Modifying The FRG-7

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Part 3

The next constructional project in this series based around the FRG-7 receiver is for an f.m. adaptor and all-mode squelch. Although the two circuits were specially designed for the FRG-7, certain allowances have been made so that they should happily marry-up to other receivers. The printed circuit board layout has been configured in such a way that it will fit on to the stand-off panel described in the previous part for the switched filter unit.

Before going any further it is perhaps worth mentioning why it is desirable to fit the f.m. facility. Quite simply there is now an increasing amount of f.m. traffic on the short-waves particularly at the h.f. end of the spectrum. In addition to the UK CB service between 27·6 and 28MHz there is now an increasing amount of f.m. use in the 28MHz amateur band. Readers familiar with f.m. operation will know that background noise under no-signal conditions, is very high and so it is essential to have some kind of muting or squelch control to turn off the audio when no signal is present. However, such a control is also a useful feature with a.m. operation as well and it was with this in mind that the two circuits were adopted rather than the more familiar method of a separate f.m./i.f. stage with its own squelch limited to f.m. use only.

Design Considerations

At this stage it is also worth mentioning why a separate f.m./i.f. was not considered as many will argue that a properly designed limiting i.f. amplifier would have given better performance. Indeed, two such circuits have been tried using Motorola and Plessey communication f.m. i.c.s and they have worked very well. However, they have also been far costlier and more complex than the circuit presented here. The biggest problem has been designing stable layouts to cope with the high gain and wide bandwidth of such i.c.s, they have had to have their own filters and buffers to prevent loading of the low level signal at the final conversion mixer.

Comparisons made between these circuits and the one finally chosen have shown only a very marginal difference in performance. The likely explanation for this would seem to be that when using the FRG-7 at a fixed location with a reasonably good antenna system the conditions are nowhere near as demanding as when operating mobile with problems such as flutter. In the latter instance the separate i.f. stage would possibly offer superior performance.

The same argument applies to some extent to the choice of carrier operated squelch instead of deviation muting. Whilst this may not be ideal for f.m., it is simple, it works and its operation can be extended to other modes, in particular a.m. and f.s.k.

Circuit Operation

The f.m. stage is centred around YIC1 and just a few other components. It uses the TA7130 which is not an i.f. stage but merely an active demodulator. Although the i.c. is rarely seen in constructional projects, it is often found in equipment made in the Far East and appears extensively in CB equipment. It is inexpensive and readily available from a number of suppliers including advertisers in *PW*.

Signal for this stage is picked-off the FRG-7 final i.f. transformer, T405 at its junction with C427, C428, Q406 and R404. The signal is then fed via YC2 to pin 1 of the TA7130(YIC1). Transformer YT1 is the quadrature coil and can be almost any 455kHz i.f. transformer but preferably a low-*Q* first stage one. With some transformers that have a higher *Q* it will be necessary to dampen the coil by fitting resistor Ry. Provision has not been made on the p.c.b. for this resistor but it can easily be soldered directly to the pins of YT1 on the underside of the board. The value of the resistor can be determined by trial and error but will probably be somewhere between 10kΩ and 39kΩ, whichever gives the best audio.

Demodulated audio appears at YC8 via YR9 from pin 7 of YIC1. The squelch stage is a fairly standard and familiar one often seen in communications equipment. It consists of an untuned i.f. amplifier, detector stage, Schmitt trigger and switched audio amplifier. The common emitter transistor, YTr1, the diode detector stage YD1, YD2 via YC3. The very high gain of this stage ensures that the d.c. that appears at the junction of YD1, YR5, swings as high as 7 volts on a strong signal and this gives the squelch a high degree of sensitivity.

Transistors YTr2 and YTr3 form a conventional Schmitt trigger which, because of the shared emitter resistor, exhibits a very positive toggling action. Resistor YR5 together with YR7 form the biasing network for YTr2 and under no-signal conditions, YR5 is set so that YTr2 is turned off which turns YTr3 on. When YTr3 is on, the audio amplifier YTr4 is turned off via YR13 and so will not amplify the audio signal appearing via YR17/YC10.