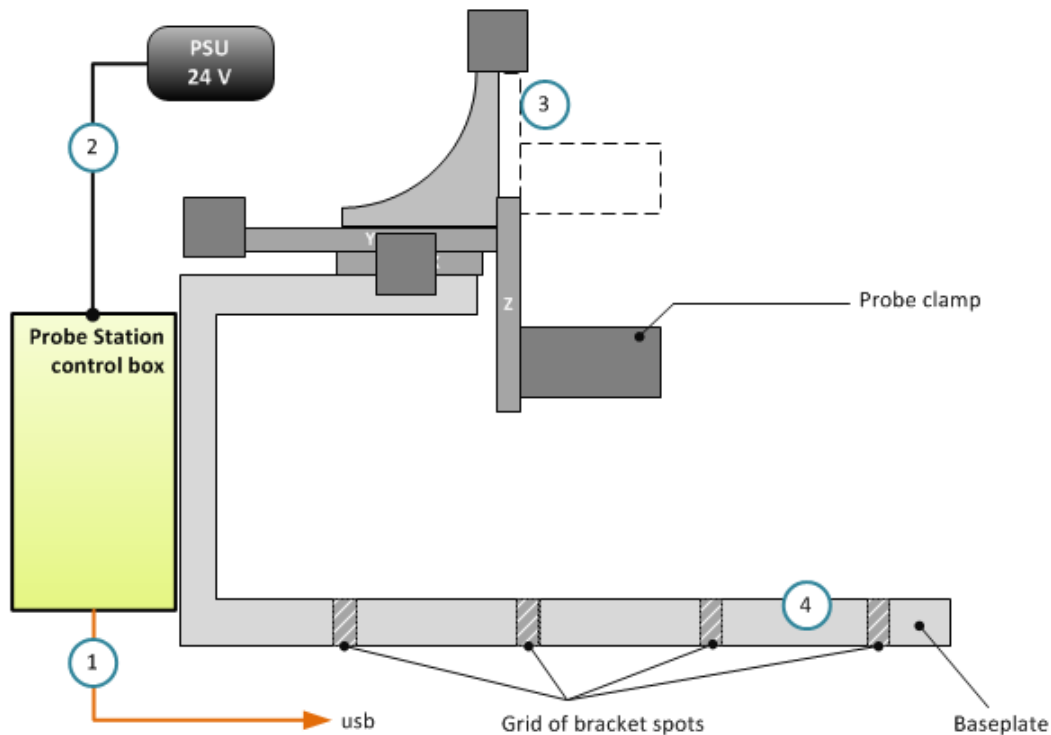

Figure 9 Numbered steps to build a setup.

1. Connect the XYZ stage with the USB cable to the computer.
2. Connect the PSU to the XYZ stage
3. With Inspector, move the probe clamp into top position, to create free working space on the baseplate.

For information on moving the clamp, see page 20, "Is the XYZ stage responding to commands?"

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

Device driver installation (Windows)

The XYZ stage requires the manual installation of an additional driver supplied with Inspector 4.8 or later.
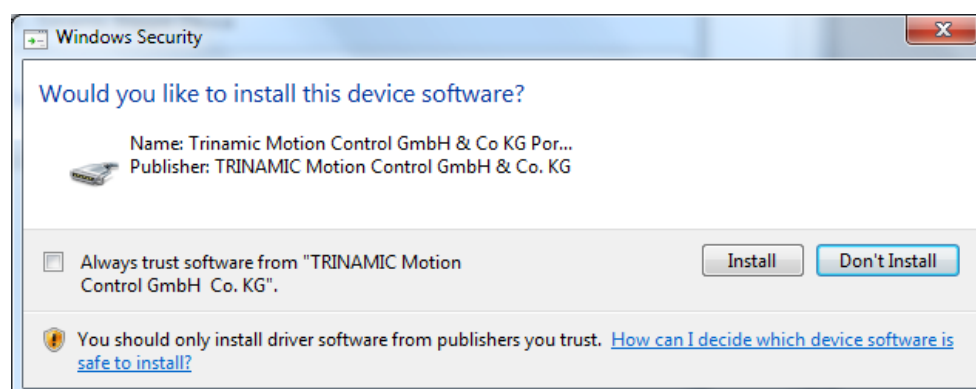
1. Open Window Device Manager

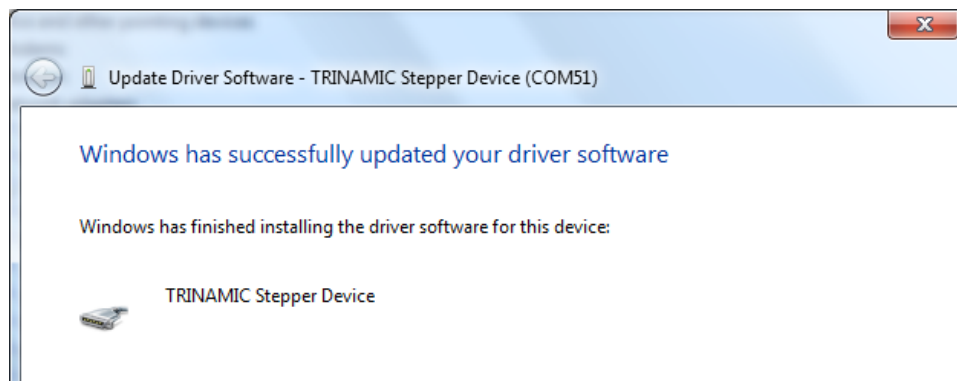1. Look for device 'Trinamic Stepper Device'.

2. 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
```
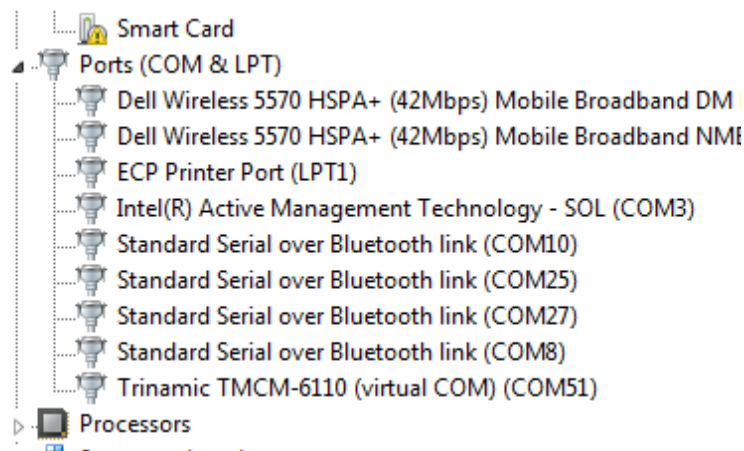
3. Press 'Install' on the following window.

4. Press **Close** to complete the driver software installation.

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

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

ℹ️ If the 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 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 **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**"

5. From the Port-list, select the serial device with the correct COM-port assigned by the Windows Device Manager.

6. Select XYZ stage generation to set matching backlash correction.
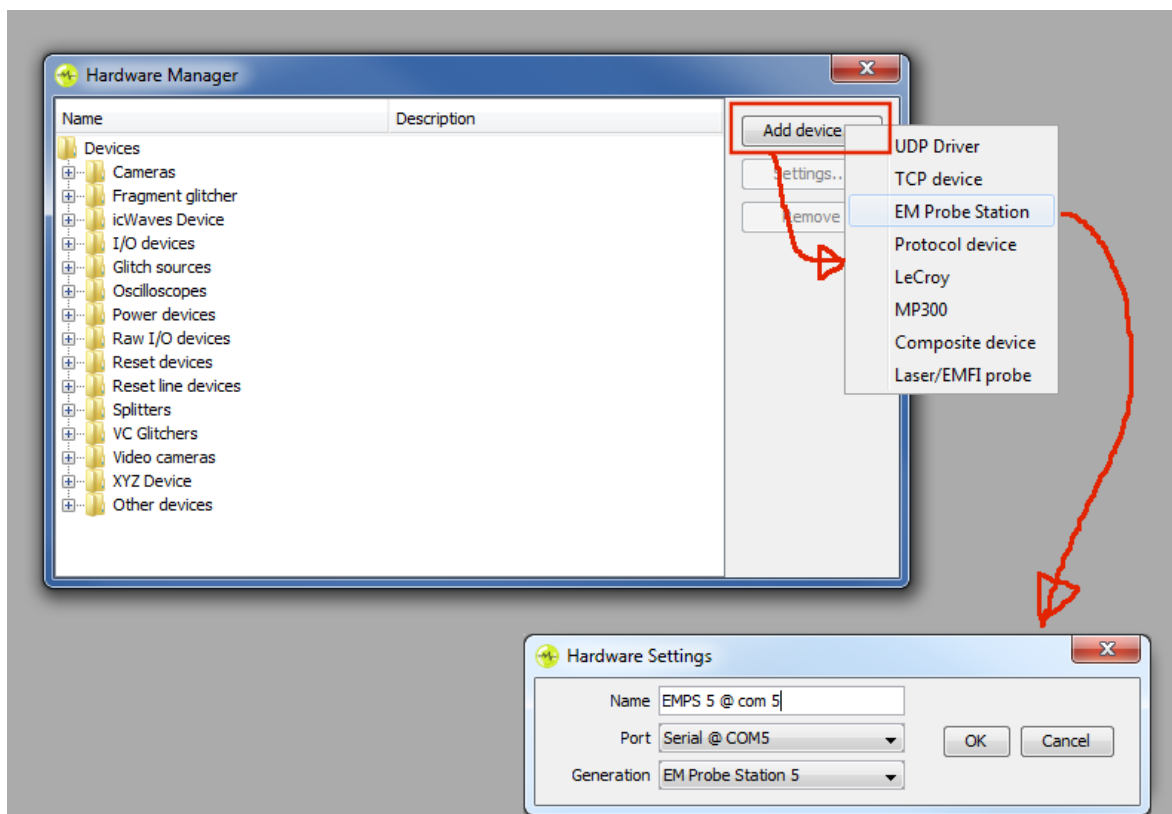
7. Press **Ok** to accept the values and close the dialog.

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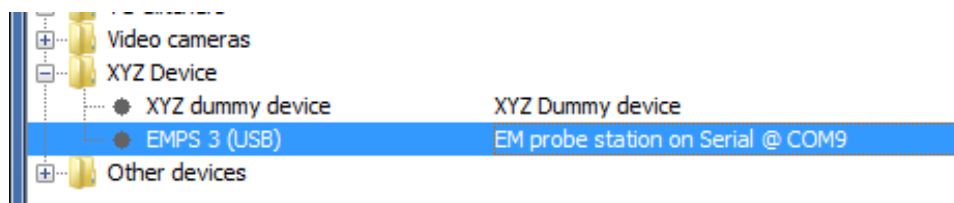
Setup maintenance

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 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 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 counter clockwise 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 threes 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 XYZ stage powered?
2. Is the XYZ stage recognized by the computer?
3. Is the 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 XYZ stage powered?

There are no visible signs to verify if the 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.

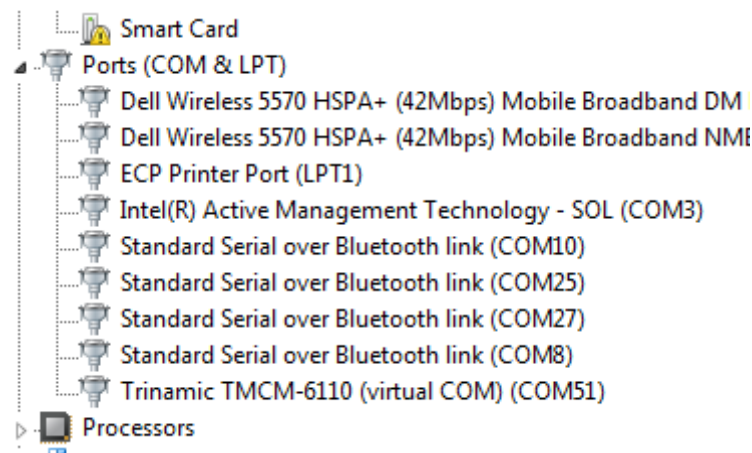## Is the XYZ stage recognized?

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 XYZ stage is successfully recognized.

Is the XYZ stage responding to commands?

1. Open Inspector.

2. From the menu bar, go to:

   - **Perturbation** >> **Single XYZ** >> **Smartcard** >> **Protocol**. (Inspector FI) *or*

   - **Acquisition** >> **XY Protocol**. (Inspector SCA)

3. In the dialog, select tab:

   - **XYZ Device**. (Inspector FI) *or*

   - **Measurement**. (Inspector SCA)

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

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

5. (*optional*, Inspector FI only) Set the Velocity slider to the right (maximum) value.

6. 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 XYZ stage successfully responds to commands.
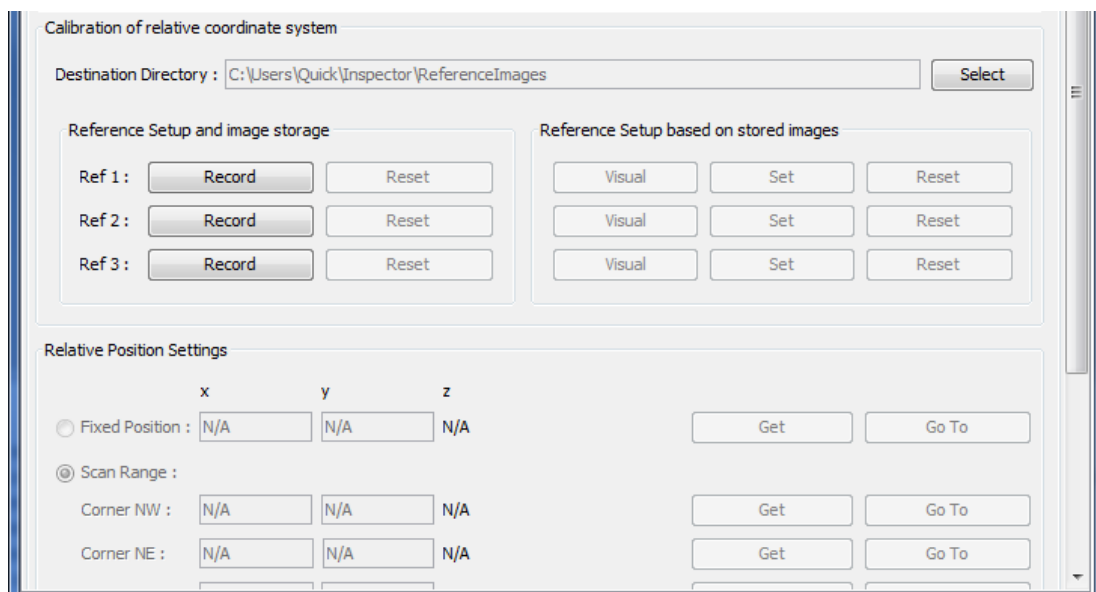
Calibration

After each power-on, the position sensors of the 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:

1. Move and lower the probe tip onto a North-West corner using the XYZ control buttons.
2. Press button **Record** for Ref 1 (Inspector FI) or **Set** for Corner A (Inspector SCA).
3. Repeat step 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.

The reference points, when projected on the XY plane, define an area ranging from North West (X_{min},Y_{min}) to South East (X_{max},Y_{max}).

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

XYZ stage is not working.	**CAUSE:** The XYZ stage is not powered.
	SOLUTION: Cable not connected, or PSU is not powered.
The column is not moving	**CAUSE1:** The XYZ stage is not powered.
	SOLUTION1: Verify connection of the power cord and the PSU cable.
	CAUSE2: The velocity slider is set to the minimum value.
	SOLUTION2: Set the slider to a higher value.
XYZ stage is not recognized by Inspector.	**CAUSE:** The XYZ stage USB drivers have not been registered successfully.
	SOLUTION: Manually add the XYZ stage USB drivers. Refer to Device driver installation (Windows)
XYZ stage is moving erratically.	**CAUSE:** By a power down of the computer with Inspector, the null-position has been lost.
	SOLUTION: Use Inspector to recalibrate for the current state of XYZ stage. (Refer to section Calibration).

Version differences

Version	
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
XYZ stage 5S	Inherit all characteristics of XYZ stage 5, plus stop switches for each axis.

Storage and travel

Securing the XYZ stage for travel.

If the 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 XYZ stage has been homed, power cycling the device is required before it allowing 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 XYZ stage.
2. Visit the Riscure Support Portal: http://support.riscure.com.

Technical specifications

Operational conditions

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

> ⚠️ Do not block the ventilation holes of the Probe Station. A blocked air flow may cause malfunction or break down.

> ℹ️ Maintain a stable and identical environment in order to reliably repeat tests.

> ℹ️ Turning OFF the 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.

> ⚠️ Use of a PSU other than supplied by Riscure 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: < 2um.
- 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 ø 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].
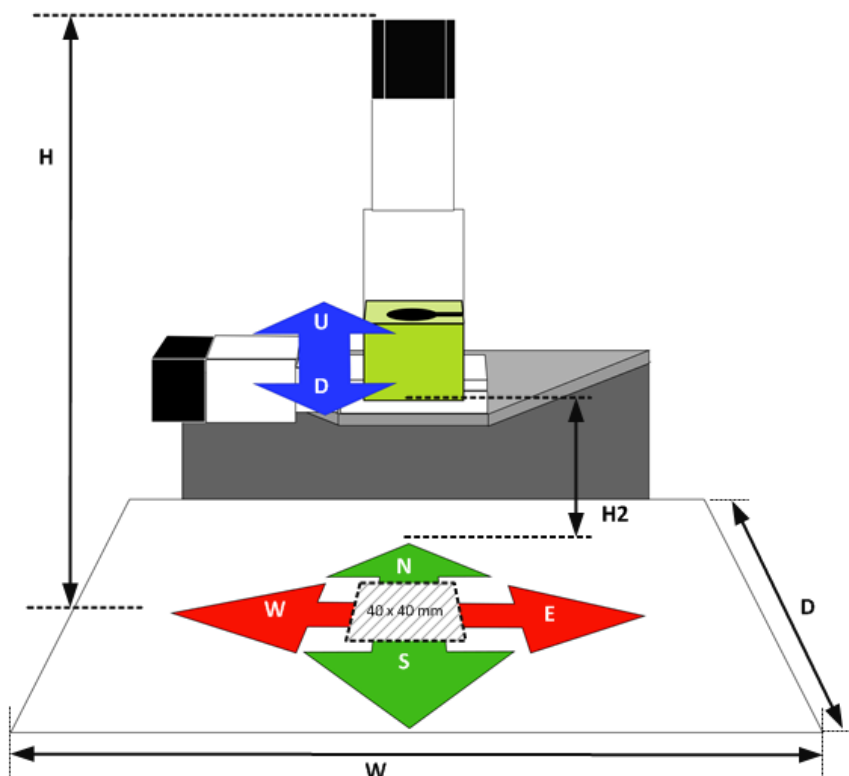- Clamp height above plate (H2) range: 85 ... 125 mm.

Figure 11 Main dimensions and control directions of the 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.

Declaration of conformity

EC-DECLARATION OF CONFORMITY

Suppliers Details

Name

Riscure B.V.

Address

Frontier Building, Delftechpark 49, 2628 XJ Delft, The Netherlands

Product Details

Product Name

Inspector

Model Name(s)

EM Probe Station

Trade Name

Riscure

Applicable Standards Details

Directives:
- LVD (2006/95/EC) - EMC directive (2004/108/EC)

Standards:
- IEC 60825-1; IEC 320 C8; IEC 60950-1; 21 CFR 1040; ANSI/ESD S20.20:2007; BS EN 61340-5-1:2007; EN55022-B; EN61000-4-2, 4-5; CISPR 11; CISPR22-B; UL 1950

Supplementary Information

The appliance fulfils the relevant requirements of the EMC-directive and the LVD-directive according to our technical documentation TCD-EM Probe Station

Declaration

I hereby declare under our sole responsibility that the product(s) mentioned above to which this declaration relates complies with the above mentioned standards and Directives

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Name	Issued Date
Dr.ir. F.G. de Beer / Technical Director	26 / 03 / 2015

Signature of representative

Notes: