As components increase their rate of data processing the Printed Circuit Board is expected to transfer data at even faster rates to keep pace. Beyond 2 Gb/s the impact of dielectric loss becomes a critical factor in the design process \[1\]. Agreement of loss measurements between PCB manufacturers and their customer base can be crucial in ensuring that design tolerances are met.

There has been a great deal of recent industry focus on the problem of making simple, fast and accurate measurements of loss during the transmission of high-frequency (1 – 20 GHz) signals through PCB interconnects. Many of the methods employ time-domain reflectometry (TDR) and time-domain transmission (TDT). There is also some focus on using vector network analyser (VNA) techniques although, at present, VNAs are not well-known or well-understood by the traditional PCB industry.

There are a wide variety of proposed methods for PCB loss measurement, including those covered in the IPC TM-650 document \[2\], Multiline \[3\] and SET2DIL \[4\]. A known reference standard would enable the meaningful, quantifiable comparison of different methods, or of the application of a given method employed by different test facilities.

NPL has proposed producing a reference PCB and calibrating it for appropriate loss parameters. This would then provide traceability to national standards for other measurement systems and, if required, it would be possible to produce, calibrate and disseminate a number of these reference boards as transfer standards for PCB loss measurement. The current proposed design of the reference PCB is shown in Figure 1. Given the wide variety of available and developing methods for loss measurement, the reference PCB is designed to incorporate a range of compatible features whilst maintaining simplicity.

Key features:
- Both microstrip and stripline transmission lines, with differing lengths of each
- Unbalanced (50 ohm) and balanced (85 ohm differential) transmission lines
- Provision for both coaxial (2.92 mm or 'K') and microwave wafer probe connections
- On-board probe calibration standards including offset shorts and ‘thrus’

Once produced, a research programme will be undertaken to measure the loss characteristics of the reference PCB using both two- and four-port VNAs and the TDR/TDT metrological capability available at NPL. The chosen loss-metric is dB/unit-length at key frequencies and special attention will be paid to establishing the equivalence of the VNA and TDR/TDT capabilities \[5\]. A measurement traceability mechanism and uncertainty budget will be determined for both domains, followed by analysis of the transference of these calibrations to other measurement systems being deployed in industry.

References

[1] "High-Speed PCB Design Considerations", Lattice Semiconductor Corp, TN1033, April 2011