SAS-2 S-Parameters of Cable Assemblies and Backplanes (08-187r0)

Barry Olawsky

Hewlett Packard

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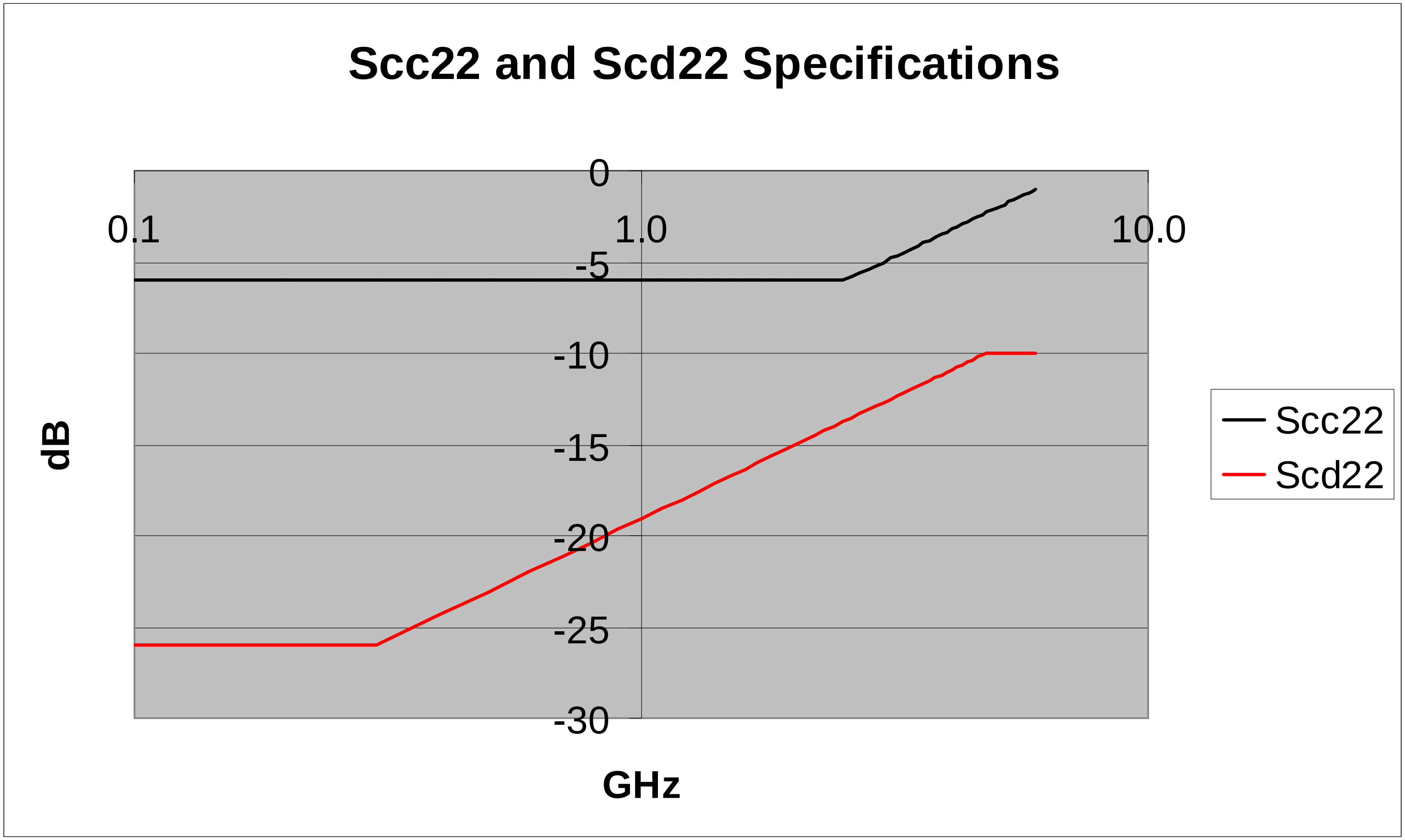
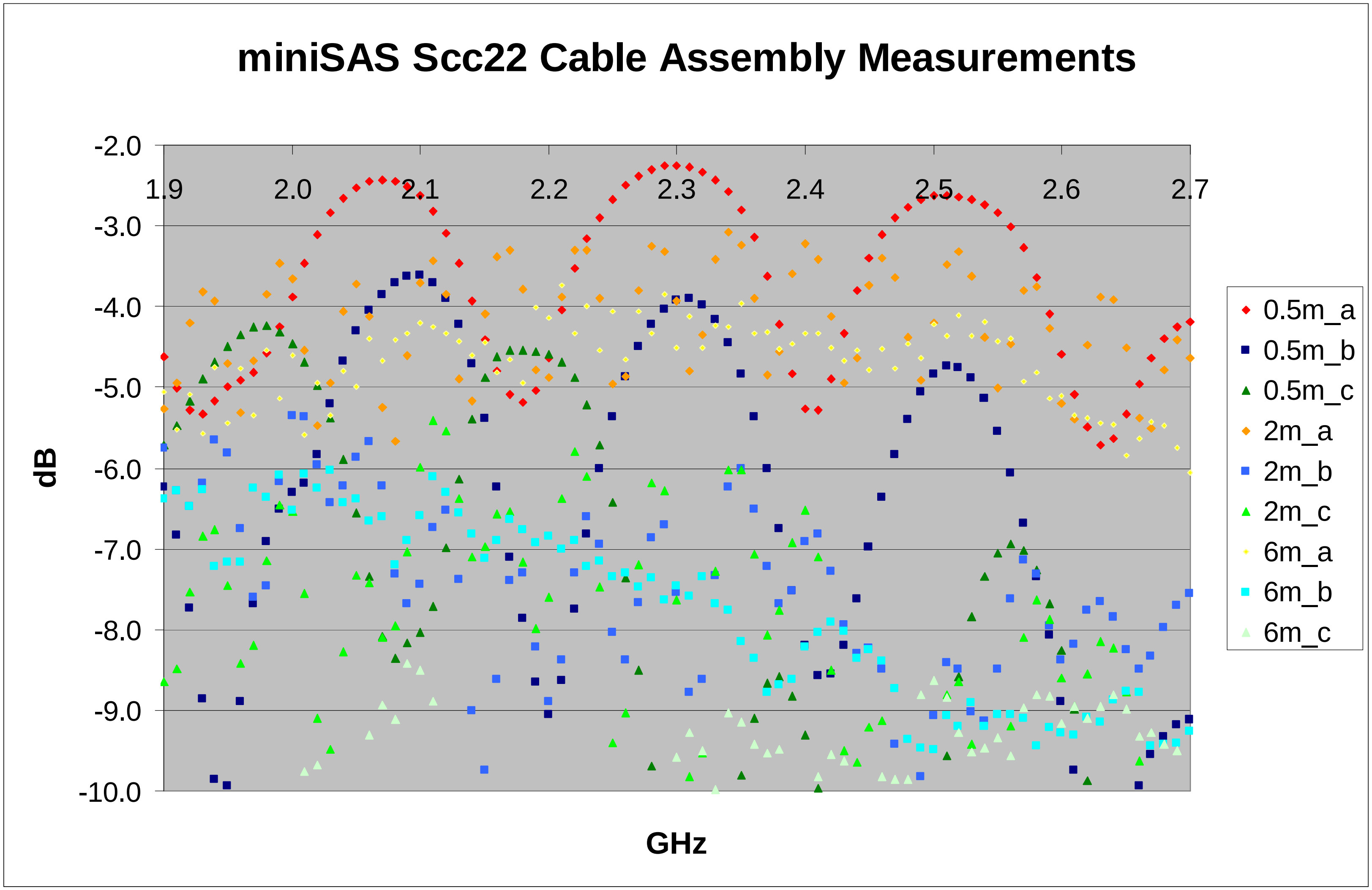
Assertion

- The common mode return loss S_{CC22} and differential to common mode return loss S_{CD22} proposed in the SAS-2 letter ballot do appear to be attainable using existing SAS connector designs.
- In addition, common layout practices and techniques used to reduce electromagnetic emissions conflict with the proposed S_{CC22} limits.

SAS-2 Letter Ballot Specifications



Cable Assembly Data

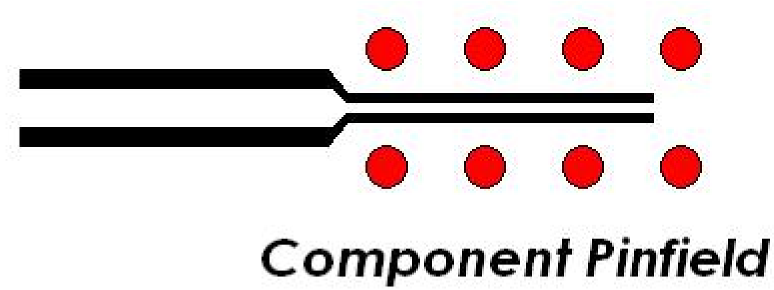


Cable Assembly Data Notes

- Samples consisting of three cable lengths from three different suppliers were measured
- Fixturing was not de-embedded but the test board traces maintained a well controlled 25-ohm common mode impedance up to the miniSAS connector footprint
- The miniSAS connector/cable interface has at least three unique coupled regions with each one yielding a unique common mode impedance … PBC mounted connector, paddle card and bulk cable

Common Mode Impedance Variations in Board Design

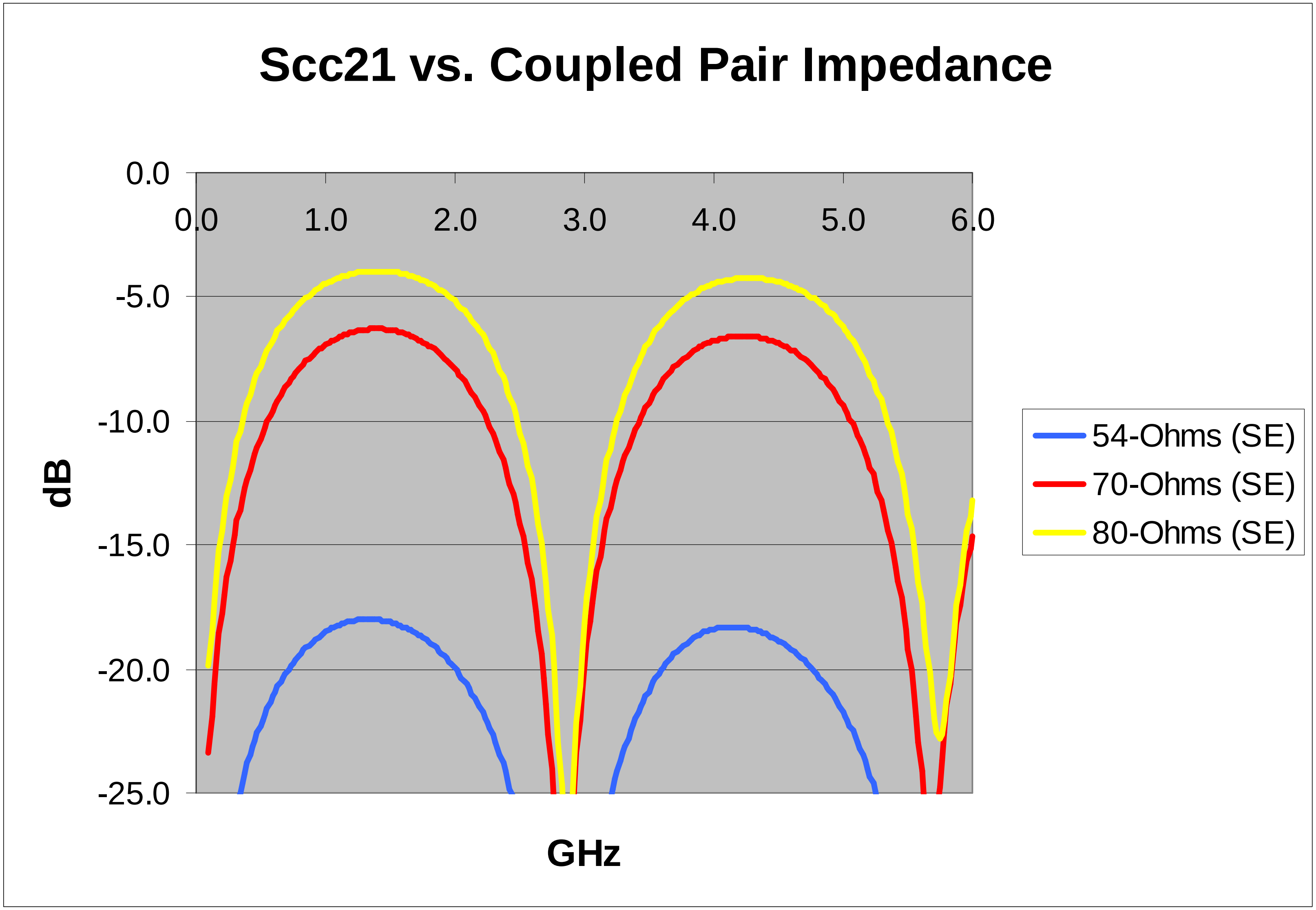
- Trace structure variation is a common layout practice
- Trace with and spacing are varied in order to access all points in connector and BGA pinfields
- Differential impedance is maintained while common mode impedance variations are tolerated



Trace Structure Simulations

- To better characterize the effects of such layout practices, three separate designs are simulated.
  - One inch uncoupled microstrip + one inch 100-ohm differential coupled microstrip with a single ended impedance of 54-ohms + 50-ohm termination for each leg
  - One inch uncoupled microstrip + one inch 100-ohm differential coupled microstrip with a single ended impedance of 70-ohms + 50-ohm termination for each leg
  - One inch uncoupled microstrip + one inch 100-ohm differential coupled microstrip with a single ended impedance of 80-ohms + 50-ohm termination for each leg
- The model is driven by a common mode source and then converted to S_{CC22} format.

Trace Structure Simulations



Reflection Coefficient (•) and S_{22}

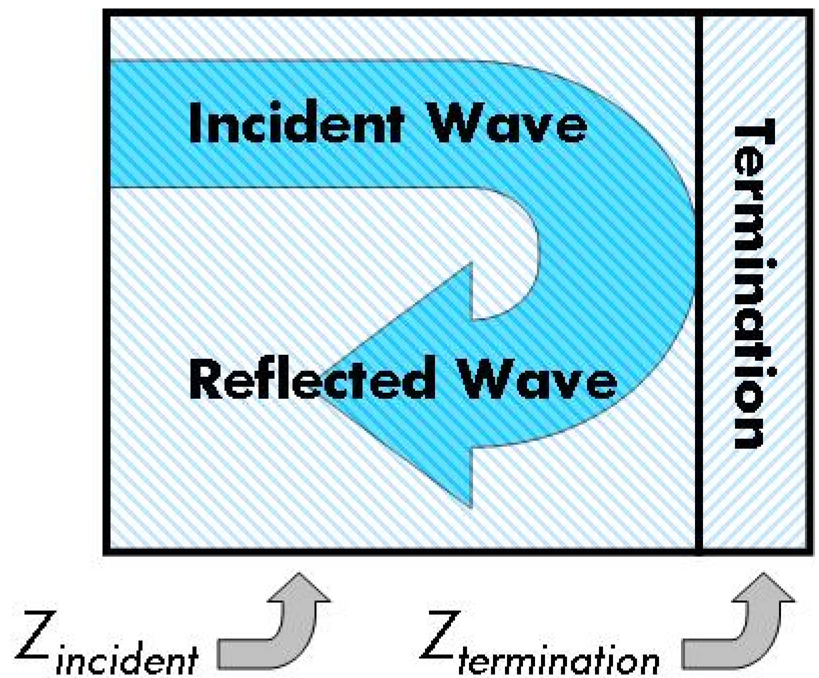
- The reflection coefficient (•) is the ratio of the amplitudes of the reflected wave to the incident wave
- It can be computed from the impedances of the incident media and termination
- For the case of a common mode impedance of 40-ohms we obtain,

$$\rho = 0.23 \ \&$$

$$S_{CC22} = -12.7\text{dB}$$

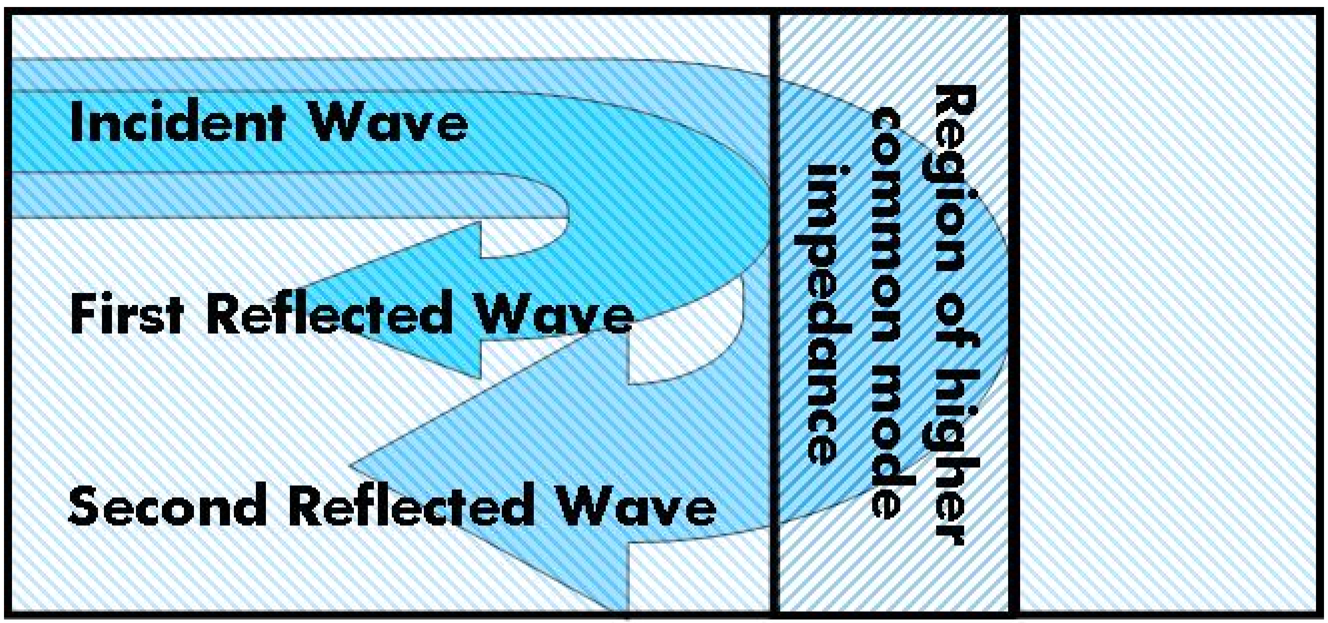
$$\Gamma = \frac{V_{reflected}}{V_{incident}} = \frac{Z_t - Z_i}{Z_t + Z_i}$$

$$S_{22} = 20\log(r)$$



Multiple Impedance Discontinuities

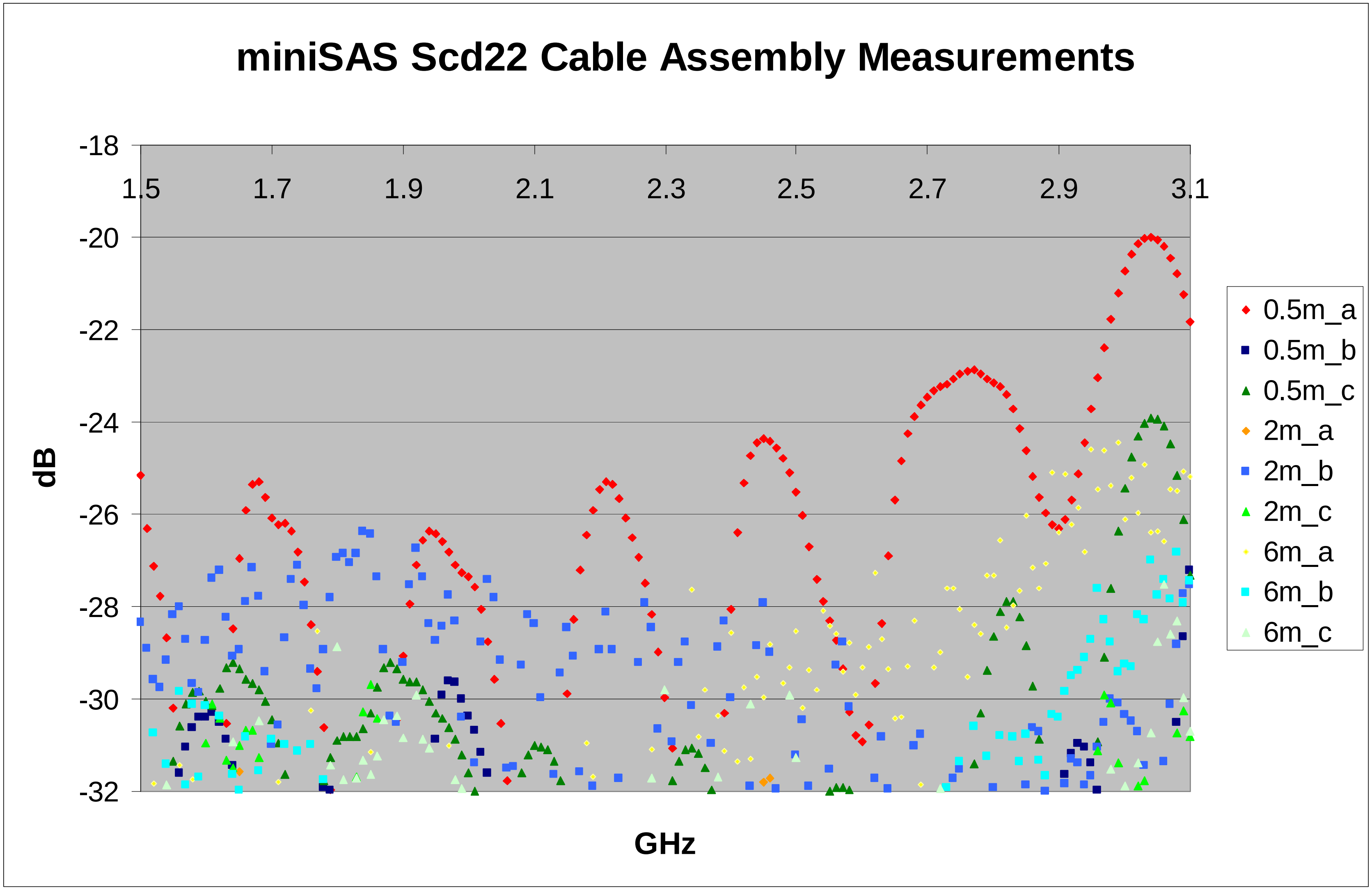
- Each change in common mode impedance will introduce a wave back to the compliance point. Multiple changes between 25 and 40 ohms will result in a return loss greater than -12.7dB at specific frequency points



Potential Scd22 Issues

- Imperfect twin-axial cable termination is very common. Any imbalance introduced during the assembly process can result in non-ideal mode conversion parameters (all S_{CD} and S_{DC} terms).

Cable Assembly Data



Conclusions

- The S_{CC22} data presented indicates letter ballot specification will be difficult to meet.
- However, the S_{CD22} cable assembly data supports the letter ballot specification numbers.