microstripline

bandpass filters

for 1296 MHz

Miniature
bandpass filters
for the amateur
1296-MHz band

UHF experimenters frequently need to filter out spurious or image responses, usually with coaxial or trough-line resonators.\textsuperscript{1-5} Although properly designed coaxial and trough-line filters offer exceptional skirt selectivity and minimum insertion loss, they are large and bulky and require access to sheet-metal cutting and forming equipment. The 1296-MHz filters presented here are based on printed-circuit microstripline techniques and are easily duplicated in the home workshop.

Two- and three-pole bandpass filters for 1296 MHz are shown schematically in fig. 1. In each of the filters parallel-resonant sections, consisting of microstripline inductors and piston trimmer capacitors, are loosely top coupled. The input and output striplines are tapped down on the inductors to provide a match to 50 ohms. The two-pole bandpass filter is functionally equivalent to the filters used at the input of the RF and LO ports of my 1296-MHz double-balanced mixer.\textsuperscript{6} In the design presented here, however, the coupling capacitor, \( C_c \), formerly a 0.5 pF chip capacitor, has been replaced by the stray coupling capacitance between the stator ends of trimmers \( C_1 \) and \( C_2 \).

As can be seen from the swept frequency response curve in fig. 2, these microstripline filters are relatively low-Q devices. The steepness of the rejection skirts may be sacrificed somewhat to minimize passband insertion loss, which for this design averages around 1 dB.

collection

Full-size artwork for the printed-
circuit microstrip filters is shown in fig. 3 and is designed for 1/16 inch (1.5mm) thick G-10 epoxy-glass printed-circuit board, double clad with 1 ounce copper. The unetched side of the board serves as a groundplane. Board dimensions are such that the filters mount easily in a miniature diecast aluminum box such as a Pomona 2417. The cutaway view of fig. 4 shows the method of mounting the piston trimmer capacitors on the circuit board.

With the circuit values shown, these filters can be adjusted to resonate anywhere in the range between 1100 and 1500 MHz. The easiest method to adjust for resonance at 1296 MHz is to connect a weak-signal source through the filter into a receiver, and adjust the trimmer capacitors for maximum received signal. Since the output impedance of the signal source and the input impedance to the receiver may deviate substantially from 50 ohms, it's a good idea to temporarily install fixed attenuators at the input and output of the filter while tuning as shown in fig. 5. There is a certain amount of interaction between the trimmer capacitors so the adjust-

* Tuned and tested two- and three-pole bandpass filters for 1296 MHz are available from Microcom. For complete specifications and prices, send a self-addressed, stamped envelope to Microcom, 14908 Sandy Lane, San Jose, California 95124.
ments should be repeated several times to insure that you have the filters tuned for minimum insertion loss.

If the filter is to be used to reduce the spurious output of a local-oscillator chain, alignment to the desired passband frequency is most easily accomplished by placing the filter in the line between the LO and the mixer and adjusting the filter for maximum indicated mixer current (fig. 6).

![Diagram](image)

**fig. 4. Method of mounting the piston trimmer capacitors on the microstriplines.**

fied more than the desired in-band signals. It is not unlikely, in fact, for lower frequency, out-of-band signals to actually force an amplifier into gain compression. Bandpass filters at the input and output of an amplifier under test will thus aid considerably in making accurate gain and dynamic range measurements.

In operational equipment it’s a good idea to place bandpass filters between each wideband stage as shown in fig. 7. The filter’s 1 dB or so of insertion loss is more than offset by the elimination of image signals and spurious responses. For maximum image rejection it is recommended that the more selective three-pole filter be installed between all active stages. In the local-oscillator chain, where harmonically related spurious signals are separated from the passband by an octave or more, the simpler two-pole resonators are usually sufficient.

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![Diagram](image)

**fig. 5. Using a weak-signal source to align a filter to 1296 MHz. The 3 dB attenuators swamp out any impedance mismatches.**

**applications**

Most amateurs who are active on 1296 MHz will probably want to have several of these bandpass filters available on their workbench. In general, accurate measurements on any two-port device are enhanced by the application of filtering at each port. Microstripline amplifiers, for example, tend to be extremely broadband; since transistors tend to have higher gain at lower frequencies, any low-frequency spurious which is applied to the amplifier will be ampli-
fig. 6. Bandpass filter can be adjusted to the local-oscillator output frequency by tuning the filter for maximum mixer current.

references

ham radio

fig. 7. Installation of bandpass filters in a typical 1296-MHz transmitter and receiver. Three-pole filters are recommended between active stages, as discussed in the text.

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