MULTIPLIER

BOOSTS SW SELECTIVITY & GAIN

Add this low-cost accessory to your shortwave receiver and enjoy more stations with greater clarity

BY JOE A ROLF

IF YOU are using a typical medium-priced shortwave receiver, chances are you need more gain and better selectivity to separate the stations on the crowded SW bands. Before you make the decision to trade in your receiver for a newer, "hotter" one, consider adding a Q multiplier; it is relatively inexpensive and just might save you a lot of money.

The reason most medium-priced SW receivers are far from ideal for serious SW listening is that they are designed with i-f bandwidths of between 5 kHz and 10 kHz. This is okay for good performance on the relatively uncluttered AM broadcast band, but on shortwave, where stations operate almost on top of each other, such a broad i-f bandwidth is often less than satisfactory. So, for a receiver that lacks a narrow i-f bandwidth, the Q multiplier can prove a

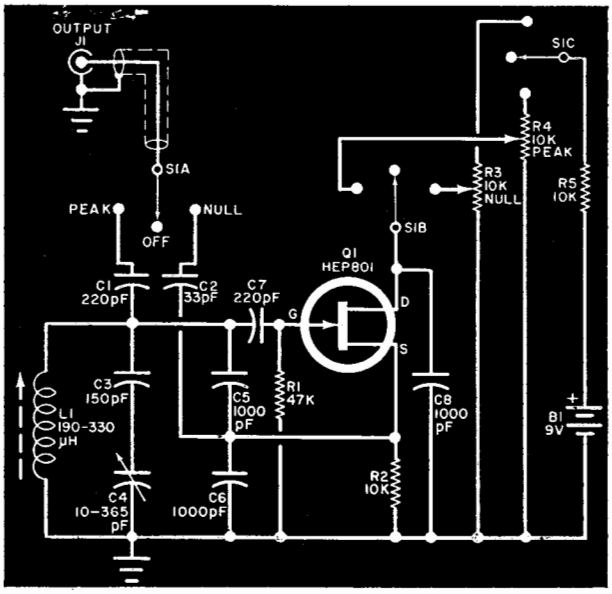

Fig. 1. The circuit is essentially a Colpitts oscillator which is adjusted by R3, R4.

PARTS LIST

B1—9-volt battery
C1,C7—220-pF polystyrene capacitor
C2—33-pF polystyrene capacitor
C3—150-pF polystyrene capacitor
C4—10-365-pF tuning capacitor (Archer No. 272-1341, or equivalent)
C5,C6—1000-pF polystyrene capacitor
C8—1000-pF ceramic disc capacitor
J1—Phono jack
L1—190-330-µH miniature adjustable choke (J.W. Miller No. 4565, or equivalent)
Q1—HEP801 (Motorola) field-effect transistor
R1—47,000-ohm, ¼-watt resistor
R2,R5—10,000-ohm, ¼-watt resistor
R3,R4—10,000-ohm miniature potentiometer (Mallory No. MLC14L or similar)
S1—Three-pole, three-position non-shorting rotary switch (Calectro No. E2-168 or similar)
Misc.—Metal chassis box; printed circuit or perf board with solder clips; battery connector; phono jack (for receiver); phono plugs (2); shielded cable; etc.

valuable accessory for shortwave tuning.

The Q multiplier described here is designed around a single field-effect transistor to provide the equivalent gain of an extra i-f stage. Additionally, it doubles as a bfo. Best of all, it can be built for less than $20.

Theory of Operation. The schematic diagram of the Q multiplier is shown in Fig. 1. The circuit consists of a simple 455-kHz Colpitts oscillator that can be adjusted in and out of oscillation by *R3* and *R4*. A field-effect transistor is used for *Q1* to provide a high impedance to the tuned circuit consisting of *L1* and *C3* through *C6*.

When the circuit oscillates, the Q (selectivity) of the tuned circuit is determined primarily by the components used. However, when the oscillator is adjusted to a regenerative point just below oscillation, component losses are offset by feedback, and the selectivity rises to many times the normal value. If the oscillator (Q multiplier) were connected in parallel with a 455-kHz i-f transformer in a receiver, the selectivity of the transformer would also be greatly increased.

In Fig. 2 is shown a typical i-f response curve for a medium-priced SW receiver and the effect a Q multiplier has on selectivity. The i-f bandpass of the receiver is reduced to a fraction of the original by the Q multiplier. Since the multiplier is tunable, it can be used to peak any signal in the original bandwidth.

By connecting the Q multiplier in a slightly different manner, the i-f response can be left unaltered except for a very sharp adjustable notch. Used in this manner, the circuit can tune out or null unwanted signals.

Since both the peak and the null functions are desirable, the Q multiplier has been designed to operate in either mode, simply

by flipping selector switch *S1*. A small 365-pF tuning capacitor (*C4*), trimmed by *C3*, tunes the circuit across the receiver's i-f bandpass. When neither the peaking nor nulling function is needed, the Q multiplier can also be switched out of the circuit and the receiver is on its own.

Construction. The Q multiplier can be assembled in any metal chassis box large enough to accommodate it. A box with a front-panel area measuring roughly 2¼" high by 3¼" wide and a depth of about 4", such as the Archer No. 270-251 from Radio Shack, will be suitable.

Since the circuit of the Q multiplier is very simple, perforated phenolic board and solder clips can be used for mounting most of the parts. Alternatively, you can design and make your own printed circuit board.

Mount *B1* on the bottom of the chassis, close to the rear wall. On the rear wall itself goes *J1*. The front panel should have mounted on it NULL and PEAK controls *R3* and *R4*, MODE switch *S1* (with appropriate position legends), and TUNE capacitor *C4*. Coil *L1* should be mounted on the board assembly in such a manner that its slug adjustment is readily accessible.

To simplify hookup to your receiver, it is a good idea to mount a phono jack on its rear apron and use a length of shielded cable to interconnect the jack and first i-f transformer as shown in Fig. 3. (Note: ground this cable only at the jack.)

Finally, solder phono plug to the ends of a length of Belden No. 8421, or equivalent, low-capacitance shielded cable. This cable should be as short as possible, preferably less than 24 inches.

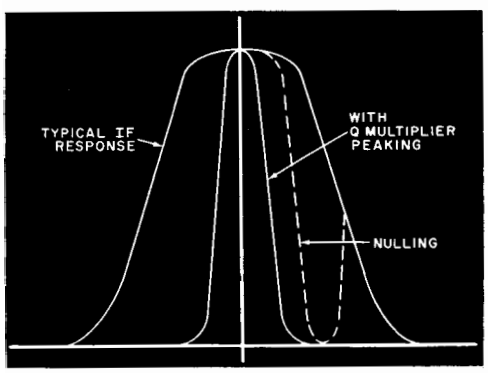

Fig. 2. Waveforms show effect of Q multiplier on i-f response of medium-priced receiver.

In Use. To put the Q multiplier into operation, connect it to the receiver with the shielded cable. Turn on your receiver and tune to a quiet spot on the AM broadcast dial. Set the Q multiplier to PEAK. With *C4* (TUNE) set to mid-position and PEAK control *R4* fully clockwise, tune *L1* until you hear a signal. If the Q multiplier is tuned to the receiver's i-f, the signal will be heard continuously across the AM band, with a beat note when you tune across a broadcast

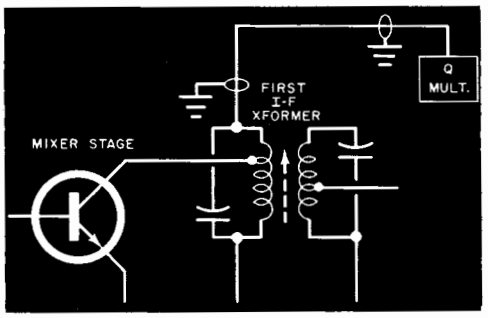

Fig. 3. Diagram shows how to connect the Q multiplier into your receiver using coax.

station. In this mode, the Q multiplier can be used as a bfo.

Switch to NULL and rotate the TUNE knob until a signal is again heard with the NULL control fully clockwise. (The setting of *C4* in the NULL and PEAK positions of the MODE switch will be slightly different, in which case it may be necessary to make a compromise adjustment of *L1* to get both to fall as near the center of the TUNE capacitor's setting as possible.) Finally, set the Q multiplier to a point below oscillation and peak the i-f transformer to which it is connected as needed.

It takes a little practice to learn how to use a Q multiplier efficiently if this is the first time you have used one. Adjusting the PEAK control clockwise increases selectivity and decreases i-f bandwidth. Greatest selectivity occurs just before oscillation, indicated by a ringing sound when the receiver is tuned across a signal.

When in NULL, the notch is made sharper as the NULL control is turned clockwise, and a very noticeable drop in signal will be heard when the Q multiplier is tuned to an unwanted signal. A little practice at the controls will enable you to peak or null any signal you hear for best reception. ◈