Practical High Speed Design, Part 2 of 3 Q & A

| Question / Comment | Answer/Response |
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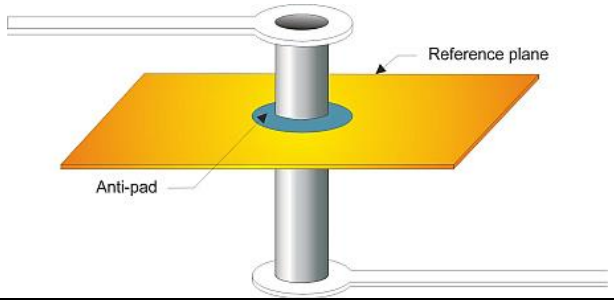
| What is an Anti Pad? | The **anti-pad** is the void area (shown as the blue annular ring in the diagram below) between the via (and any pad associated with it) and the copper of a co-located plane. It should be designed so that it maintains the impedance of a transmission line as it passes through the plane.<br><br>http://www.polarinstruments.com/support/si/AP8178.html<br><br>  |
| Is it okay to create serpentine with 45 degrees?<br><br>How big of an effect is there in using 90-degree vs 45-degree vs arcs in trace length matching? | To answer the first question, it is okay to serpentine with 45 degree angles.<br><br>Getting away from 90 degree turns has been a technique used for many decades. Trying to quantify the reasons is a tedious process. However, the higher the frequency of operation the more important it is to use 45 degree traces, if not rounded traces. I always liked the analogy of water flowing through pipes. If you ever watch the interaction of the walls to the water and how that interaction takes on different looks based on speed, you get the importance of routing in a way that facilitates the smooth flow of a wave. |
| If you have a very dense design, routing differential pairs and single ended, what parameter would you compromise? Would it be the distance between diff pairs? The distance between traces within the pair? The distance from diff pair to single ended traces? | Each parameter being compromised creates its own negative set of results. If you can tolerate the signal being noisy, then the common-mode impedance is not as important. If you are worried about attenuation, then focus on the substrate loss tangent. If you are worried about cross-talk, focus on spacing. If you are worried that reflections are going to be significantly detrimental to the signal shape being received, focus on impedance matching. In the end, all of these parameters are going to affect the quality of the signal at the load at some level so the answer is not simple. Therefore, trend cautiously when deviating from any parameter. |

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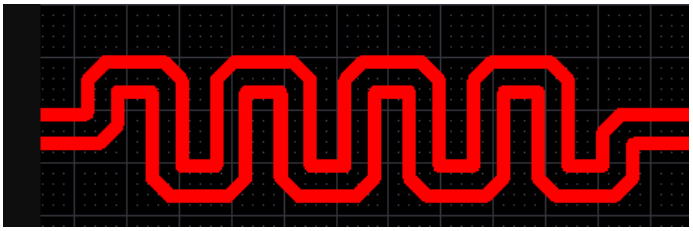
| Text books can be quite expensive. Can you recommend one good text that covers all these topics your webinar series covers formulas, materials, techniques, etc.?<br><br>If not one book, what books do you think would make good additions to my library? | Wouldn't that be grand to have such a book! Unfortunately, I do not know of such at this point. Maybe I should write one! (*NDC side note - we are very much planning on Sean writing this book! Stay Tuned....*) Be aware that any book you get will be written in a flavor that shows the background of the writer, and some of them have a very narrow past of experience to draw upon.<br><br>Here are a few references that were drawn upon in the making of this webinar:<br><br>Transmission Line Design Handbook<br>By B. Wadell (1991)<br><br>*High-Speed Digital System Design, A Handbook of Interconnect Theory and Design Practices*<br>By Hall, Hall, & McCall (2000)<br><br>*High-Speed Digital Design A Book of Black Magic*<br>By Johnson & Graham (1993)<br><br>*Advanced Signal Integrity for High-Speed Digital Designs*<br>By S. Hall, H. Heck (2009)<br><br>*High-Speed Circuit Board Signal Integrity*<br>By S. Thierauf (2004) |
| Should a differential signal serpentine the pair together or symmetrically? | When the need arises to delay a differential pair, I prefer to do so in a traditional serpentine manner like below.<br><br>  <br><br>When you create a delay using symmetry, you increase the radiation characteristics. |

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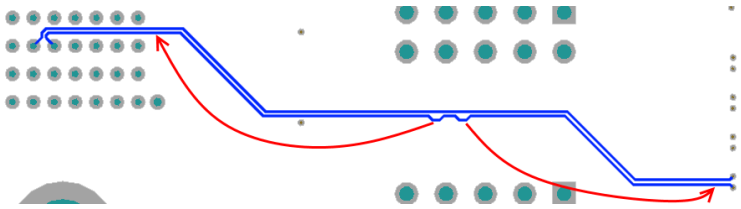
| You addressed the copper traces, what about vias and their influence on high speed signals (via stubs, changing between layers with different dielectric constants, etc.)? | All good points and we would like to visit them in a future webinar. As a side note, Jeff Condit did a deep dive on via some time ago. Though this is not a webinar on the high speed aspects of the via, it provides an excellent introduction as to what they are and how to handle them. Here's the link to request that webinar:<br><br>http://ninedotconnects.com/webinar-deep-dive-vias |
| If you put a spiral inductor on a trace, couldn't you end up setting up a resonant circuit with a CMOS pin load? | Agreed. But given that some SERDES are getting above 28Gb speed, the upper frequency content is at 70GHz. Anytime I have frequencies over 1GHz, I treat every line as an RF trace. |
| When differential pairs start and end far from each other what is the best solution for length tuning? | There are two different answers based on the use case.<br><br>Case 1 (unidirectional): Create the match as close to the source as possible.<br><br>  <br><br>Case 2 (bidirectional): Split the matching so that half is at one end and the other half is at the other end. This creates a compromise so that the wave travels in as much of a symmetrical manner as possible.<br><br>  |