AN IMPROVEMENT TO THE FRG-7 S-METER

by Brian Aase

One small annoyance of the FRG-7 is the total uselessness of the built-in S-meter. Although it is calibrated to read a certain maximum signal strength at full scale, the characteristics of the AGC amplifier circuit which drives the meter are such that a large voltage change (and hence, a large meter deflection) takes place very early on, then practically no further change occurs with further signal increases. Therefore, it is quite common to note readings of S9 on residual background noise, while just about every readable station produces a uniform indication of about +20 or so, regardless of their relative strength. In the case of the FRG-7, an S9 reading is produced with only 1.9 microvolts of RF input signal, even though full scale is set to read 10,000 microvolts.

In setting out to rectify this problem, my first task was to decide what the meter should read for given signal levels. A handy table is given on page 192 of the "World DX Guide" (1st edition). While the values in the table do not always quite adhere to the rule of 6 dB change per S-unit, they are still a useful and convenient standard. Now, designing a linearizing circuit based on these values poses no great problems by itself, but the situation is complicated by one further inconvenience; the calibration markings of the FRG-7's meter in the region above S9 are themselves very nonlinear. This then dictates that two separate correction factors be designed into the same circuit. I soon realized that for the sake of simplicity, some compromises would have to be made. Figure 1 shows a simple and compact correction circuit which enables the meter to provide useful and logical indications to the operator. Its absolute accuracy is not yet optimum, and it does drift a bit with temperature (though not much). But it is most certainly a great improvement over the original situation, and can be built for a very minimal cost.

Common parts are used, with the IC being an LM324 quad-section op amp. (One caution: do not try to use a 741-style op amp, as only the 324 can allow both its input and output to swing completely to ground.) Diodes are general purpose small-signal silicon types, such as 1N914, 1N4148, or 1N4447. Resistors are 5% tolerance. The .1 uF capacitor must be mounted very close to the IC to prevent oscillation.

My unit was built on a small printed circuit board and mounted inside the receiver chassis. 12 volt DC power can be tapped from any convenient spot such as TP407. Take the wire which used to connect to the S-meter, and connect it instead to the correction circuit input. Then wire the output of the circuit up to the meter. A ground connection must also be provided to the circuit. For best results, calibration should be performed using an RF generator whose output is accurately metered. An accurate digital voltmeter is also needed. Preset VR 401 on the IF-AF board to maximum resistance, and set the two trimpots on the correction circuit to about midpoint. Now set the signal generator to 7.5 mHz, and set its output amplitude to exactly 50 microvolts. Carefully tune in the the signal, and set the 5K trimpot for exactly 0.226 volts DC at the indicated test point. Now set the 1 K trimpot for a reading of S9 on the meter. This completes calibration.

If the needed equipment is not available, useful performance might still be achieved by the following method: Replace the two trimpots in the correction circuit with 620 ohm resistors. Now tune in an "average" strength signal, and set VR410 (on the IF-AF board) for about an S9 reading on the meter. I've tabulated the performance of this circuit in my own receiver. As you can see, the accuracy is not perfect, but it is still far better than the original, and was done for only a couple of dollars cost.

Performance of modified S-meter driver:

Meter Reading	Actual Input Signal	Standard Value*
S1	0.5 uV	0.5 uV
S2	1.0	1.0
S3	2.0	1.6
S4	3.5	2.5
S5	6.7	5.0
S6	11	10
S7	18	16
S8	33	30
S9	50	50
+10	300**	150
+20	1800**	500
+40	5000	5000
full scale	10,000 uV	10,000 uV

* per table in "World DX Guide", 1st edition, p. 192

** large error due to wide markings of meter scale

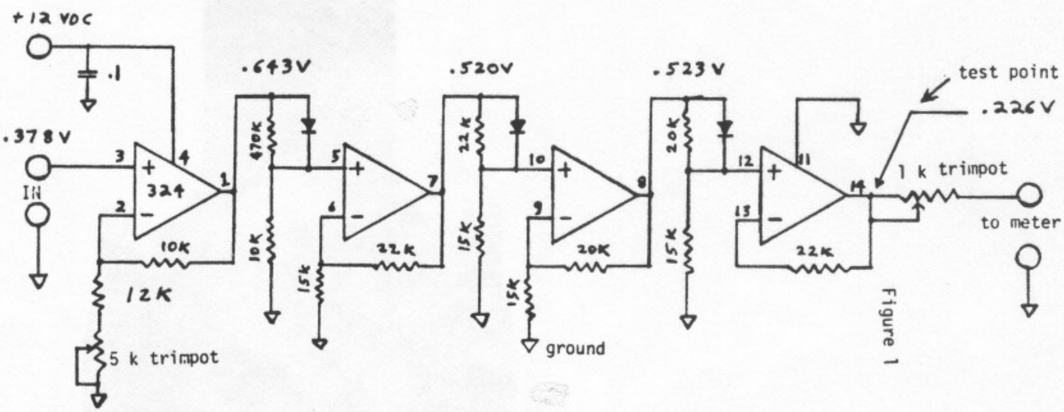

Figure 1

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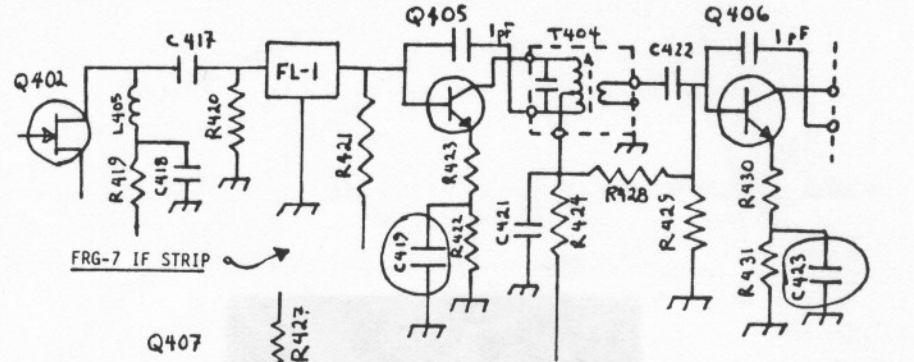
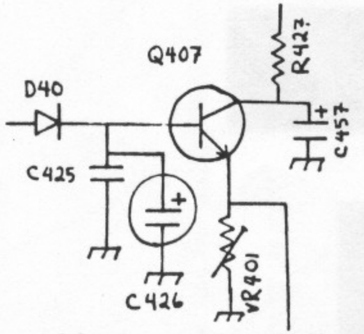
FRG-7 SELECTIVITY, AVC AND PARALLAX MODS by Ralph Sanserino



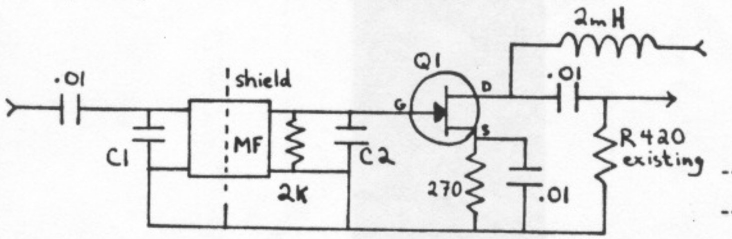


C417, 422, 425--.01 uF C418, 419, 421, 423--.047 uF
C426--47 uF C457--2.2 uF R419, 424--220 Ω
R420--5 kΩ R421--220 kΩ R422--1 kΩ R423--100Ω
R427--39 kΩ R428--10 kΩ R429--3.3 kΩ R430--15Ω
R431--470 Ω
Q405, 406, 407--2SC372Y

Selectivity & AVC change #1: change emitter by-pass capacitors C419 and C423 to Vernitron #TF-01A ceramic filter. Change C426 from 47 uF to 5 uF, watch polarity. Easiest way to make this mod is to twist off C419 and C423 and solder the TF-01A to underside of PC board. You can try the same with C426.

Selectivity and AVC change #2: Make change #1 and also change ceramic filter FL-1 to Vernitron #VTD-3-1 ceramic filter. VTD-3-1 will give you 4 kHz minimum at -6dB and 10 kHz maximum at -60dB selectivity.

Selectivity and AVC change #3: Make change #1 except change C426 from 47 uF to 25 uF, watch polarity. Add mechanical filter, see schematic below:



MF: mechanical filter
Collins F455FD-38 or the sharper F455FD-29 can be used.

C1 & C2:
--for F455FD-38 = 1000 pF mica
--for F455FD-29 = 510 pF mica

A shield may be needed between input & output of MF, mount MF on copper clad board and solder a piece of the copper clad board between input and output of the MF.
Insert this circuit between C417 and R420. Remove C417 and use its mounting holes for input and output to this unit. Mount MF and components on Vector board and use very short RF-174 coax for hookup; keep center conductor leads on Vector board short. This is similar to Radio West's selectivity modification.

Parallax: Remove chassis cover. Tune main dial against stop at high end, note relationship between dial pointer and mark on dial. Dial has to go back in same place at re-assembly. Remove nut holding dial, remove dial, loosen 4 screws holding tuning assembly, put dial back in place, push the tuning assembly towards front panel making sure dial does not touch front panel: Tighten back 2 screws on tuning assembly, remove dial and tighten front 2 screws, re-assemble dial in original position.

Note: Radio West can supply the Vernitron filter mentioned above. Gilfer Associates has a "MOD-1" kit which you can get to replace the stock filter with a good quality MuRata ceramic filter--either 3 kHz or 4 kHz at -6 dB.