RTPGE Channel & Component Testing Experiences and Recommendations

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Cabling test methods and equipment have evolved over several decades of work, culminating in the following TIA standards:

TIA-568-C.2

And for BALUN-less measurements:
TIA-1183

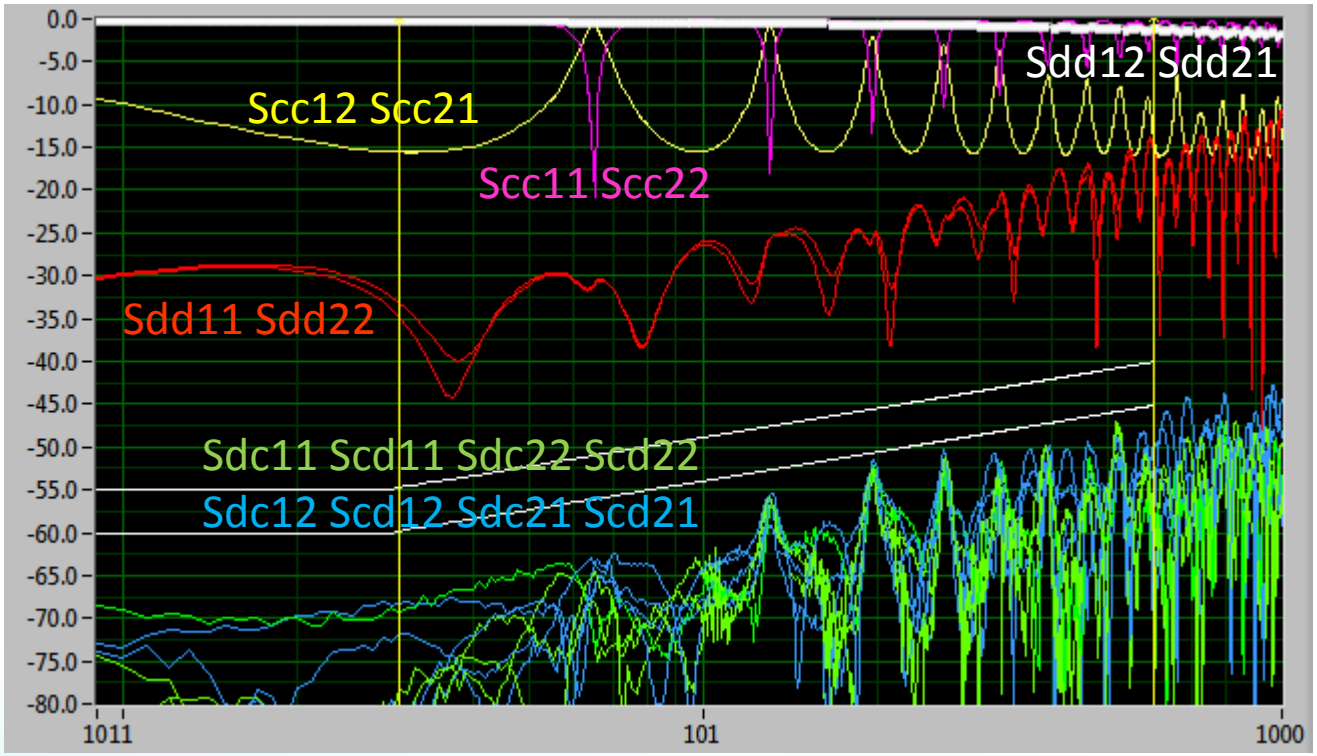
Similar ISO work has also been completed:

ISO/IEC 11801

And associated component standards such as:
IEC 60603-7

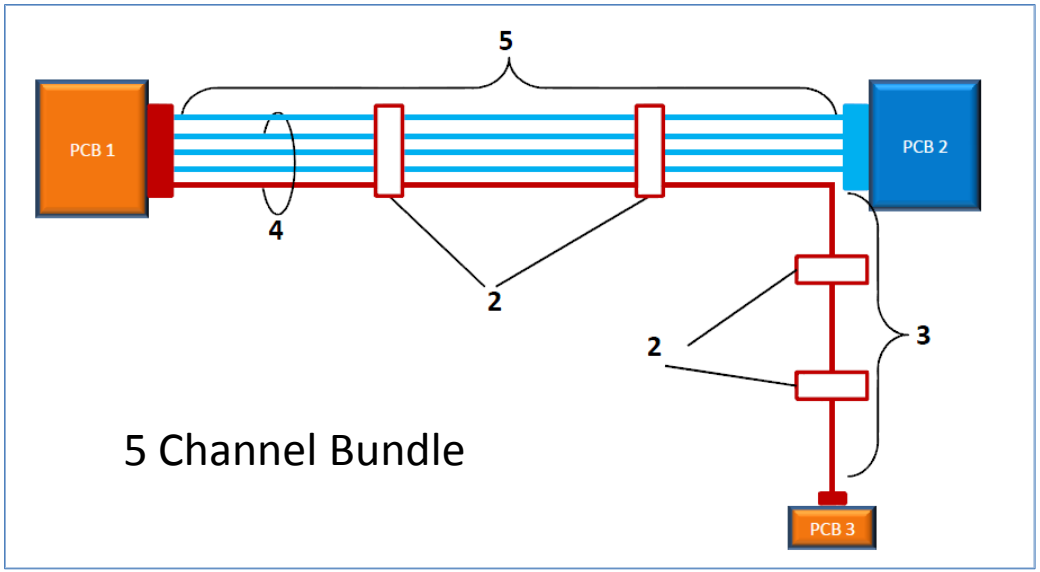
All of these standards can and should be applied to RTPGE channel testing and certifications

There are a number of different Scattering Parameters that require very accurate measurement, in particular the need for much tighter balance, or mode conversion parameters.

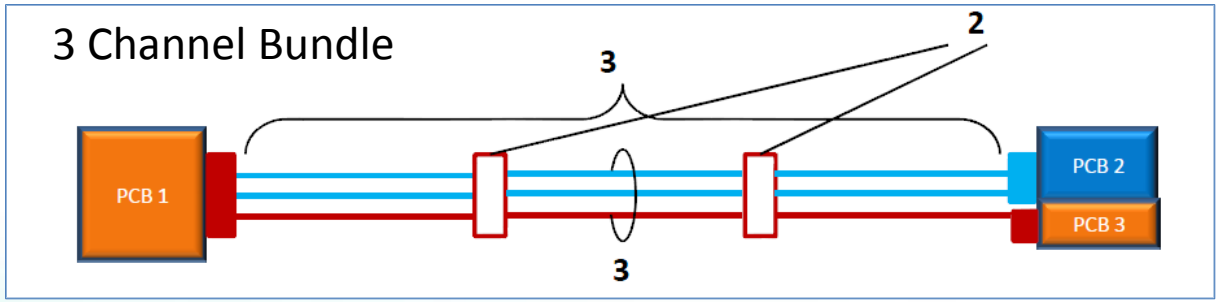


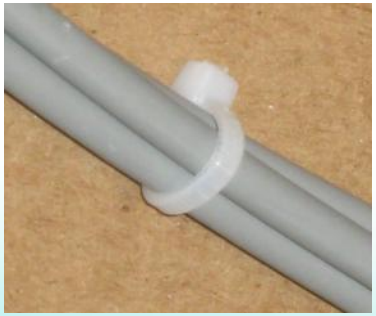
Example: Measured cable S-parameters, color coded for easy identification

Automotive needs call for specific test configurations including in-line connections and harnessing



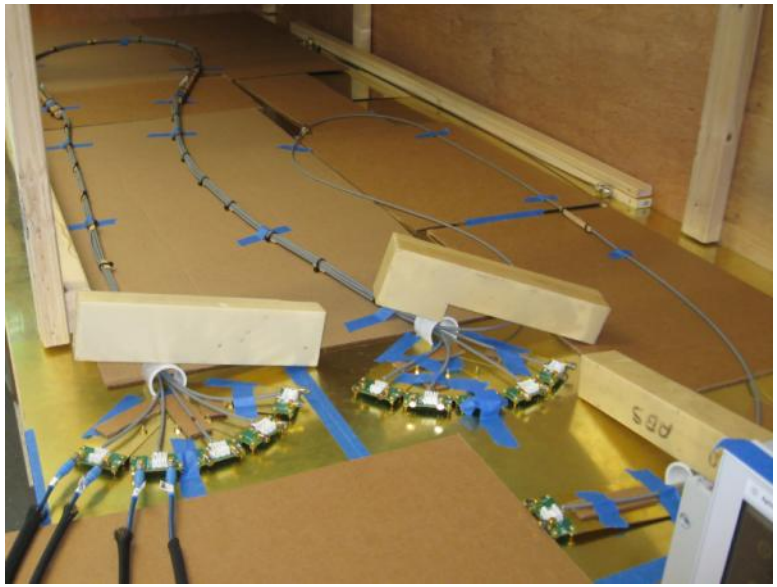
5 Channel Bundle





Bundling for worst case Alien Crosstalk tests

Various techniques and test setups have already been proven in



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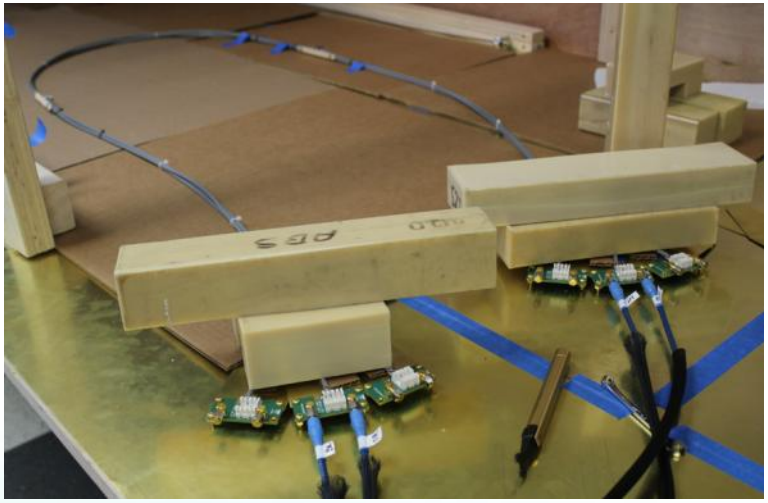
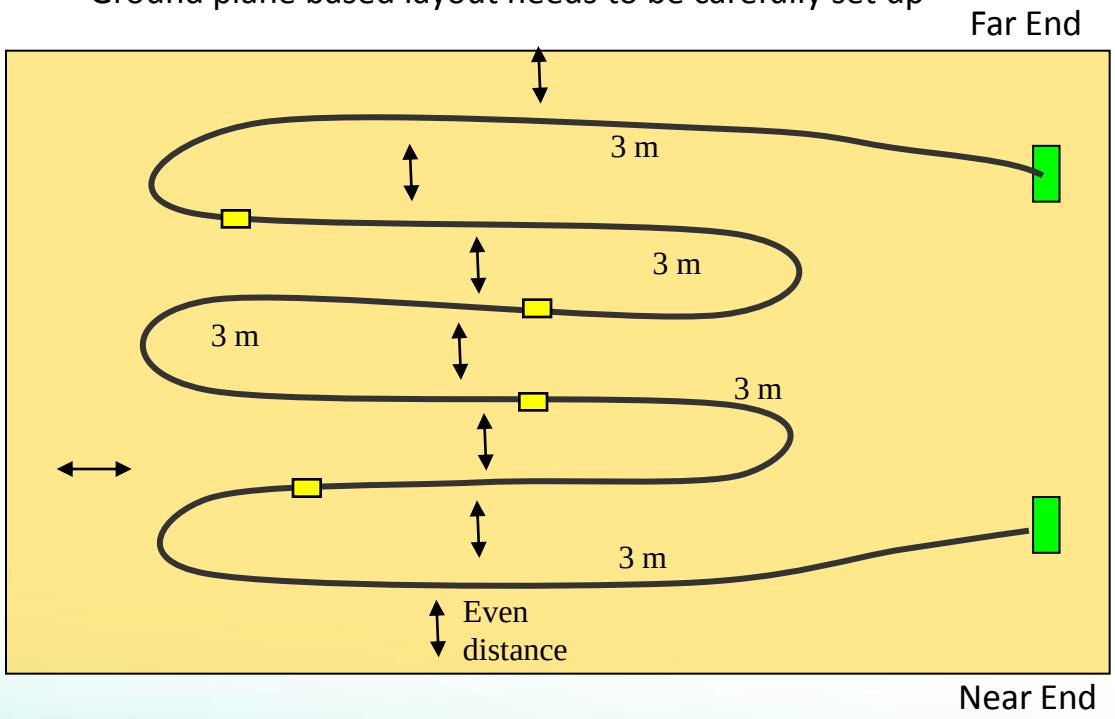


3 Channel Bundle

Connector alien crosstalk

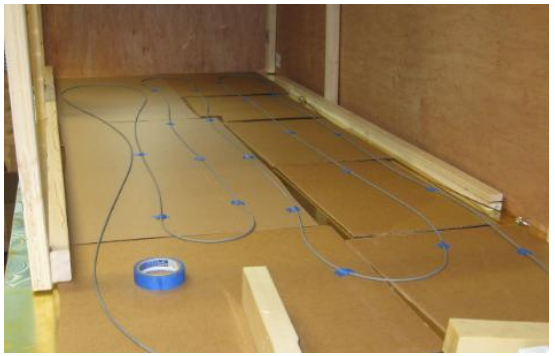
A full length 15 meter 4 connection channel is also necessary

Ground plane based layout needs to be carefully set up



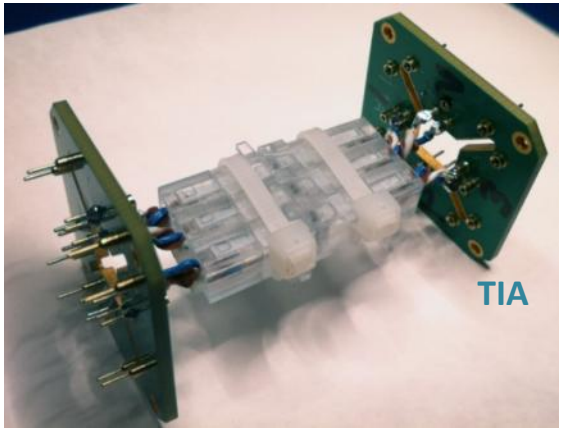
While ground plane referenced, the cabling should be accurately suspended over the ground by low dielectric material (such as cardboard or foam)

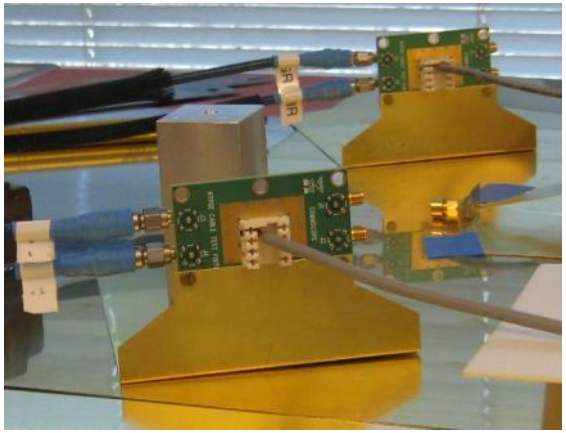
10 mm is suggested for channels

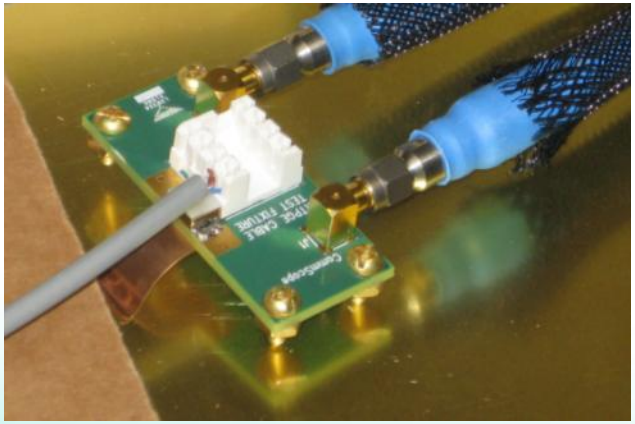


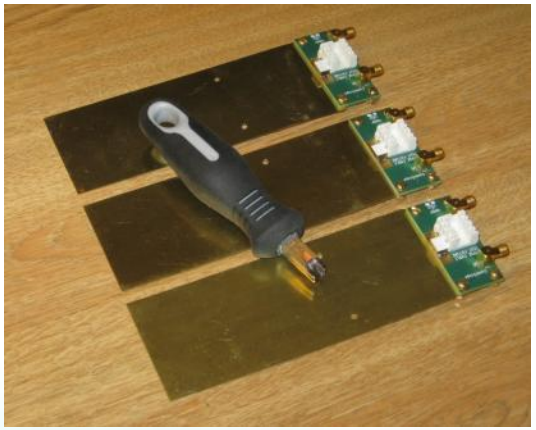
Cylindrical test platforms have also been demonstrated

Measurements generally require a “Test Head”, many of which have already been prototyped, developed and verified – including the conventional TIA utilized version



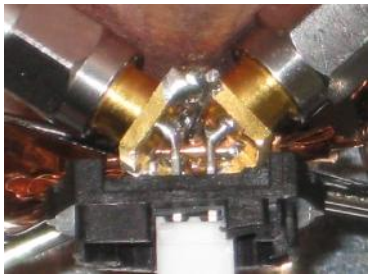


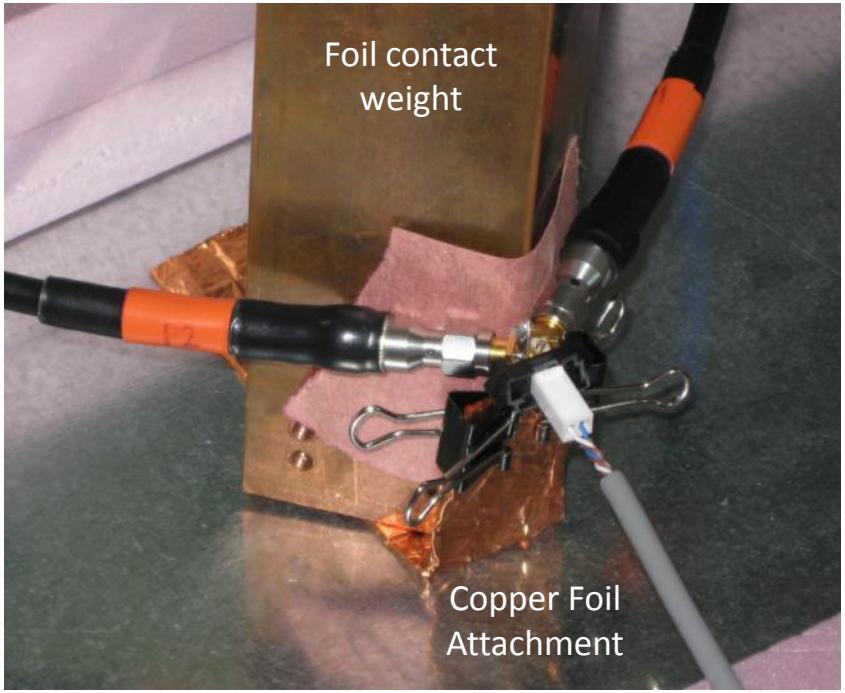




For the exceptionally rigorous **Mode Conversion tests**, many participants prefer smaller more minimized test heads that can be easier to achieve tight balance requirements

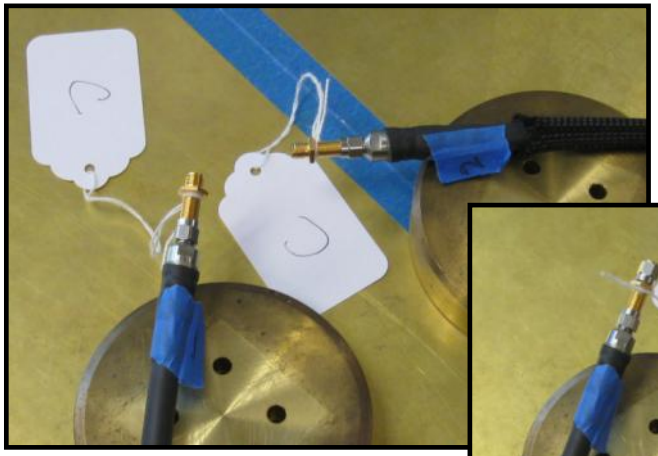
Very short direct attachments

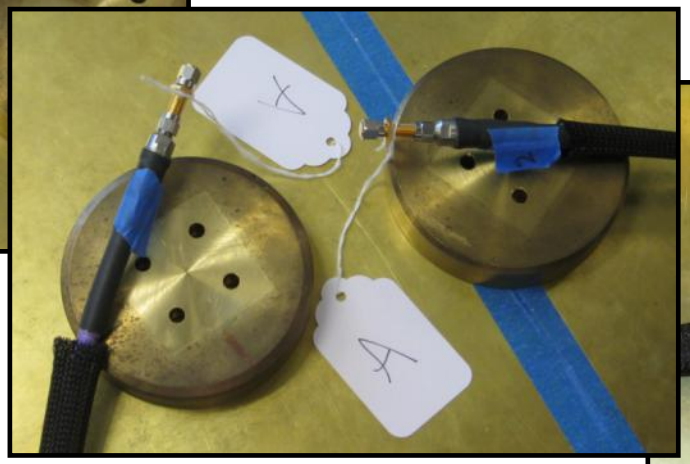


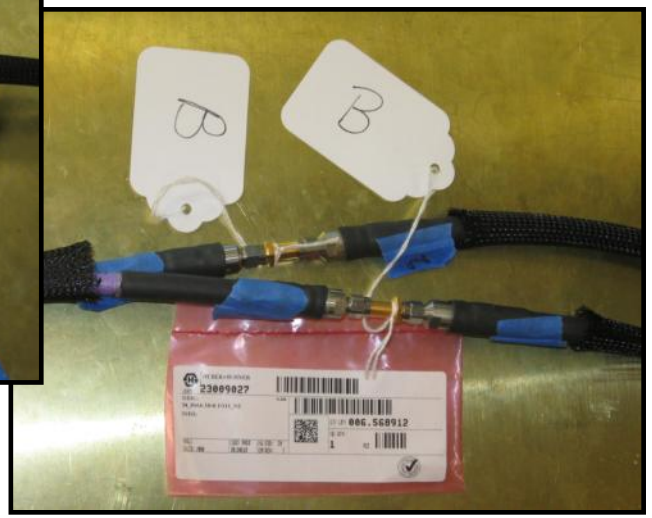


- To achieve accurate cabling measurements, the test heads need to be electrically attached to the ground plane
- This prevents test signal leakage back into the coax test attachment cables

Network Analyzer calibrations should be verified for mode conversion







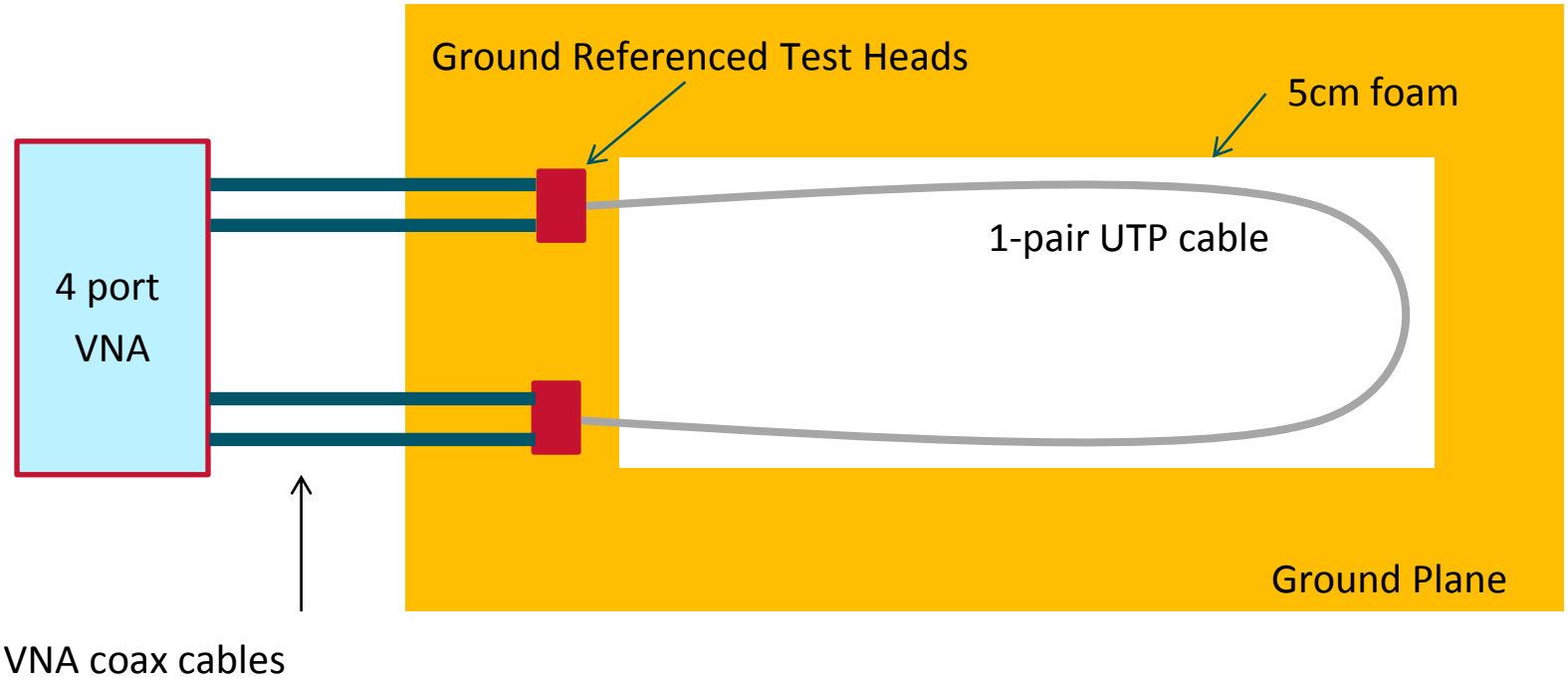
0TD01D01036.0 Gore RF Cables are used with a manual calibration

Calibration checks:

1. Matched thru connectors open ended
2. Thru connectors with matched loads (Fairview ST1822)
3. Connected thru connectors (Huber Suhner 34_SMA-50-0-1/111_NE)

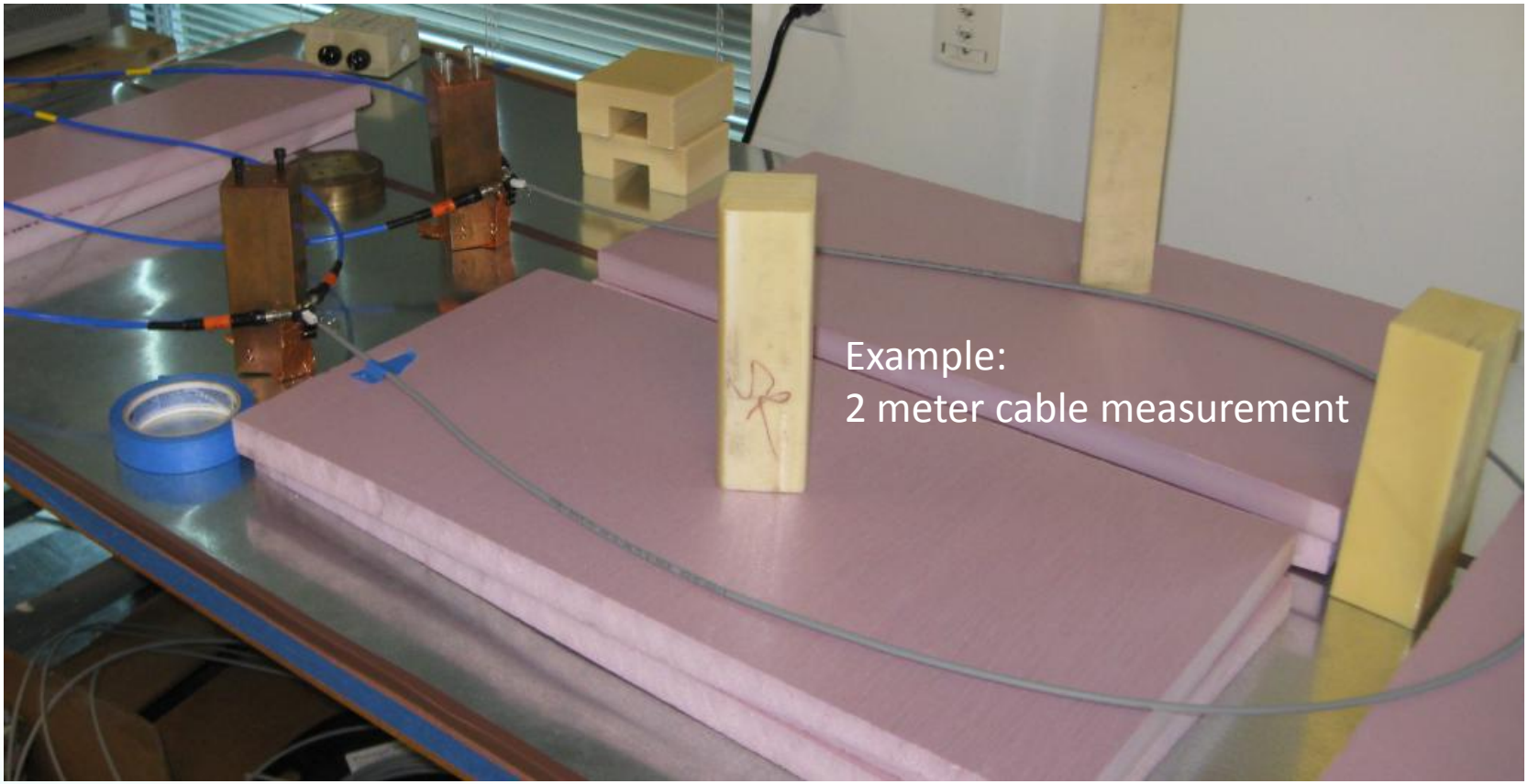
The balance (matching) of the calibration and artifacts can be verified by testing in swapped positions

SETUP FOR MODE CONVERSION MEASUREMENT

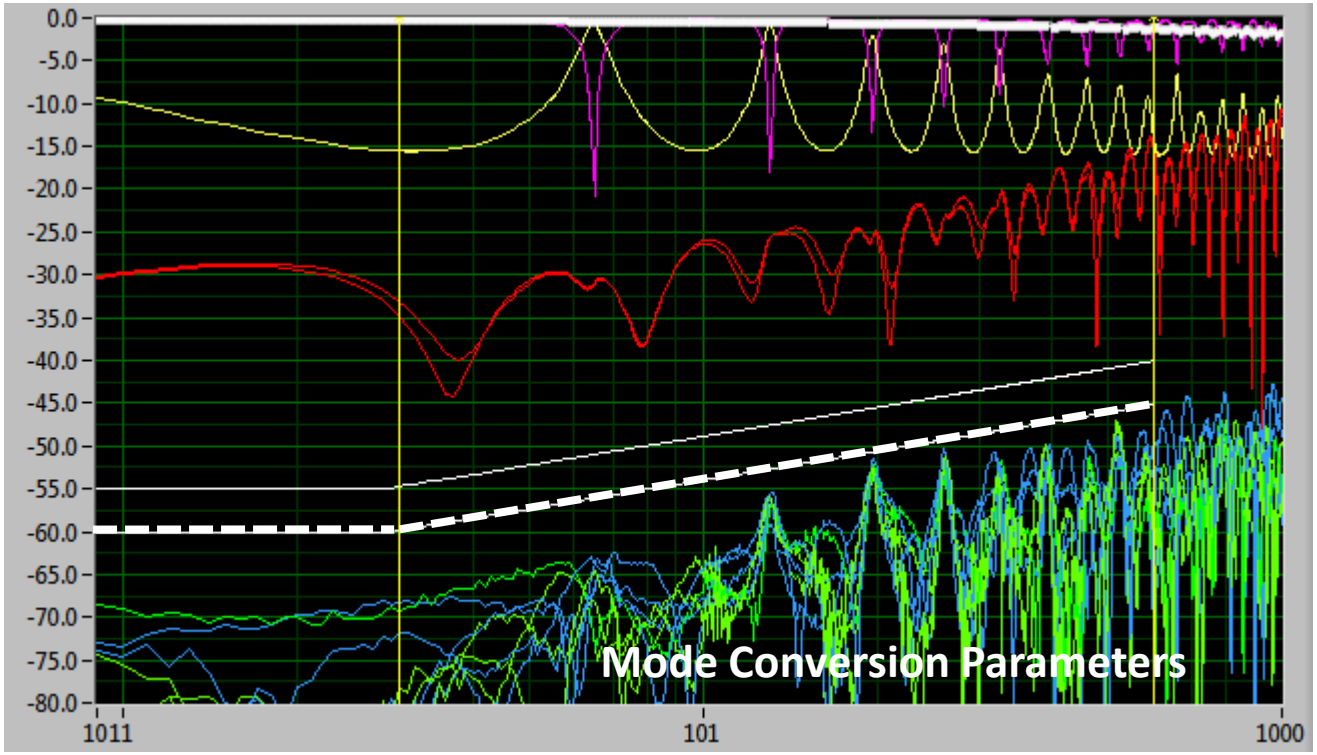


Notes:

- Test Head grounds are low inductance attached to the Ground Plane
- For details of the measurement setup, please refer to "*CommScope presentation on S4P measurement from 802.3bp RTPGE EMC Ad Hoc Conference Call on 10/18/2013*"

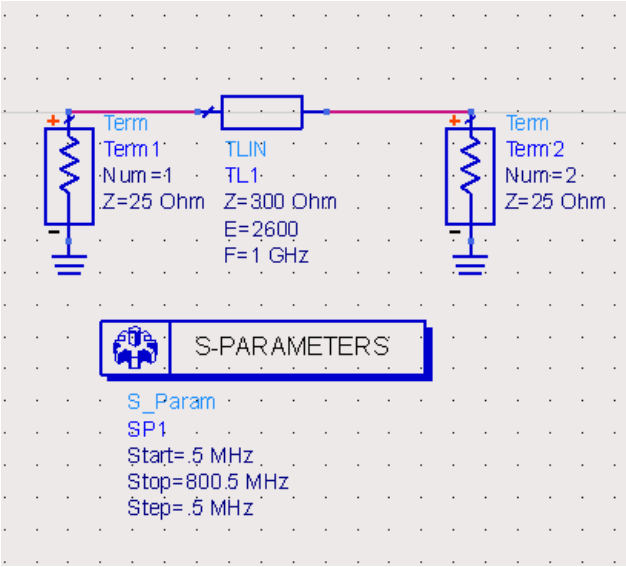


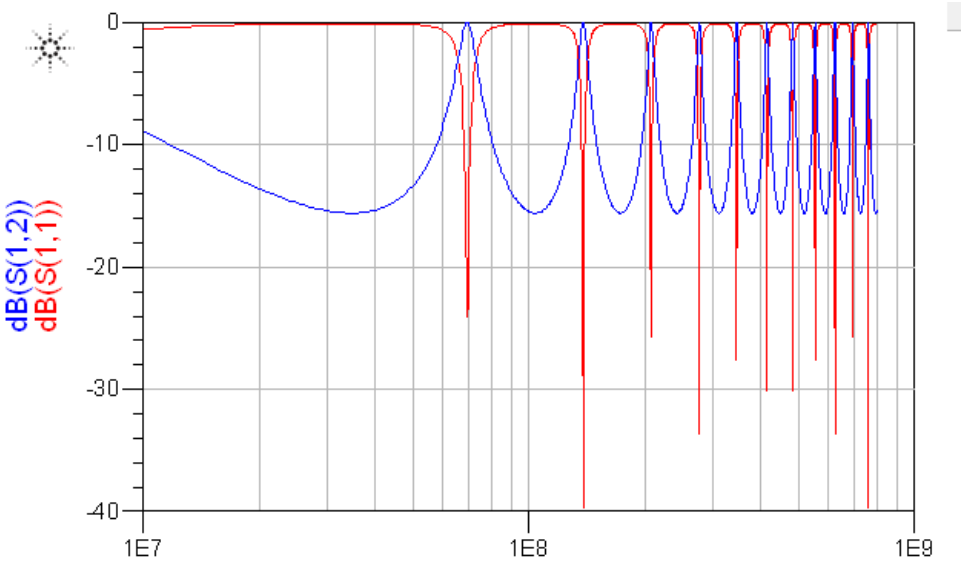
BCI and Stripline oriented measurements specify
5 cm spacing from the ground plane reference



A complete set of performance parameters has been successfully tested, meeting proposed requirements, including the rigorous mode conversion proposals

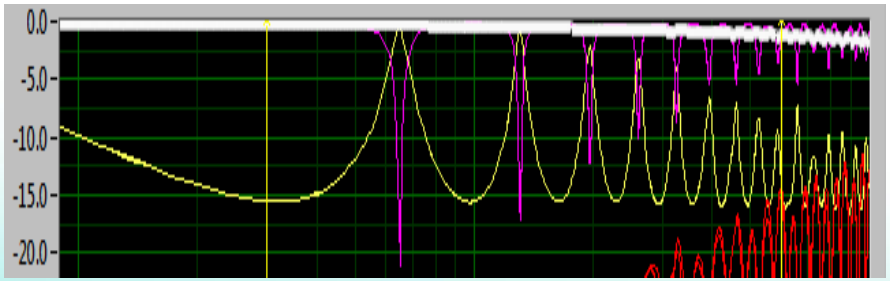
Agilent ADS is an electrical simulation tool that has successfully been used for a wide range of verification and analysis





Example: Confirmation of the 300 Ω common mode impedance of the 2 meter cable @ 5 cm

2 meter cable measurement



In conclusion

- Accurate and consistent cable balance measurements are achievable and have been demonstrated.
- Methods and tools have been presented.
- Documentation of testing guidelines should be started. The following draft should be considered for input.

Suggested Testing Guidelines For RTPGE Cabling

A minimum of five component and channel test configurations should be qualified:

1. A single channel of 15 meters with 4 in-line connections equally spaced between 5 cable sections, for measuring the internal differential performance parameters
2. A uniform bundle of three channels, all 3 meters with 2 in-line connections equally spaced between 3 cable sections, for measuring the internal and exogenous differential performance parameters
3. A bundle of five Channels with four 5 meter 2 connection channels bundled around an 8 meter 4 connection channel for measuring the internal and exogenous differential performance parameters

Note: Differential Test Setup -

Differential channel parameters may be measured using any of the conventional BALUN based methods detailed in ANSI/TIA-568-C.2 or non-BALUN methods outlined in TIA 1183. For either, industry accepted practices for ensuring accurate results must be followed, including calibrations, impedance controlled test fixtures, impedance matched test leads and proper terminations. It should be noted that differential requirements may be specified at a 25Ω common mode impedance, but it is acceptable for differential measurements to be made at the 50Ω impedance specified in ANSI/TIA-568-C.2.

4. A single 2 meter cable, for measuring the cable mode conversion performance parameters
5. A single 2 meter channel with 1 in-line connection, for measuring the connection mode conversion performance parameters

Suggested Testing Guidelines (continued)

Note: Balance Test Setup -

The tight balance requirements for RTPGE EMC performance require extra care in setup and verification. The network analyzer and test heads must be qualified to high mode conversion loss. These guidelines should be followed:

a) Use of a 4 port network analyzer and flex insensitive test attachment cables is recommended

b) Test platform or cylinder will support the cable/channel at uniform height over a uniform ground reference and test head grounds will be attached to the ground reference with a direct low inductance connection. Test height can vary from 10 mm to 5 cm according to the application.

c) Calibration is necessary and calibration should be verified to 10dB better than test requirements through the following measurement checks:

- Termination of test attachment cables (and test heads) with matched loads and also with stable matched opens will verify the balance floor of high loss tests such as BCI or Stripline measurements.
- Direct differential through-connection of test attachment cables (and test heads) using two matched low loss connections will verify the balance floor of low loss tests such as direct cable, connector and channel measurements.
- Verification of check artifact matching can be done by swapping between ports to meet balance requirements in each case.
- Less than the 10 dB margin can be acceptable, but will require improved performance of devices being tested.

d) Test platform should be stable and movement during testing should be avoided. Network analyzer functions and test practices that can negatively affect results should be avoided.

Thank You