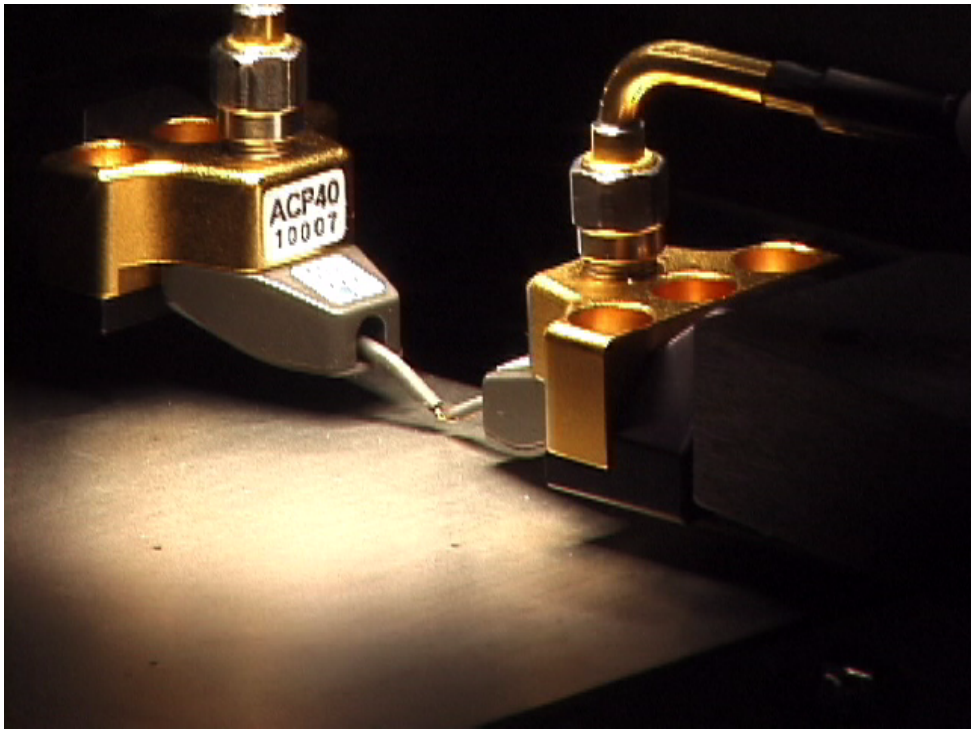
Technical Publication

Microwave Probe
Setup Guide

Innovating Test Technologies For Better Measurements Faster



Multimedia Enhanced

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Before You Begin

About This Guide

Welcome to the *Microwave Probe Setup Guide*. The purpose of this guide is to demonstrate set-up and alignment of microwave probes onto a calibration standard substrate. The Summit 9100 probe station and a Agilent VNA are used in this procedure.

Guide Contents

Chapter	Description
1 Overview	Describes how to use Adobe Acrobat Reader to enhance instruction (in several languages).
2 Setup and Alignment	Describes the setup and alignment procedure in performing accurate two-port microwave measurements.

Notational Conventions

This manual may use the following conventions and comments:



WARNING is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.



DANGER is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.



CAUTION is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

This includes situations that ***may*** cause damage to hardware via electrostatic discharge (ESD).



NOTE is used to indicate important information about the product that is not hazard related.



The globe indicates a World Wide Web address.

For More Information

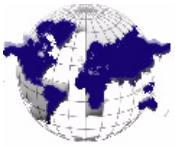
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CHAPTER

1 Overview

Introduction to Multimedia



English

NOTE

Language Translation

Currently,only the English language is spoken in the PDF version of this document. Therefore, "English" is the only mulitimedia link available. However, other languages are inticipated in future versions. See The Globe.

This document is a tutorial, which is available both as a hard copy (printed version) and as a PDF (electronic Portable Document Format). In the PDF version, multimedia, such as audio and video, enhance the text and graphics found in the printed version. Furthermore, in the PDF version, text may be spoken in a language other than English.

HOW TO USE MULTIMEDIA

When Acrobat Reader opens a PDF document, the hand tool is used as the default cursor when moved over the body of the document. This hand cursor will change to the multimedia cursor when moved over a Language Link, such as English.

When the cursor is over a Language Link, click the link once to view a movie or hear a sound clip. Of course, to listen, your computer must be equipped with speakers or headphones. Press ESC (escape) on your keyboard to cancel the presentation.

The Globe

When you see a globe in the document, click a Language Link to hear the text in the language of your choice. Note that the translation may be part of a movie.

Printed or PDF?

We recommend that you use the PDF version to optimize your understanding and retention of the topics presented in this tutorial. The PDF version is available on CD. Note that Adobe Acrobat Reader must be present on your system to use this multimedia. To download this free reader, go to www.Adobe.com and follow the links to the most current version. The most current version of the Reader (as of this writing) is also available on the CD, should you have it in your possession.

The instructions set forth in the printed version are only described in English but feature many of the static graphics as found in the PDF version. However, you may find that even without the dynamics of audio and video, the printed version will be sufficient for your needs.

CHAPTER

2 Setup and Alignment

Tools and Components

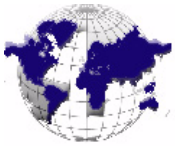
Required Components

- Probe station
- VNA (Vector Network Analyzer)
- Microscope
- ISS (Impedance Standard Substrate)
- Contact substrate
- Probes
- Positioners and cables

Required Tools

- Torque wrench
- Allen (hex) wrench (7/16-inch)

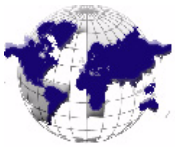
Introduction and Overview



English

Narrator's Introduction

Thank you for your interest in Cascade Microtech Probing Solutions. This document provides information on how to install, configure and use your microwave probes to ensure absolute confidence in your measurement results.



English

Summit 9100 RF Setup

This document, and the accompanying PDF, detail the correct setup procedure that should be followed in performing accurate two-port microwave measurements.

Cascade's Summit 9100 manual probe station is used for the demonstration.

In a RFIC development environment, microwave measurements and techniques are required for modeling and ongoing process control, engineering verifications, production screening, and various troubleshooting steps.

The following graphic shows a typical RF device characterization setup. To the right (below the monitor) is a vector network analyzer, commonly called a VNA. Cables from the test set ports of this VNA route over a Cascade's Summit 9100 manual probe station to a pair of microwave probes. These probes can be aligned

either through a microscope or through a camera system onto the calibration substrate and test devices.

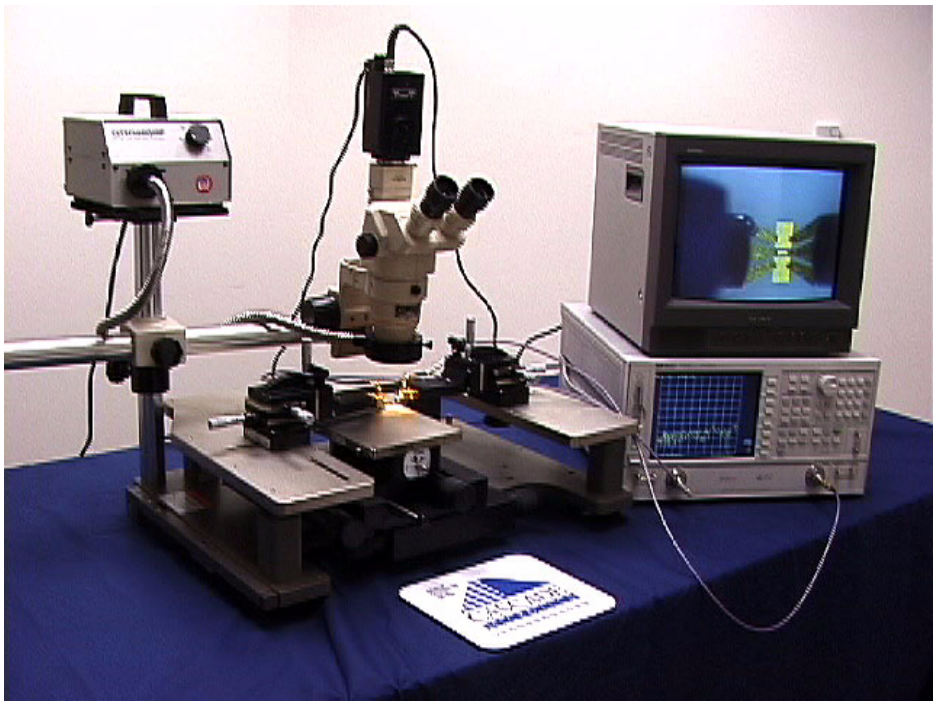


Figure 1. Station setup.

Procedures

English

Platen Handle

Before mounting the probes onto the positioners, the platen handle should be placed in the fully down position and remain in this position throughout the entire setup procedure.

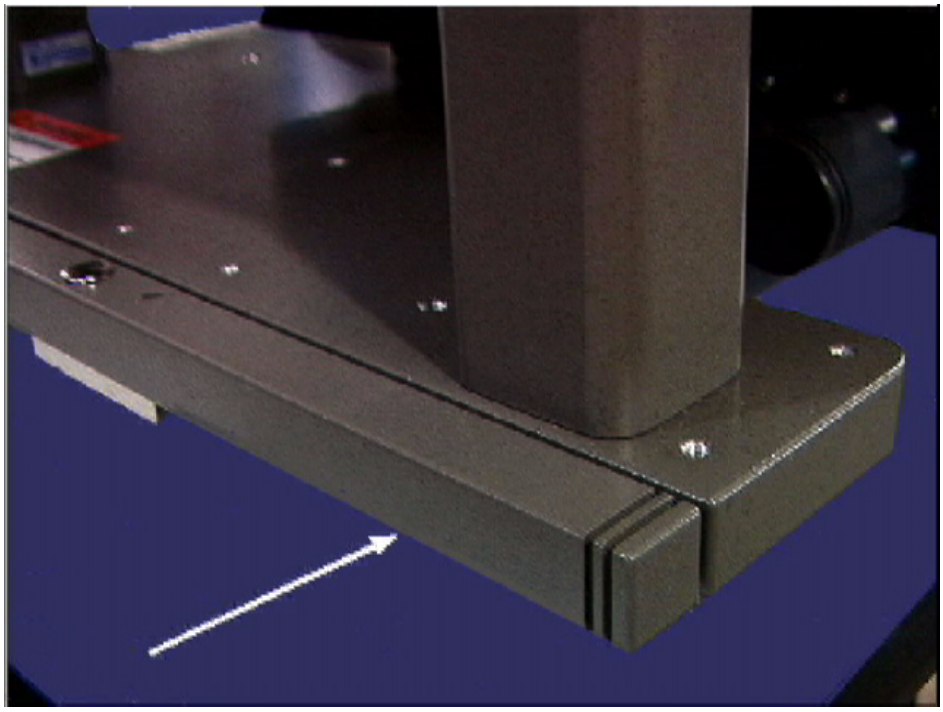


Figure 2. Probe handle in down position.

This handle is used to raise and lower the platen of the probe station in the z-axis only.

Microwave Probes

Installation of the microwave probes is simple, but use caution to avoid tip damage when handling a probe. After securing the probes with a hex (Allen) wrench, attach the coaxial cable to the probe by finger-tightening the connector and then by firmly tightening with a torque wrench.

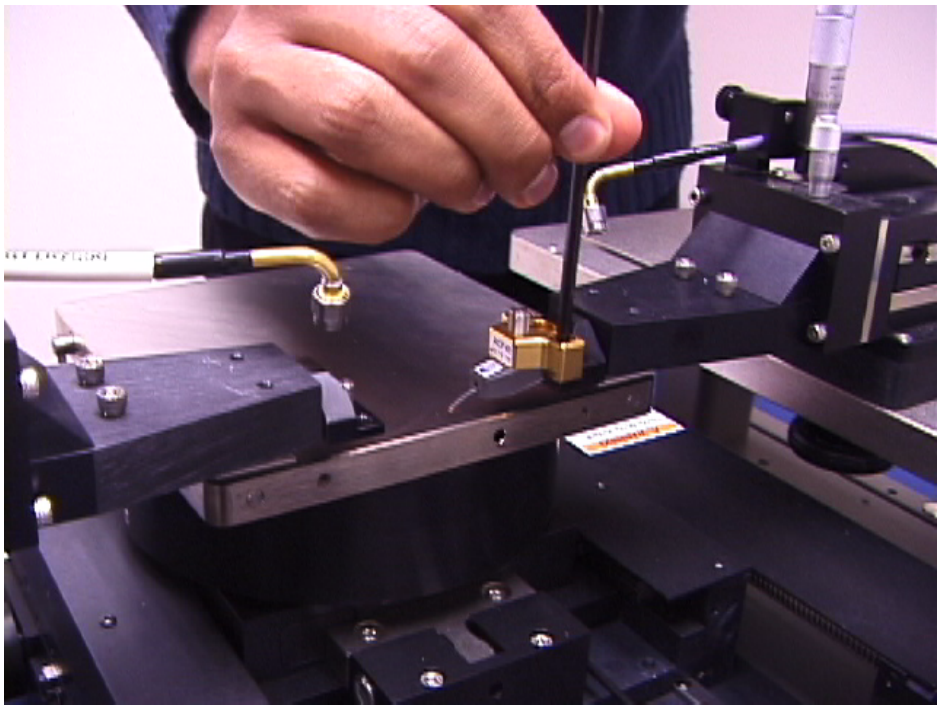


Figure 3. Securing probe to probe arm.

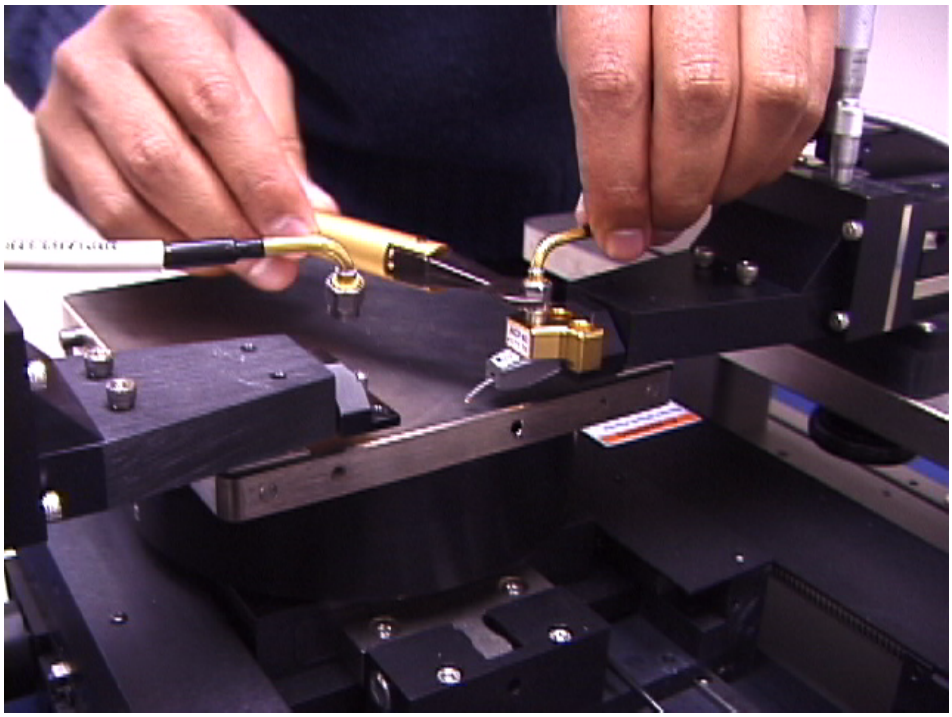


Figure 4. Tightening connector.

Strain Relief

Once the cable has been connected to the probe, it is important to use the cable strain relief, which clamps the cable to the side of the positioner. This eliminates any stress on the connectors and prevents any movement of the cable that would cause vibration at the probe tip. Consequently, this helps to optimize the measurement repeatability.

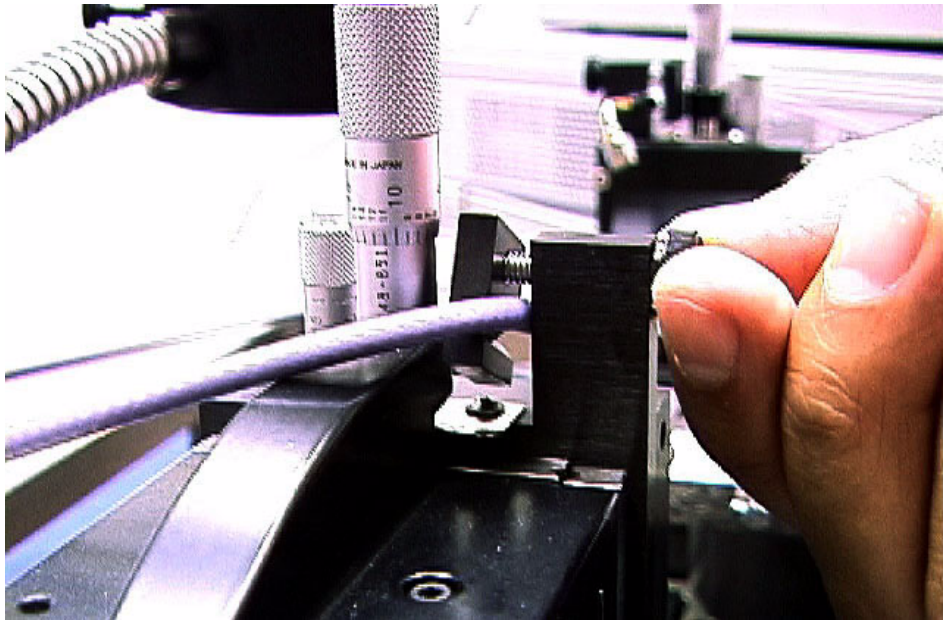


Figure 5. Tightening strain relief against cable.

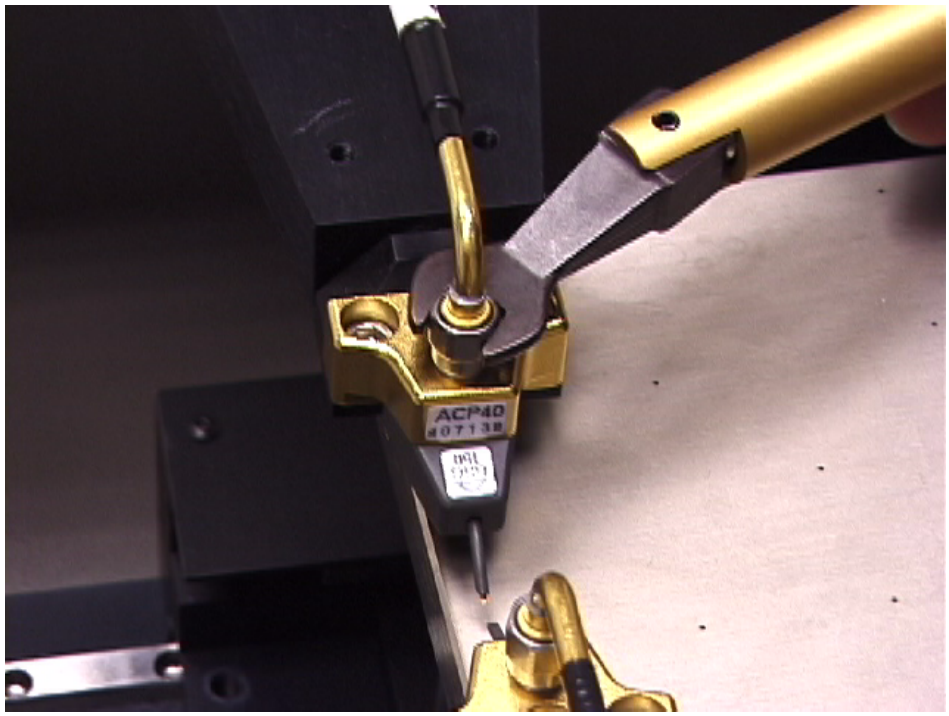


Figure 6. Tightening second connector.

Repeat the same procedure with the other probe.

English

Substrates

In on-wafer measurements, a Contact Substrate is used to evaluate the planarity of the probes. The Contact Substrate is an alumina substrate with a gold top layer.

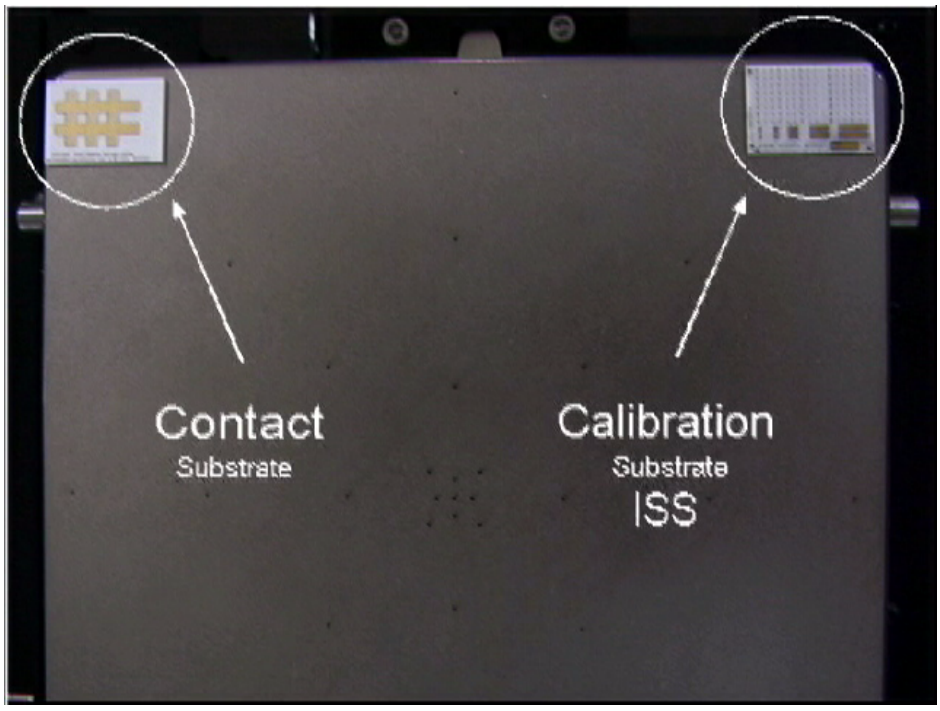


Figure 7. Substrates on auxiliary stage.

The Impedance Standard Substrate, commonly called the ISS, consists of all the standards required for calibration.

Place the Contact Substrate and the ISS onto the auxiliary stages. These are located in the upper-left and right-hand corners of the chuck. Align them so that they are square with the edges of the chuck. Then, turn on the vacuum.

Stage Movement

Move the stage so that the probes are placed over the Contact Substrate. Be careful to ensure that the probes are raised high enough so that the Contact Substrate moves safely under the probes. Failure to do this could result in the

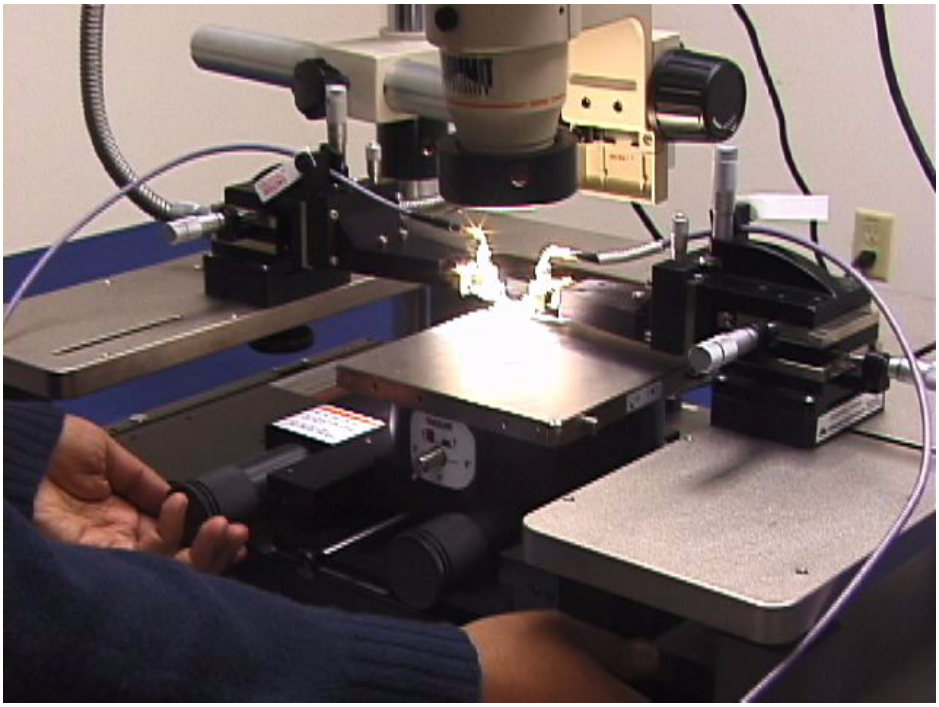


Figure 8. Positioning stage over contact substrate.

Probes Position

Contact Substrate hitting the side of the probe tips and causing them to be permanently damaged. Align the two probes so that they are opposite each other.

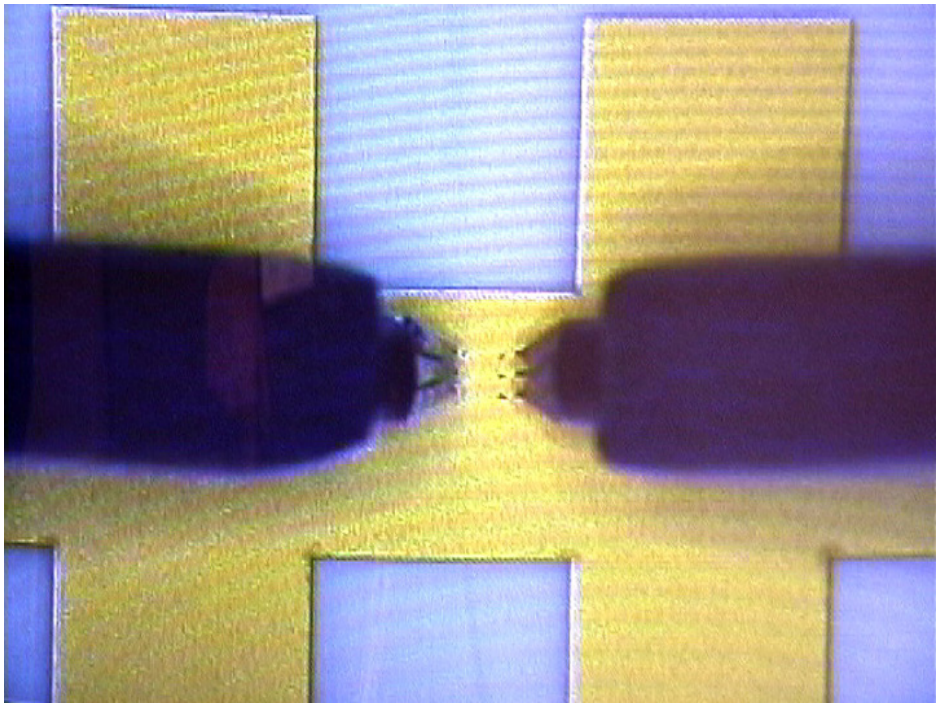
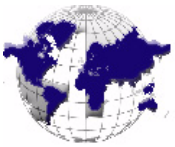


Figure 9. Aligning probes.



Focus and Planarization

Focus the microscope onto the Contact Substrate. The probe tips will appear out of focus. Then use the z-micrometer on the positioner to lower the probe tips toward the Contact Substrate. The probe tips will begin to come into focus as they move closer toward the surface of the ISS. Evaluate tip contact by gently touching down on the soft gold of the Contact Substrate. As the probe makes contact, the contact force will cause it to move forward. This motion is called ‘skate’. Only

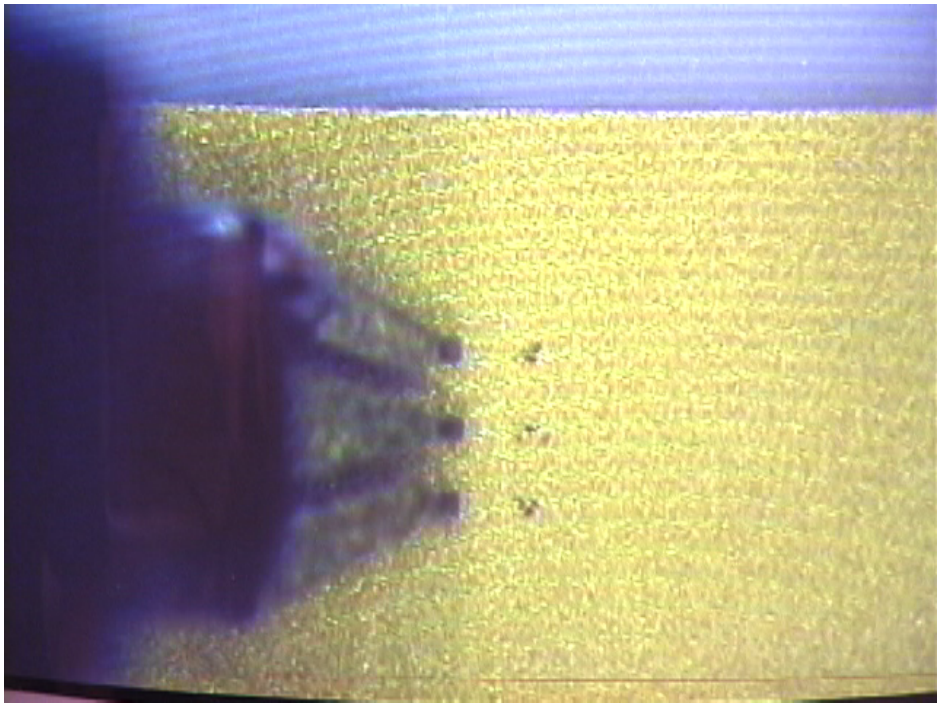


Figure 10. Marks are planar (correct probe tip planarity).

about 25 to 30 microns of skate is required to make proper electrical contact. The marks left by the probe on the Contact Substrate should be barely visible and very even as can be seen here.

The probe should be maintained in the microscope's field of view.

However, if the probe is not planar then one probe finger may make a deeper mark than the others. This can be seen here where one of the probe's ground fingers is not able to touch down. The probe positioner planarity control is then

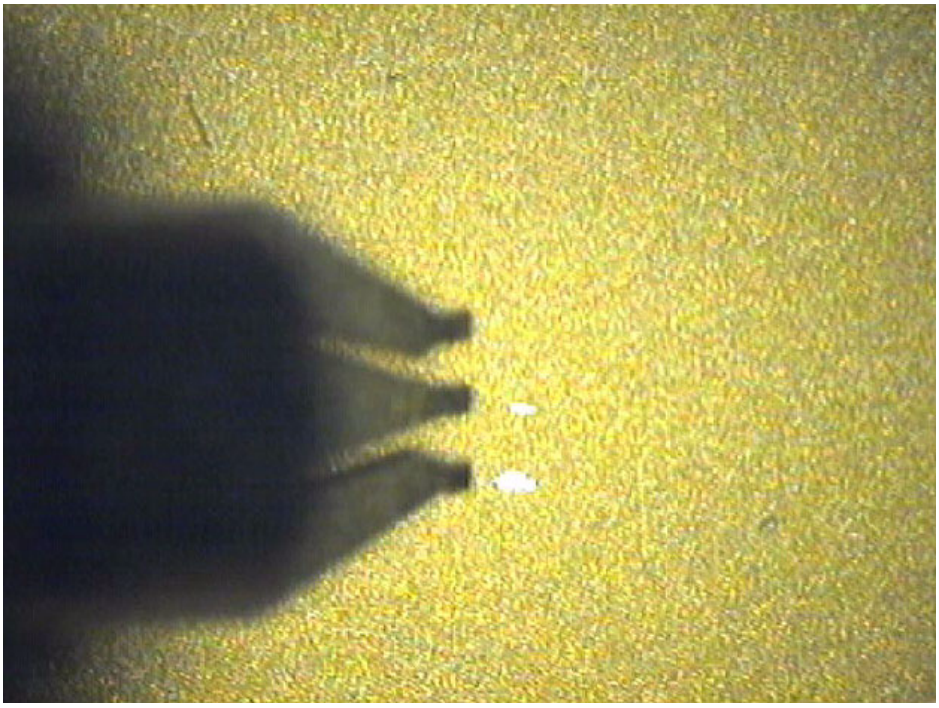


Figure 11. Marks are not planar (incorrect probe tip planarity).

used to achieve even marks. Move the other probe into the field of view and follow the same procedure for planarization as before.

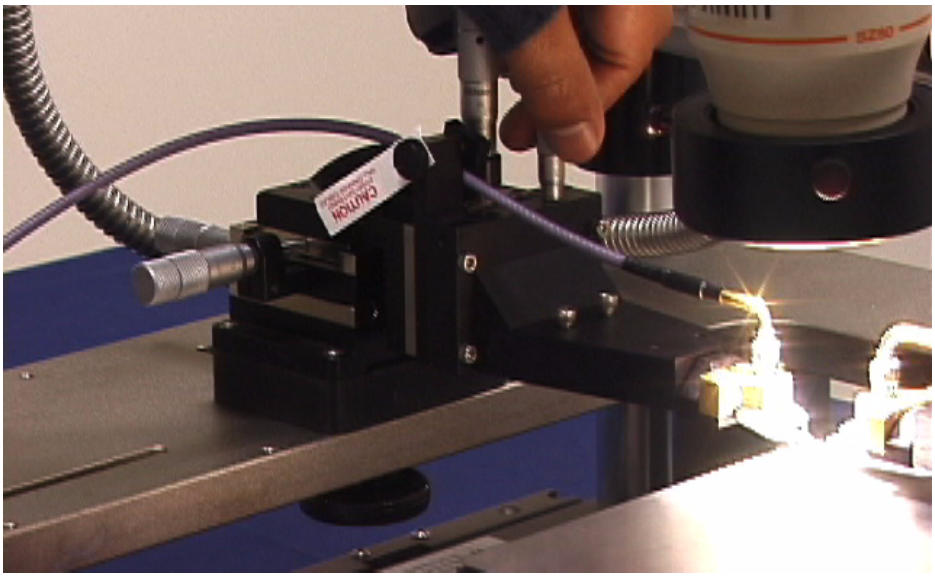


Figure 12. Adjusting planarity.

Once the probe has been planarized, it should be raised off the surface of the substrate and moved to the side using the z- and y-micrometers respectively.

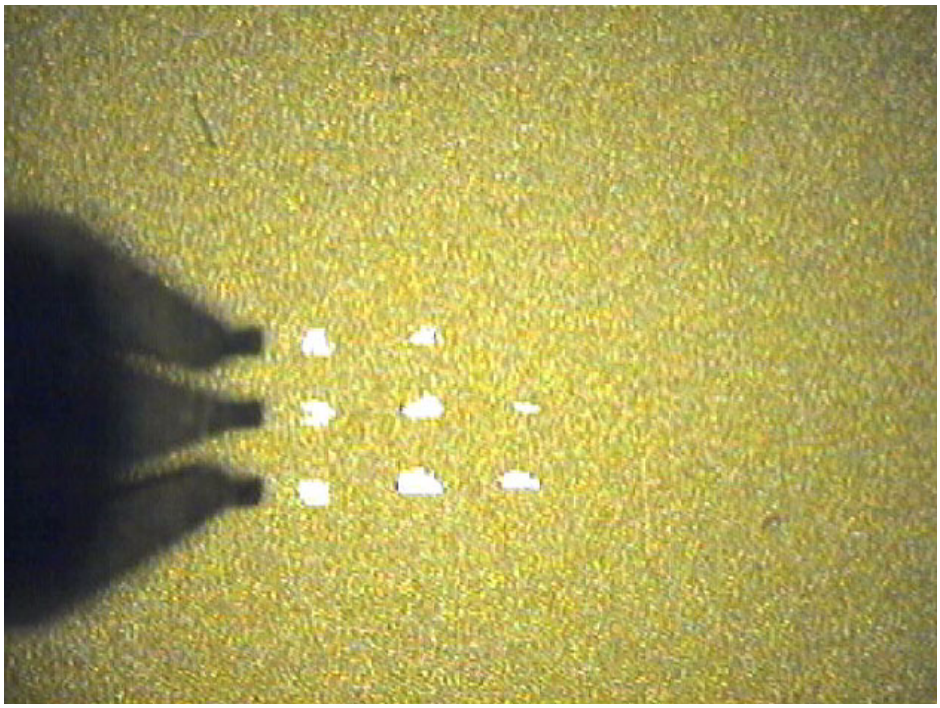
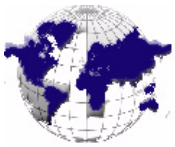


Figure 13. Progression of marks from non-planar to planar (from right to left).



English

ISS Substrate

Making sure that both probes are off the surface of the Contact Substrate, move the stage so that the probes now sit over the ISS. The ISS is approximately the same thickness as the Contact Substrate. However, it is still important to be careful that the ISS does not hit the side of the probe tips.

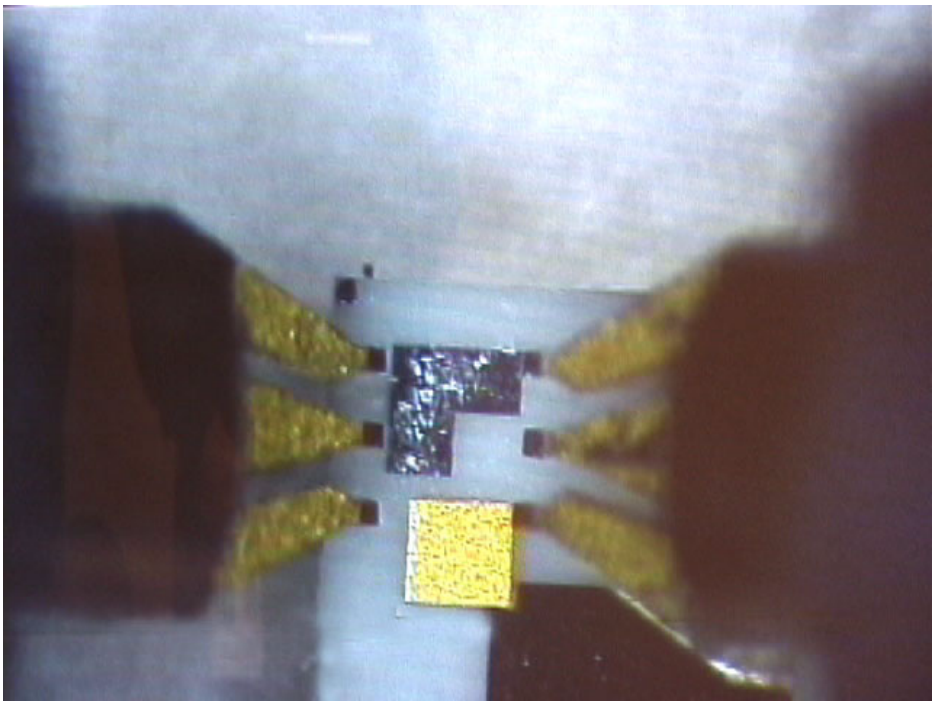


Figure 14. Probes over left index mark.

ISS Map

Move the stage so that the probes sit over the mark in the top left-hand corner of the ISS. A map is provided with the substrates that detail the specifics of the ISS.

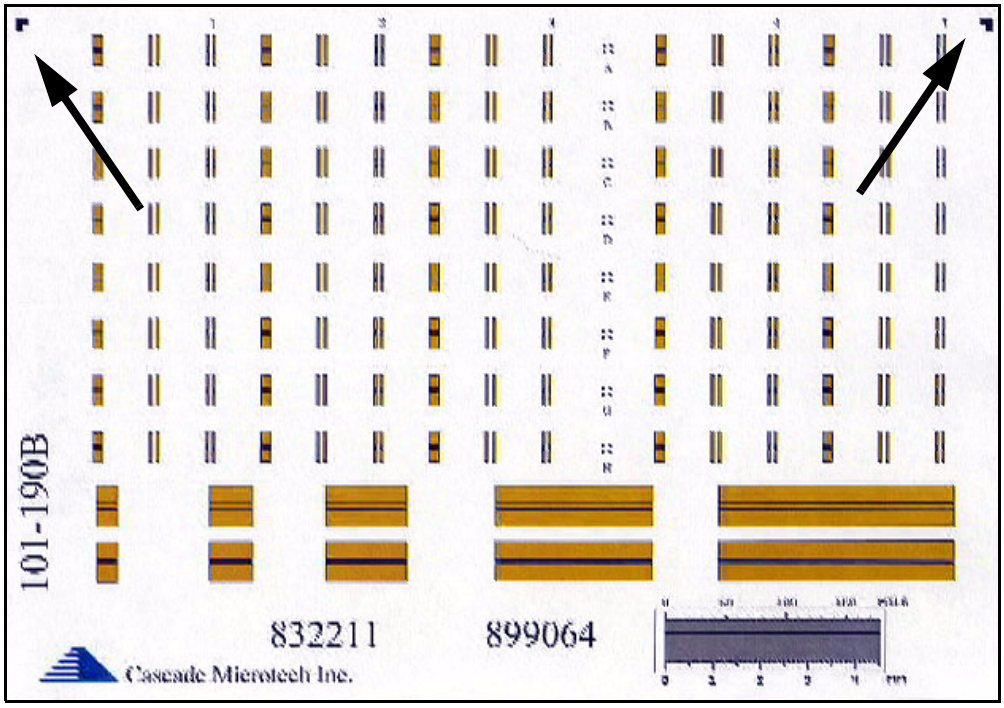
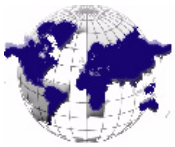


Figure 15. ISS map with pointers to index marks.

On this map there are two markers on the top-left and right-hand corners of the ISS that are used to align the probes to the substrate. These are used for manual probe stations only. For semiautomatic probe stations, a software theta correction for the ISS is used.



English

Alignment Check

To evaluate whether the probes are correctly aligned to the ISS, the probes should first be placed over the marker in the left-hand corner. Moving the stage in the x-axis only, the marker in the right-hand corner should reside in the same position relative to the probe tips.

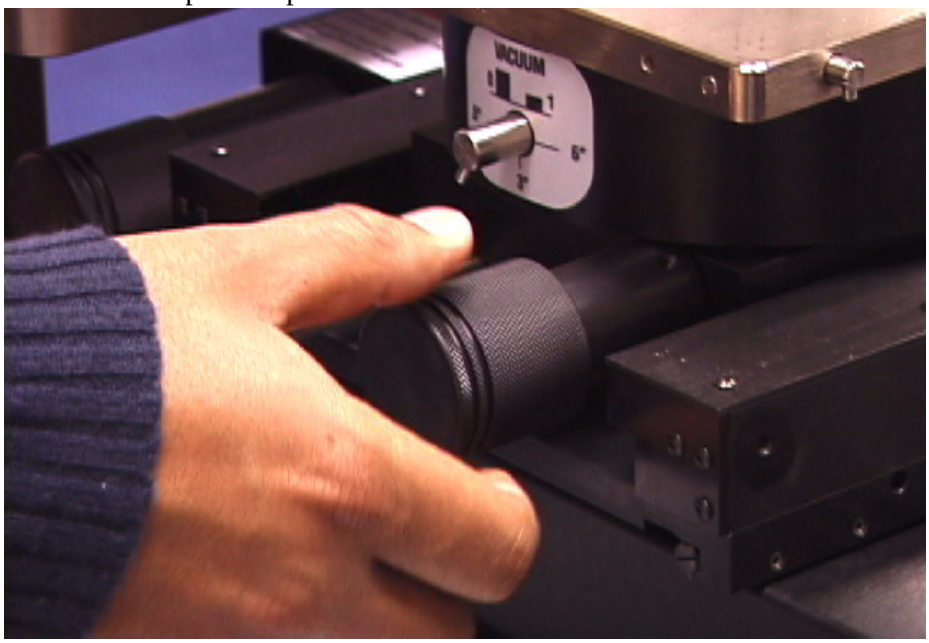


Figure 16. Adjusting theta.

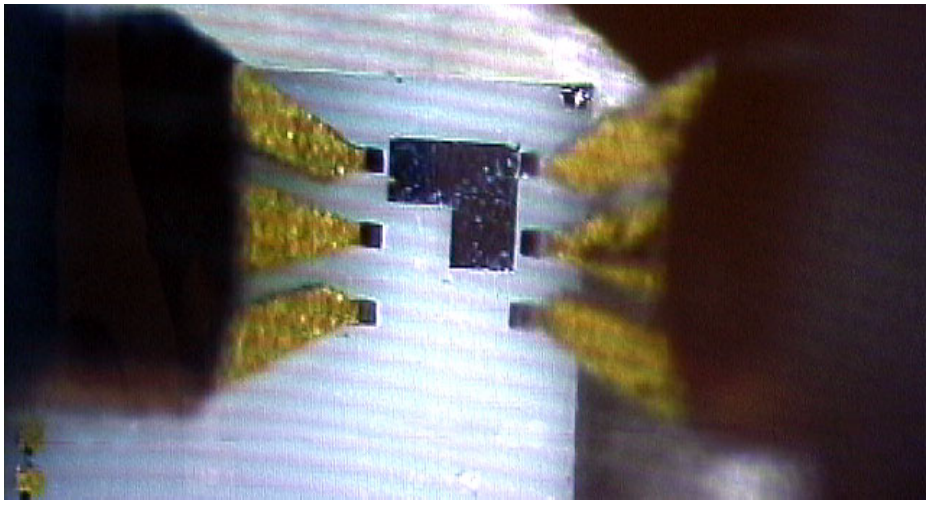
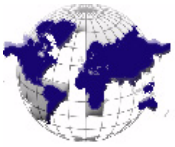


Figure 17. Probes over right marker after adjusting theta.

Theta Adjustment

If the marker is not positioned relative to the probe tips, then the theta adjustment on the stage is used to correct this. Following this theta correction, the stage is then moved again only in the x-axis from corner to corner to check proper probe alignment to the ISS.





ISS Structures

The reverse side of the map provides details describing the structures on the ISS.

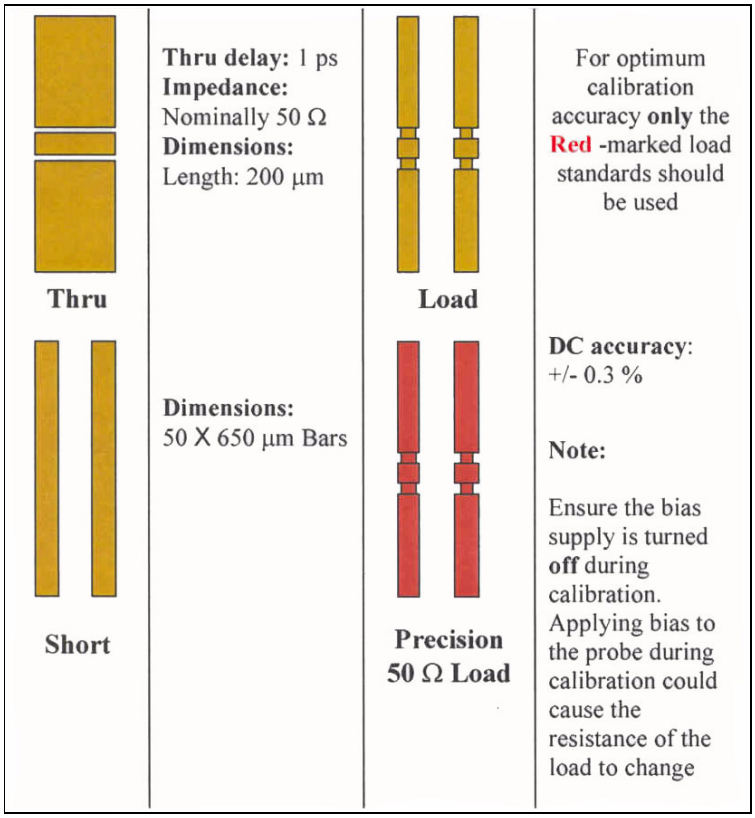


Figure 18. ISS structures.

Normal ISS structures include shorting bars, precisely trimmed loads, 'Thru' lines, and longer transmission lines. Lifting the probe in the air above the ISS by raising the platen handle, conveniently and reliably creates open 'standards'. Only the red-marked resistors (see fig. 18) that are marked on the map should be used for calibration. These standards have been pulse-trimmed to 50 Ohms.

For the substrate used here, each row consists of five (5) sets of Thru, Short and Load standards. Select a set that consists of a load that is marked "red" on the map.

In the following example, the 3rd set of standards on the 3rd row will be used to perform the calibration.

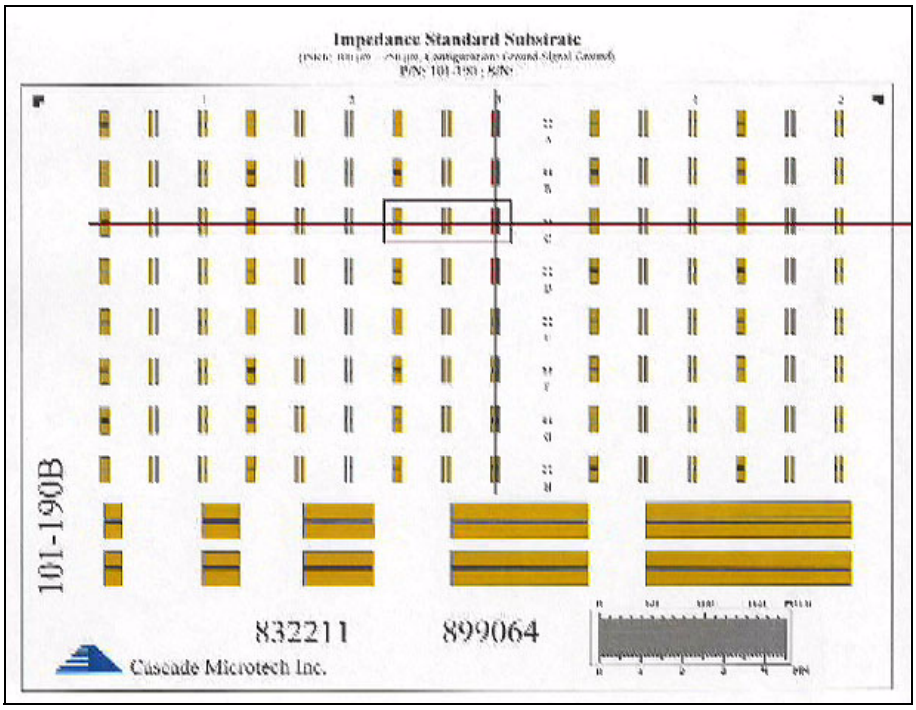


Figure 19. Selected standards.

Alignment Marks

Between the 3rd and 4th sets of standards on each row, there is also a set of alignment marks.

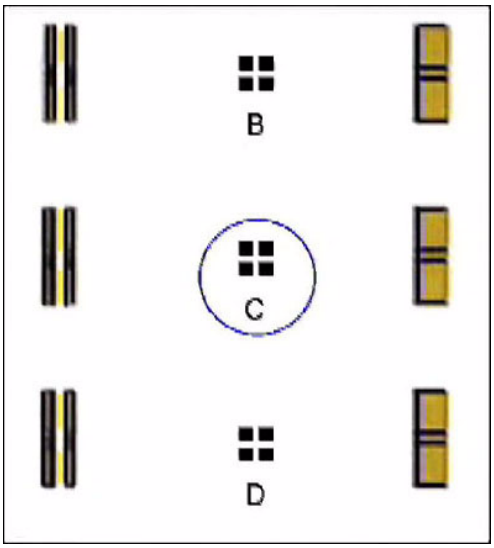
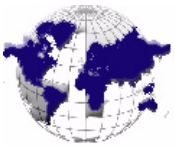


Figure 20. Alignment marks for probe separation and skate.

The alignments marks are used to set the correct probe separation and skate.

The alignment marks that should be used are the ones that are in the same row as the calibration standards that were selected.



Reference Planes

The initial contact with the probe tips should be made at reference plane X: the midpoint between the outer flat edge and the internal apex. The desired skate, which is again the forward movement of the probe tips after initial contact with the substrate, is then achieved by adjusting the z-height on the positioner to move the edge of the probe tips to reference plane Y: the midpoint between the internal apex and the flag points.

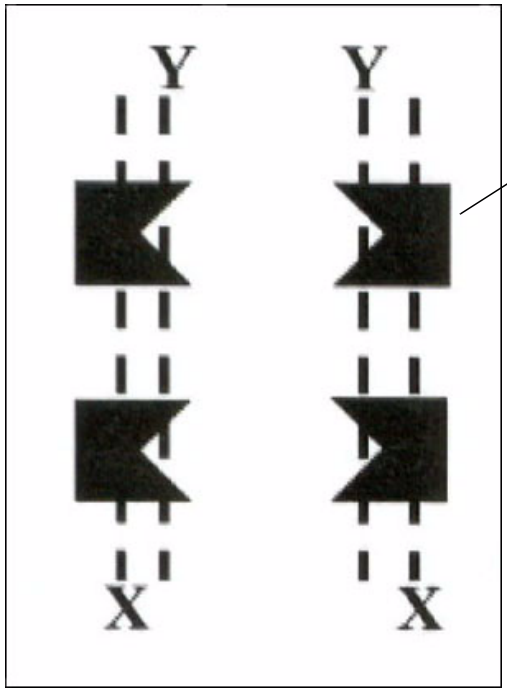
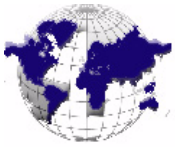


Figure 21. Alignment marks.



English

Platen Position

By raising the platen and moving the x-axis of the stage, each of the calibration standards can be contacted.

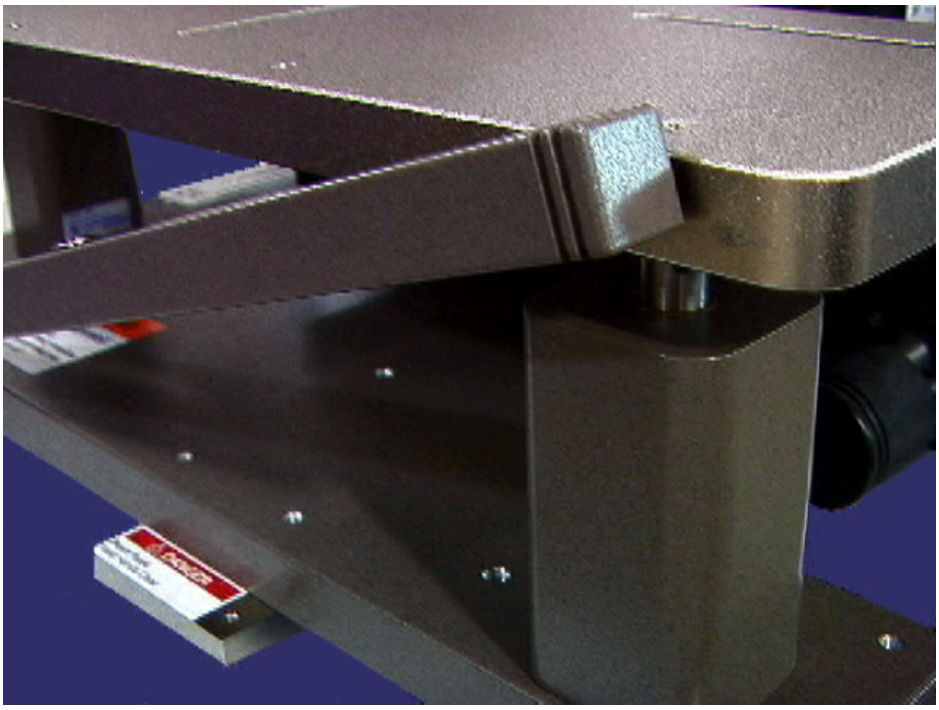


Figure 22. Platen raised.

Standards Contact

Here the probes are contacting the Load, the Short, and the Thru respectively. As explained earlier, the Open is created by simply raising the platen handle.

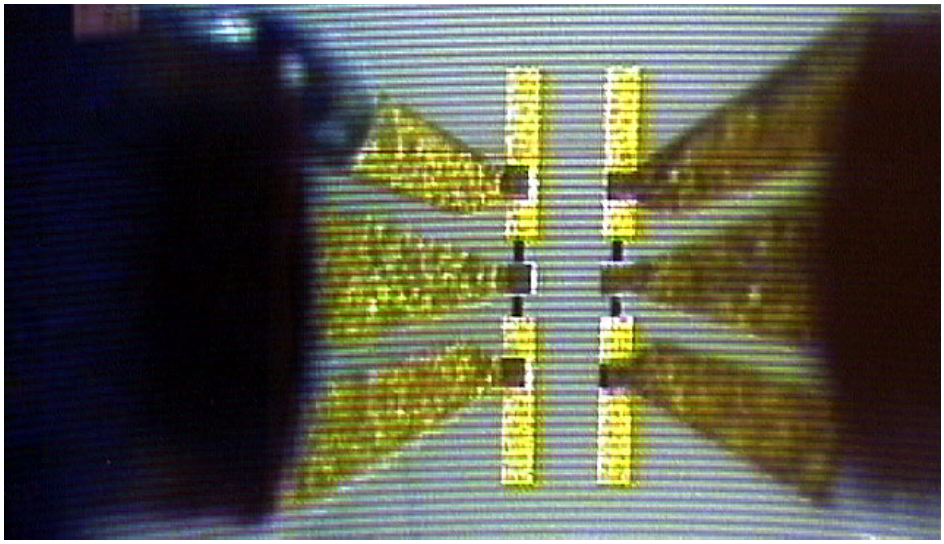


Figure 23. Contacting the Load.

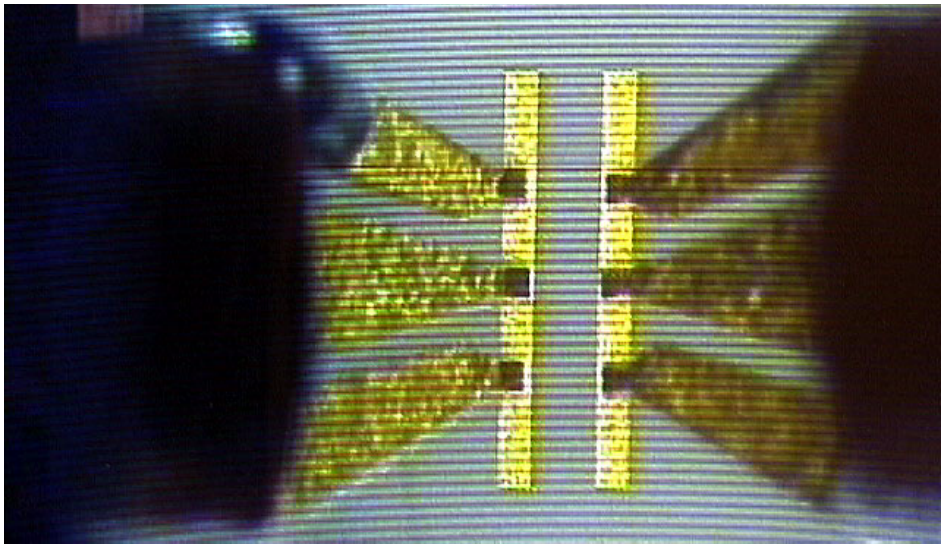


Figure 24. Contacting the Short.

The setup procedure is now complete.

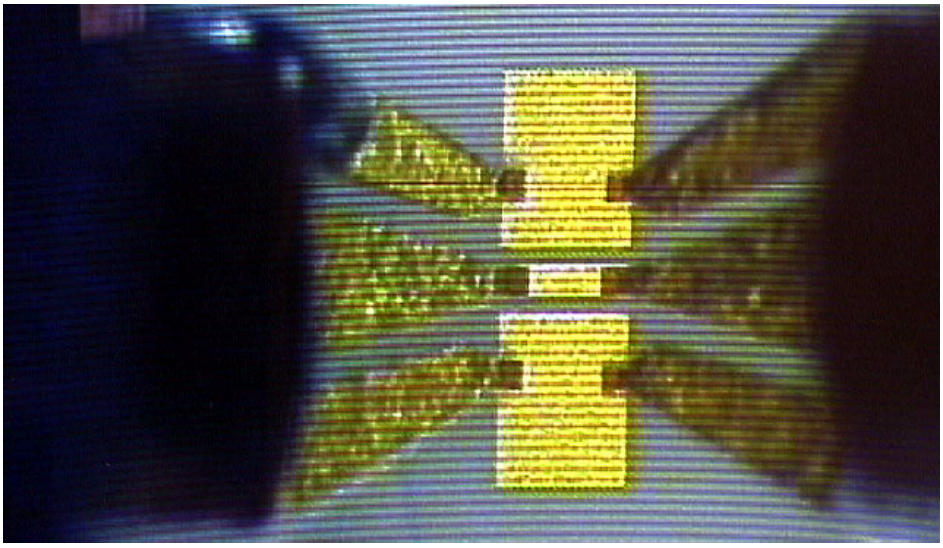
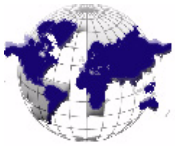


Figure 25. Contacting the Thru.



English

We hope that you have found this presentation to be of value. Please contact Cascade Microtech if you have any questions regarding this or any other application.