

Course Description

Course name	#030 - PCB Filters and Multiplexers using Standard SMT Components
Duration	2 days
Format	Public Classroom and Inhouse Event. Not Suitable Online

Overview

Mr. Daniel G. Swanson Jr., DGS Associates, LLC, Boulder, CO. USA, is teaching this course in **PCB Filters and Multiplexers using Standard SMT Components**.

Explore the capabilities of well-known topologies like combline, interdigital and edge coupled as well as lesser-known printed lumped element topologies. Learn EM simulation and unique optimization methods that are keys to rapid, successful design.

Technical Focus

Filters are one of the fundamental building blocks of **RF and microwave systems**, along with amplifiers, oscillators, mixers, and switches.

When we design a printed circuit board (PCB) based system, we rely on surface mount technology (SMT) components to realize a very compact, low-cost system. Although there are now some standard filter designs available in SMT format, we often need to design a custom filter or multiplexer. These custom filter designs can be realized using standard SMT inductors and capacitors and perhaps a few printed distributed structures as well.

Successful designs have been demonstrated across a frequency range of tens of MHz up to 6GHz. This frequency range covers most of the current wireless standards and many of the military communications bands as well.

Course Content

This course is devoted to the fundamentals of practical **filter design for RF and microwave systems** in a low cost, PCB environment.

The central challenge is to identify the most useful filter topologies for this construction method and frequency range. The search for a useful topology must include knowledge of each component's spurious response. Various SMT component libraries will be examined with this in mind.

Another serious challenge to the designer is the rather limited catalogue of standard component values that are readily available. Simple techniques to overcome this limitation will be demonstrated. Although the majority of designs are fixed in frequency and bandwidth, some tunable bandpass and notch filter topologies will be presented.

We will apply EM simulation to our designs when the layout becomes highly compacted, or when non-standard connections to library components are required. EM simulation will also be used to optimize the performance of edge launched PCB connectors.

Example filter designs that cover a broad range of applications will be presented with measured data and error analysis. The instructor will choose examples to develop based on the interests of the class.

Who should attend?

The course material is suitable for filter designers, designers of other components, systems engineers, and technical managers.

Course Daily Schedule

Introduction to PCB Filter Design

We will start with a brief discussion of PCB construction techniques and how they affect our filter designs.

Then we will turn to basic filter design concepts. Starting with lowpass prototypes, we will touch on Chebyshev and elliptic prototypes and find prototype element values.

Next, we will turn to the concept of cross-couplings and how they introduce finite transmission zeros.

Finally, we will discuss some of the more useful filter topologies we have found for PCB based bandpass and notch filters.

- Basic PCB Construction
- Basic Filter Concepts
- Chebyshev and Elliptic Prototypes
- Cross-Coupled Filters
 - Useful Bandpass Topologies
 - Useful Bandstop Topologies

PCB Filters and Connectors

The bulk of this session will be devoted to examples of Chebyshev and elliptic function filters that have been built using standard SMT components. In most cases we will show the evolution of the design from ideal lumped prototype to final layout with comments on the design decisions that were made.

Before we can measure our filters, we need a reliable transition from the PCB to our connector of choice. SMA edge launch connectors are quite popular and are available in several styles.

We will spend a few moments discussing how to optimize these connectors for higher frequency performance.

- Lowpass Filter Examples
- Bandpass Filter Examples
- Notch Filter Examples
- Diplexer Examples
- Multiplexers
- Edge Launch Connectors

Instructor Biography

Mr. Daniel G. Swanson Jr. DGS Associates, LLC, Boulder, CO

Mr. Swanson launched DGS Associates, LLC in August 2015 to develop microwave filter design software and robust filter optimization engines for single filter and multiplexer optimization. His expertise areas include advanced synthesis techniques and EM simulation of planar and 3D filter structures.

Mr. Swanson's filter design activities include military, wireless, and communications applications. He is a Life Fellow of the IEEE and is a past chairman of the MTT-8 Filters and Passive Components Technical Committee. He is on the editorial board for the IEEE MTT-S Transactions and IEEE MTT-S Microwave and Wireless Components Letters. Mr. Swanson is the primary author of *Microwave Circuit Modeling Using Electromagnetic Field Simulation*, published by Artech House. He has published numerous technical papers, given many workshops and short course presentations, and holds two patents.

Mr. Swanson has been a member of the Continuing Education Institute-Europe faculty since 1998.