

Waveguide Bandpass Filter with Coaxial Interfaces Reduces Equipment Costs

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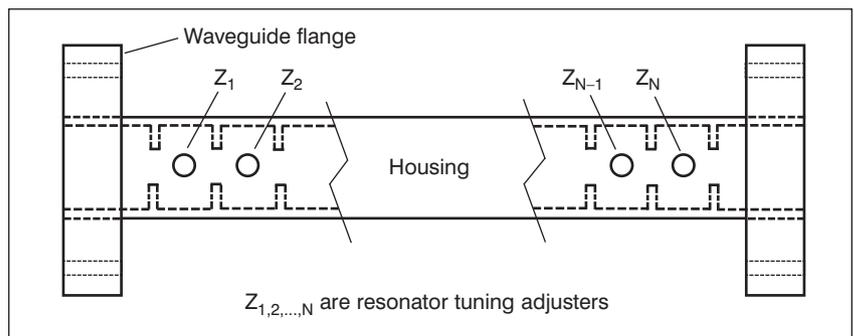
At microwave frequencies from about 8 GHz to 18 GHz, waveguide bandpass filters are often needed to provide required selectivity. In communications equipment, these filters are often connected to various adjacent coaxial components. Conventional rectangular waveguide filters are normally supplied with waveguide flanges as shown in Figure 1. To use these filters in a coaxial system, two external coax to waveguide adapters will be needed. By designing the filter for coaxial interfaces using SMA connectors (as shown in Figure 2), appreciable savings in cost and size can be obtained.

Waveguide filters can use probe couplings for input and output

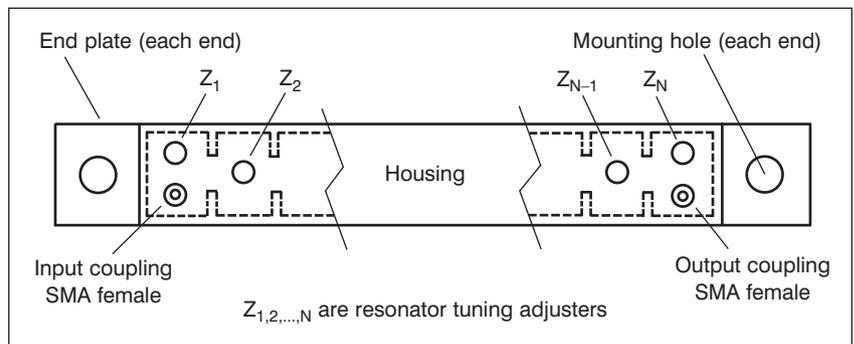
For small and moderate bandwidths, waveguide bandpass filter input and output couplings can be realized by using probe couplings from coaxial lines rather than waveguide input and output couplings with inductive irises, posts, or vanes. As illustrated in Figure 2, the waveguide filter housing no longer uses waveguide flanges. Instead, milled block quarter-inch thick brass end plates are silver-soldered to the ends of the waveguide housing. Vertical number 8-32 clearance holes (or another size, as required) are drilled in the end plates to provide convenient mounting holes for the filter. The tuning screws for the first and last resonators are offset on the E-Plane wall of the waveguide to make room for offset input and output probe assemblies.

Probe assembly design details

The SMA input and output coaxial connectors used in

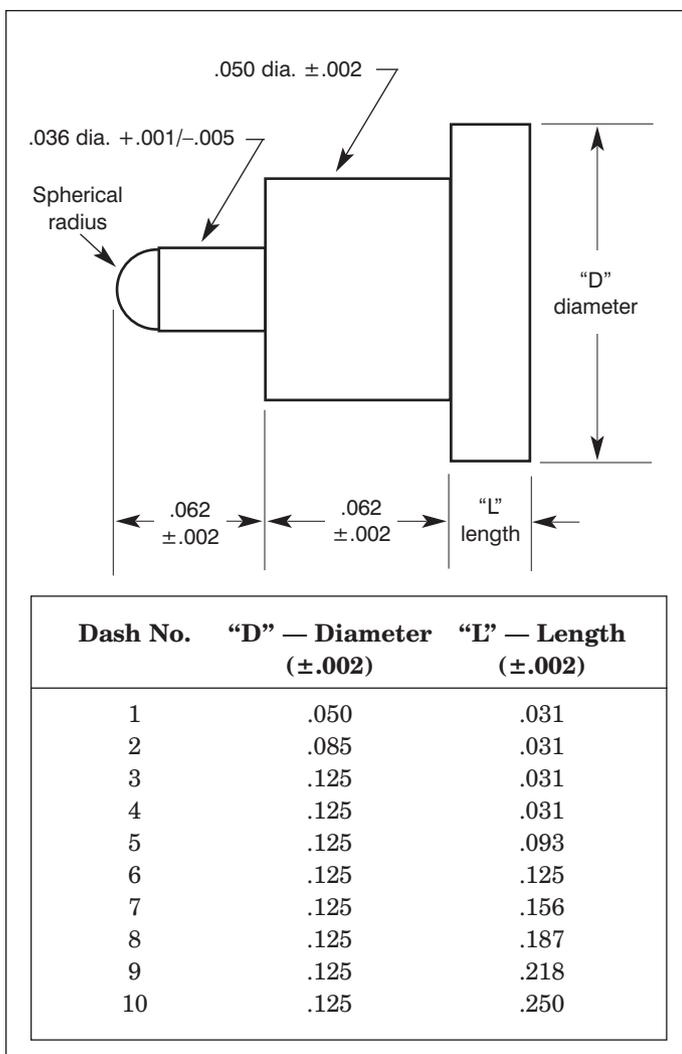


▲ **Figure 1. Waveguide bandpass filter.**



▲ **Figure 2. Waveguide band pass filter with coaxial interfaces.**

the probe assembly are modified double female SMA adapters (straight jack to jack) with captivated center conductors. The adapters are modified by cutting off 0.070 ± 0.002 from the adapter end that will screw into the filter housing. Adapters have number 0.250-36 UNS-2A threads which must be chased after the cutoff modification. The SMA adapters are equipped with 0.062 thick by 0.312 across the flats hex nuts and 0.400 outer diameter by 0.018 thick nominal one-quarter-inch internal tooth washers. Stainless steel adapters and



▲ **Figure 3. Probe mechanical details.**

hardware with passivated finishes are preferred for durability. SMA adapters should also be chosen for low VSWR in the filter passband.

Probe design details

The input and output probe assemblies are small brass probes that can be inserted into the center conductors of the modified SMA female to female adapters. Mechanical dimensions for a family of probes are shown in Figure 3. Discrete input and output coupling ranges are provided by different dash number probes, which are used on a cut and try basis. For probes of each dash number, there is a modest range of continuous adjustment available via the threaded SMA adapters which screw into a tapped waveguide filter housing. In a test setup, the depths of probe insertion into the waveguide are adjusted using swept frequency displays of return loss and amplitude. After filter alignment has been finalized, the input and output probe assemblies should be stacked to the waveguide housing using epoxy or equivalent with the filter securely mounted and connected to adjacent components.

Conclusions

Adjacent external coaxial components will occasionally contribute to source and load mismatched impedances. The adjustable probe assemblies, with first and last resonator tuning adjustments, can provide some help in alleviating this situation. The capability of coupling adjustability plus savings in cost and size make waveguide band-pass filters with coaxial interfaces a desirable design alternative. ■

References

1. S. B. Cohn, "Direct-Coupled Resonator Filters," *Proc. IRE*, Vol. 45, 1957: 187-196.

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