

Heathkit of the Month #24:
by Bob Eckweiler, AF6C

Heathkit

The Heathkit QF-1 Q-Multiplier

Introduction:

In the fifties and into the sixties many of the less expensive general coverage receivers lacked decent selectivity. A typical fifties single conversion receiver has a bandwidth of 6 KC* at -6 dB and a whopping 30 KC at -60 dB.

An improvement found on the better single conversion receivers is the crystal filter. This filter should not be confused with today's sealed lattice crystal filters. These filters typically consisted of a single crystal at the IF frequency. The circuit included a rotary switch (often six-position) and a phasing capacitor control. The switch offered an "Off" position where the filter is out of the circuit and five "Selectivity" positions, each more selective than the last. Position five of the selectivity could offer 100 CPS at -6 dB and 7 KC at -60 dB. Modern sealed lattice crystal filters have much steeper skirts (A typical CW filter might be 400 Hz at -6 dB and only 2KHz at -60 dB.) And that is at an IF frequency over seven times higher.

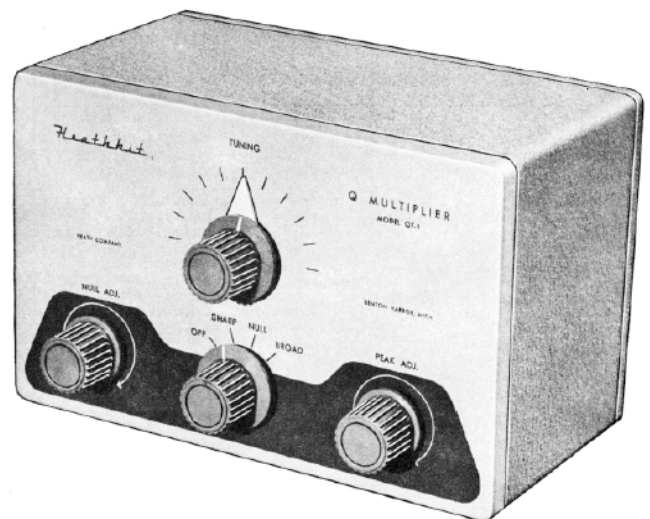
Another way selectivity was improved in the old days was to reduce the frequency of the IF. The National NC-300 and the Heathkit RX-1 Mohawk have second IF frequencies of 85 and 50 KC respectively. At these low IFs it is easier to improve selectivity. The trade off is that image rejection is poor if the receiver is single conversion. At 85 KC an image just 170 KC could easily make it through the receiver. The solution was to go to double conversion, with a high frequency IF to reduce images and a low IF to provide better selectivity. The NC-300 and Mohawk have first IF frequencies of 2,215 and 1,682 KC respectively.

For the 50's - 60's ham with a single conversion receiver with a 455 KC IF (such as the National NC-88, the Hammarlund HQ-129X, or the Heathkit AR-3) poor selectivity and crowded bands presented a challenge. Bob knows! *The NC-88 was his receiver during his novice days.*

A solution to poor selectivity is the Q-Multiplier. This regenerative device hooks up to the mixer of a receiver and allows an improvement in selectivity as well as gain, or the ability to notch out an interfering heterodyne or other narrow band signal.

The Heathkit QF-1 Q-Multiplier:

The Heathkit Q-Multiplier was first introduced in late 1955 as a way to improve the selectivity of many receivers of the day (especially on the Heathkit AR-3). It was designated the QF-1 and sold for \$9.95. The small unit measures 7-3/8" W x 4-11/16" H x 4-1/8" deep, weighs 1-1/2 lbs. and has four controls on the front panel:



Heathkit QF-1 Q-Multiplier

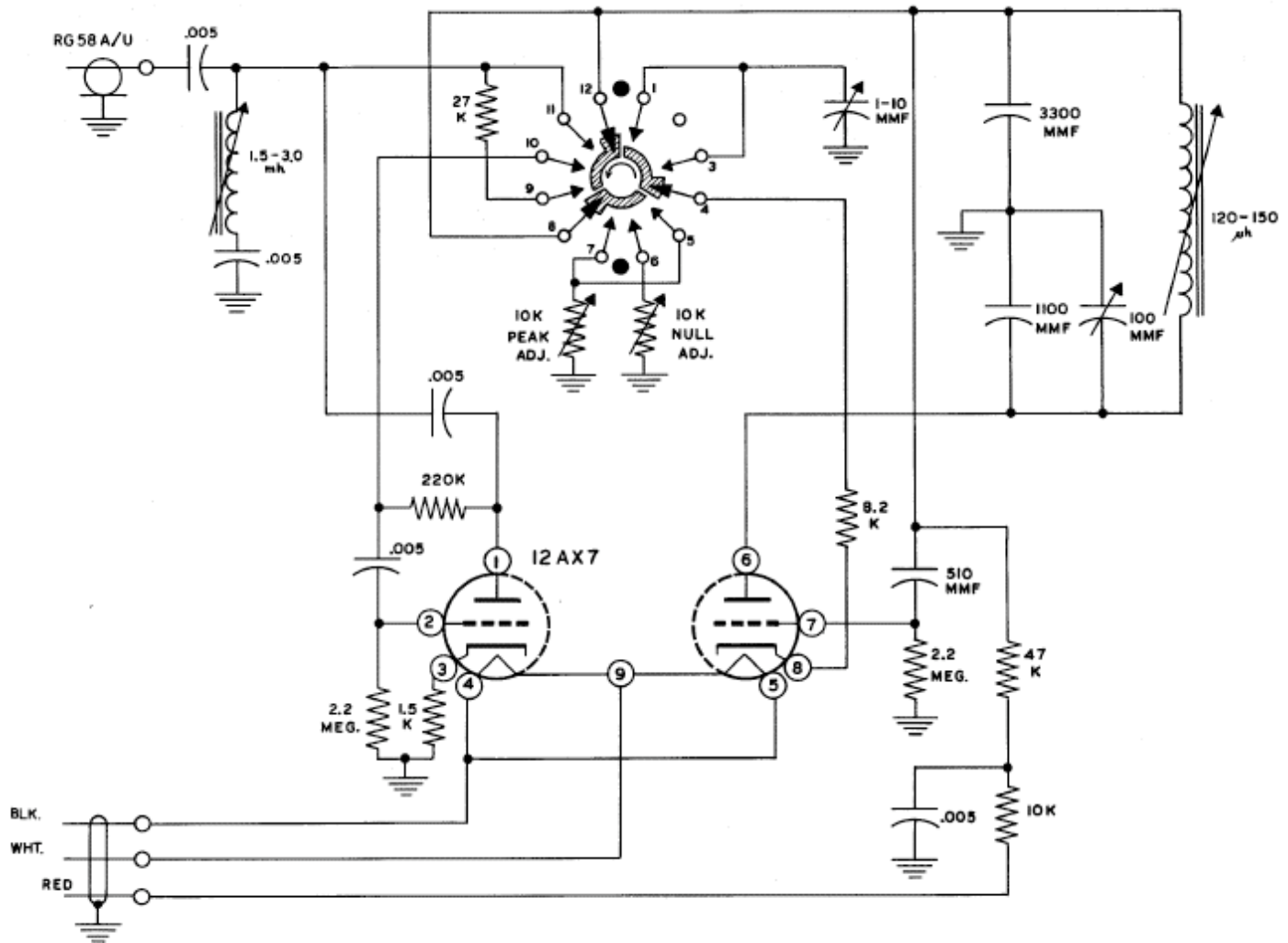
Front Panel Controls:

Top Row:

- Passband **Tuning** (Vernier capacitor)

Bottom Row (left to right):

- **Null Adj.** (potentiometer)
- Function: **OFF, Sharp, Null, Broad** (rotary switch)



SCHEMATIC OF Q MULTIPLIER QF-1

• **Peak Adj.** (potentiometer)

On the rear there are two cables coming out through two grommets. One cable is for power: The QF-1 derives its power from the receiver (6.3VAC @ 300 ma and 150 - 250 VDC @ 2 ma) to power the one tube, a 12AX7 dual triode. The second cable is a short length of RG-58 coax cable that connects internally to the receiver. That connection is to the plate of the mixer for the 455 KC IF or the plate side of the first 455 KC IF transformer. The QF-1 kit came with an octal plug and socket and an RCA plug and jack to make the power and IF connections respectively if the receiver lacks them.

The instructions suggest you check the receiver's 455 KC IF alignment first and, if you

use the RCA connector, to realign the first IF to compensate for the added length of RG-58 cable to the RCA connector. The length of IF cable between receiver connector and the Q-Multiplier is compensated for inside the QF-1.

How the QF-1 Works:

In the Sharp mode the QF-1 acts as a very high "Q" tuned circuit in parallel with the first IF transformer. A parallel circuit has high impedance at the tuned frequency and lower impedance as the frequency moves away from resonance. Since the "Q" is very high, the slope of resonance is steep and signals are rapidly attenuated as their frequency deviates from the QF-1's center frequency. This high "Q" is achieved by a high "Q" coil that is significantly enhanced by a regenerative circuit using the

HOM rev. new

first triode section of the dual triode tube. The "Q" may be increased up to around 4,000. The gain of the signal is also increased in the bandpass. The actual "Q" may be adjusted by the Peak Adj. control, thus adjusting the bandwidth (and the gain).

In the Broad mode a resistor is switched in allowing a higher gain at a broader bandwidth. Otherwise it is identical to the Sharp mode.

In the Null mode the second section of the dual triode tube acts as an inverting circuit that changes the high "Q" circuit across the IF transformer from a parallel into a series impedance. A series resonant circuit has a low impedance at resonance, shunting any signal to ground that is at its resonance point. Signals off the resonance are passed through the normal receiver IF bandpass. The Null Adj. control adjusts the "Q" of the null.

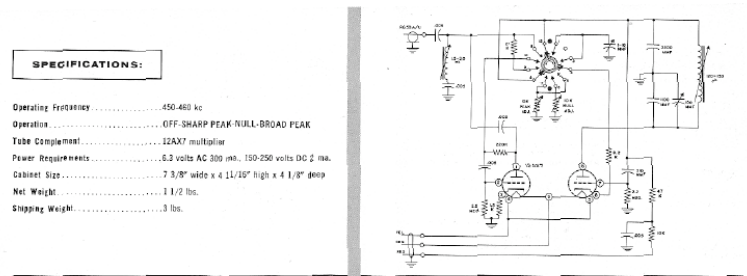
The HD-11 and GD-125 Q-Multiplier:

Heathkit replaced the QF-1 with the HD-11 in 1961 (\$14.95), and the GD-125 in 1966. The GD-125 stopped production in 1971. The later two units had some minor circuit variations and one big addition; they included the power supply so no power connections to the receiver were needed with these units. The minor changes were in the Peak Adj. and Null Adj. circuit values. The last unit also omitted a small trimmer capacitor. The HD-11 looks almost identical to the QF-1 in size. The graphics on the front are green instead of gray and the front panel sports a neon pilot light. The GD-125 is in a totally restyled low-profile case.

Operation:

Operating the QF-1 Q-Multiplier takes some practice, especially in Null mode. It helps to have a stable receiver as a drifting signal will need to be retuned precisely by the receiver tuning or you will also need to retune the Q-Multiplier.

Heathkit of the Month #24 - QF-1 "Q"-Multiplier



HEATHKIT

"Q" multiplier KIT

features

- Will peak or null any signal within the receiver IF bandpass.
- Provides effective Q of approximately 4,000 for extremely sharp tuning.
- Inexpensive to own - easy to build - simple to operate.

The Heathkit Q Multiplier is the kind of device that must be used to be appreciated. A tremendous help on the phone and CW bands when QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null". Use it to peak the desired signal or to null an undesired signal or heterodyne. It not only functions to sharpen the selectivity of your receiver, but also allows you to select (and either peak or null) a particular frequency within the IF bandpass of your receiver. Tunes to any signal being received by the IF circuits by means of a convenient tuning knob on the front panel. Vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation.

The Model QF-1 operates with any receiver having an IF frequency between 450 and 460 kc. Will not function with AC-DC type receivers. It requires only 6.3 volts AC at 300 ma. and 150 to 250 volts DC at 2 ma. for operation. Derives its operating power from your receiver. Simple and easy to connect with the cable and plugs supplied.

Uses a 12AX7 tube, and special high Q shielded coils. Don't be deceived by the low price. This Q Multiplier is "top quality" all the way through.

MODEL QF-1
\$9.95
SHPG. WT. 3 LBS.

QF-1 ad from the Heathkits for 1956 Catalog

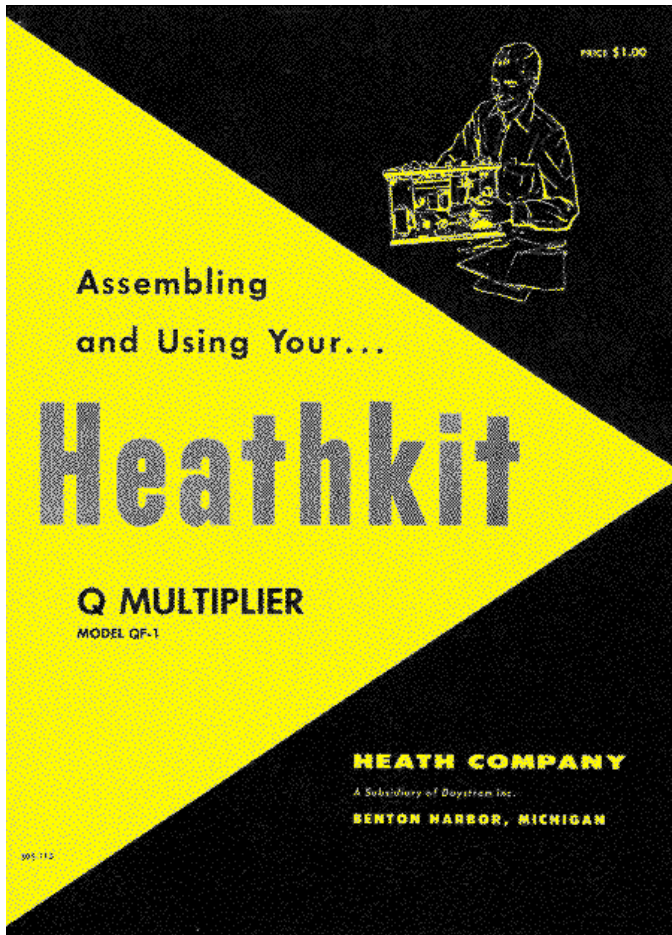
The vernier Tuning control tunes the Q-Multiplier across the receiver pass band. It is smooth and easy to adjust in most cases. If the heterodyning oscillator in the receiver is lower than the received signal frequency then the QF-1 tunes the IF backwards. On some receivers the relationship between the oscillator and signal frequency changes with band, which makes tuning work normally on some bands and backwards on others. This can make tuning the Q-multiplier confusing.

In the Sharp mode adjusting the Peak Adj. control changes the selectivity from broad to very sharp. As the selectivity increases so does the gain. If you go too far the unit will break into oscillation, were you should then back off until the point the oscillation stops for highest selectivity. You may then tune across the passband of your receiver with the vernier tuning control.

The Null mode is even sharper than the peak. Tuning is critical and requires a lot of practice to become usable in normal operation. However once it is learned it can really be effective

in nulling out heterodynes and nearby unwanted CW signals.

The Broad mode is identical to the sharp mode except that a resistor is switched in that brings the "Q" down, resulting in easier tuning and higher gain for a given bandwidth. This mode may also be used as a tunable BFO by increasing the Peak Adj. control to just beyond the oscillation point.



QF-1 Q-Multiplier Manual Cover

Receiver Modification:

Most receivers need some modification to use the QF-1 Q-multiplier. If the receiver has an auxiliary connector that provides B+ and 6.3VAC filament power you are halfway there. If not then you must tap into the receiver power supply and wire the needed voltages to a connector you install on the back apron of the receiver. the alternative is to build a separate power supply to power the QF-1. Many people

have built a power supply right into the QF-1; there is plenty of room.

The other modification is a connection, using a short piece of RG-58 or similar coax cable, from the mixer tube plate driving the first 455 KC IF to an RCA connector on the rear of the receiver. The connector and its mate were supplied as part of the kit. Once the modification is made the first 455 KC IF transformer should be realigned to compensate for the added capacitance of the coax. The additional length of coax between the QF-1 and the receiver is tuned out internally in the QF-1. The realignment assures that if the Q-Multiplier is disconnected the receiver will perform as it always has.

Conclusion:

If you have an old single conversion receiver that uses a 455 KC IF, and that you've restored you might keep an eye out for any of the Heathkit Q-Multiplier models to enhance the receiver's performance.

** This article is about a device from the fifties so the abbreviation KC (for kilocycles per second) is being used instead KHz (for kilohertz).*

73, from AF6C



Remember if you come across any old Heathkit Manuals or Catalogs that you do not need, please pass them along to me.

Thanks - AF6C

This article originally appeared in the December 2010 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.