

# Precise, Repeatable RF Measurements

Applying CPW Probes  
to  
Everyday Test Problems



# Problem!

- Electronic components and assemblies are:
  - Shrinking
  - Higher in frequency
  - Higher performance
- Which leads to:
  - Parts too small to see, touch or test
  - Demand for a more excellent test signal environment
  - Demand for more precise test methods



# Shrinking Dimensions

- Components
  - 0201 !?!
- Packages
  - Micro BGAs
  - SMD with lead pitch too small to touch
- Interconnect (Boards and Assemblies)
  - Conductor traces to less than 4 mils



# Increasing Frequency

- Wireless
  - Commodity Commercial Product - 6 GHz
- CPU
  - On board interfaces with 10 GHz bandwidth
- Telecommunications
  - 10/20/40 Gbit



# Increasing Performance

- SOIC
  - More functions in same area
    - Means more electrical contacts to effectively stimulate
    - Means higher mix of signal type
      - always some with higher bandwidth
- Improving Test Equipment
  - Broader Bandwidth/ Higher Dynamic Range
    - Means higher quality test interfaces (contacts)



# Problem Bottom Line

- Fixture problem - Parasitic Electrical Elements
  - “Hand Size” fixtures have larger contacts, looser tolerances
- Handling problem
  - Human dexterity too challenged!
- Vision problem - Parts too small to see!

## Rule of Thumb

Repeatable measurements require  
1 mil contact placement accuracy at 10 GHz

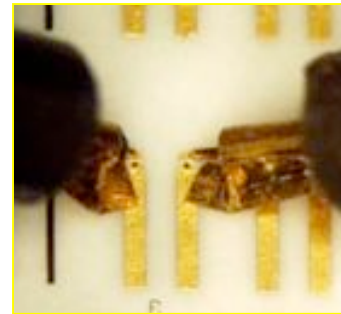


# General Solution

- CPW Probes

  - (Co Planar Waveguide contacts)

  - Electrical reference plane at a precise point in space
  - Planar precise contact



- DUT holder

  - Secure, maneuverable, easy to load unload device holder

- Probe Holding Fixture

  - Rigid, repeatable and flexible placement of probes



What does this look like?

# CPW Probes

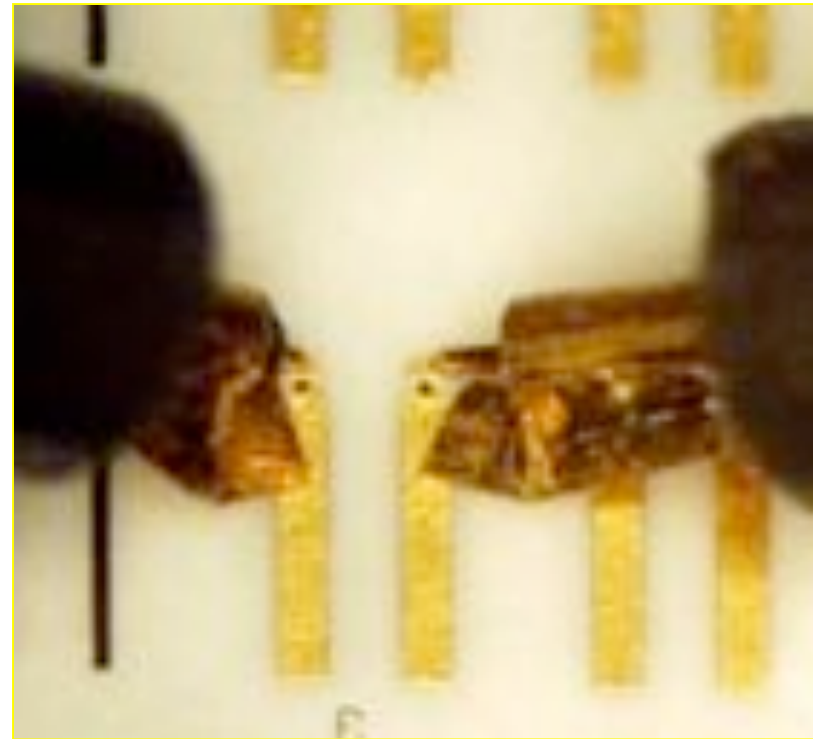
- Planar Contacts
  - Wide range of styles
    - GSG, GS, SG, ??
  - Wide range of pitch
    - 75  $\mu$  to 2500  $\mu$
- Controlled Impedance
- Traceable Calibration
- Relatively low cost
  - Defined by Bandwidth
    - 18 GHz, 40 GHz, ...220 GHz





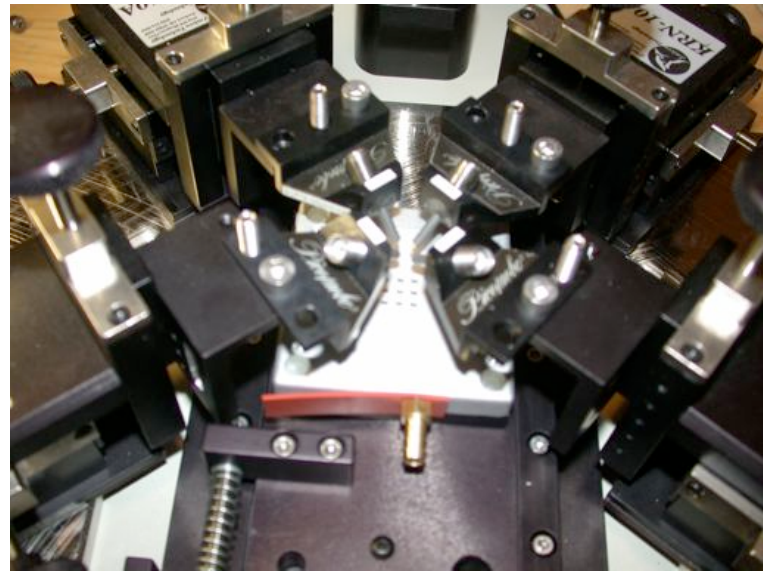
# CPW Probe Calibration

- Std Calibration Kit
- Std Procedures
  - Internal to Test Equipment
    - OSLT
    - LRM
    - TRL
  - Software Controlled
    - SOLR
    - Multiline (NIST)
    - Others



# DUT Holder

- Low Cost Probe Station
  - Necessary features
    - X-Y-Z Movement
      - 1” x-y travel
      - 50 mils z-lift
    - Vacuum hold down
    - 10X+ Optics
    - Adequate light



The Basic - LMS-2709

# DUT Holder

- Personal Probe Station
  - Expanded features
    - X-Y-Z Movement
      - 2.5" X 4" x-y
      - .25" z-lift
    - Vacuum hold down
    - 7X-112X Optics
    - Adequate light
    - Thermal Chuck option
    - Probe card holder
    - Camera/Video Systems



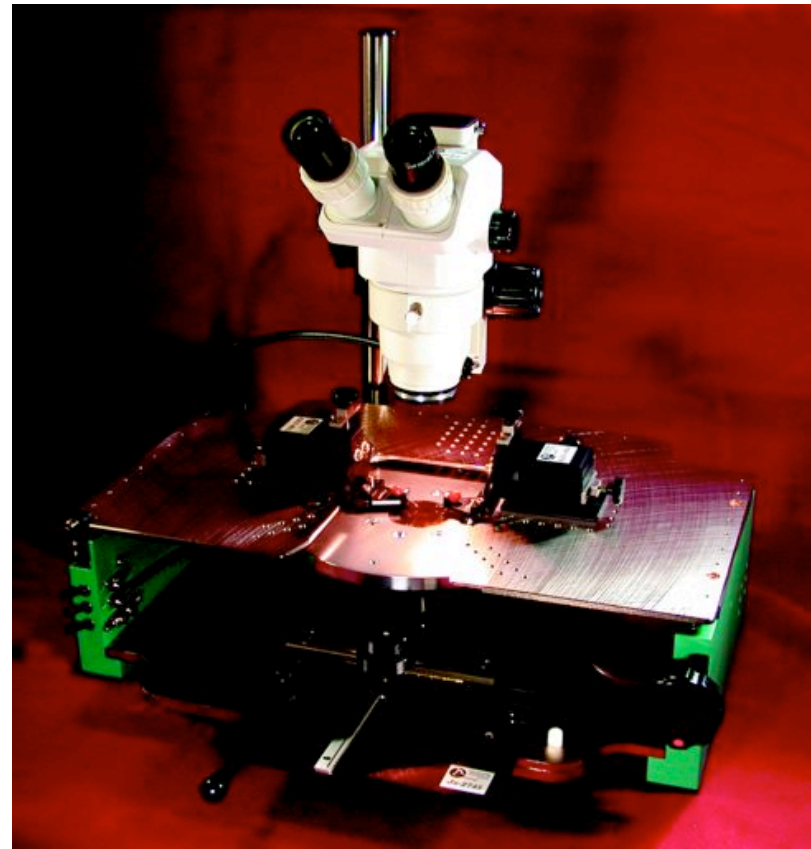
Compact Manual Probe Station

Jr-2727



# DUT Holder

- Manual Probe Station
  - Much expanded features
    - Larger DUT
    - X-Y-Z Movement
      - 6" X 7" x-y
      - .25" z-lift
    - Vacuum hold down
    - 7-112X Optics
    - Adequate light
    - Thermal Chuck option
    - Probe card holder
    - Camera/Video Systems
    - Top plate mounted test equipment



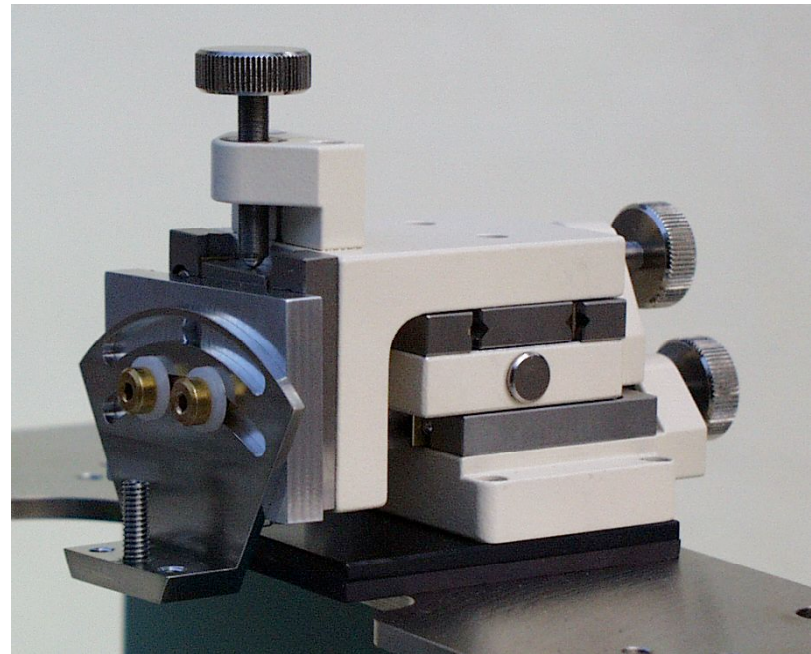
Full Featured Manual Probe Station

Jr-2745



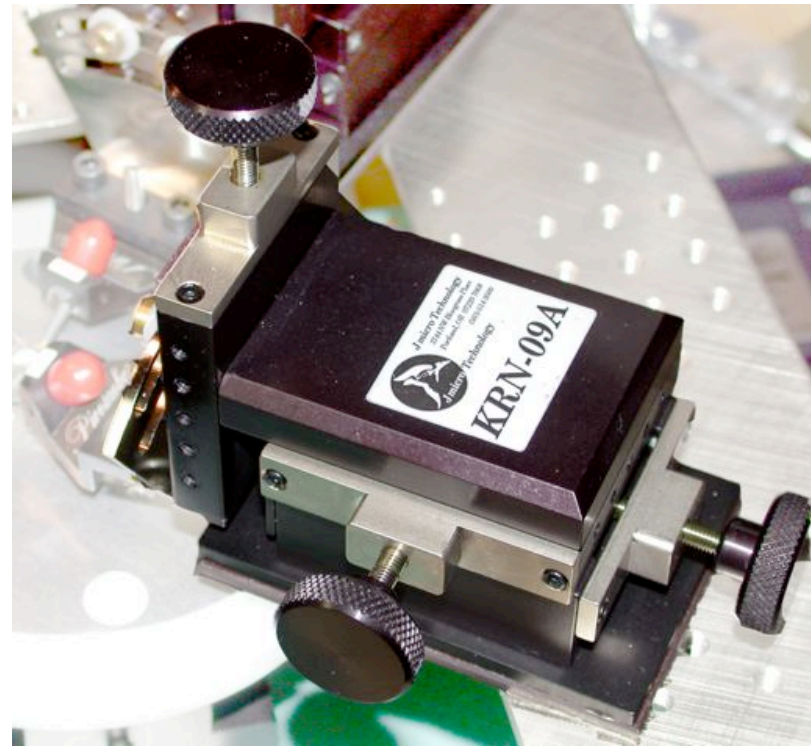
# Manipulator/Probe Holder

- Magnetic Mount
  - X, Y, Z movement
    - Modest Cost
    - Flexible fixture
      - Position anywhere
    - Compact in-line control
    - $\approx 0.5''$  all axis travel



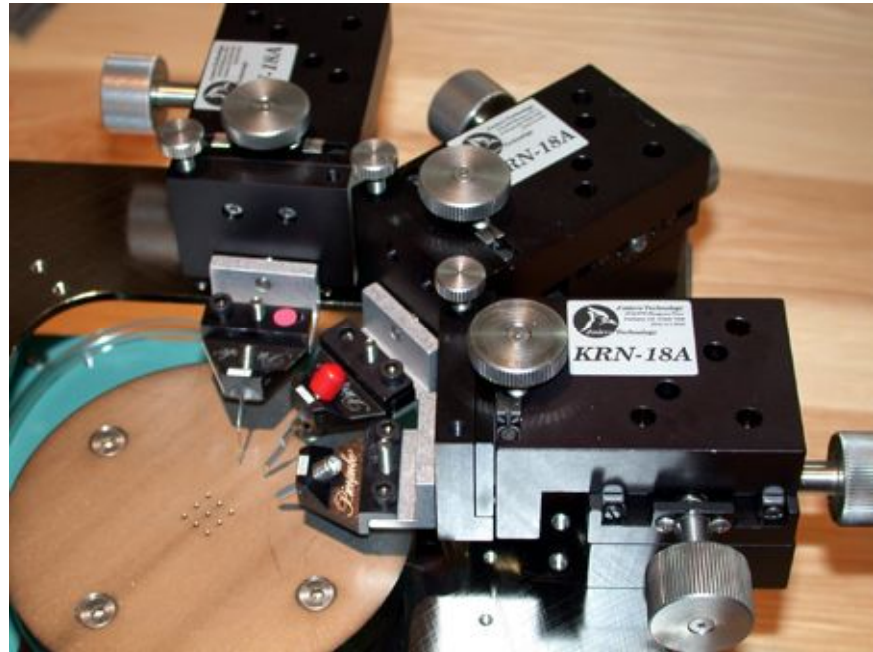
# Manipulator/Probe Holder

- Magnetic Mount
  - X, Y, Z movement
  - Modest Cost
  - Flexible fixture
    - Position anywhere
  - In axis control
  - 0.5” all axis travel



# Manipulator/Probe Holder

- Bolt Mount
  - Higher Cost
  - Increased Stability
  - High Performance
  - 0.8" x-y axis travel
  - $\approx 0.5$ " z axis travel
  - 1.5" gross adjustment z-axis



# The Promise

- CPW probes on precise manipulators give Engineers and Technicians the ability to make:
  - INCREDIBLE measurements to:
    - AMAZING bandwidths
    - for any devices with CPW compatible contacts.



## Some Examples!



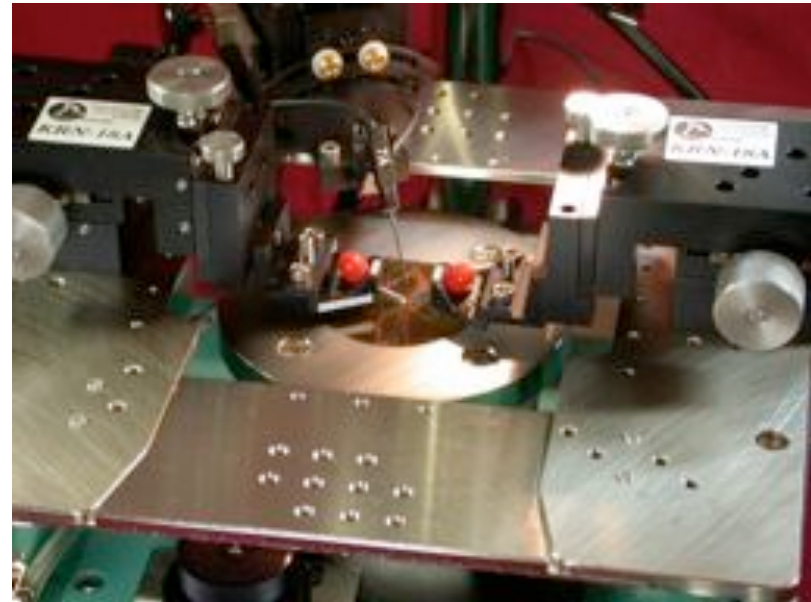
# First Order Examples

- What can be measured?
  - Semiconductor like devices
    - MMICs
    - Transistors
    - MEMS
    - Sensors
    - Integrated Antennas
  - Surface Mount Devices
    - Micro BGA
    - Leadless carriers
- Anything with CPW contacts!



# Semiconductor Device

- GaAs IC  
(Or any advanced IC)  
II-VI or III-V
- Process Control Monitor (PCM)
  - RF Performance
  - Pulsed IV Performance

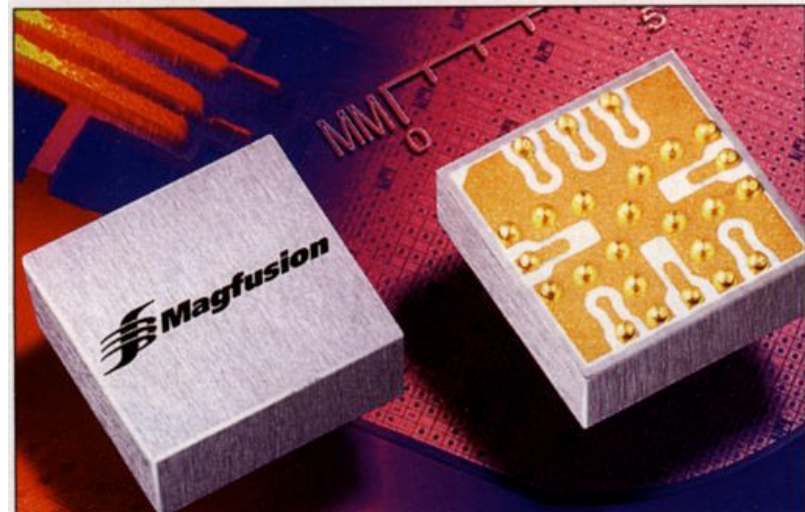


Direct Measured Data Without Compromise



# Surface Mount Devices

- Micro BGA
- Leadless Carrier
- Leaded Carrier
  - Std SOIC
- Upside down on either a conductive or non conductive chuck

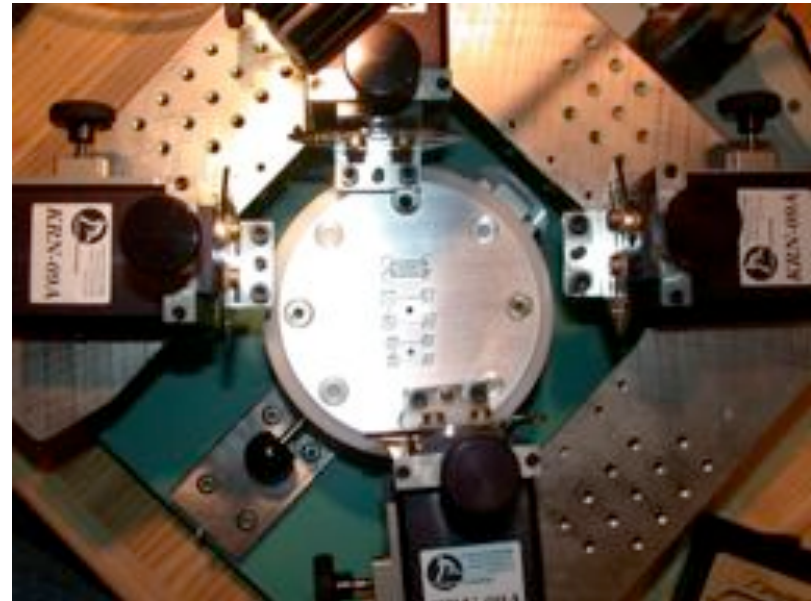


CPW-like Contacts on Bottom



# SMD Passive

- Hybrid Coupler
  - SG CPW Probes
  - Custom Chuck
  - Standard Calibration
  - Note:
    - Best Results at higher frequency when probes are factory tuned for min reflection on passive devices



Custom Chuck

# SMD Passive

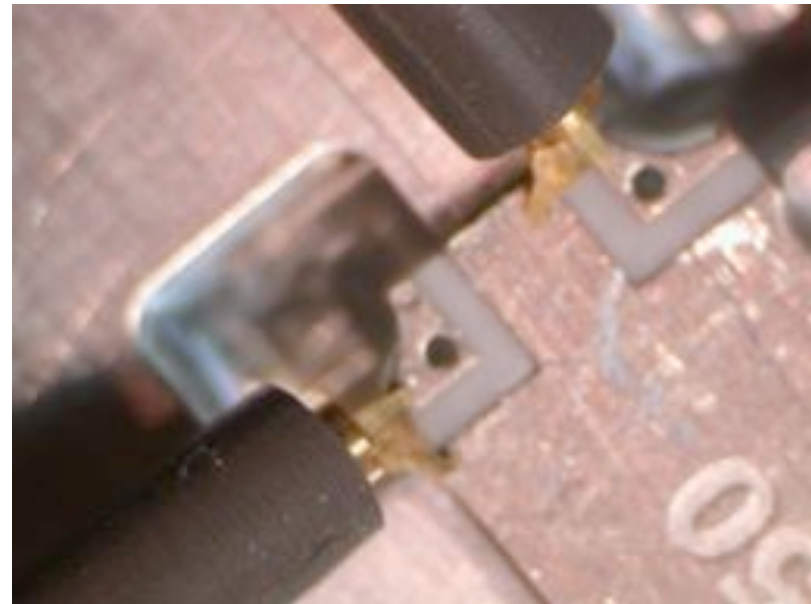
- Hybrid Coupler
  - SG CPW Probes
  - Custom Chuck
  - Standard Calibration
  - Note:
    - Best Results at higher frequency when probes are factory tuned for min reflection on passive devices



Four Sided Probing

# SMD Passive

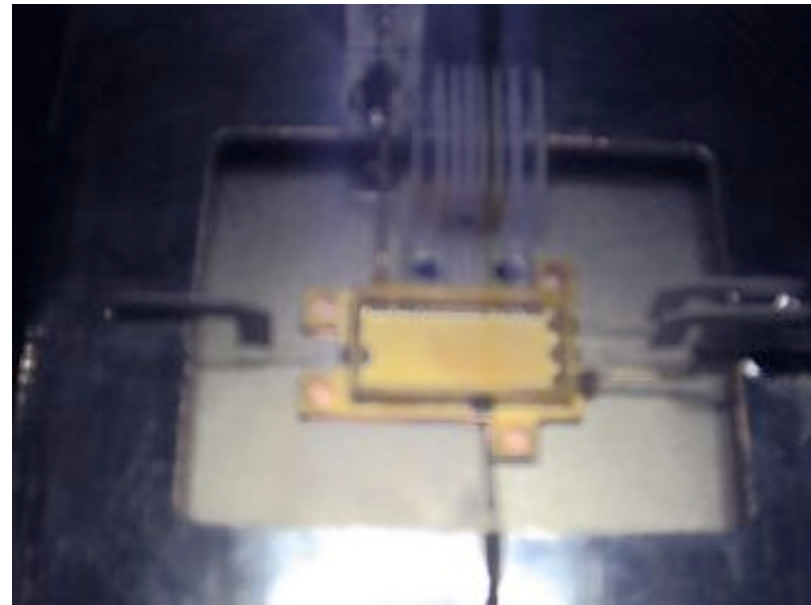
- Hybrid Coupler
  - SG CPW Probes
  - Custom Chuck
  - Standard Calibration
  - Note:
    - Best Results at higher frequency when probes are factory tuned for min reflection on passive devices



Signal Ground Contacts

# Anything CPW - Hittite

- MMIC Package
  - CPW-like launch
  - Custom DUT holder
    - Template
  - Std Probes
  - Std or Custom Calibration

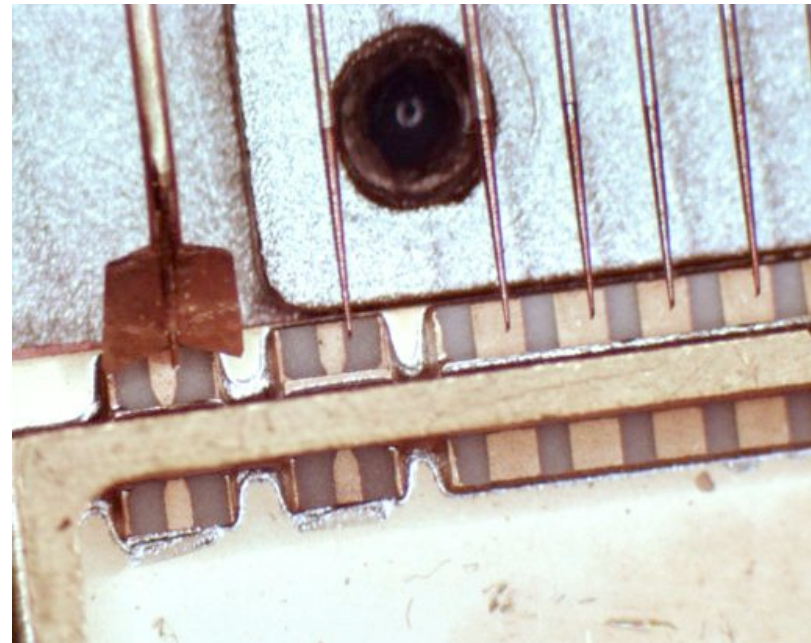


Custom MMIC Module



# Anything CPW - Hittite

- MMIC Package
  - CPW-like launch
  - Custom DUT holder
    - Template
  - Std Probes
    - In this case on a probe card
  - Std or Custom Calibration

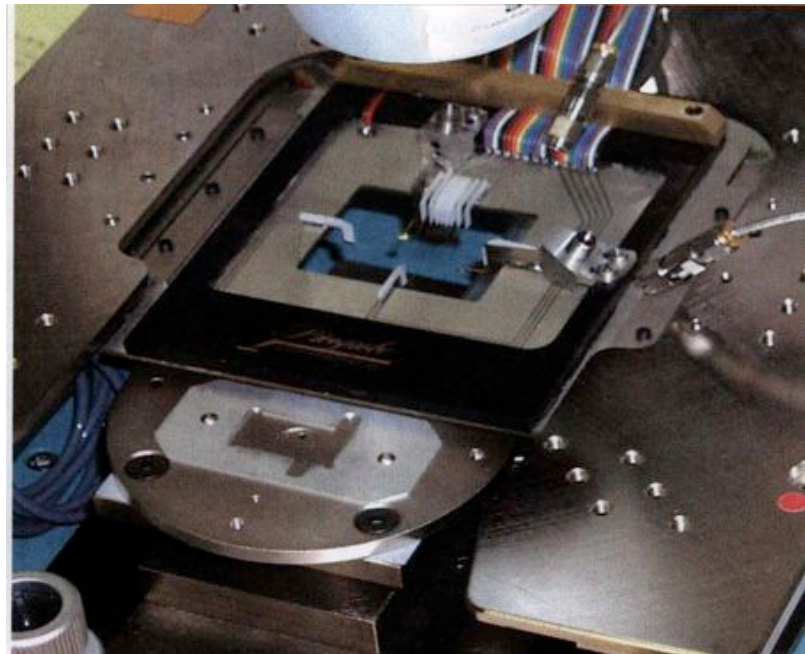


CPW like Thru Wall Launch



# Anything CPW - Hittite

- MMIC Package
  - CPW-like launch
  - Custom DUT holder
    - Template
  - Std Probes
  - Std or Custom Calibration



Probe Card With CPW Probes



# Interconnect Structures

- High Performance PCB
  - Signal integrity
  - Transition
  - Impedance
  - Parasitic elements



Probes Contact Directly on PWB

# Interconnect Structures

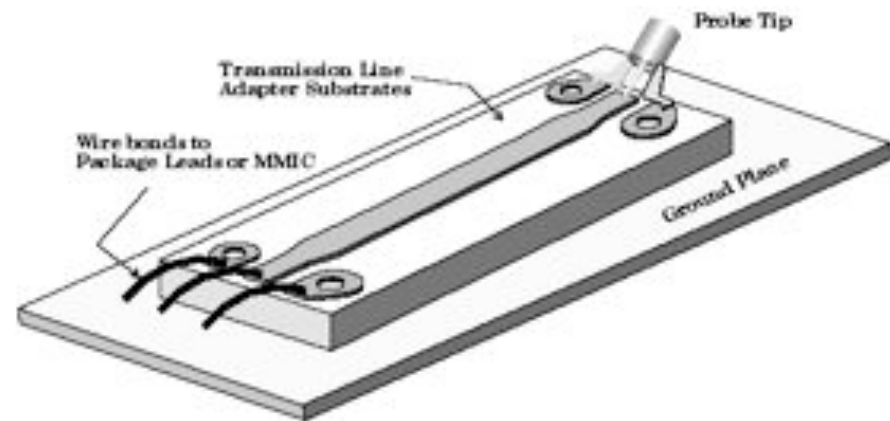
- High Performance PCB
  - Signal integrity
  - Transition
  - Impedance
  - Parasitic elements



Signal Ground Style Probes

# Interconnect Structures

- High Performance ceramic material characterization
  - Signal integrity
  - Transition
  - Impedance
  - Parasitic elements



ProbePoint™ 0510 Test Interface Circuit

Probe Directly on Ground-Signal-Ground  
Interconnect Structures



# Interconnect Structures

- High Performance ceramic material characterization
  - Signal integrity
  - Transition
  - Impedance
  - Parasitic elements



Device Characterization Substrates for  
Modeling and Quality Control



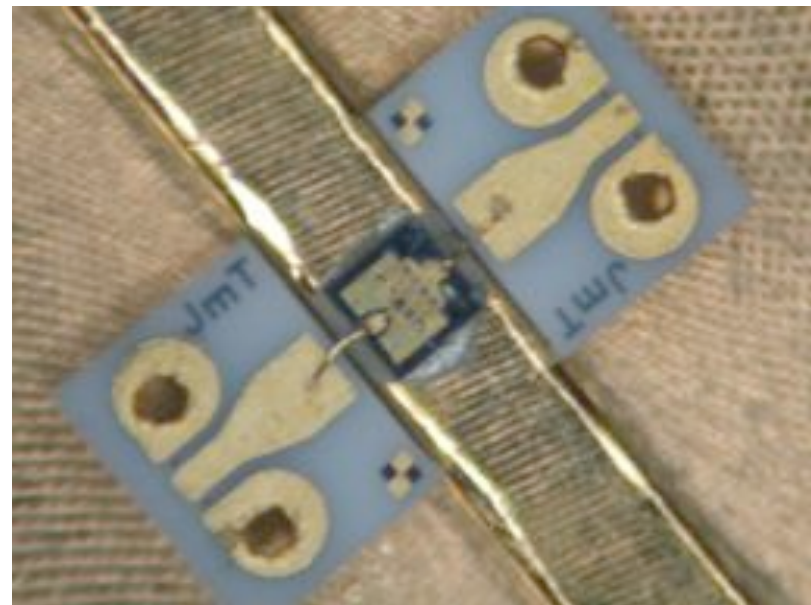
# Second Order

- Measurements that require fixturing
  - Transistor Modeling and Evaluation
  - Microstrip or 3-D structures
    - Diodes - Single Port Devices
    - Microstrip Carriers
    - Packages - Not CPW
  - Qualification Samples That Require Ability to Archive and Handling
    - Robustness
    - Traceability



# Transistors - Not CPW

- Fixture
  - Carrier
  - CPW to  $\mu$ Strip Adapter
  - Cal Substrate
  - Std carrier/adapters  
from:  
J microTechnology, Inc.



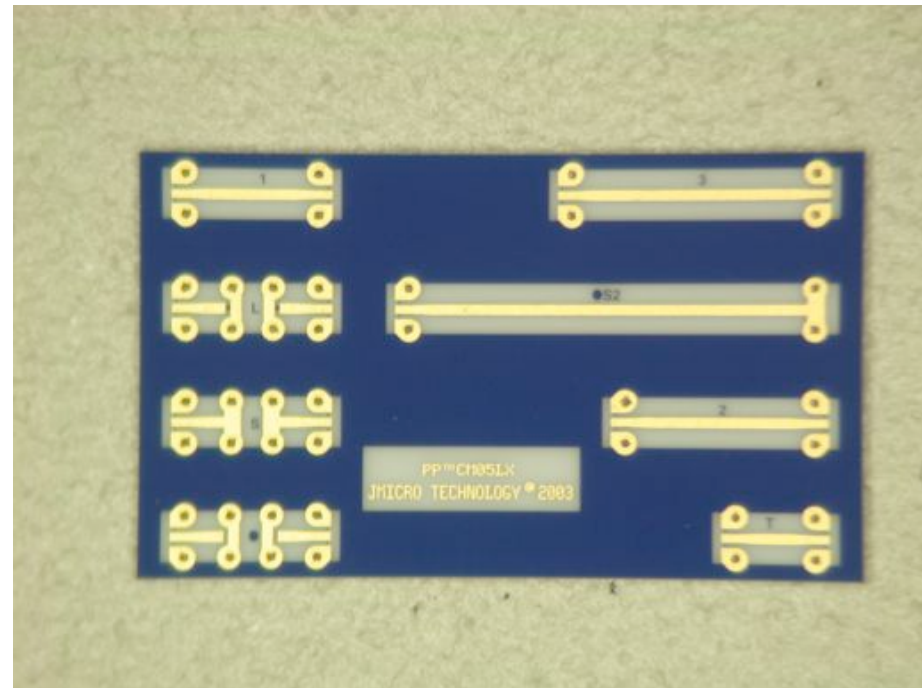
Transistor on Carrier

PP™ 1003 + PP™ CAR



# Transistors - Not CPW Calibration

- Fixture
  - Carrier
  - CPW to MSTRIP Adapter
  - **Cal Substrate**



Calibration Substrate

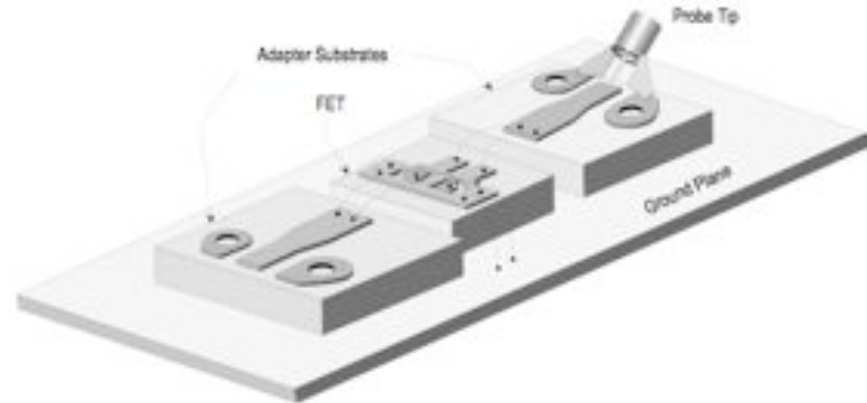
PP™ CM05LX





# Transistors - Not CPW

- Procedure
  - Assemble Carrier
  - Calibrate Probes through Adapter Substrate
  - Measure



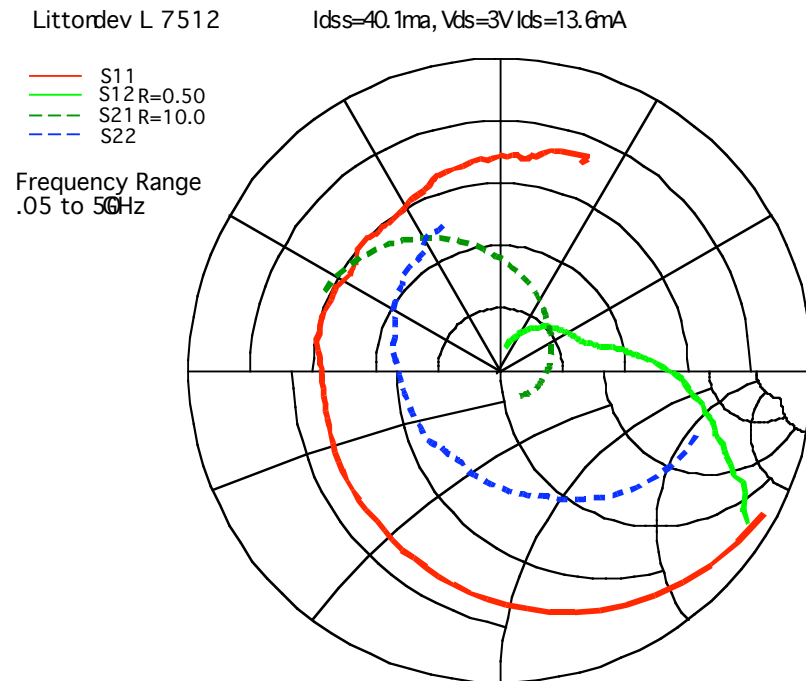
Two Adapters + One Carrier + One DUT

Testable CPW Fixture



# Transistors - Not CPW

- Results
  - Consistent
  - Repeatable
  - Correlation to other sites operators and very importantly customers.
  - Meets generally accepted quality procedures

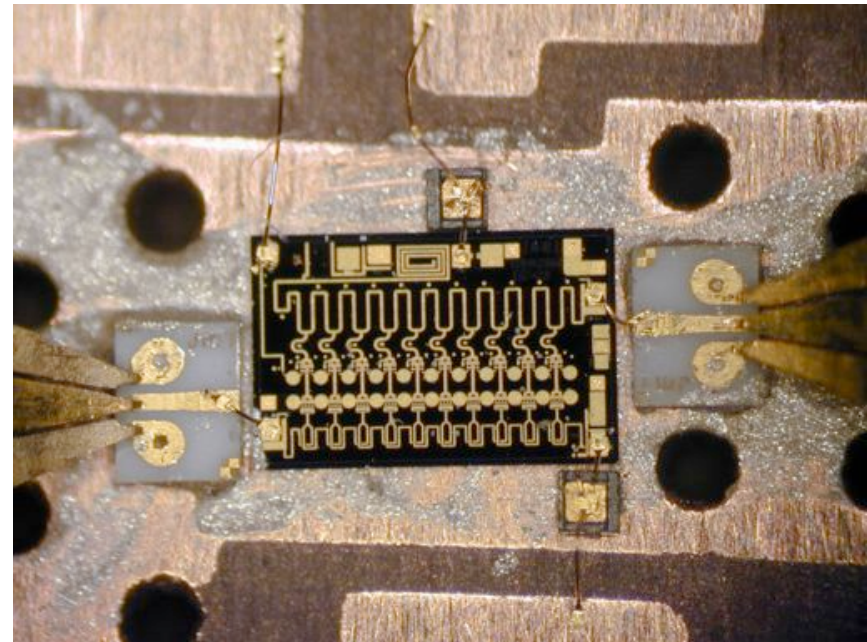


Measured Data Without Compromise



# MMIC - Not CPW

- Results
  - Consistent
  - Repeatable
  - Correlation to other sites and operators.

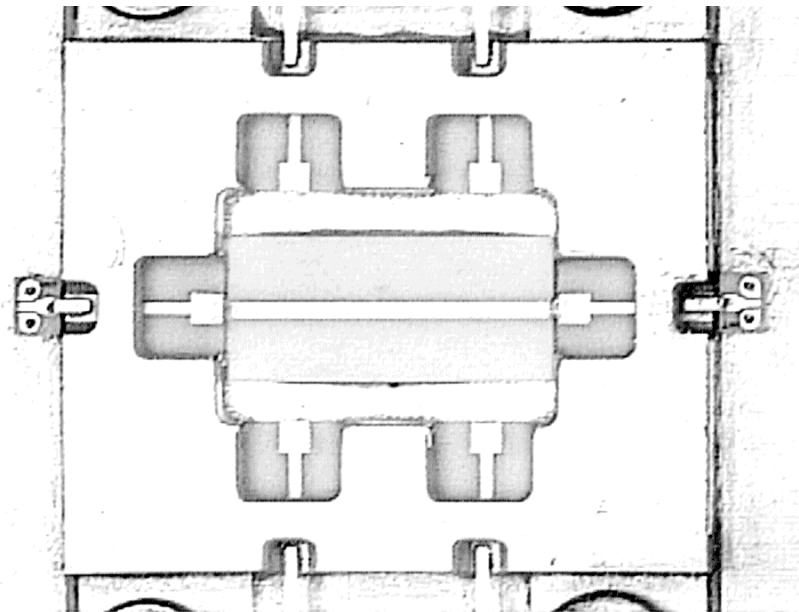


Applicable to More Complex Devices Also

# Package Characterization

- Fixture
- Calibration
- Measure

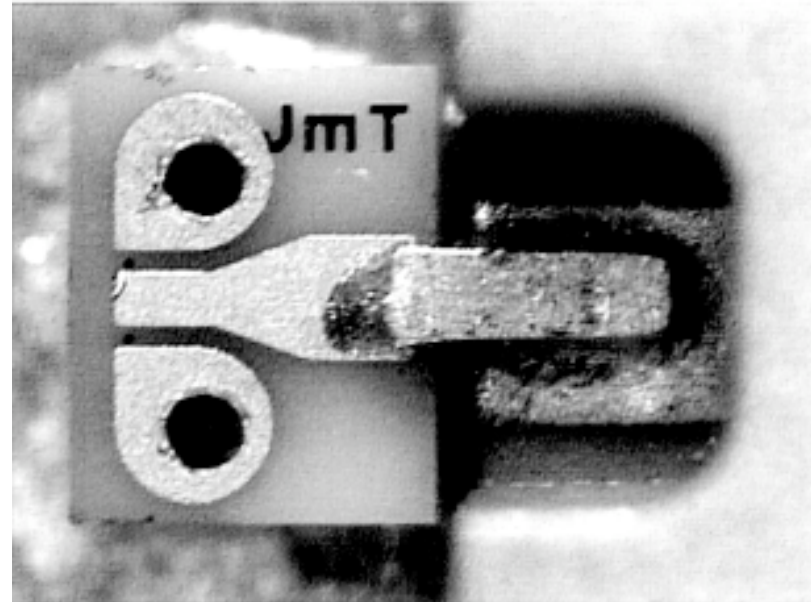
Industry Std approach  
Circa 1994



# Package Characterization

– Detail

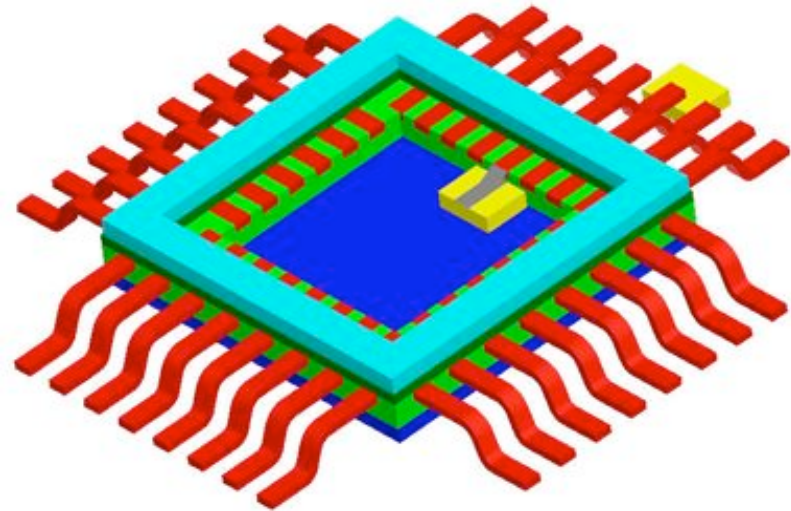
Industry Std approach  
Circa 1994



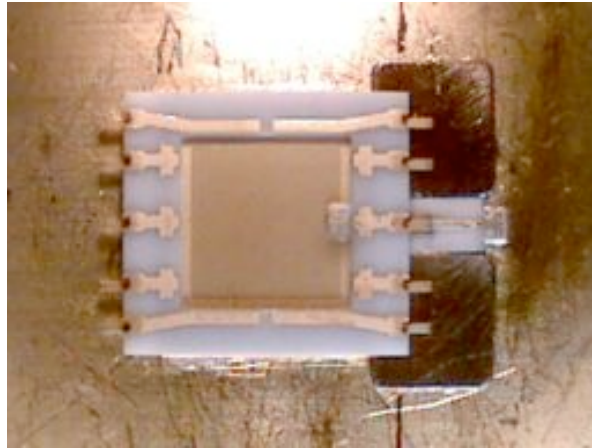
# Package Characterization

- Fixture
- Calibration
- Measure

Industry Std approach



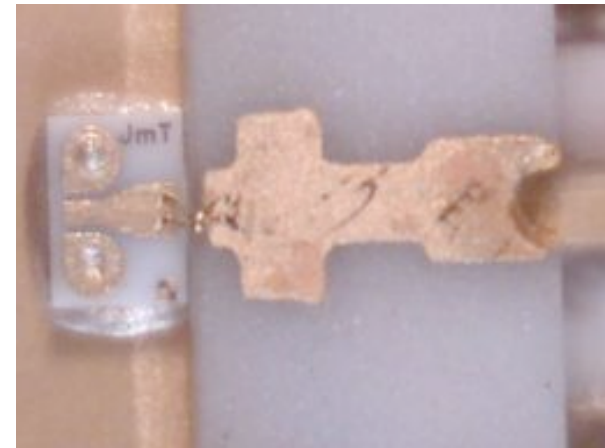
# Package Characterization



Industry Std Approach

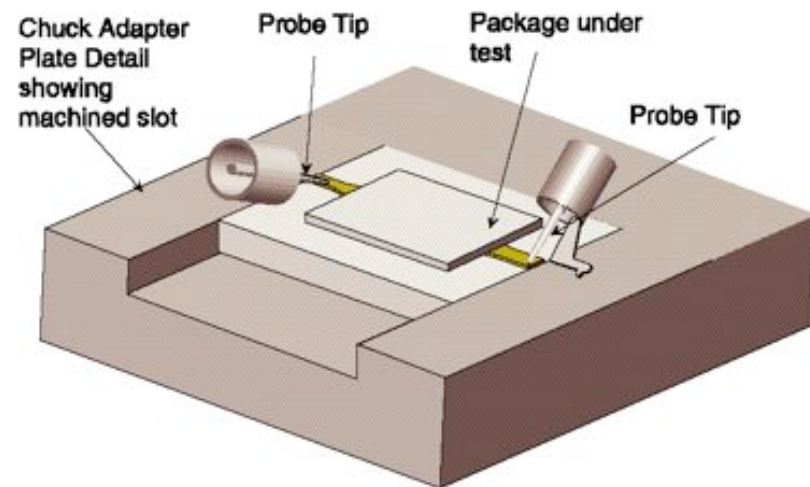
Today

StratEdge Package 2006



# Microstrip Carriers

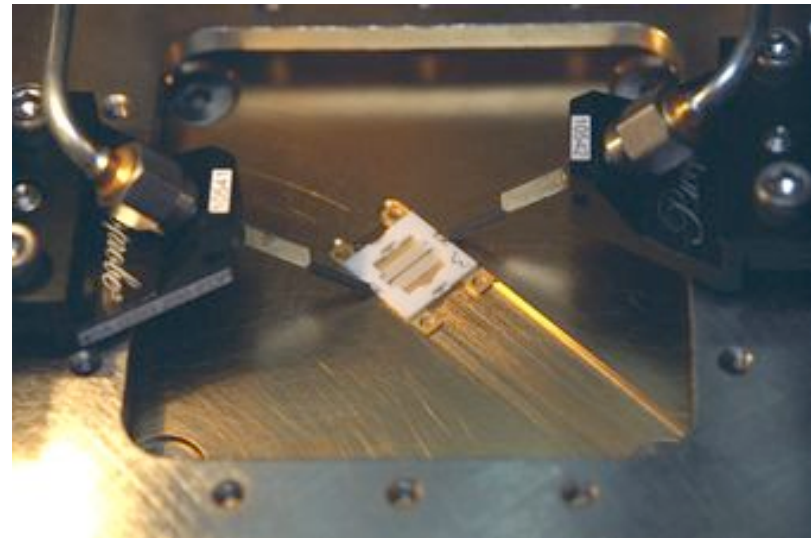
- Custom DUT Holder
  - Custom Chuck
  - Custom Calibration
  - Rapid Repeatable Measurements





# Microstrip Carriers

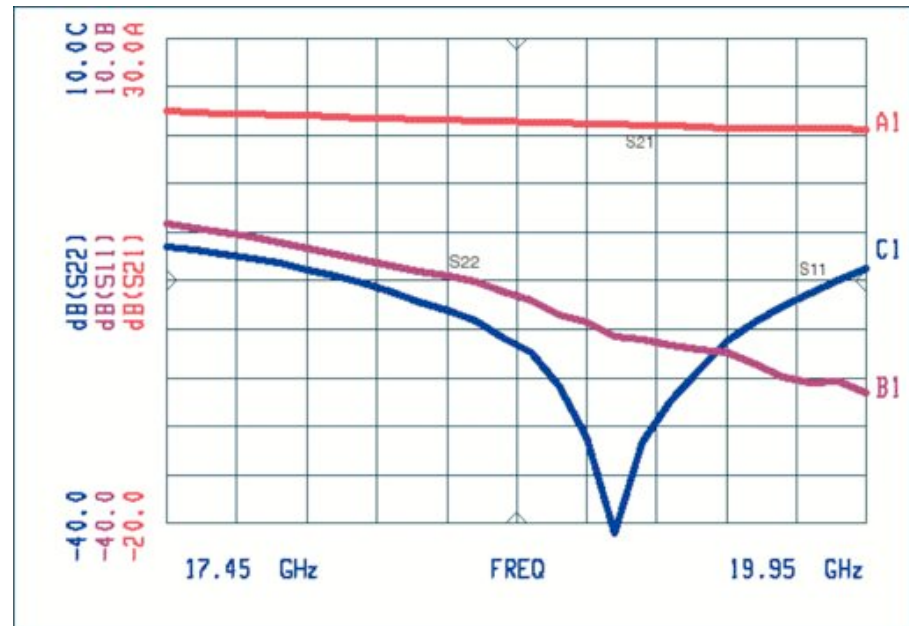
- Custom DUT Holder
  - Custom Chuck
  - Custom Calibration
  - Rapid Repeatable Measurements



Custom Chuck For Ground Contact

# Microstrip Carriers

- Custom DUT Holder
  - Custom Chuck
  - Custom Calibration
  - Rapid Repeatable Measurements
  - **Typical Data**



Measured Data Without Compromise



# Diodes - Not CPW

- Procedure
  - Assemble Carrier
  - Calibrate Probes through adapter Substrate
  - Measure



The Same Process Can Be Used  
On 1-Port Measurements Also!

# CPW Probes “Raised The Bar”

- Quality microwave transition removes uncertainty to improve test contacts integrity and methods for micro component measurements
- Standardized calibration procedure assures
  - Precision
  - Repeatability
  - Cross facility data correlation



# CPW Adapter Substrates Expand the Applications

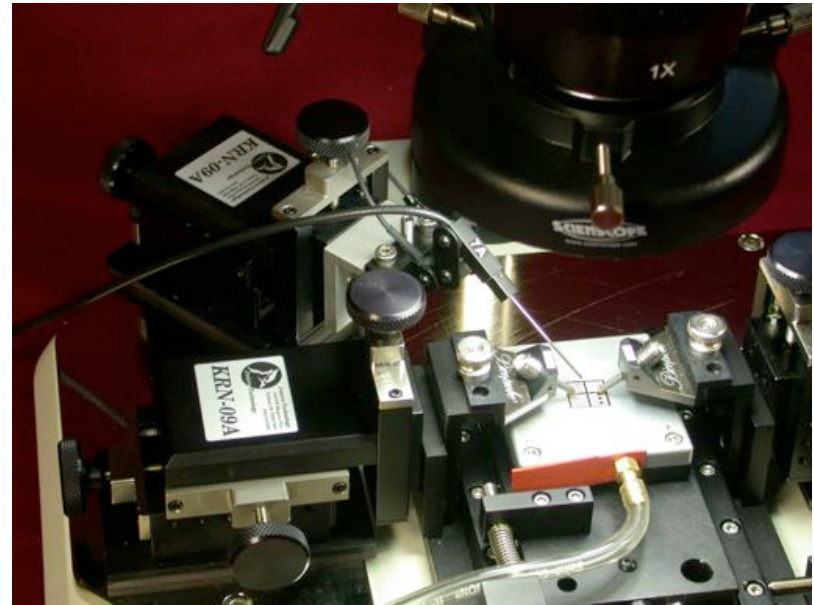
- Microstrip devices become testable
- Measurement data has excellent
  - Precision
  - Repeatability
  - Cross facility data correlation



All derived from the ability to use CPW probes

# J microTechnology, Inc. Your Source for Productive Probing Equipment

- Probe Stations
  - Optics
  - Probe Positioners
  - Temperature Control
- CPW Probes
- CPW Adapter Substrates
- Calibration Substrates



# More Info?

Contact J microTechnology, Inc.

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(503) 614-9509

