APPLICATION NOTE

AE-AN-TR-005-TR Multicoax Series Board Optimization Procedures

Purpose:
This application note provides detailed information on how printed circuit boards can be optimized for use with the TR Multicoax Series Device.

Optimization Procedure: Amphenol Ardent Concepts offers services which can provide optimized PCB footprint geometry based specifically on each customers' unique PCB stack up.

- First, an Optimization Checklist supplied by Amphenol Ardent should be filled out. It provides the input parameters for simulating the unique information stack up of every board. This checklist is a requirement prior to beginning any optimization work.
- Next, the Optimization Checklist and PCB stack up will go through an initial review by Amphenol Ardent's SI team. Shortly after the customer will receive a quote for optimization services. Once the Purchase Order is received the Footprint Optimization work will be initiated.

Footprint Optimization Deliverables: Customers can expect the following from Amphenol Ardent's Footprint Optimization procedure.

- TR Footprint Optimization report
- S2P files
- S parameters in .xlsx format
- HFSS models are available for additional charge and must be covered by NDA (restrictions may apply).

HFSS Simulation:

The simulation determines the optimal board footprint parameters for TR Multicoax Series. The simulation models the performance of a signal as it transitions under the connector, thru the interface, and up to a few inches of coax cable.

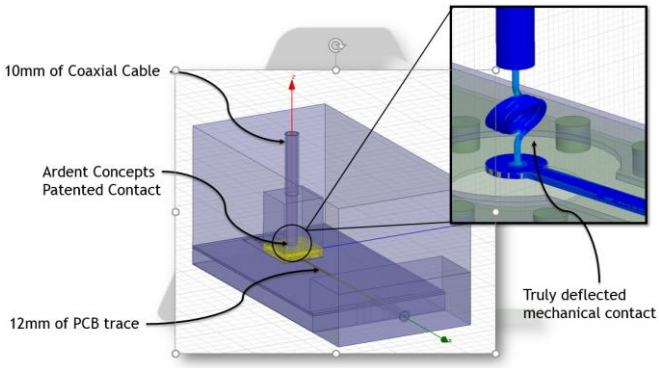

***Figure 1*: TR Footprint Optimization Modeling Example**

- The default optimization return loss performance for the TR assembly at the connector is -20 dB for up to 20 GHz and -12 dB from 20 GHz to 40 GHz.
- Impedance will be controlled to ±5% of 50 Ω (rise time 25 ps)
- Since there is a grounded metal air gap channel under the connector, a capacitive reaction will occur and a narrower inductive trace is required under the connector.
    - A model of the interface is included in the simulation and the channel height is 4.5 mils.
    - The HFSS simulation model includes along with the cabling, TR assembly, and TR footprint, an additional 0.5 inches of the incident board trace beyond the footprint.

Parameters Kept Constant for Simulation Optimizations:

- Top layer anti-pad ground diameter
- Microstrip top metal return channel width (guard channel).
- GND and signal via diameters
- Return via bolt circle diameter
- Return via location on the bolt circle

Parameters Frequently Adjusted During the Optimization Procedure are the Following:

- Signal capture pad diameter
- First return layer anti-pad diameter
- Trace width under connector
- GND via depth (stripline)
- Internal capture pad diameter (stripline)
- Internal anti-pad diameters (stripline)

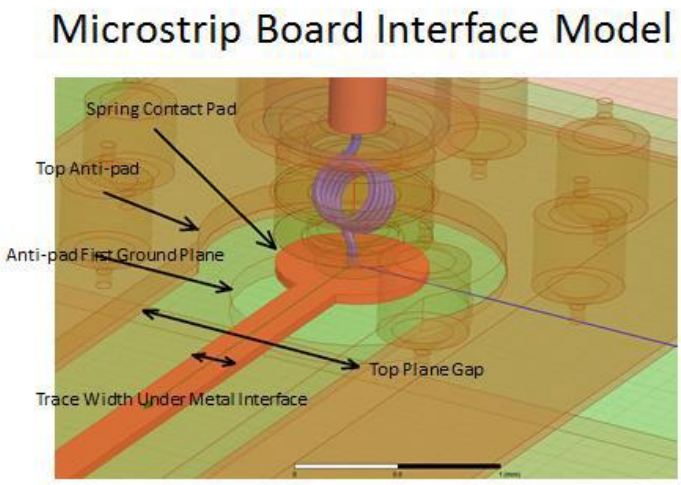

***Figure 2*: Tuned Simulation Parameters**

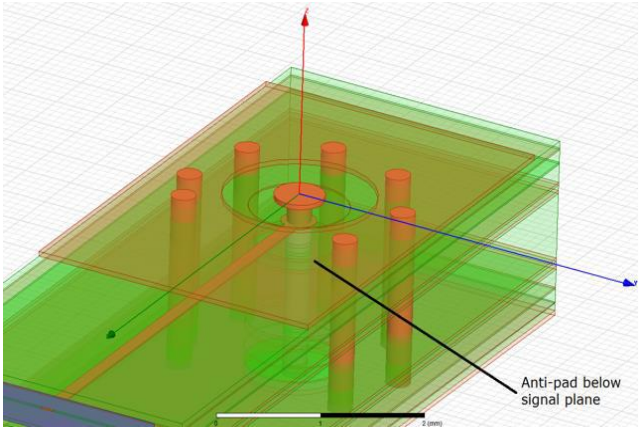

***Figure 3*: Stripline Model Showing the Through 83 mil Diameter Ground Via Bolt Circle Coax Structure**

Optimization Review:

- After the variable parameters have been quantified, a report is compiled that provides the new connector footprint parameters.

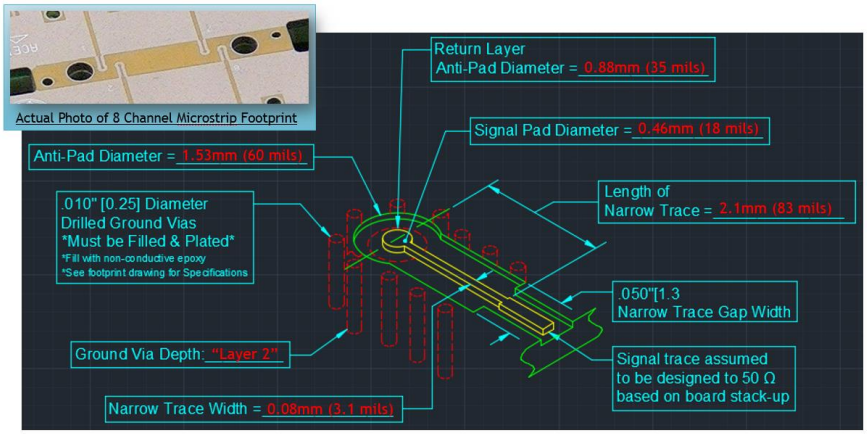

***Figure 4*: Example of TR Footprint Optimization; Dimensional Results**

- Thru Scattering parameter graphs are provided to quantify the reflected and transmitted power with the new footprint optimization parameters. The following simulated S-Parameter graphs are provided: Return Loss, Insertion Loss, Step Response Time Domain Reflection (TDR)

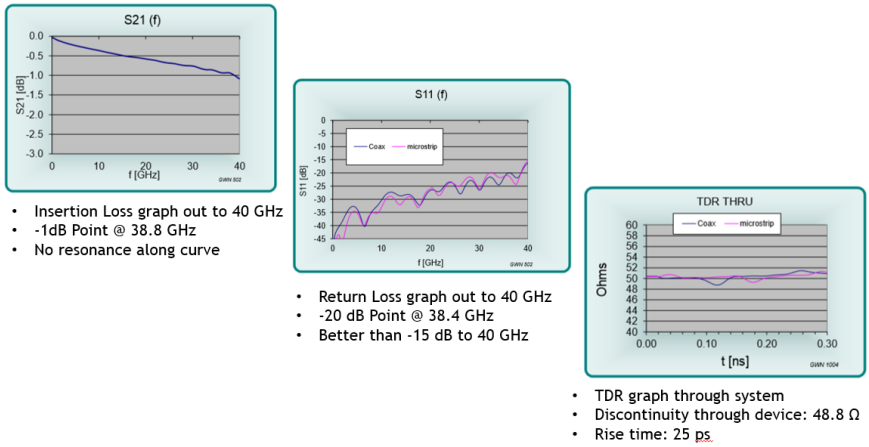

Figure 4: **Example of TR Footprint Optimization; Modeling Results.**

NOTE: The current footprint for the connector has tolerance limitations for modifications. The Time Domain Reflection graph provides a high-resolution image of impedance values with a rise time of 25 ps for a frequency span bandwidth of 40 GHz.

NOTE: The graphs provide a forward and reverse pathway thru the connector (legend indicated by coax and microstrip).

NOTE: Standard Rise Time is 25 ps

Final Board Review: After the board optimization parameters have been verified and implemented, a new board file is sent to Ardent to verify that TR will be compatible with your board. Board review procedure includes:

- Verification of Footprint Specification Tolerances with Cadence Board File Viewer

NOTE: The final board review does not contain HFSS model, only simulation results. A model may be attainable, please consult factory.

- After the board file has been reviewed, specifications or configurations measured out of tolerance are noted and corrections are recommended.
- Approval of a board footprint is awarded when specifications are determined within tolerance.
- The final board review will also communicate reminders of important parameters to consider.

  - **Filled and plated vias**
  - **No solder mask area under connector**
  - **No narrow trace width tapers**
  - **No solder in TR footprint area**
  - **Hard gold plated footprint area**

Application Note Summary:

- Optimization checklist must be filled out prior to beginning any optimization work.
- Optional optimization report can also be filled out to determine footprint specification parameters.
- Default optimization return loss performance for the TR assembly at the connector is -20 dB for up to 20 GHz and -12 dB from 20 GHz to 40 GHz.
- The following simulated S-Parameter graphs are provided with optimization:
    - Return Loss, Insertion Loss, Step Response Time Domain Reflection (TDR)
- Since there is a grounded metal air gap channel under the connector, a capacitive reaction will occur and a narrower inductive trace is required under the connector.
- The final board review does not contain HFSS model, only simulation results. A model may be attainable by inquiring with factory.

Who Is Amphenol Ardent Concepts?

Amphenol Ardent Concepts is a leading designer and manufacturer of high performance multicoax and coaxial assemblies, connectors, and sockets used in the development of next generation semiconductors and electronics systems. Our core technology is the smallest, fastest, most electrically efficient compression mount connector technology worldwide. As data rate requirements increase and devices and systems shrink, Ardent's products deliver superior signal integrity in a dense footprint that can be reusable across programs to maximize cost savings.