

Coaxial Delay Lines: Design Considerations

Introduction

Coaxial delay lines have long been used in electronic systems to delay, filter or calibrate signals. They can be provided in many different sizes and formed into countless configurations. However, in order to obtain optimal delay line performance, designers should make several considerations. Prudent front-end design can improve cost, size, configuration and overall electrical performance of not just the delay line, but the overall system.

Design Considerations:

Configuration. Circular coils provide the most economical and consistent delay line package. Other configurations such as oval or square are expensive to coil and usually require an invasive service loop to compensate for cable physical length variations. Overall delay line performance is further enhanced with circular configurations because; precise connector locations can be easily achieved through coil relaxation.

Length Tolerances: Length should be specified electrically in lieu of physically, since the physical length for a specified electrical length may vary. We recommend tolerances of ± 15 to ± 20 pico-seconds at frequencies electrical between 800 and 2000 MHz. If necessary, the electrical tolerance may also be specified in degrees. Furthermore, since mechanical forming may induce electrical length changes, we recommend that final electrical testing and trimming be performed on fully coiled delay lines

Cable Types: Standard MIL-C-17 Semi-Rigid Cables use a solid PTFE dielectric with inherently large phase (electrical length) variations which may affect system performance. To minimize variations, upgrade to Micro-Coax low-loss "LL" micro-porous PTFE dielectrics. These dielectrics are very stable electrically eliminating the need to compensate within the system for cable length changes. Expensive temperature cycling of the delay lines prior to assembly is also necessary. See attached graphical comparison of solid and "LL" dielectrics.

Packaging: We recommend solder tacking as the most effective method to ground and maintain configuration in lieu of tie wrapping and tape. Where connectors are a concern, the delay lines may be configured with SMT ready leads to solder directly onto PC Boards.

System Design: We recommend that the delay lines be considered through out the system design process. Delay lines with long and complicated leads or pigtails are expensive, difficult to ship and ungainly to assemble. Also, any long leads are easily damaged, potentially affecting system performance. Finally, multiple delay lines can often be nested together for maximum utilization of space.