Blindmate RF Connector for E-Band Production Test

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Overview

• Introduction

• Production E-Band test (60-90 GHz)
  – Current Connector Options and Limitations

• Summary of Connectors for production test

• Performance comparison with non-Blindmate connectors

• Summary
E-Band Market Drivers

- There are several primary market drivers that are requiring more test in the E-band
  - Automotive Radar
  - 802.11ad
  - Cell Phone Short/Back Haul
Market Growth Coming

- The largest of these is projected to be Automotive Radar
  - An anticipated CAGR of ~33% through 2018
What does this mean for Probe Cards?

• The market will require:
  – Hard dock probe cards instead of cabled (soft dock)
    • Prefer blind-mate connectors to standard coax connectors
  – Large number of RF connectors
    • Each automotive die can have 5+ RF high speed channels
    • x4 would then require more than 20 RF connectors per probe card
What should a full production connector look like?

• **Simple to connect**
  – Requires no manual ‘threading’

• **Minimize need for recalibration**
  – No flexing of coax

• **No need for the test engineer to install the probe card**

• **High performance (better than -10 dB RL)**
  – Air dielectric is preferred
## Current Types of Connectors for above 40 GHz

<table>
<thead>
<tr>
<th>Connector</th>
<th>BW</th>
<th>Type of Connector</th>
<th>Example</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.85 mm</td>
<td>67 GHz</td>
<td>Thread-on</td>
<td><img src="image1.png" alt="Image" /></td>
<td>Soft Dock</td>
</tr>
<tr>
<td>1 mm</td>
<td>110 GHz</td>
<td>Thread-on</td>
<td><img src="image2.png" alt="Image" /></td>
<td>Soft Dock</td>
</tr>
<tr>
<td>SMPM</td>
<td>65 GHz</td>
<td>Blindmate</td>
<td><img src="image3.png" alt="Image" /></td>
<td>Not enough BW</td>
</tr>
<tr>
<td>SMPS</td>
<td>100 GHz</td>
<td>Blindmate</td>
<td><img src="image4.png" alt="Image" /></td>
<td>Low number of cycles (&lt;500)</td>
</tr>
<tr>
<td>SSB</td>
<td>65 GHz</td>
<td>Blindmate</td>
<td><img src="image5.png" alt="Image" /></td>
<td>Not enough BW</td>
</tr>
</tbody>
</table>
In order to meet the requirements for a full production connector, Cascade Microtech is developing a Blind-mate Waveguide connector.
Cascade Microtech fabricated an evaluation probe card to test RF performance when using a Pyramid Probe®

- The evaluation Probe card had 4 waveguide connectors
- 4.5” probe card
- Used the smallest Pyramid Probe (RFC)
Test Setup

• A Golden Pyramid Probe
  – Designed for 80 GHz performance

• PCB using Blindmate Waveguide
  – Semi-rigid 0.031” coax between the waveguide and the Pyramid Probe

• Cascade Microtech Summit 12k Probe Station

• Keysight E8361C with frequency extenders
  – Using Coax to waveguide adapters (WR12)
RF Data – Return Loss

- Better than -10 dB from 65 GHz to 90 GHz
  - Better than -15 dB from 68 to 84 GHz
RF Data – Insertion Loss

- Better than -6 dB insertion loss from 65 GHz to 90 GHz
TDR Measurement

- The TDR data shows that the impedance discontinuity is less than 60 milli-rho at the waveguide to coax transition.
Comparison with 1mm

- Comparing with a typical probe card using 1 mm connectors, the performance is similar over the frequency range
  - 22 mm of waveguide and ~40 mm for coax
  - 1 mm connector (~13 mm long) and ~40 mm of coax

**Insertion Loss**

**Return Loss**
Next Steps

• Continuing work to evaluate the number of cycles
  – Our expectation is that mechanical wear should have a minimal effect

• Evaluation of the repeatability of RF performance with dock/undocking cycles
Summary

• We have characterized a direct dock waveguide connector that could be used with ATE systems
  – It meets the performance requirements for 65-90 GHz
• The hard dock waveguide connector will work well for full production test
Questions?