Philipp F. Freidl[1,3], **Sebastian Sattler[1]** , Michael Gadringer[1] , Dominik Amschl[1] ,
Ulrich Mühlmann[2] , Gerald Holweg[3] , Wolfgang Bösch[1*]
[1] Institute of Microwave and Photonic Engineering, Graz University of Technology, Graz, Austria
[2] NXP Semiconductors, Gratkorn, Austria
[3] Development Center Graz, Infineon Technologies Austria AG, Graz, Austria
* wbosch@tugraz.at, www.ihf.tugraz.at

TU Graz

IHF

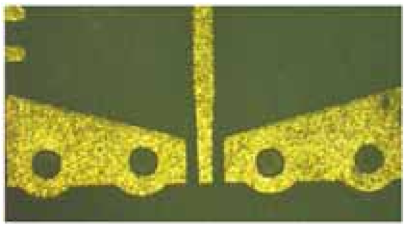
PCB RF Probe Landing Pads for mm-Wave Measurements

Introduction

The commercial deployment of radio frequency systems in the mm-wave regime is a driving force for the implementation of planar structures on printed circuits boards (PCB).

The characterization of such structures on a mm-wave PCB requires a well defined transition from a co-axial interface of a measurement device to a planar interface of the device under test (DUT). One solution on the market which provides these transitions is a probe station with RF probes. The initial costs for a probe station are significant, but a single RF probe can endure several thousand touchdowns. Another advantage of this approach is the highly repeatable contacting process.

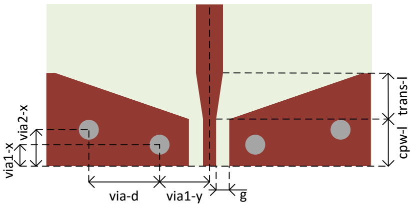
The design of the landing pads has a significant impact on the overall performance of the measurement system using RF probes. To ensure maximum measurement accuracy the landing pad should provide a low reflective, low-loss and low dispersive transition between the probe tips and the microstrip interface of the DUT. While the design of landing pads up to mm-wave frequencies for on-wafer measurements is a well investigated topic, there is little literature available which focuses on landing pads for PCB applications at mm-wave frequencies.



Photograph of the landing pad

Design

The presented design of the landing pad consists of three areas: (1) a grounded coplanar waveguide (GCPW) which provides a suitable landing structure for the coplanar like mode of a ground-signal-ground (GSG) probe and transforms it into a grounded CPW mode, (2) a transition area which transforms the grounded CPW mode into a microstrip mode, and (3) a microstrip area, where the landing pad structure connects to the DUT.



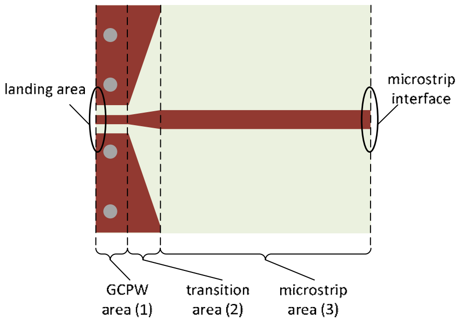
Dimensions of the landing pad structure for the parameter variation

The initial structure was derived from the limitations imposed by the probe and the selected substrate material (Rogers RO3003, 127 µm thick). Thereafter the dimensions as well as the number and positions of the vias were then optimized using 3D-EM simulations. The resulting distances are summarized in the table below named variant #1.

Additionally, landing pads with different design parameters were manufactured (#2 - #7 in the table).

variant	via1-x	via2-x	via1-y	via-d	g
#1	150	150	400	600	55
#2	100	200	400	600	55
#3	200	100	400	600	55
#4	150	150	370	600	55
#5	150	150	430	600	55
#6	150	150	400	600	50
#7	150	150	400	600	55

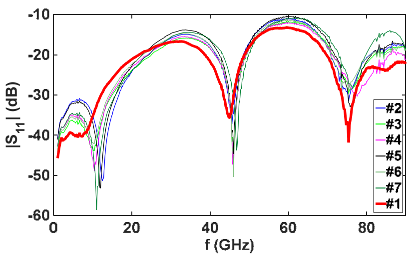
Parameter sets for the different variants (µm)



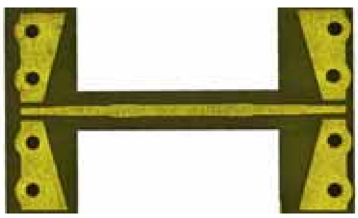
Design of the landing pad

Measurements

The input matching of the seven landing pad variants were measured over the frequency range DC – 90 GHz. In the plot variant #1 is indicated by the bold red trace. Over the considered frequency range a minimum return loss of -13 dB can be recognized. Additionally, a resonant behavior between 70 – 80 GHz was accomplished supporting the operation in the mm-wave regime.

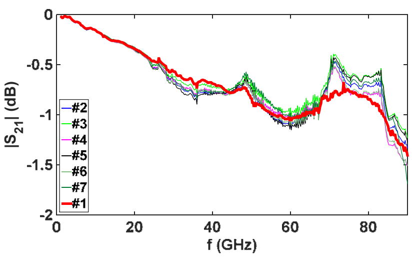


Input matching of the fixture

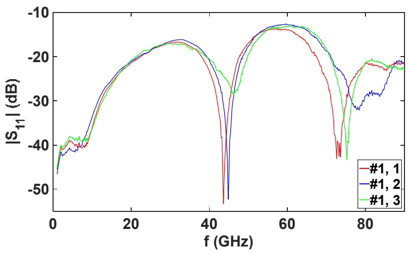


Picture of the landing pads (#1) in a Through configuration

The insertion loss measurements were accomplished arranging the landing pads in a Through configuration. All variants show a resonant behavior around 45 GHz and 75 GHz which corresponds to the zeros in the input matching measurements. Compared to all other variants, #1 shows the most linear behavior over the considered frequency range.



Attenuation of the through configuration



Variation of the input matching for different realizations of #1

To investigate the sensitivity of the selected design (#1) to production and probing tolerances the input matching for three landing pads located at different positions of the PCB are compared. Deviations in the behavior can be recognized at the zero around 45 GHz and above 75 GHz.

Conclusion

This poster summarizes design and optimization of landing pads for PCB probing applications. Measurements of the landing pads showed a minimum input matching of -13 dB and a maximum insertion loss of 1.4 dB over the frequency range DC – 90 GHz.
Investigations are ongoing to identify the sources for the variation between the individual realizations of the launching structure to improve the repeatability especially in the frequency range above 70 GHz.

Acknowledgments

This work was funded by the Austrian Research Promotion Agency (FFG) under the K-Project Secure Contactless Sphere – Smart RFID-Technologies for a Connected World.

The authors would like to express their gratitude for manufacturing the prototypes to Erich Schlaffer from AT&S (Austria Technologie & Systemtechnik Aktiengesellschaft).

MESS16 Microelectronic Systems Symposium
28-29 April 2016 • Wien

SeCoS

ihf Institute of microwave and photonic engineering