Broadcast band interference

Has your shortwave reception been spoiled when a nearby AM broadcast-band radio station caused your receiver to overload? Are you plagued by unwanted musical blurps and bleeps when you tune across your favorite shortwave band?

If your answer to these questions is "yes," this article will be of interest. Simple solutions to this problem are easy to achieve, and at minimum expense.

The Nature of the Problem

Some shortwave or all-wave receivers lack the ability to reject strong signals, and this causes the receiver to become desensed (an apparent weakening of the signal you are listening to). These interfering signals need not be on or even near the frequency to which your receiver is tuned. You might be listening to WWV on 10 MHz while having overload problems from a nearby AM station on 1240 kHz, for example.

Overloading takes place in the front end or early circuits of a receiver. This involves the RF amplifier and mixer stages of the receiver. The *dynamic range* of a receiver is a measure of its ability to accommodate strong signals without an impairment of performance. The higher the dynamic range in dB (decibels) the better the receiver will be in a hostile environment of strong signals.

Most low- and medium-cost shortwave receivers have insufficient dynamic range to "ignore" strong signals. In this situation we can cure part of the problem by using a trap or filter between the antenna and the receiver input terminal.

The Anatomy of Filters and Traps

A trap is a high-Q tuned circuit that is resonant at the frequency of the interfering signal. It may be placed in series with the antenna lead (parallel-tuned trap), or it may be connected from the antenna lead to ground (series trap). These configurations are shown in Figure 1.

A trap is tunable by varying the capacitance or the inductance of the circuit. It is adjusted until the interfering signal vanishes or is greatly reduced in amplitude.

A filter, on the other hand, rejects unwanted frequencies while allowing all desired frequencies to pass from the antenna to the receiver. A filter that is designed to reject all of the signals in the 550-1600 kHz range is called a "band-reject" filter. It allows the passage of signals below and above the standard broadcast band.

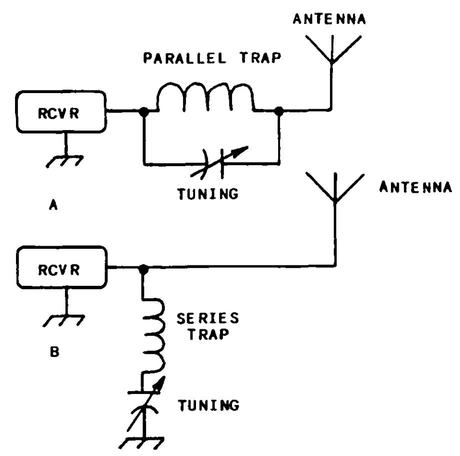

Figure 1 -- Examples of tuned traps. A parallel-tuned trap is shown at A. Example B is a series-tuned trap. Use the configuration that provides the greatest attenuation of the unwanted signal.

Traps and filters may be designed to eliminate strong signals in the shortwave spectrum also. The *ARRL Handbook* contains extensive information about the design of low-pass, high-pass, and band-pass filters for any MF or HF part of the radio spectrum.

How to Build a Trap

We learned earlier that the Q (quality factor) of a trap must be high if the trap is to perform effectively. Therefore, if the trap coil has a slug or toroid core, the core material needs to be designed for the best Q it can provide at the selected trap frequency.

Not all core materials are the same. The wrong core can destroy the Q of a tuned circuit. Air-wound coils, such as commercial Miniductor stock (made by the B & W Corp.), are excellent for ensuring high Q. In a like manner, hand-wound, single-layer coils that are wound on low-loss coil forms can exhibit a high Q. The larger the wire diameter, the better the Q.

Coil forms made from tubular stock, such as ceramic, phenolic, acrylic, and Lexan are good. PVC tubing is suitable for use below, say, 10 MHz.

The trap leads should be kept short and direct in the interest of preserving the trap Q. Likewise with filters. Traps and filters work best if they are enclosed in a metal box.

Maintain a spacing between the trap coil and the box walls that is at least the width of one coil diameter. This helps prevent the metal box from degrading the tuned-circuit Q. If a trap or filter is not shielded in this manner, it can pick up the interfering signal along its length, and this greatly reduces the effectiveness of the trap or filter.

An earth ground should be connected to the filter or trap case. The objective is to minimize the leakage of energy from the input of the trap or filter to its output terminal. The greater the leakage the lower the attenuation of unwanted frequencies.

Coils that are wound on toroid cores may not need to be shielded. Toroidal inductors and transformers have a self-shielding property. The connecting leads on the capacitors and coils, if long enough, may pick up energy from the interfering signal, and this can negate the self-shielding traits of the toroid. Keep the leads short!

Build a BC-Band Trap

Figure 2 contains circuits for series and parallel traps for the standard broadcast band. It does not matter what impedance your antenna or feed line is when you install a trap of this type. In other words, it may be used with a single-wire-fed antenna, or with a system that has a coaxial feed line.

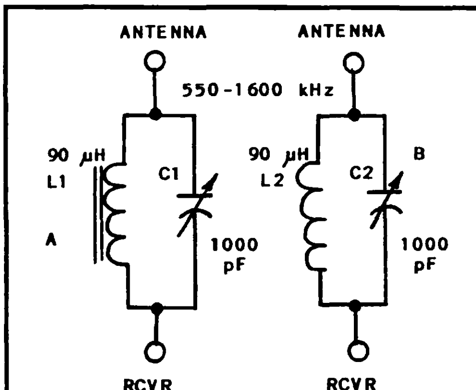

Figure 2 -- Toroidal (A) and solenoidal, air core (B) trap coils. C1 and C2 are ARCO no. 4611 mica compression trimmers for use from 550 to 900 kHz (300-1000 pF). For operation from 800 to 1600 kHz use an ARCO no. 466 (105 - 480 pF) trimmer. L1 has 35 turns of no. 26 enam. wire on an Amidon Assoc.[1] FT-82-61 ferrite core. L2 contains 52 turns of no. 20 enam. wire, close wound on a two inch OD coil form that is three inches long.

This is not true when you use a filter, since all filters are designed for a particular impedance -- generally 50 ohms. If a filter is not terminated in its characteristic impedance, it will not function as a filter, and it will cause the SWR (standing-wave ratio) in your antenna system to increase. This can cause signal losses.

BC-Band Filters

Figure 3A details the circuit for a high-pass filter that rejects the AM broadcast band and those frequencies that lie below the BC band. All signals above 1700 kHz will pass through the filter without being attenuated. The filter impedance is 50 ohms.

Figure 3B contains the circuit for a band-reject filter. This circuit was designed by Ed Wetherhold, W3NQN, who is a filter designer for Honeywell Corp. It was first presented in *QST* for February 1978. The filter rejects the frequencies from 550-1600 kHz, but allows signal energy above and below that range to pass. The filter impedance is 50 ohms. You will need to switch the filter out of the antenna circuit when listening to the AM broadcast band.

Tag Ends

I have presented only basic information about filters and traps. I have avoided the use of filter-design equations in order to keep things simple and to the point. Since filter design is a fine art, we'll leave it up to the experts!

The practical information provided here will enable you to cope with your overloading problem effectively. The interference malady is a common one for those who live in urban areas where many AM broadcast-band stations may operate around the clock.

I once lived two blocks from a 50-kW AM station (WXYZ) in Detroit. It severely disrupted my ham radio and shortwave reception. A similar problem existed when I lived one block from a 5-kW AM transmitter in Meriden, Connecticut. I was able in both instances to resolve my overloading problem by installing tuned traps in the antenna line.

It is vital that you place your trap or filter as close to the receiver antenna jack as practicable. If not, the lead between the trap and the receiver can pick up unwanted signal energy and degrade the trap performance.

Don't be afraid to heat a soldering iron and build a trap or filter. It is not a difficult task, even for those of you who lack electronics experience. mt

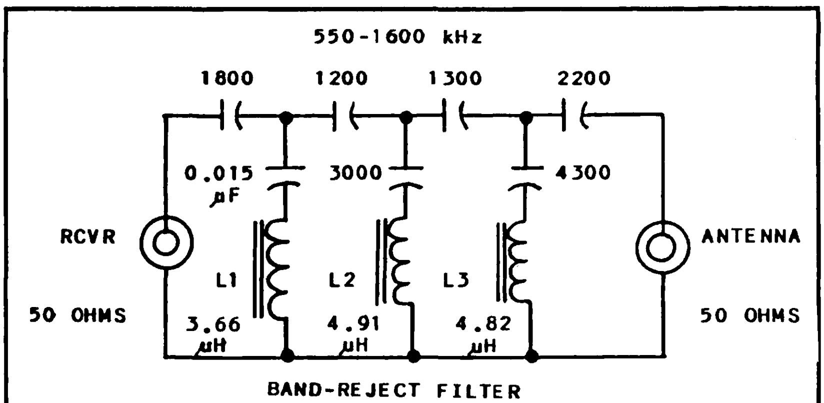

Figure 3 -- Circuit for the Wetherhold band-reject filter. Capacitors are polystyrene or silver mica and are in pF unless otherwise noted. L1 has 26 turns of no. 22 enam. wire on an Amidon T50-2 toroid. L2 uses 30 turns of 24 enam. wire on a T50-2 core. L3 has 29 turns of no. 24 enam. wire on a T50-2 core.

1 Amidon Assoc., Inc., 12033 Otsego St., N. Hollywood, CA 91607. Toroids and other ferromagnectic forms are available by mail. Catalog available. 818-760-4429.

OOPS!

An error in pasteup in last month's Dip Meter article repeated the Fig 1 illustration. Below is the correct illustration and caption for Fig 3.

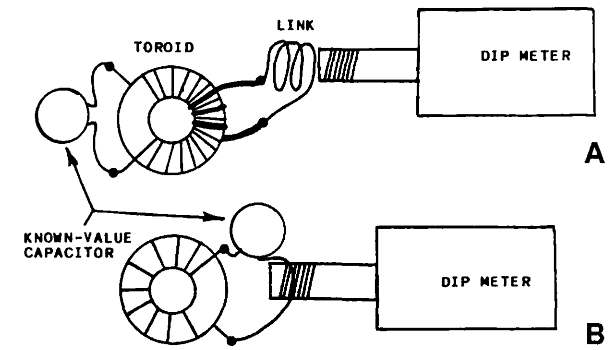

Figure 3 (Jan) -- Example A shows how to check a tuned circuit that uses a toroid coil (see text). A small link is wound over the toroid winding (heavy lines) and it is connected to a small external link. The dipper coil is placed near the external link. Illustration B shows how to couple to a toroidal tuned circuit by placing the dipper coil inside the loop formed by the pigtails of the fixed-value capacitor.