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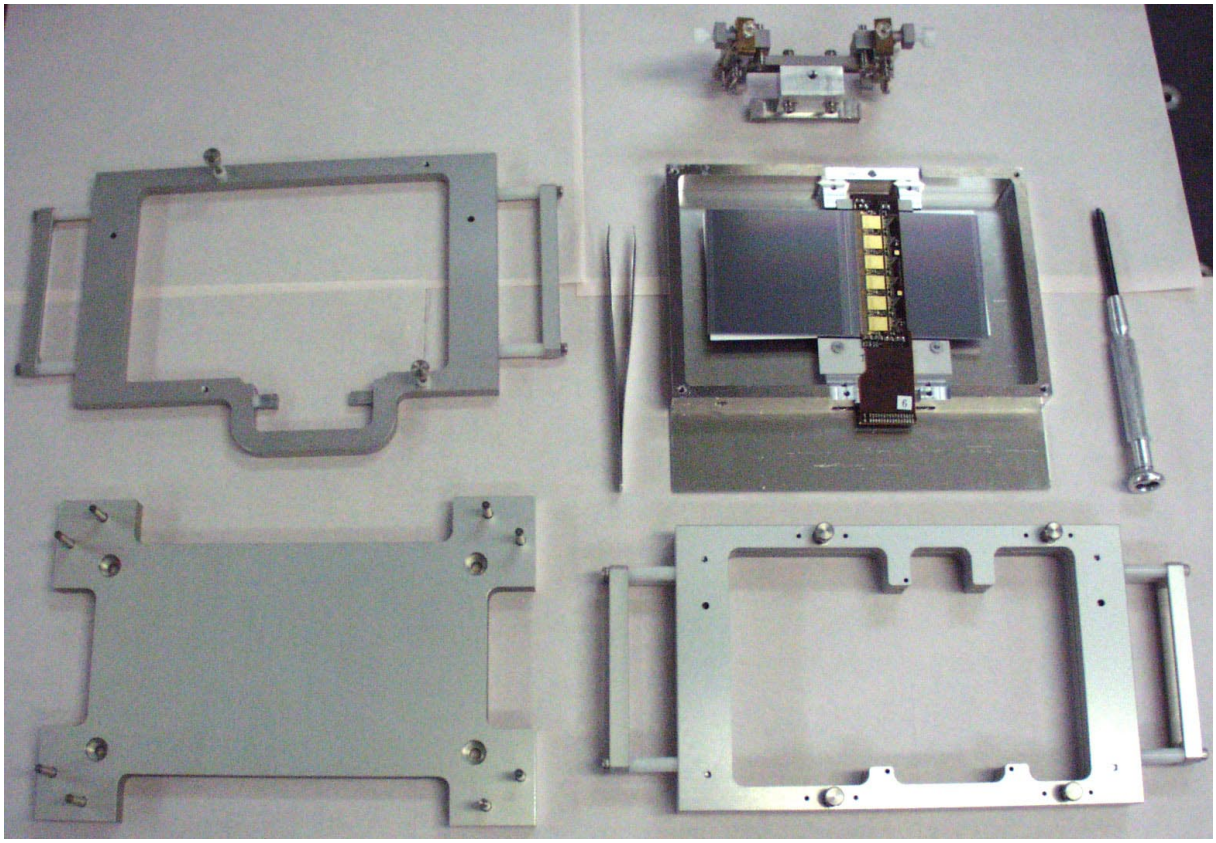
Metrology procedure for the barrel SCT modules at KEK

1. Introduction

The ATLAS SCT barrel module is required to be assembled in high precision of a few micron meters particularly in x-y plane. Knowledge about z positions, such as deviation from the flatness, to individual module is also required to be as accurate as about 10 micron meters. It is, therefore, inevitable to perform detailed three dimensional metrology to all the assembled modules not only to verify the modules to meet assembly criteria but also to collect detailed knowledge of the module shape.
In this document, focusing on how to use jigs and how to handle the modules, we would briefly illustrate the procedure for the barrel module metrology at KEK.

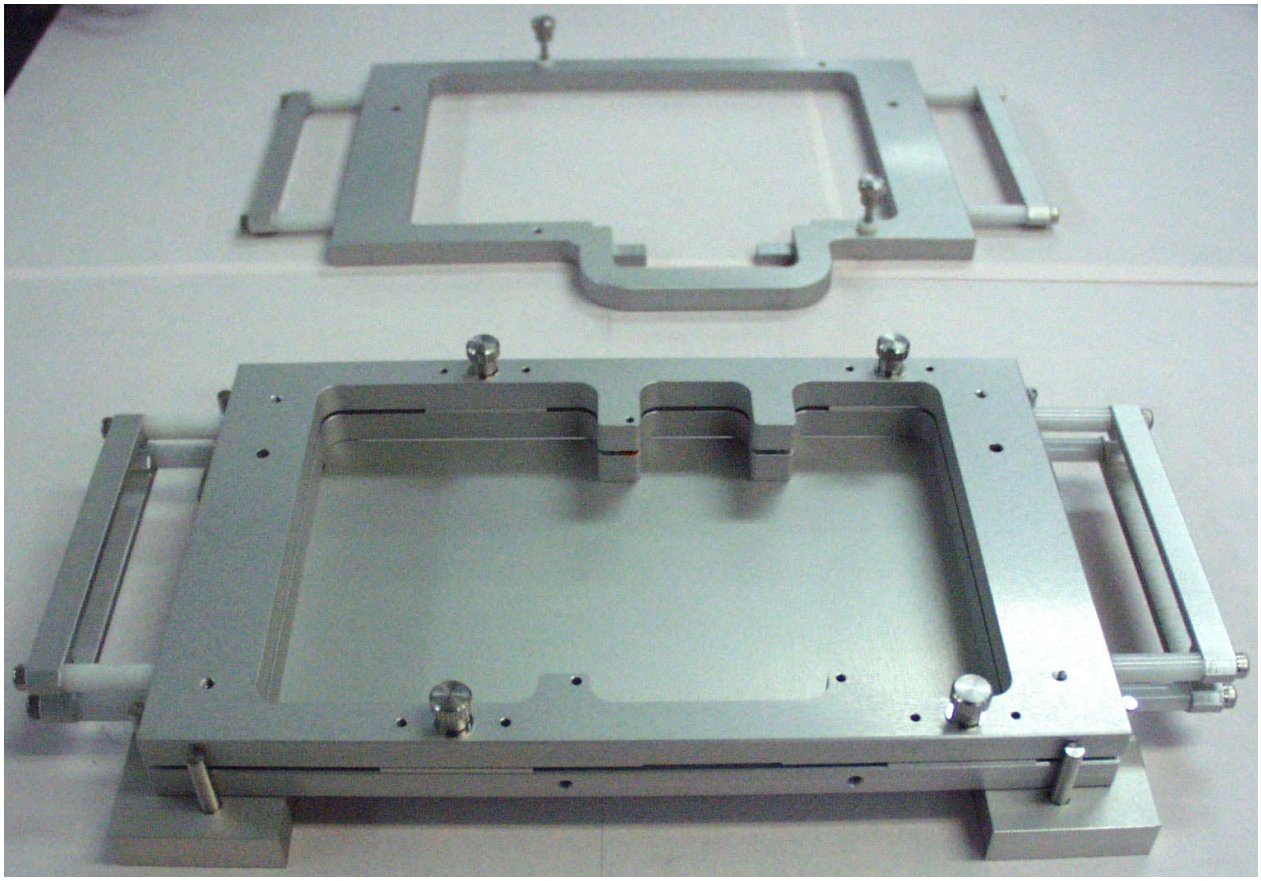
2. Jigs and tools

A set of metrology jigs and relevant objects are pictured below.



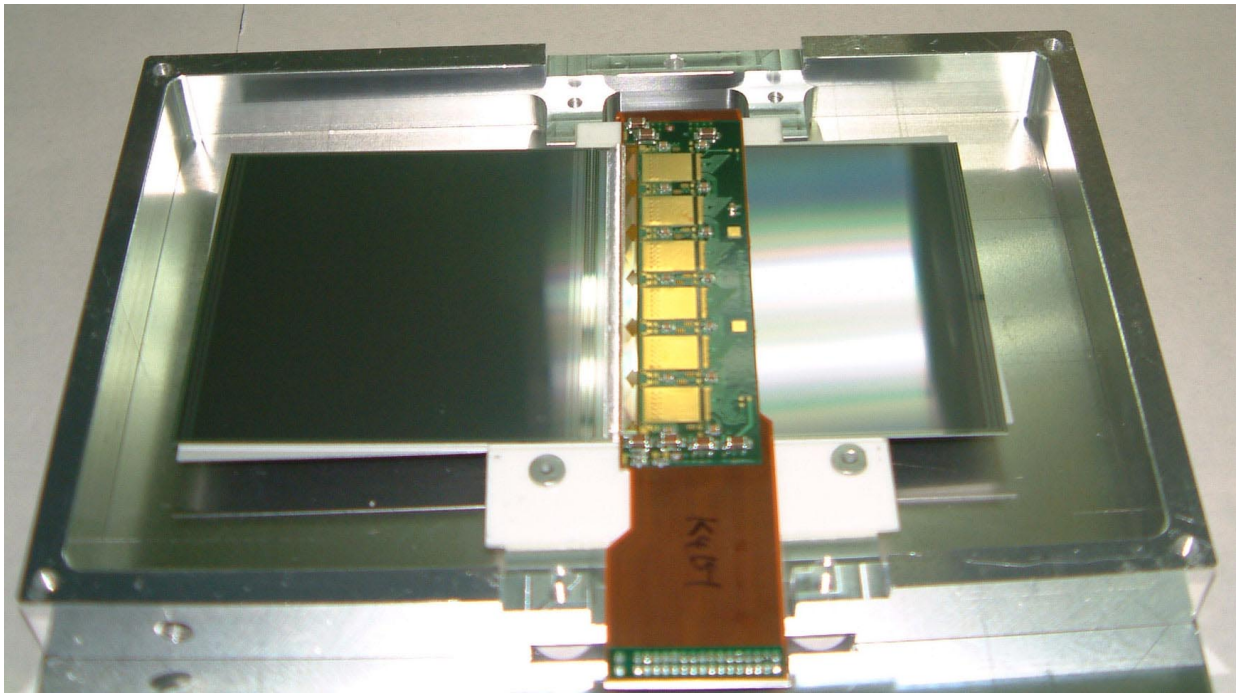
A crab like tool shown at back right is a module picker with which the module inside the module box (right middle) can be handled securely to transfer to the metrology frames (right front). Shown at left middle is a guide frame which is to be attached on the metrology frame when the module held with the picker is positioned on the frame. The one at left front is a temporary base plate to be used as a work bench for guiding and positioning the metrology frames.

Principal parts of the metrology jigs consist of two almost identical frames, top and bottom ones. As shown below they are screwed on top of each other, in between the module to be sandwiched.

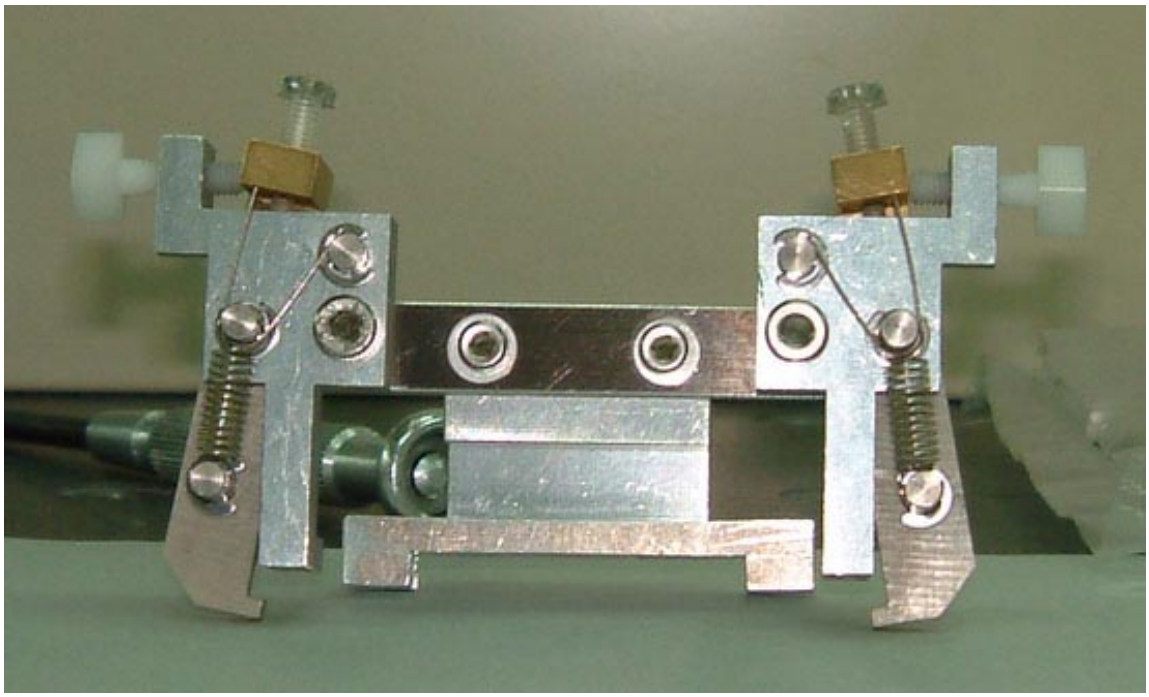


Shown at front is the mated frames laid on the temporary base plate. The frame at back is a guide for positioning the barrel module clutched with the picker safely on the jig.

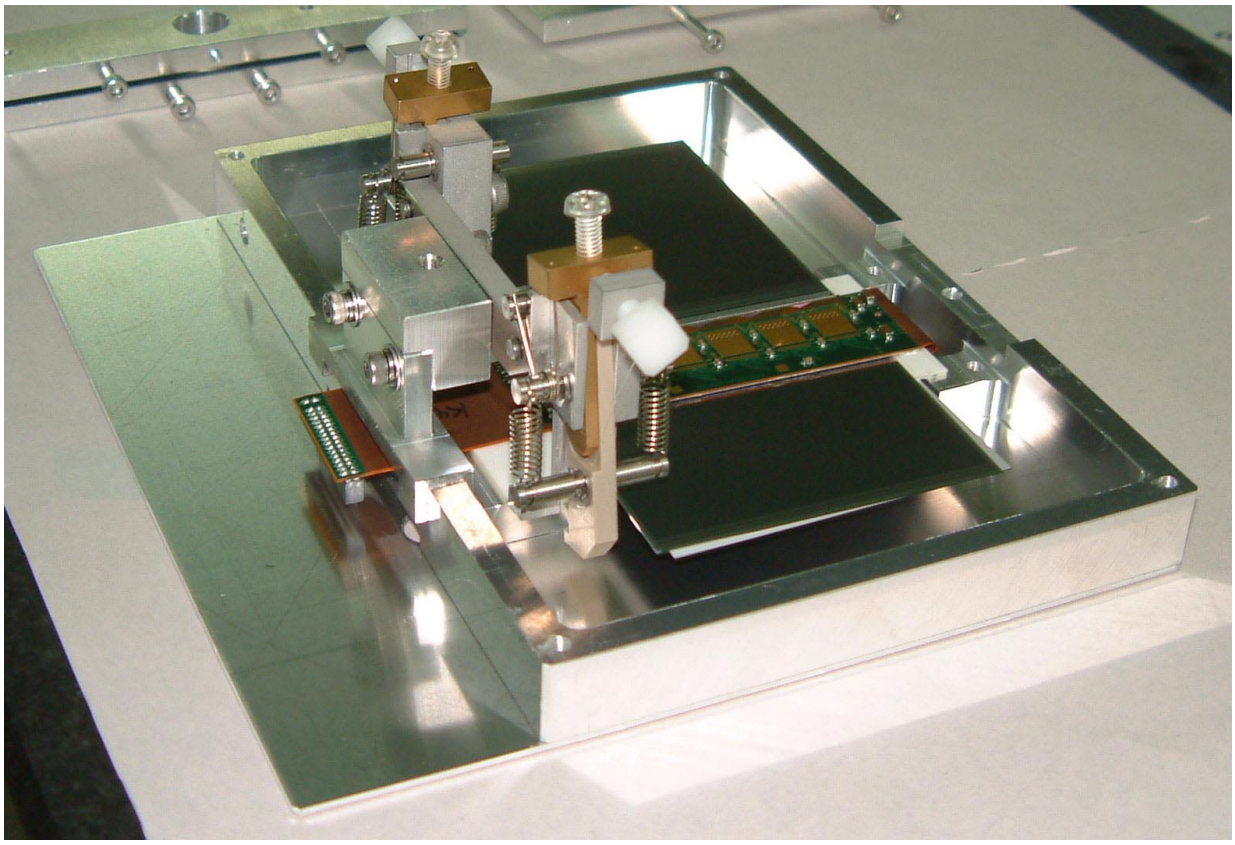
3. Module bringing out from the box



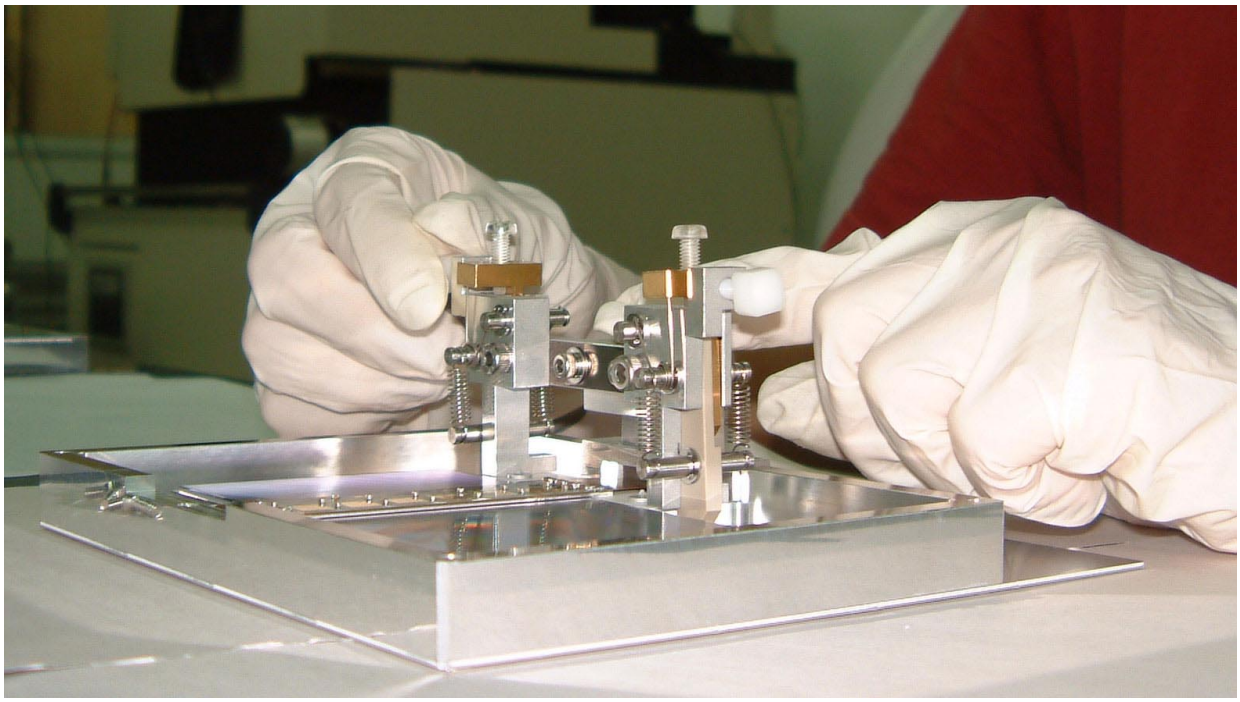
The module is placed inside the box. The top cover and plastic fixtures have been removed.



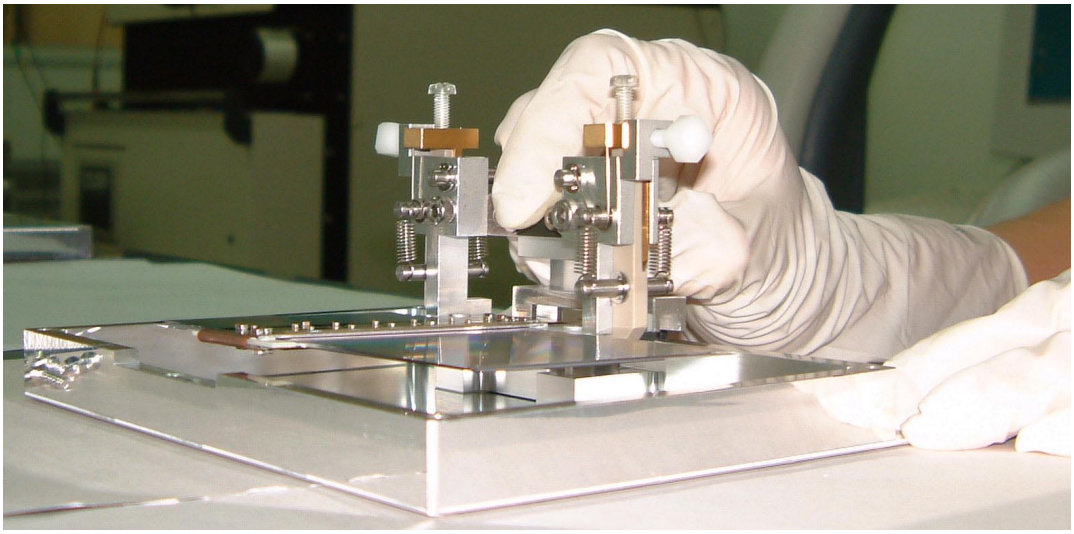
The module picker with a positioning handle which could fit on the step structure of the module box around the opening for the hybrid pig tail. The step structure can be shown in the previous picture.



The picker is positioned on the steps of the box frame to pick up the module.

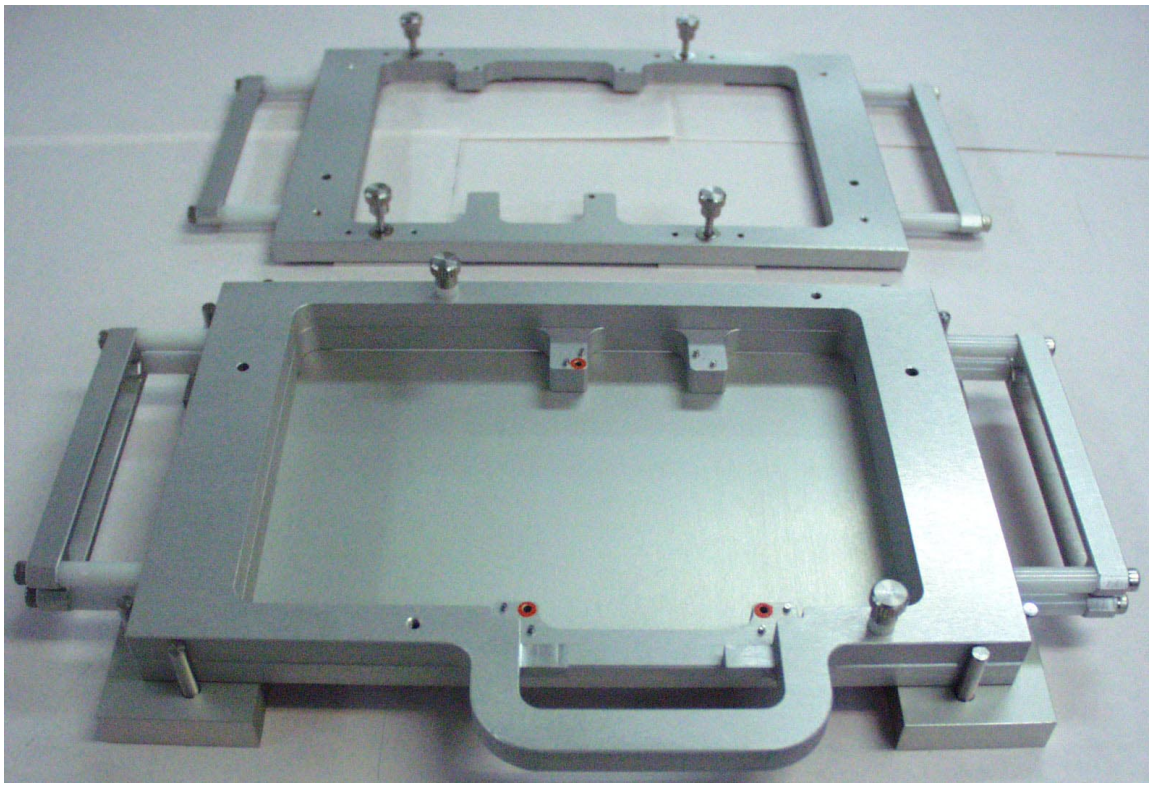


Closing picker's arms by turning screws to clutch the module



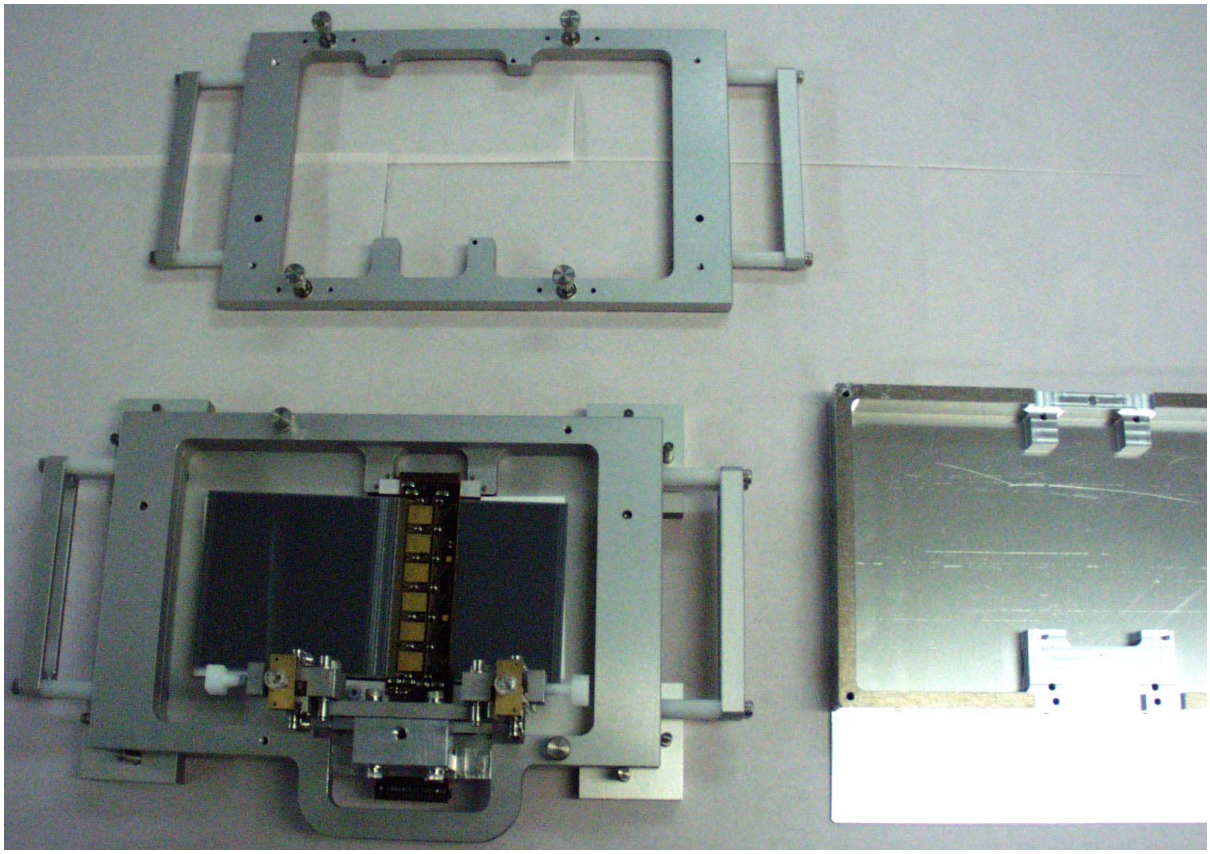
Lifting up the module from the box by holding the positioning handle of the picker

4. Module setting on the metrology jig

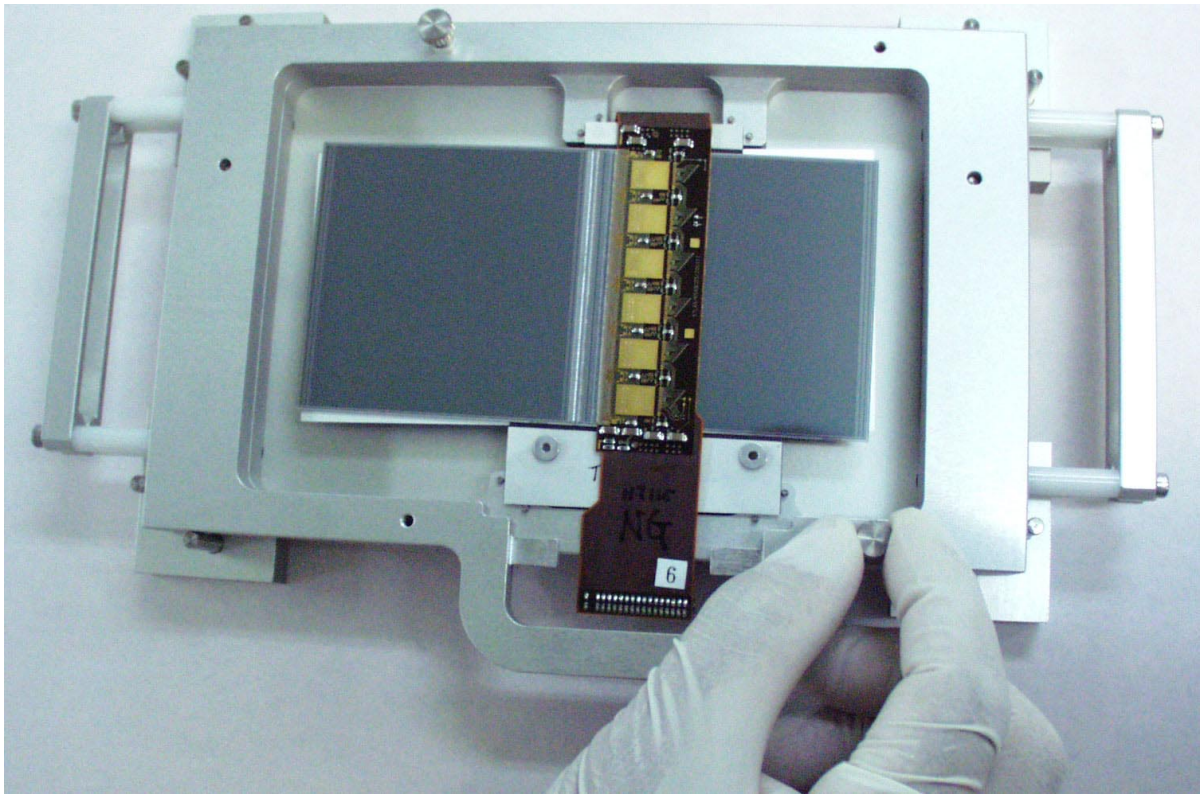


The top frame (shown in back) is detached from the bottom frame, and instead the guide frame is attached for the preparation of positioning the module on the bottom frame. The guide frame provides the same step structure as the box frame, so that the module picked by the picker is unambiguously positioned on the jig by fitting the picker's support handle on top of the step structure of the guide frame.

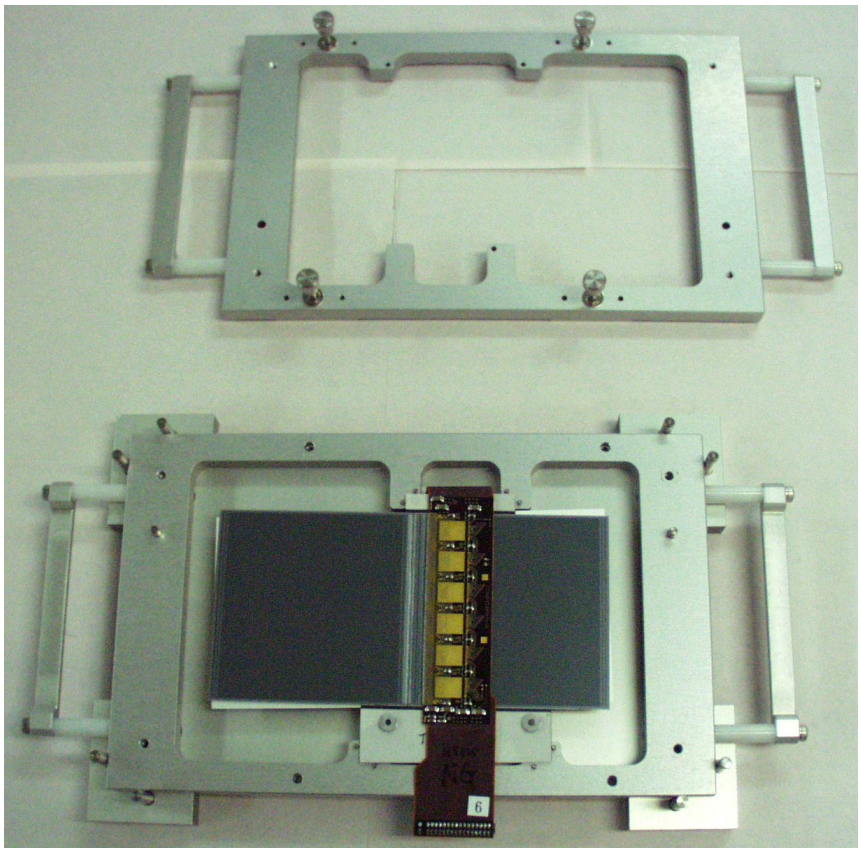
Three tiny red circles are the gaskets to hold the module by means of vacuum chucking, thus the module could be held at these three points with minimal stress.



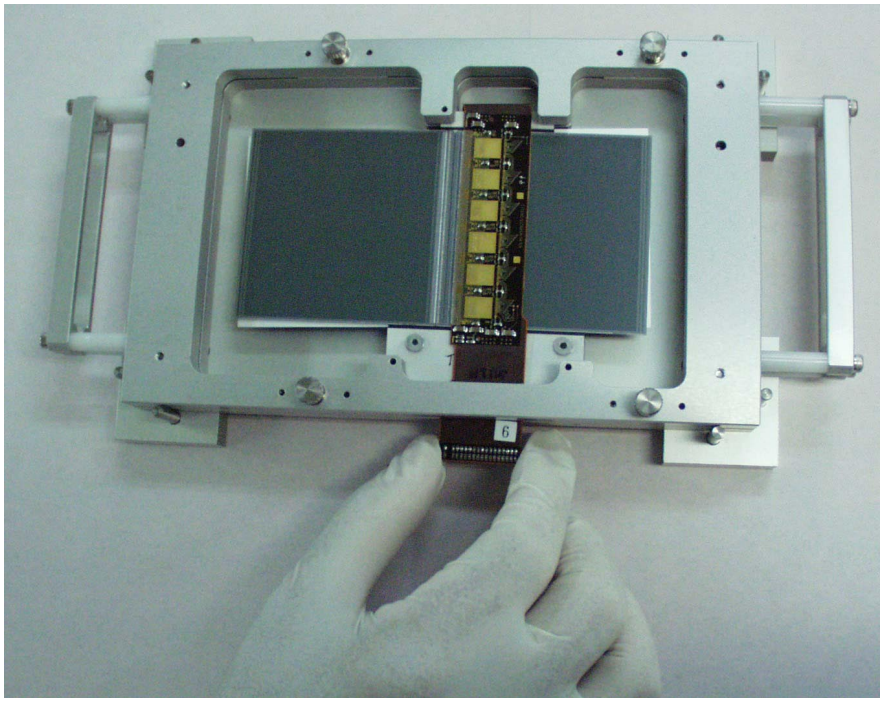
The module held with the picker is positioned on the bottom frame with a help of the guide frame. Shown at right is an empty module box.



The guide frame is being unscrewed to be detached from the bottom frame.



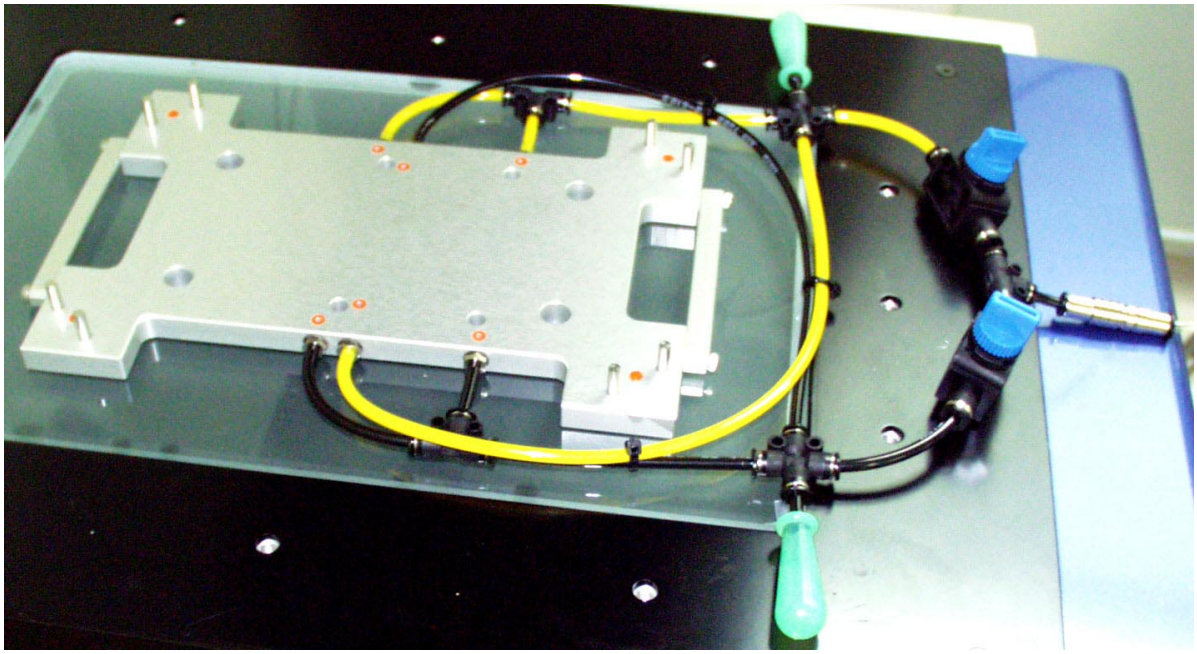
The guide frame has been removed, while the module is laid on the bottom frame. Shown above is the top frame to be overlaid on top of the bottom frame to sandwich the module.



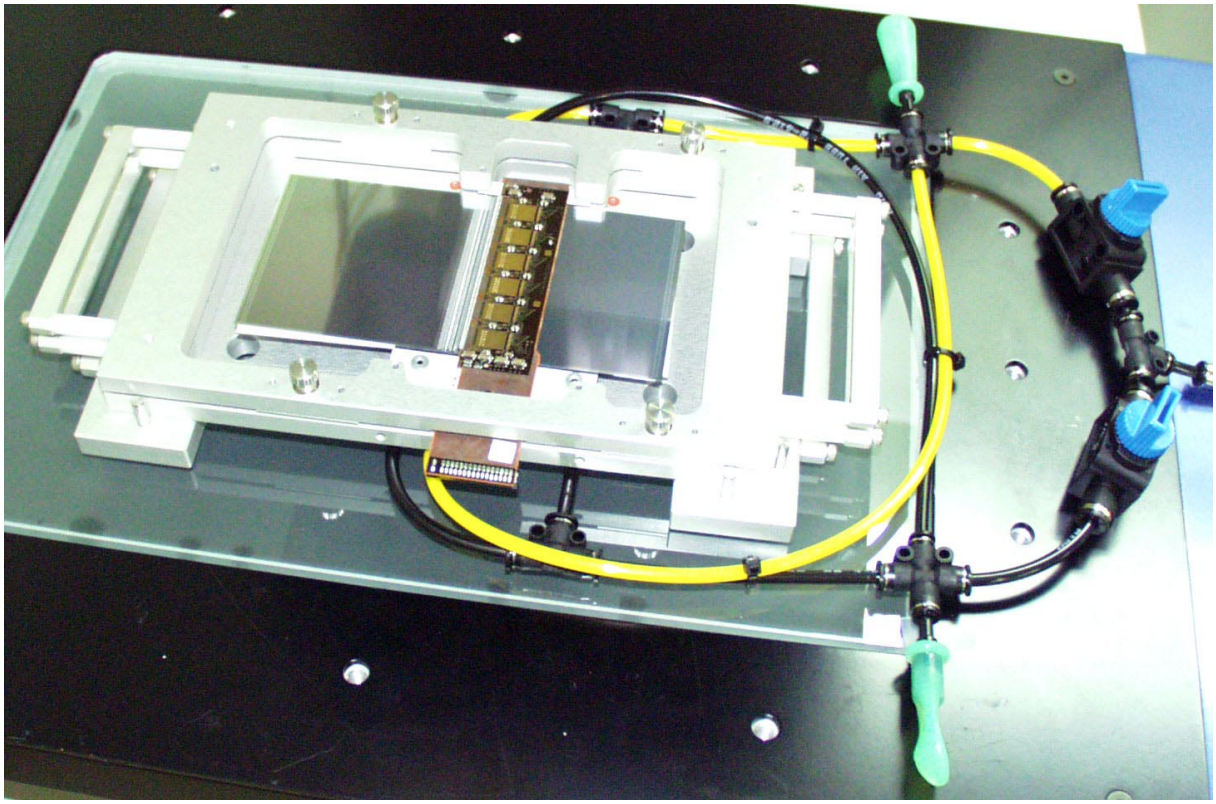
The top frame is overlaid and screwed on top of the bottom frame. The module is sandwiched with the frames. The module is made sure, by slightly wiggling, to be properly positioned in the jig without stress.

5. The jig setting on Mitsutoyo Quick Vision Pro250

A base plate is placed on the measuring table of Quick Vision Pro250

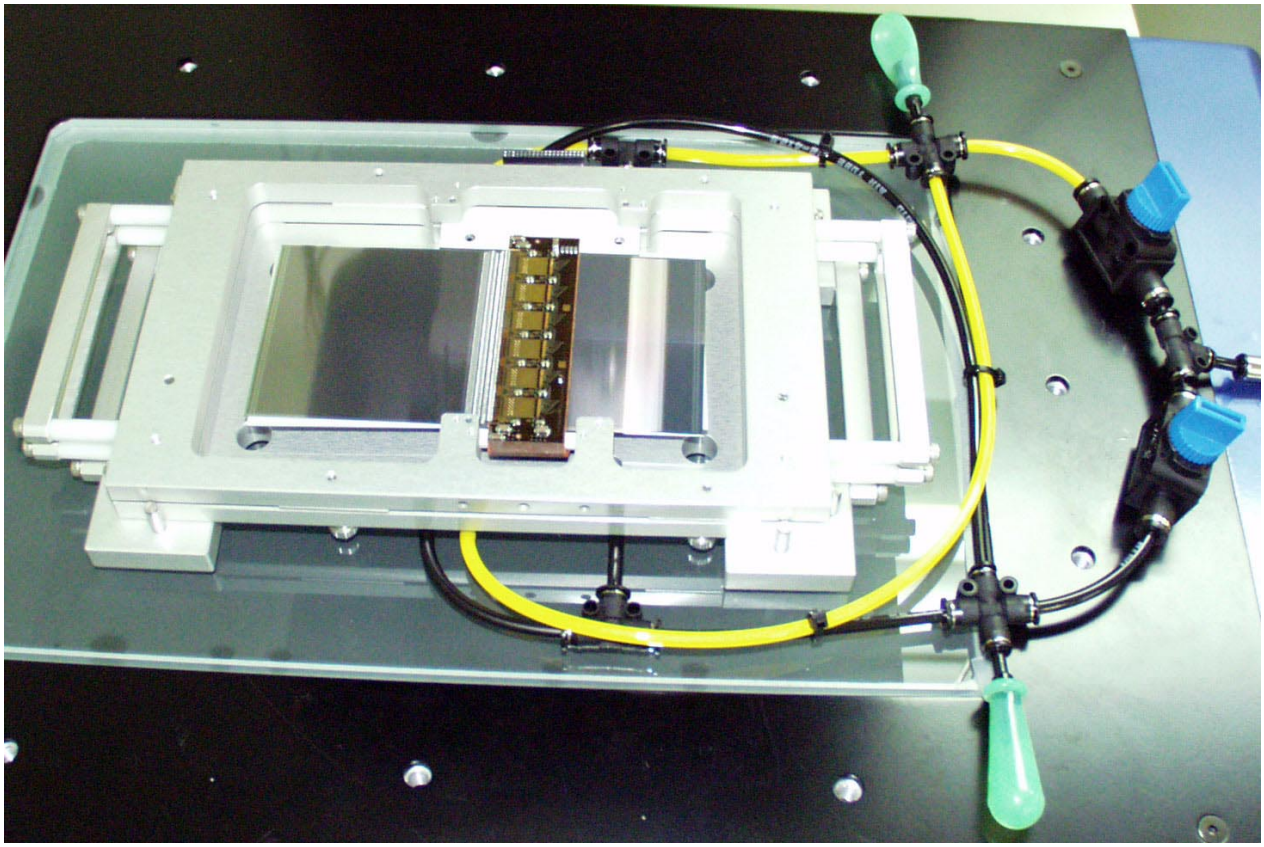


The base plate provides vacuum chucking to the module through the jig.
The base plate is equipped with vacuum lines and a pair of valves.
A pair of nipples is implemented to monitor status of the vacuum.



The module held by the jig is set on the base plate. The module is, at first, fixed on the bottom frame by vacuum for the front side measurement. Activation of the vacuum can be checked by observing one of the nipples, in this case the near one, squashed properly.

6. Backside measurement



After finishing the front side measurement, in order to proceed to the backside measurement, the jig with the module is simply flipped over on the base plate. Be careful not to forget to close the valve to release the vacuum chucking before flipping the jig. Shown above is the backside of the module. The active vacuum line is changed by opening another valve so that the module is sucked on the top frame which is now placed at the bottom, attaching on the base plate. As can be observed in the picture, the far nipple has been squashed in this time.

7. Module returning to the box

After completing the metrology measurements, the module should be returned to the module box. The procedure of putting it back from the jig to the box is just the reverse process of bringing the module from the box to the jig. By reversing the steps explained in the sections 4 and 3 successively, the module can be returned safely back to the box.