A New Approach for Contest Filters

When operating more than one amateur radio on HF frequencies on separate bands but close proximity (simultaneous operations), providing isolation between stations is mandatory to prevent performance degradation due to overload related problems such as desensitization and spurious behavior. For example, during some Radioteletype (RTTY) Contests, simultaneous operations are used. I have found that in order to operate effectively with a Single Operator / 2 Radios (SO2R) mode, some type of RF filtering was necessary to prevent interaction between the radios.

I have developed prototype filters using a multiple band-reject approach based on a concept Steve, DA1RR (now AK4R), suggested. This differs from the usual band-pass filter approach that has traditionally been used. The filter remains connected during both transmit and receive periods and works by rejecting signals from all amateur HF bands not being utilized by the station to which it is connected. Some of the major potential advantages include high power (1000 vs. 300 W) multiple band operations in a single compact using relatively low power components.

The prototype works on all 5 bands (80-10 meters) normally used for contesting and is easy to switch between bands. In addition, it can be placed on the output of that amplifier where the harmonics will be attenuated.

Brief listings of the features and characteristics of the band-pass and band-reject contest filters allow a comparison of the two approaches.

Band-pass filter features and characteristics:

- All filters have some amount of loss. The loss decreases efficiency and causes the generation of heat. Most Band-pass filter have 0.3 - 0.8 dB loss.
- Most commercially available band-pass filters can't handle RF power levels greater than 300 Watts.
- Band-pass filters require several components and change in value will effect efficiency.
- One filter is required for each band. 5 Filters for operating 5 bands.
- Band-pass filters provide 30-50 dB rejection on adjacent bands and greater than 50 dB of other bands.
- Band-pass filters require either switching for each band change by physically disconnecting the RF connectors from one filter and installing a new filter or be part of a automatic switch system that requires Band Data from the HF Transceiver.

Band-reject filter features and characteristics:

- Must have high-Q to reduce losses and heat.
- Most filters handle full legal limit.
- One filter is required for each band (5 filters for operating 5 bands).

- Contest reject filters can be built with coaxial cable and with lumped elements (L's and C's). Typically one L and one C for each Band filter.
- Band-reject filters typically have < .2 dB loss and provide 25-35 dB rejection on all other bands depending on the components used.
- Coaxial reject filters (coax stubs) can be used on several bands that are harmonically related.
- Coaxial reject filters (coax stubs) are physically large due the diameter and length of the coax used for the stubs.
- Due to the high-Q of the filters, the 3dB bandwidth is very narrow and may not provide high rejection across any given band.

The biggest difference between how the filters work is as follows:

With band-pass filters, all the RF energy must pass through the filter (which usually has series inductors and capacitors that must be capable of handling large levels of RF current or high voltage).

With band-reject filters, the input and output is connected together with a large piece of wire that easily passes large amounts of RF current.

The main reason I have selected to build the band-reject is the ease of design and the excellent rejection on all other bands.

You may ask why the band-reject filters can handle a full 1500-Watts. The answer to this is quite simple and is explained here.

Amateur Rules part 97.307 (d) says:

(d) The mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must not exceed 50 mw and must be at least 40 dB below the mean power of the fundamental emission. For a transmitter of mean power less than 5 Watts, the attenuation must be at least 30 dB. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

Therefore, If 50 mw is the maximum power allow in the harmonics, even at legal limit, physically small components can easily handle several hundred mw of power and provide greater than 30 dB of rejection.

One concern for contest filter use is the possibility of changing bands while not changing the filter's operating band to the same band. This can cause component damage and is a problem common to both the band-pass or band-reject filter approaches. The damage will most likely be worse with the reject filter since all the RF power is going into virtually a dead short. If you are using a solid state transmitter, the RF short causes a bad VSWR and will cause the RF power to be reduced to a safe level and should not damage the filter if the problem is quickly found. In the event a linear amplifier is being used and the filter is on the output of the amplifier, the filter will be damaged since the bad VSWR on the output is not senses to reduce the input power.

There are some tricks to making the filters work right but only the basics will be covered here. I will say that the proper selection of components can have a large influence on the band-pass characteristics of the band of operation

The AF4Z prototype 5 band Contest Filter

The filter was built in a 8.5" X 3" X 2" aluminum box. The basic schematic is shown below: