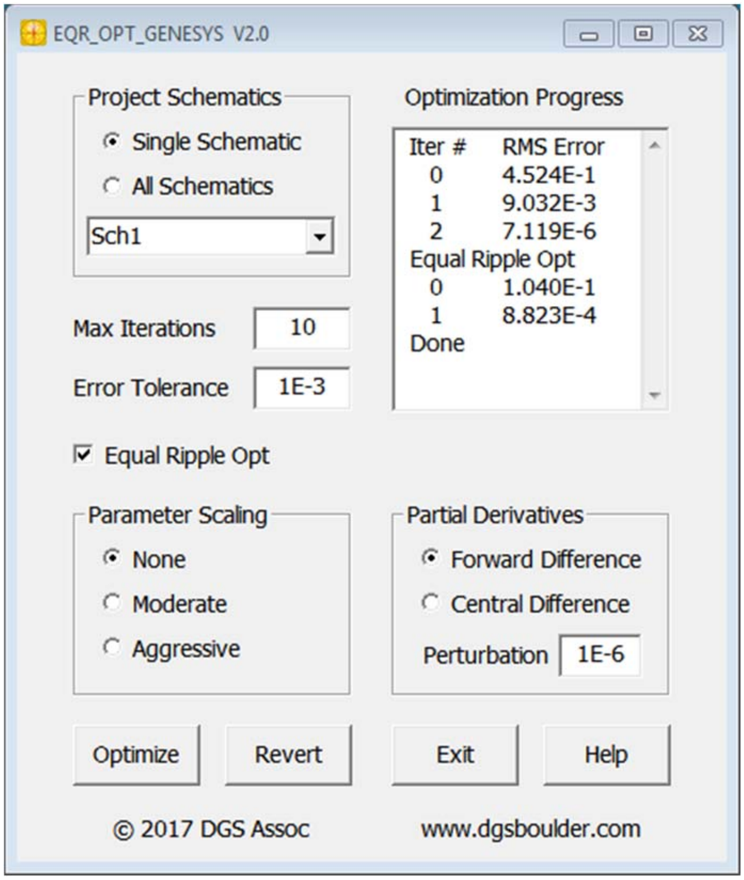
# Equal Ripple Optimization for Keysight Genesys




Equal Ripple Optimization for Keysight Genesys (EQR_OPT_GENESYS) is a specialized engine for filter optimization. It leverages the COM Automation API and can optimize any filter that can be defined in the Genesys design environment. It can also be used to port tune S-parameter files imported from any EM simulator. Unlike many general purpose optimizers, EQR_OPT_GENESYS finds an exact equal ripple response and controls the band edge frequencies exactly. General purpose optimizers often fail to find all the reflection zeros in the passband, particularly for higher order filters.

EQR_OPT_GENSYS can optimize individual bandpass filters, diplexers and multiplexers. Once an initial solution is found, it is easy to modify the bandwidth or shift the center frequency of the filter. Variables can be used in schematics and constraints on element values are supported.

**Key Features**

- Exact equal ripple optimization of any bandpass filter.
- Exact equal ripple optimization of diplexers and multiplexers.
- Supports port tuning of imported S-parameter files from EM simulators.
- Access to all the library elements in the Genesys design environment.
- Compatible with M/Filter and S/Filter.
- Example files for many filter topologies are included.
- Tested and supported on 32 and 64 bit versions of Windows XP and Windows 7 thru 10.

**Example 1: Edge coupled microstrip filter using analytical models**

Any combination of analytical models or EM based models from the Genesys element library can be used in the filter schematic. In this case we are using analytical models to describe an N=5 edge coupled filter in microstrip. Ten variables are needed to define the resonator frequencies, the coupling between resonators and the return loss level. Genesys M/Filter can be used to find starting values for the optimization.

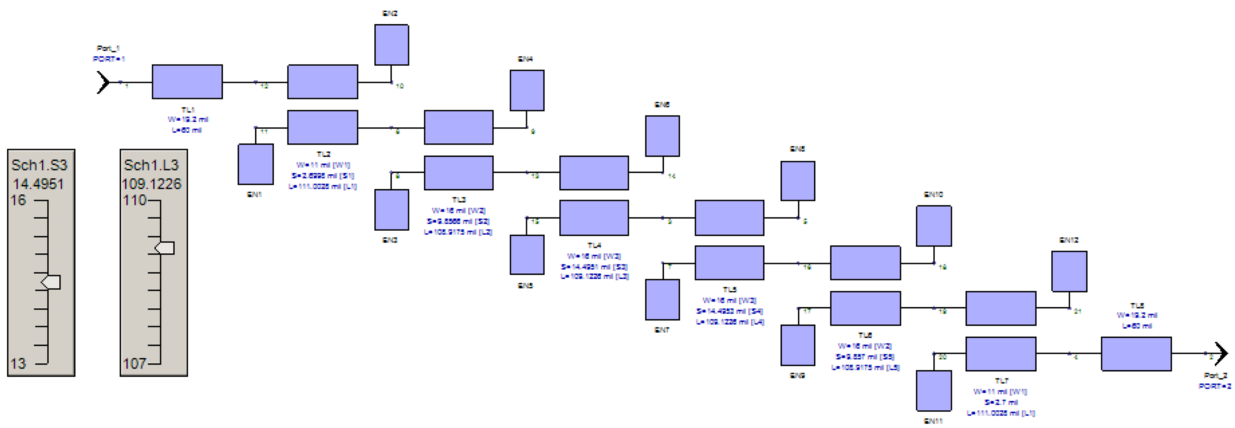



**Figure 1.** Genesys schematic for a microstrip edge coupled filter.

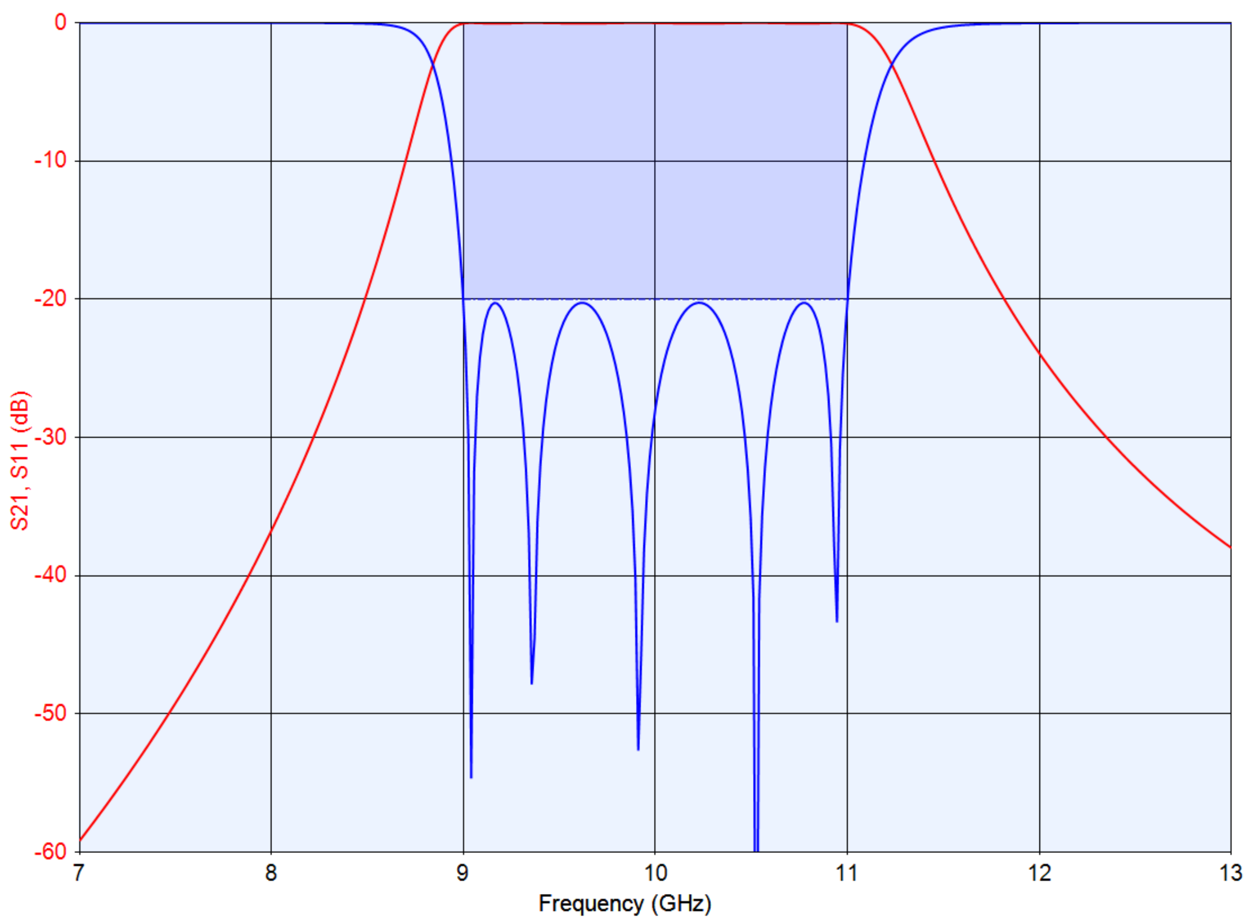



**Figure 2.** Optimized equal ripple response after 8 iterations.

**Example 2: Resonator loaded combline filter**

This combline filter model is actually quite accurate when compared to EM simulation. The resonator lengths and coupling inductors are commensurate. The shunt element with negative impedance at the input and output is a correction factor for the tapped resonator computed according to Edward (Bud) Cristal. We can turn this model into a cross-coupled filter by "growing" the cross-couplings into the network using the optimizer. We can adjust the return loss level by moving the output tap up or down.

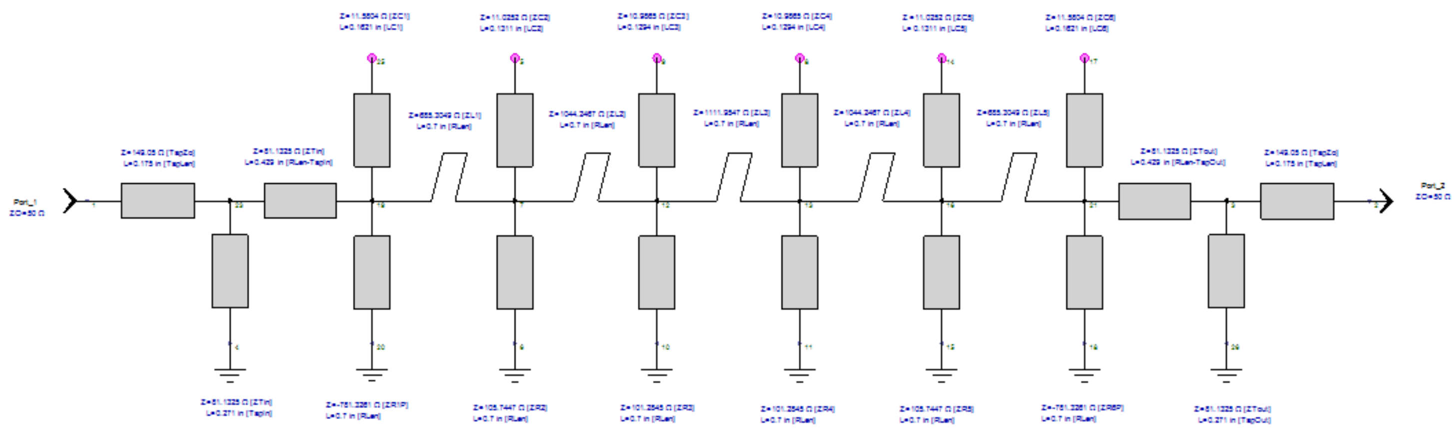


**Figure 3.** Combline filter schematic from the CCL program.

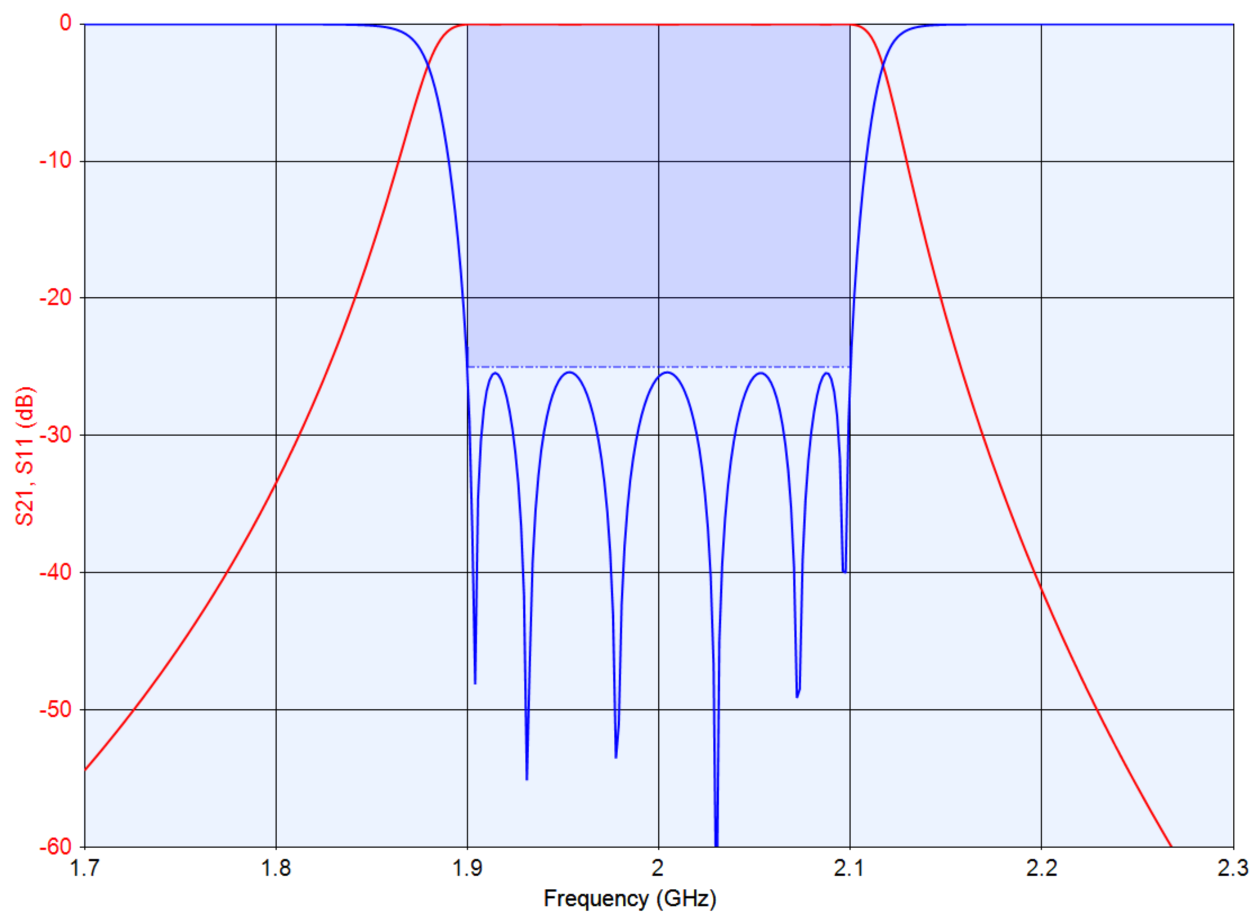



**Figure 4.** Optimized equal ripple response after 6 iterations.

**Example 3: N=12 Contiguous Combline Diplexer**

The diplexer is two N=12 filter models of the type shown in Example 2. We started with doubly terminated filter designs with separation between the channels of one eighth of the passband width. Then we brought the channels together with optimization by moving the band edge frequencies. In this case there are 48 variables being optimized simultaneously. The two figures below show the starting point for the final optimization and the final optimized result. Note that the return loss is perfectly equal ripple across the two passbands and the cross-over region. This is only possible with precise control of the filter band edge frequencies.

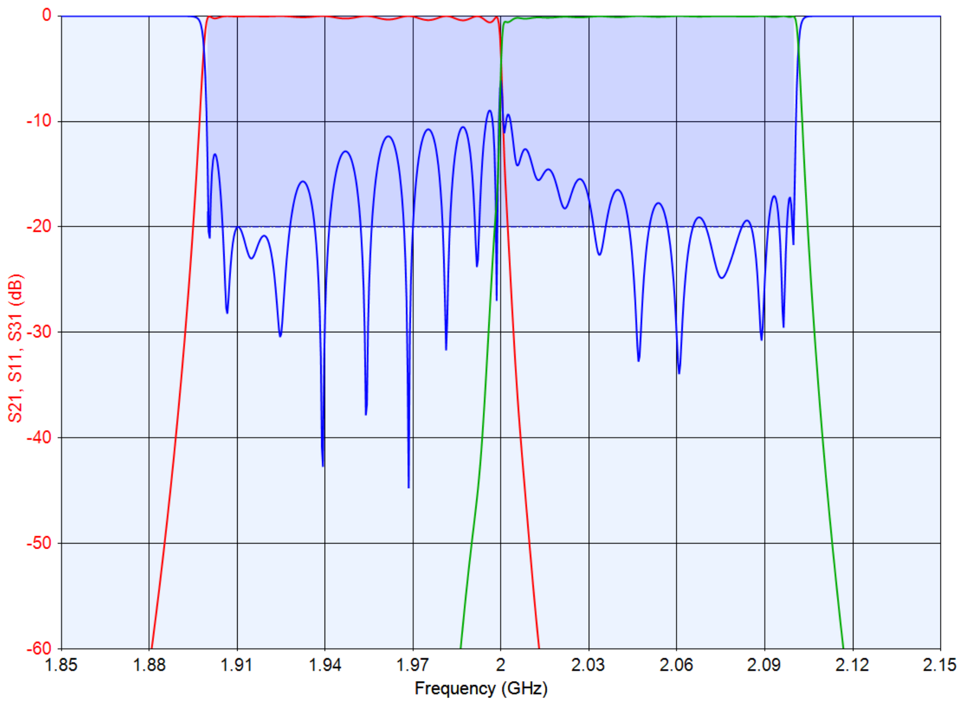



**Figure 5.** Starting point for final optimization.

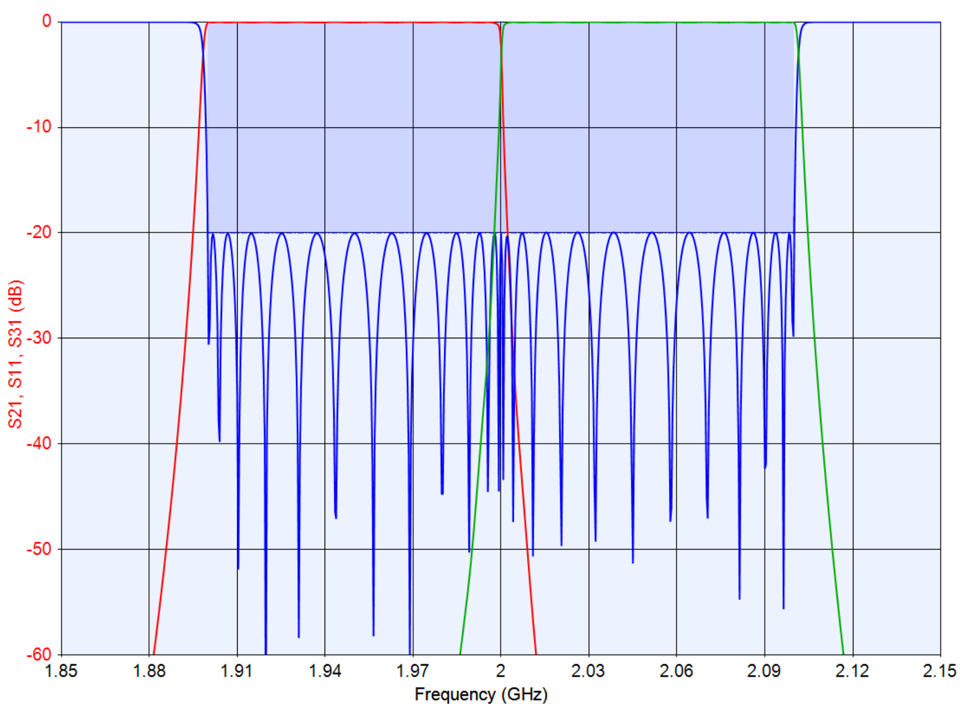



**Figure 6.** Optimized equal ripple response after 6 iterations.