Microwave Probe Test Evaluation on Teradyne A585

Motivation

Challenge

Calibration Concept

Test H/W of TRF1012

Probe Interface

Measurement Results

Conclusion

The Team

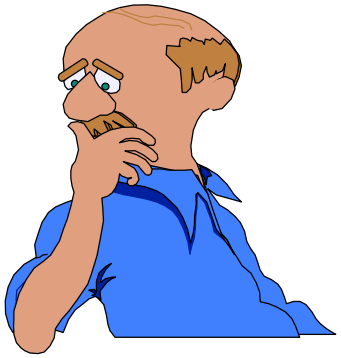
Joerg Paulus
Texas Instruments

Michael Janssen
Texas Instruments

Harald Parzhuber
Texas Instruments

Dieter Luecking
Teradyne

Manfred Kanther
Texas Instruments



Detlef Bergmann
Teradyne

RF Probe Test (1.9 GHz)

Motivation

Discover wafer process influences to the RF performance at wafer level already.

Perform a device RF performance validation as soon as silicon is available.

Potential for Die delivery to customers demands for a full performance probe test.

Advanced packaging methods like flip-chip will require RF probing.

Interleave testing between probe and final test improves the test efficiency and reduces cost.

RF Probe Test (1.9 GHz)

Challenge

Establish controlled impedance transmission lines to the device bond pads.

Establish an RF probe test setup calibration process at wafer level.

Solution Strategy

Utilize overhead testhead docking system of A580 tester.

Utilize probe card POGO/OSP connection system for flexible probe card changes.

Utilize Cascade's Membrane probe contact technology.

Generate wafer standards for test system calibration.

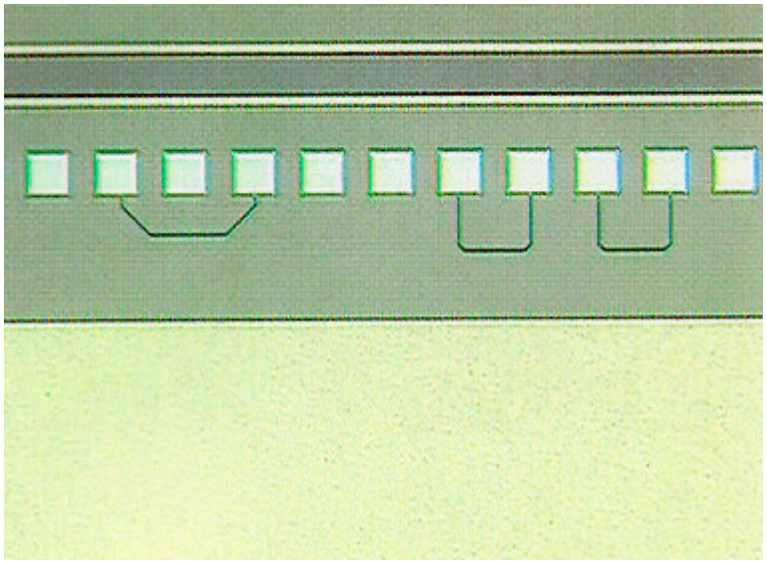
RF Probe Test (1.9 GHz)

Calibration Concept

High Frequency parametric tests demand for a calibrated test setup.

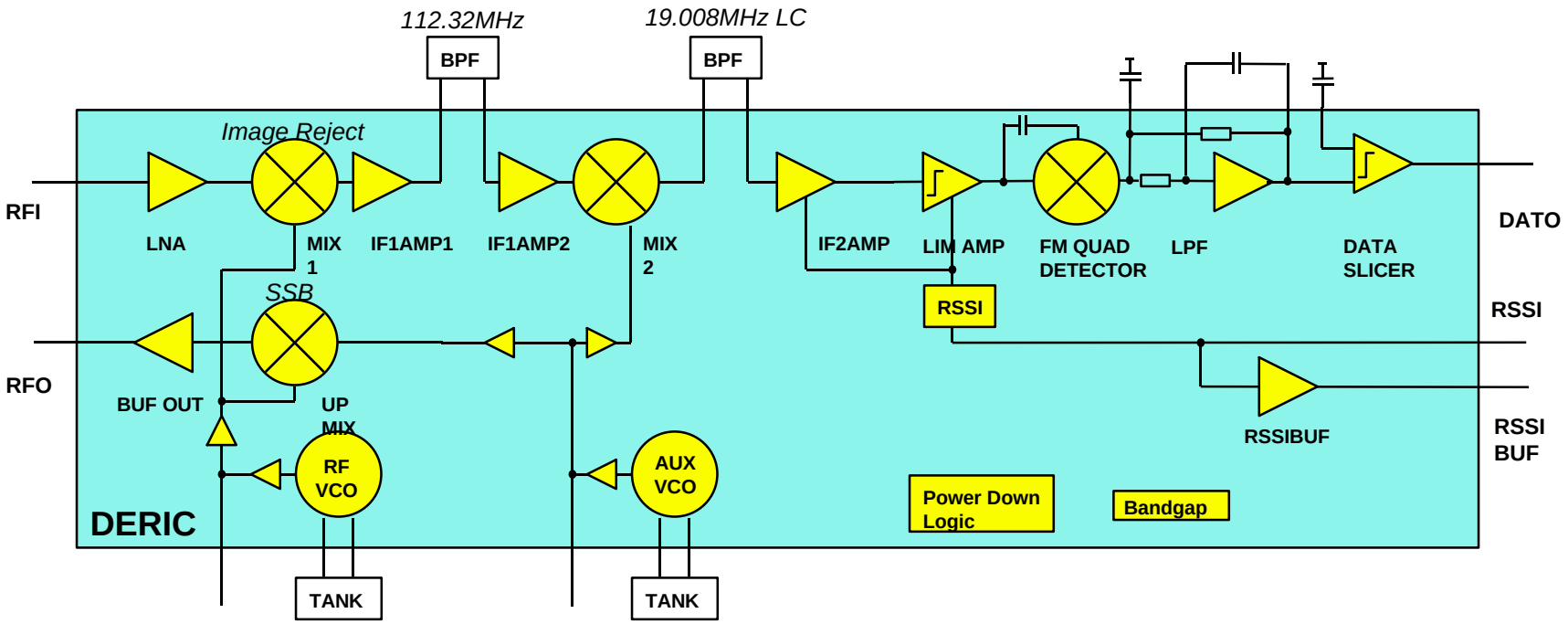
The reference level or calibration point of supplied and measured signals should be the die pad for bare dies.

Calibration structures like 50 ohm resistors, Opens and Shorts are needed.



RF Probe Test (1.9 GHz)

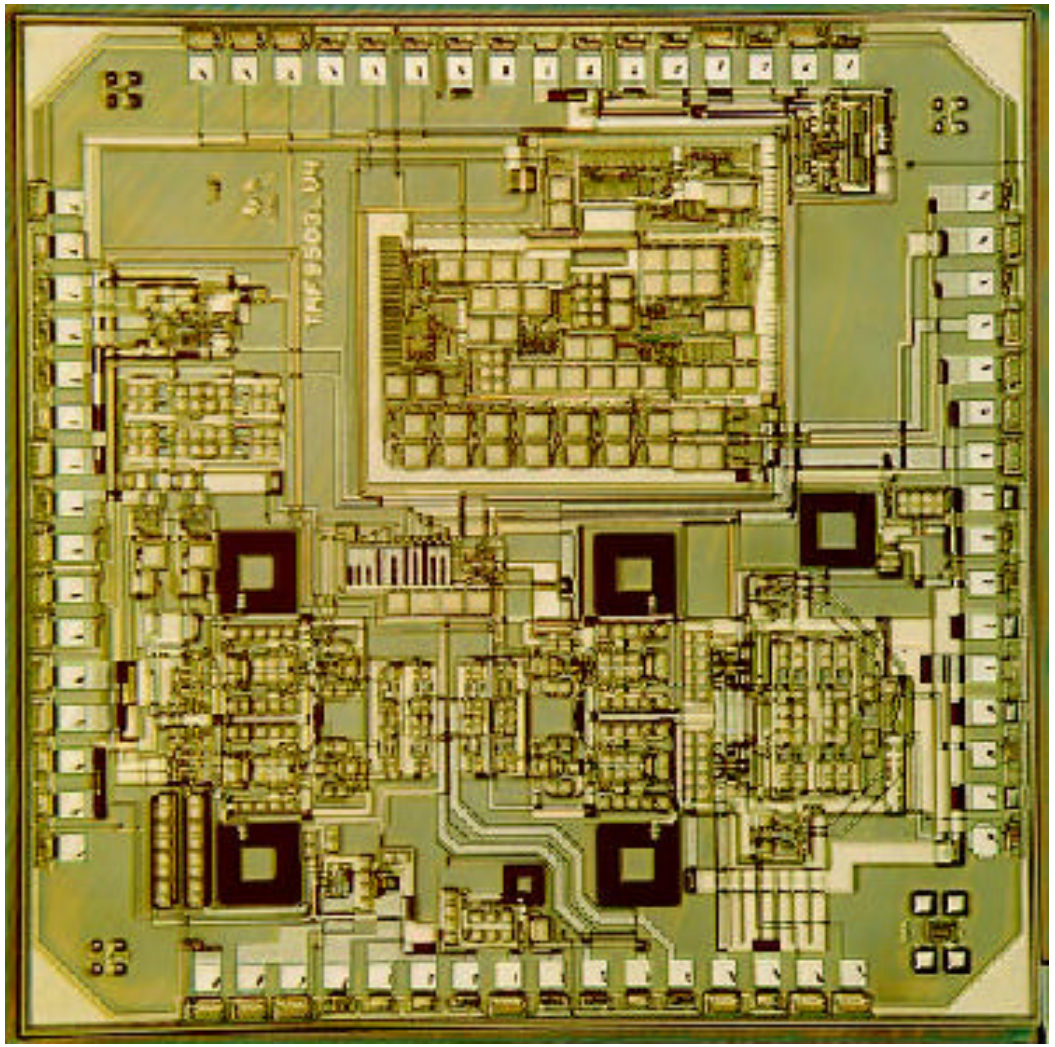
DECT RF Transceiver



- VCC = 3.0V +/- 10%
- Receiver Sensistivity = -90dBm. -> 8dB NF at Antenna. -> 5.5dB NF at Image Reject Mixer
- Receiver Intermodulation Rejection. IP3 = -23dBm at Antenna -> -25dBm at Receiver input
- RF VCO Phase Noise = -106dBc/Hz @ 1MHz offset
- Receiver RSSI. Dynamic range = 70dB. Linear over: RFin = -93dBm (antenna) -> VRssi = 0.75V
  RFin = -33dBm (antenna) -> VRssi = 1.96V
- Transmit Output Level = 0dBm

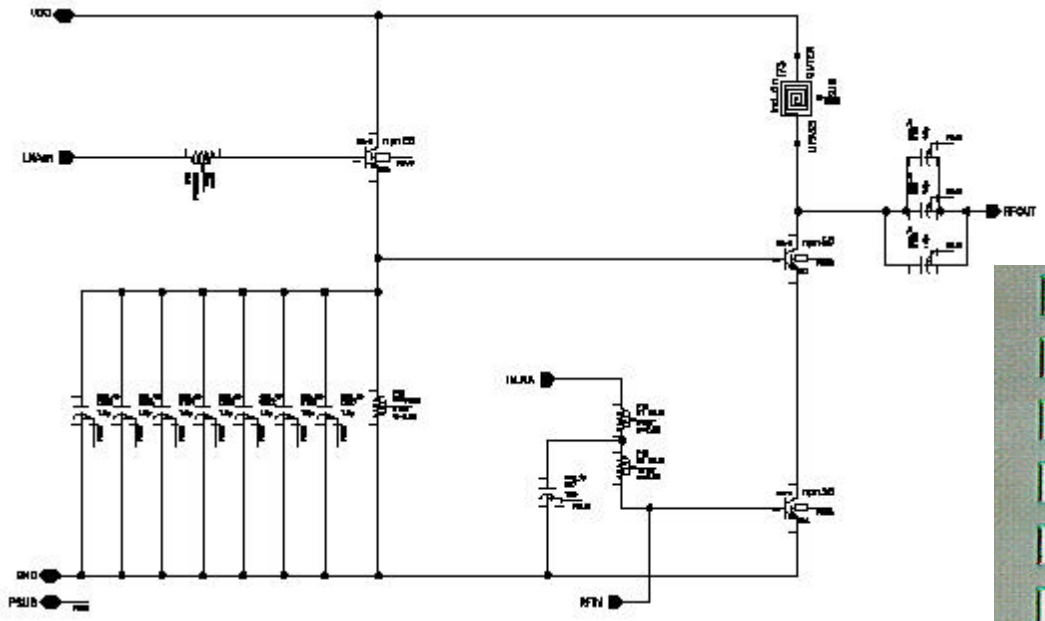
RF Probe Test (1.9 GHz)

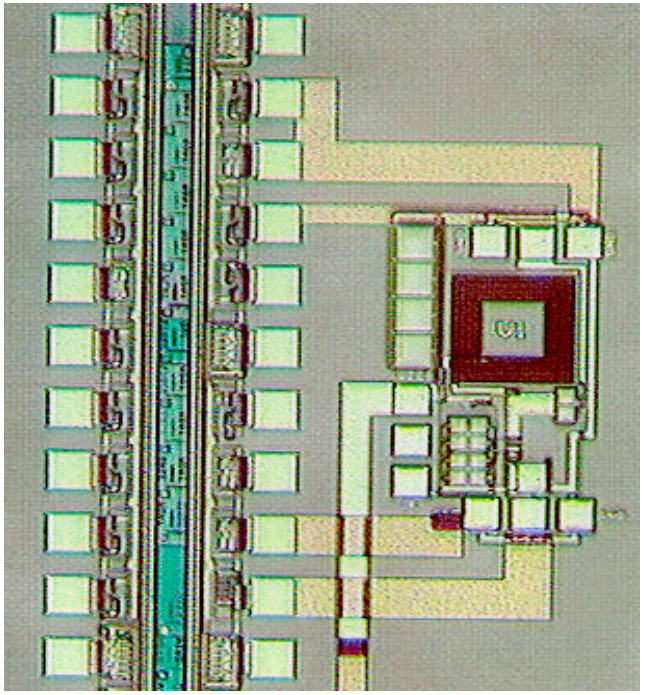
Chip Photo
TRF1012



RF Probe Test (1.9 GHz)

LNA schematic and Chip Photo

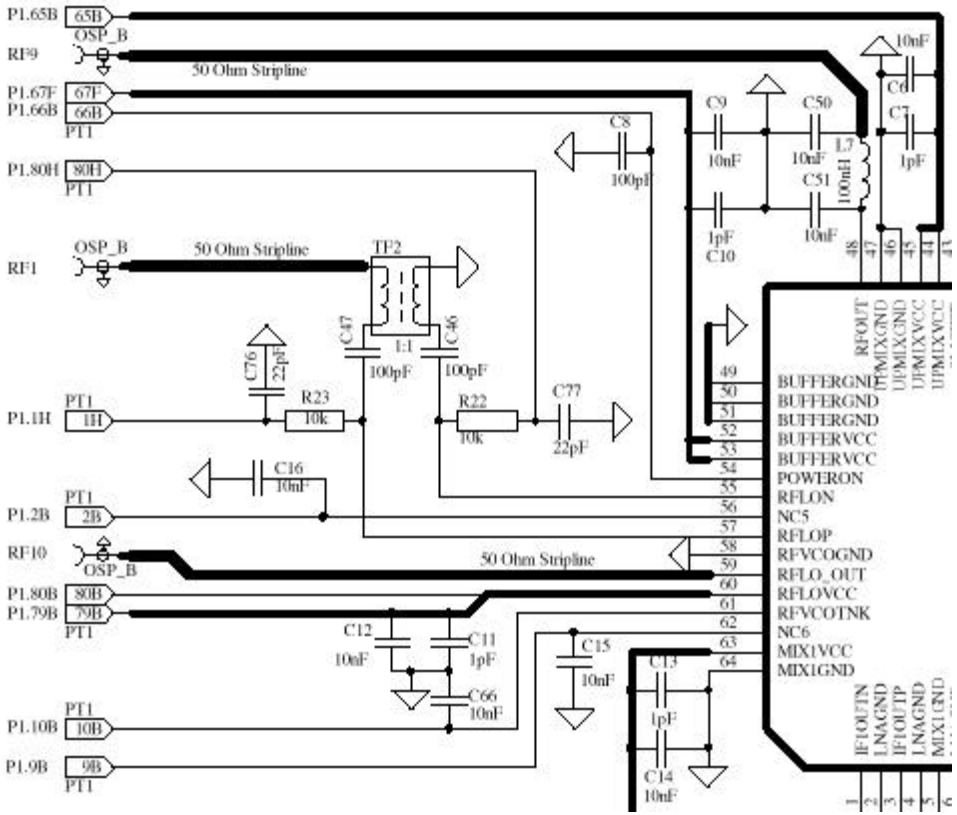




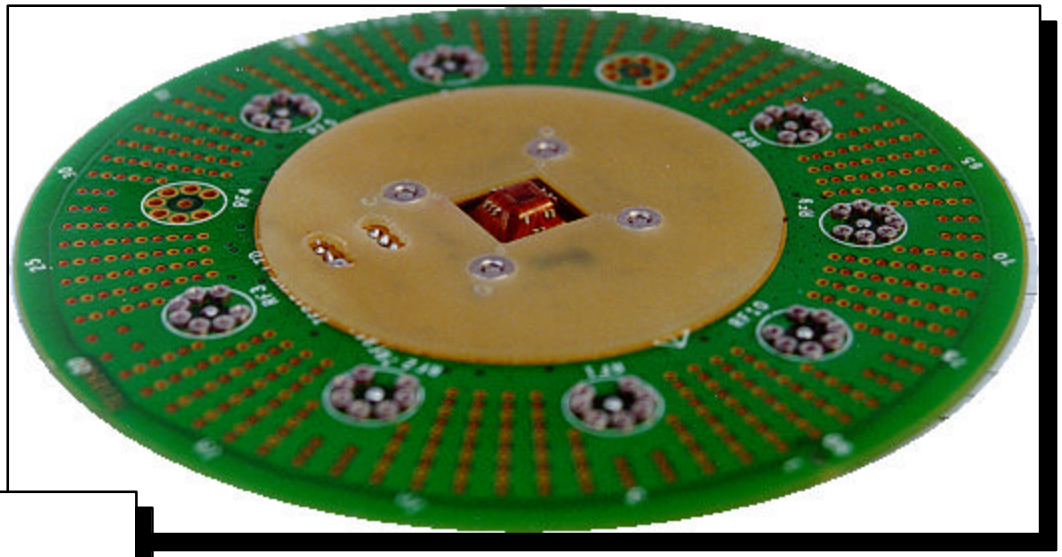
The LNA was separately placed on a single chip for lab to tester correlation exercise.

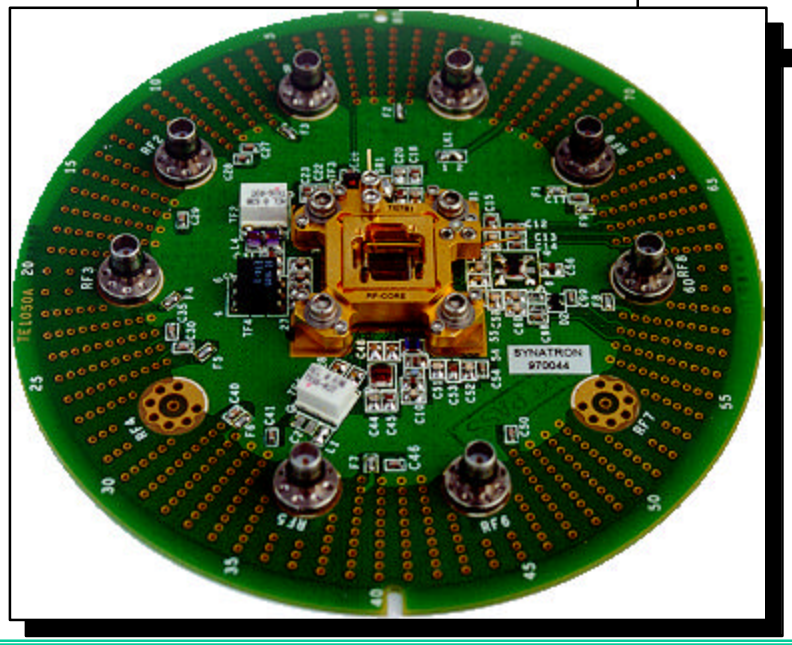
RF Probe Test (1.9 GHz)

Test Schematic



RF Probe Test (1.9 GHz)

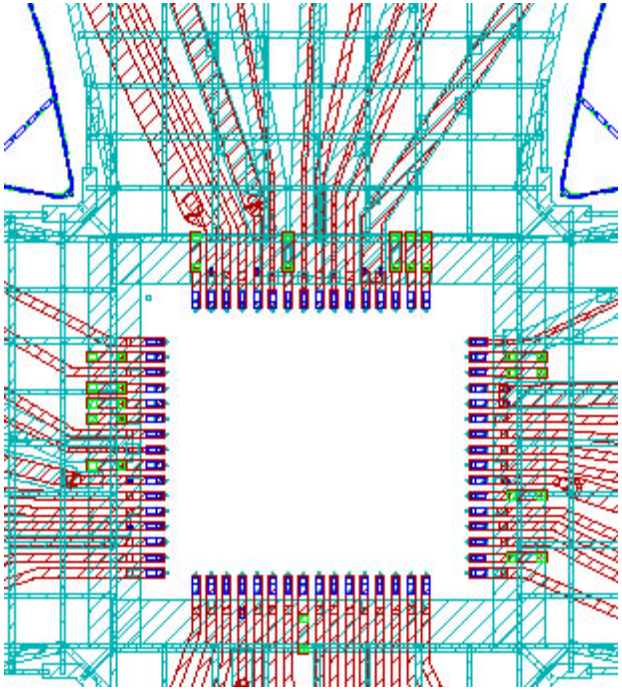


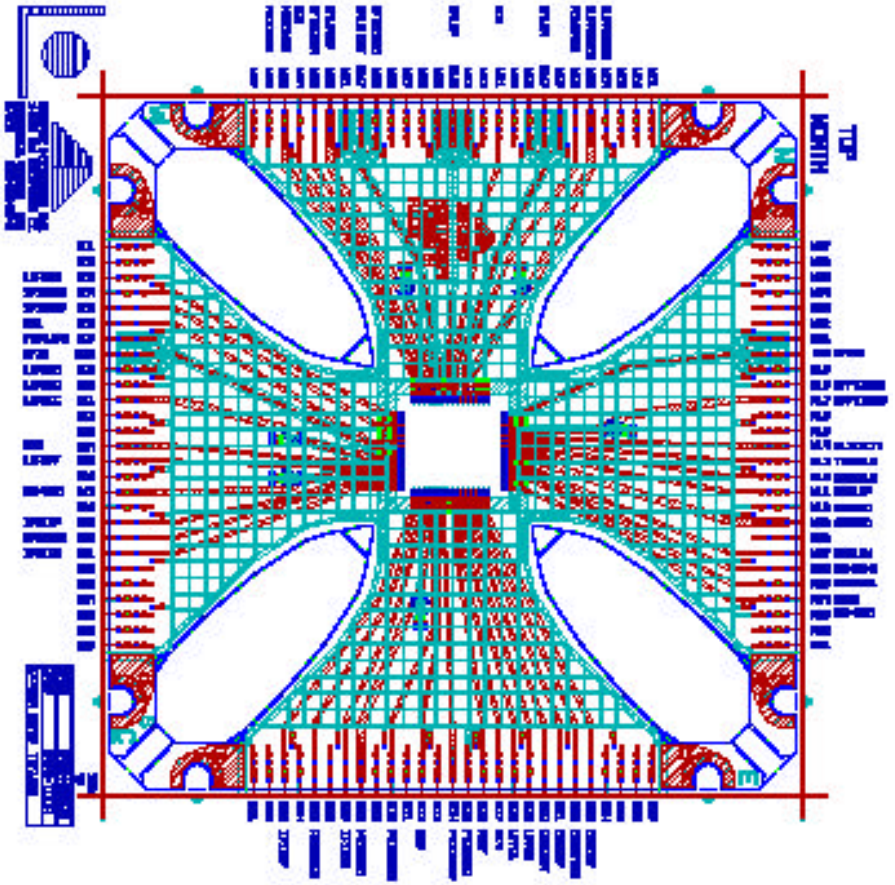


Details of the TERADYNE / CASCADE Probe card

RF Probe Test (1.9 GHz)

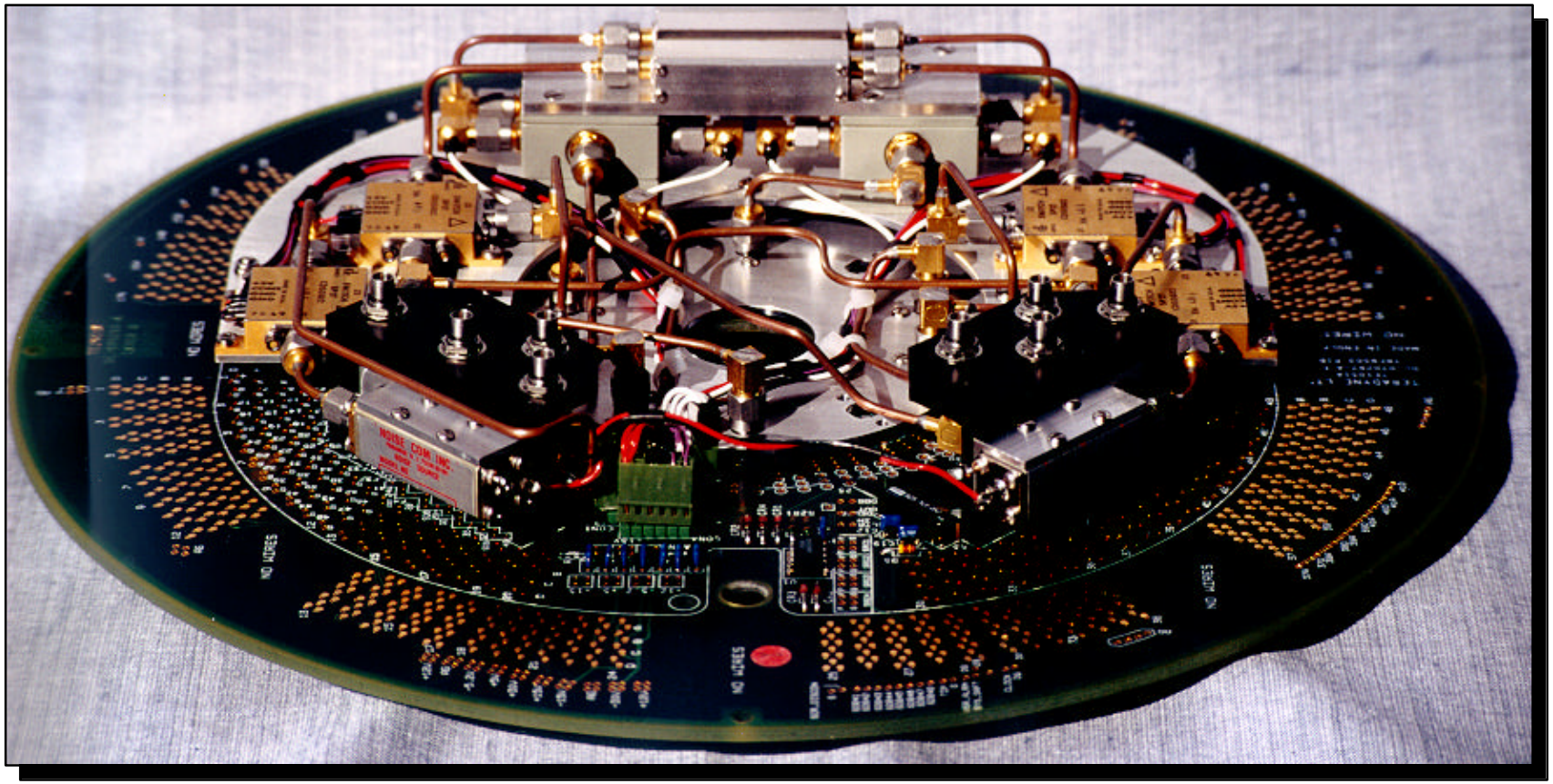
Membrane Layout





Texas Instruments

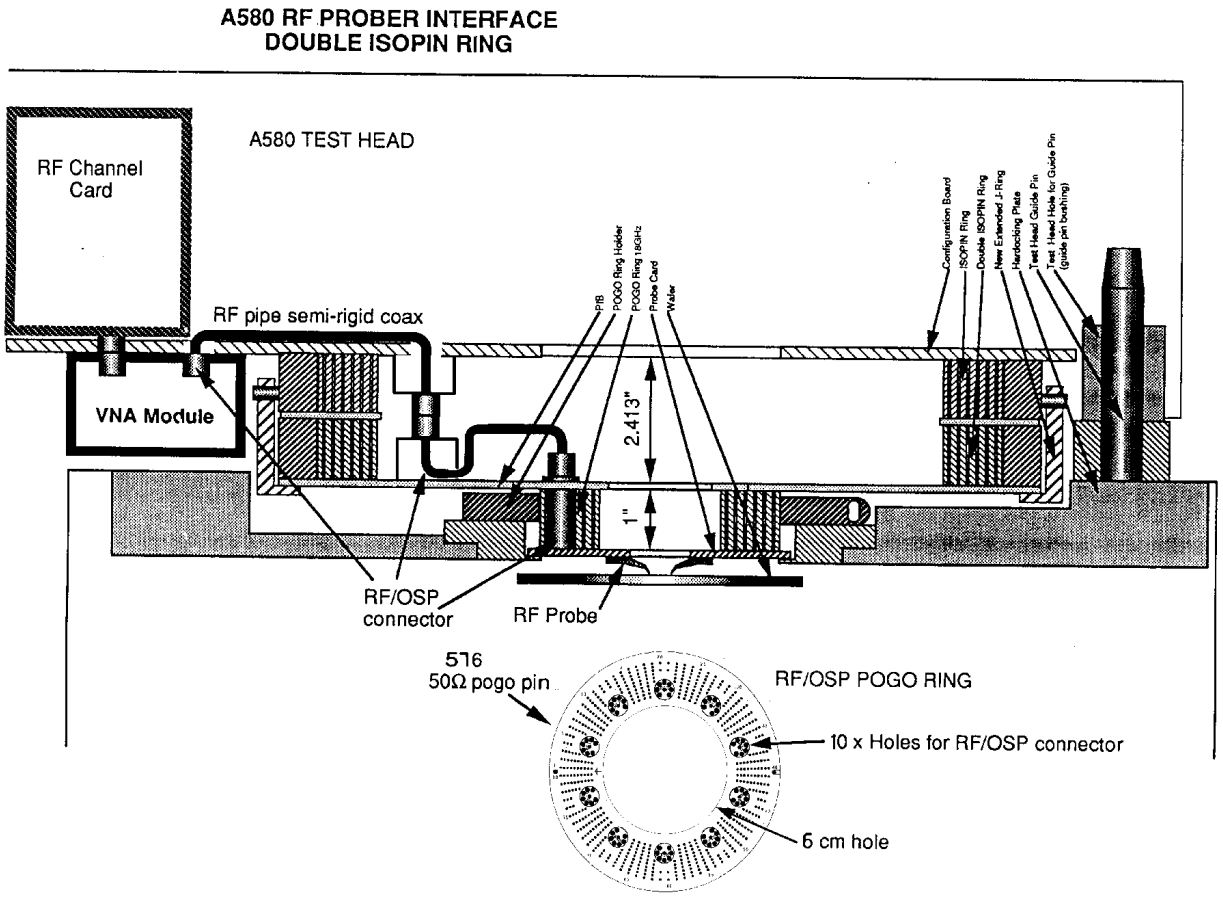
RF Probe Test (1.9 GHz)



PIB shown with RF semi-rigid cabling

RF Probe Test (1.9 GHz)

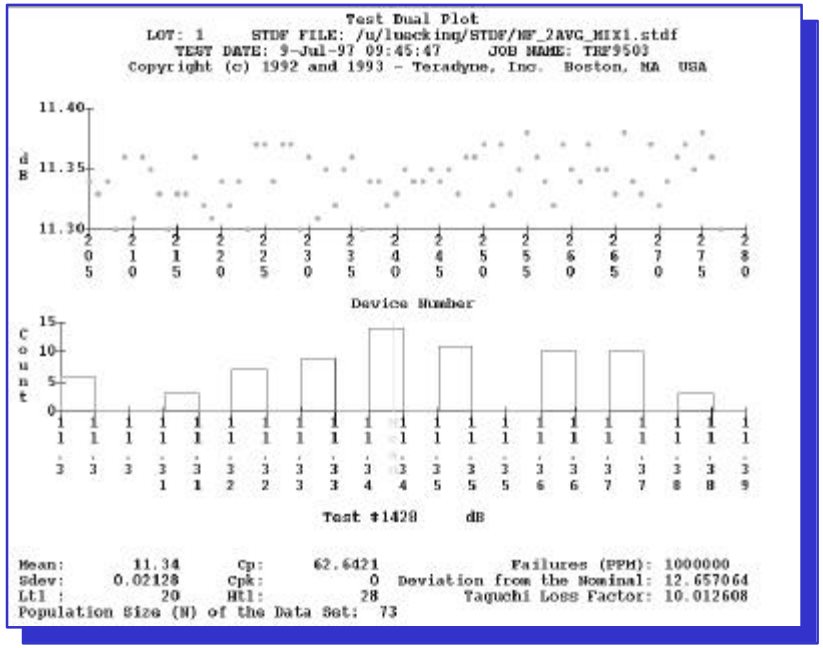
Overhead Docking Construction



RF Probe Test (1.9 GHz)

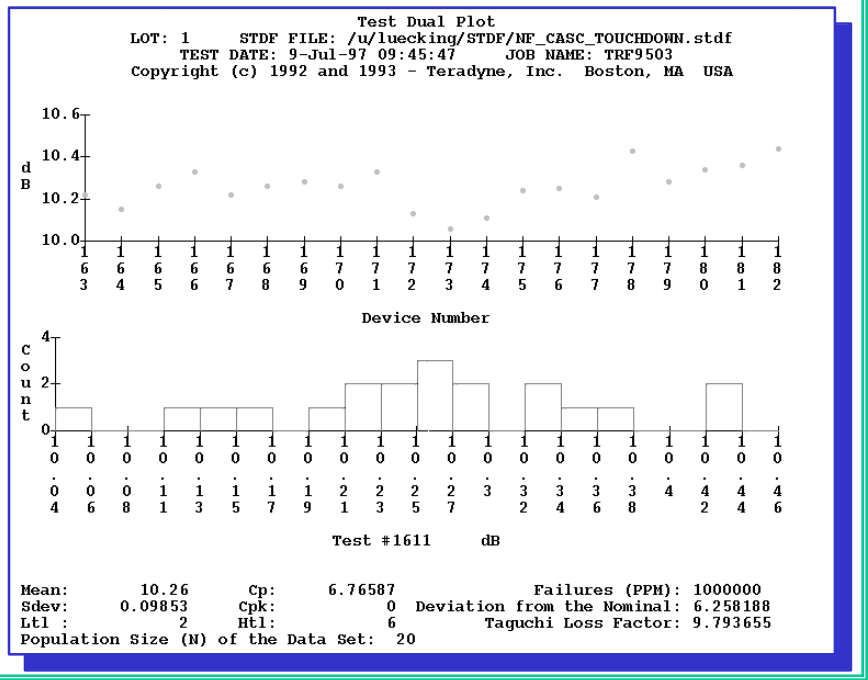
Repeatability Data

Distribution of gain probed with CASCADE Membrane Probe
73 runs on same device
Input Level: ***-36dBm*** @ DUT
Input frequency: 1905MHz
Output frequency: 112MHz



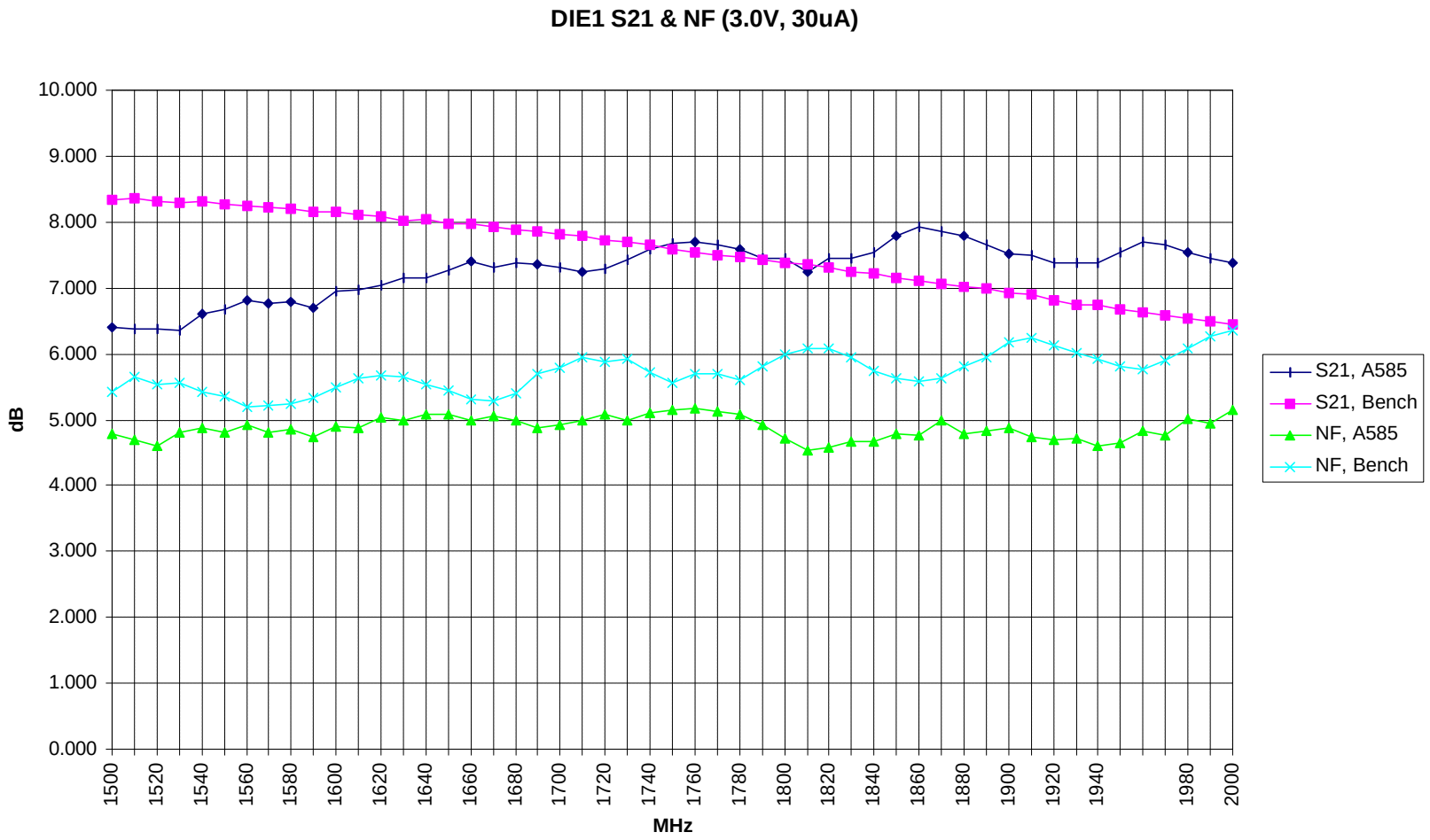
Stability of de-embedded On-Wafer Noise Figure of Mixer1 over 20 touchdowns

Shown: Distribution of Noise Figure
20 touchdowns on same device (1 between every measurement)
Input frequency: 1905MHz
Output frequency: 112MHz



RF Probe Test (1.9 GHz)

Correlation Data



RF Probe Test (1.9 GHz)

Conclusion

A probe test setup was established with controlled impedance lines from the tester microwave source to the device bond pad.

Special calibration wafers with calibration structures were manufactured for complete probe card de-embedding.

Special LNA wafer was designed and processed for probe test to lab measurement correlation study.

Acceptable repeatability and reproducibility of RF measurements at wafer probe were achieved.

A correlation study of RF measurements at wafer probe and in the lab revealed that the different test environment must be taken into account to assess the results correctly.