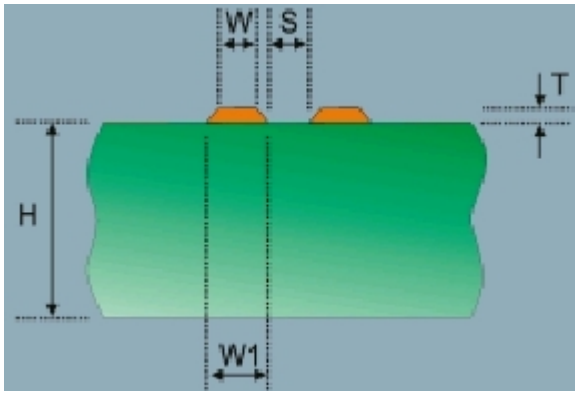
Application Notes

Application Note AP153

Testing impedance of differential pairs without ground (Coplanar strips)

Background
The structure pictured alongside is defined as "Coplanar Strips". You may like to think of it as an edge coupled differential pair, minus the underlying ground plane. From a modelling standpoint the structure is like a paired wire transmission line. However you may ask - as this is a differential structure how you should test the impedance?



Coplanar Strips
(Edge coupled differential pair without ground plane)

Testing
In a structure as pictured above all the signal current flows out through one conductor and the return comes back through the other. With a signal of equal positive and negative going potential a virtual ground exists midway between the two traces.

How do I connect probes to this?
Imagine using a differential probe with + on one line and - on the other, you are left with nowhere to connect the ground. So, in order to test you need to think of this structure as a single ended transmission line. Think again and imagine connecting a single ended probe. Signal goes to one side of the transmission line and the ground connects to the other.

Using a single ended TDR and probe connection you can connect the probe either way around and measure the impedance of the structure using the system set for Single ended measurements. The measurement returned will represent the impedance of the transmission line.

Yes, but I need to model this structure...
The coplanar strips model does not appear directly in the Si6000b, however there is a very simple adjustment you can make to one of the standard structures in the Si6000b to enable you to predict the finished impedance.

Simply select the "Differential surface coplanar waveguide" (the one without a lower ground plane) and set the "D" dimension so it is 20 x the "S" dimension. This way the adjacent coplanar grounds will be far enough away to have negligible influence. Now you can model the above structure before putting it into production.

If you have found this note useful you may also find application note AP151 of interest.
AP151 discusses how copper thickness influences the impedance of the above structure.

More information?
Further information on measuring PCB controlled impedances is available by email from martyn.gaudion@polarinstruments.com
For information on field solving impedance design software please contact: ken.taylor@polarinstruments.com

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