c/o PW Publishing Ltd, Tayfield House, 38 Poole Road, Westbourne, Bournemouth BH49DW
• E-mail: j.p.hare@sussex.ac.uk

Cascode Preselector for the 80m Band

Jonathan Hare G1EXG describes a preamplifier called a cascode preselector that can really help weak signal reception on the shortwave bands. This version is for the 80m band but the circuit will work well for other bands.

The 80m (3.5 to 3.8 MHz in the UK) band is a great band for local or long distance reception. As a schoolboy I learned most of my world geography listening to 80m, hearing over 90 countries in just a couple of years. I used a homemade direct conversion receiver, an inverted-vee antenna and a preamplifier. As the sunspot cycle declines over the next few years, the lower frequency bands such as 80m will again start to be the main focus for radio amateurs. For many of us, though, living in cities and towns, the local electrical noise on the 80m band has become a problem. It's certainly much higher than it was 20 or 30 years ago.

Because I love 80m and wanted to continue listening, I have tackled the problem by using directional loop antennas and noise cancelling devices as you will see on my YouTube channel (referenced at the end of this article). Apart from the noise from my neighbours' terrible TV (which is very close in our terrace), this set-up works well (for examples, again see my YouTube links at the end of the article). The signal from the loop is lower than with, say, a full sized dipole antenna and because I like to listen on homemade receivers that are not as sensitive as commercial gear, I have developed preamplifiers to provide better sensitivity.

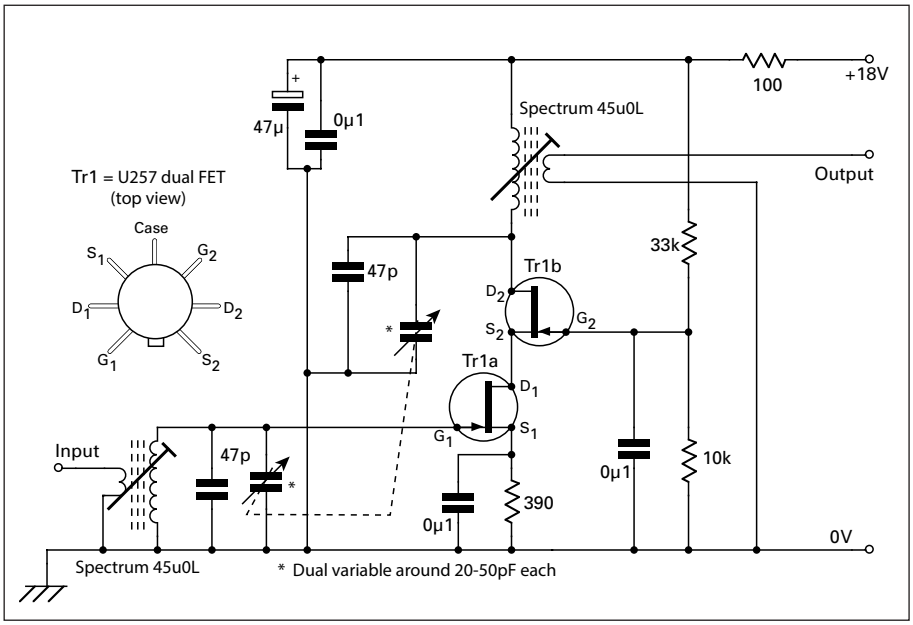

Fig. 1: Circuit diagram of the cascode 80m preselector. The U257 is a matched pair of FETs in one package. See text for coil and the tuning capacitor specifications and other details.

Preamps and Preselectors

Modern shortwave radios and transceivers usually have plenty of sensitivity and with a full sized antenna don't usually need a preamplifier. A preamplifier can really help, though, with homemade receivers such as direct conversion types that have all the main gain in the audio amplifier stages. A preamplifier can also, perhaps, bring new life back into an old valve radio. It is also useful for boosting the relatively low level pick-up from a receiving loop or ferrite stick antenna that are so useful these days for nulling out local noise.

Preamp vs. Preselector

Whatever your application, it's always best to have tuned circuits before and after a preamplifier to improve selectivity. There are many strong local signals that an untuned preamplifier might amplify and, consequently, 'challenge' the dynamic range of the input stage of your receiver. A tuned preamplifier for the shortwave bands is essential and is often called a preselector. In this article, I describe a very effective cascode preselector.

Problems with Simple Preamps

There are many circuits that use a single transistor or FET to create useful preamplifiers. The nature of these circuits is that the gain tends to limit the frequency range. This is a consequence of the Miller effect, which effectively multiplies the input capacitance, thereby limiting the frequency range of the preamplifier. At VHF/UHF frequencies, where stray capacitance between stages of the preamplifier causes unwanted feedback, instability can often occur, requiring special adjustment (neutralisation) to prevent it.

The Cascode Arrangement

The cascode amplifier is a special arrangement that overcomes many of these problems. It is usually a two-

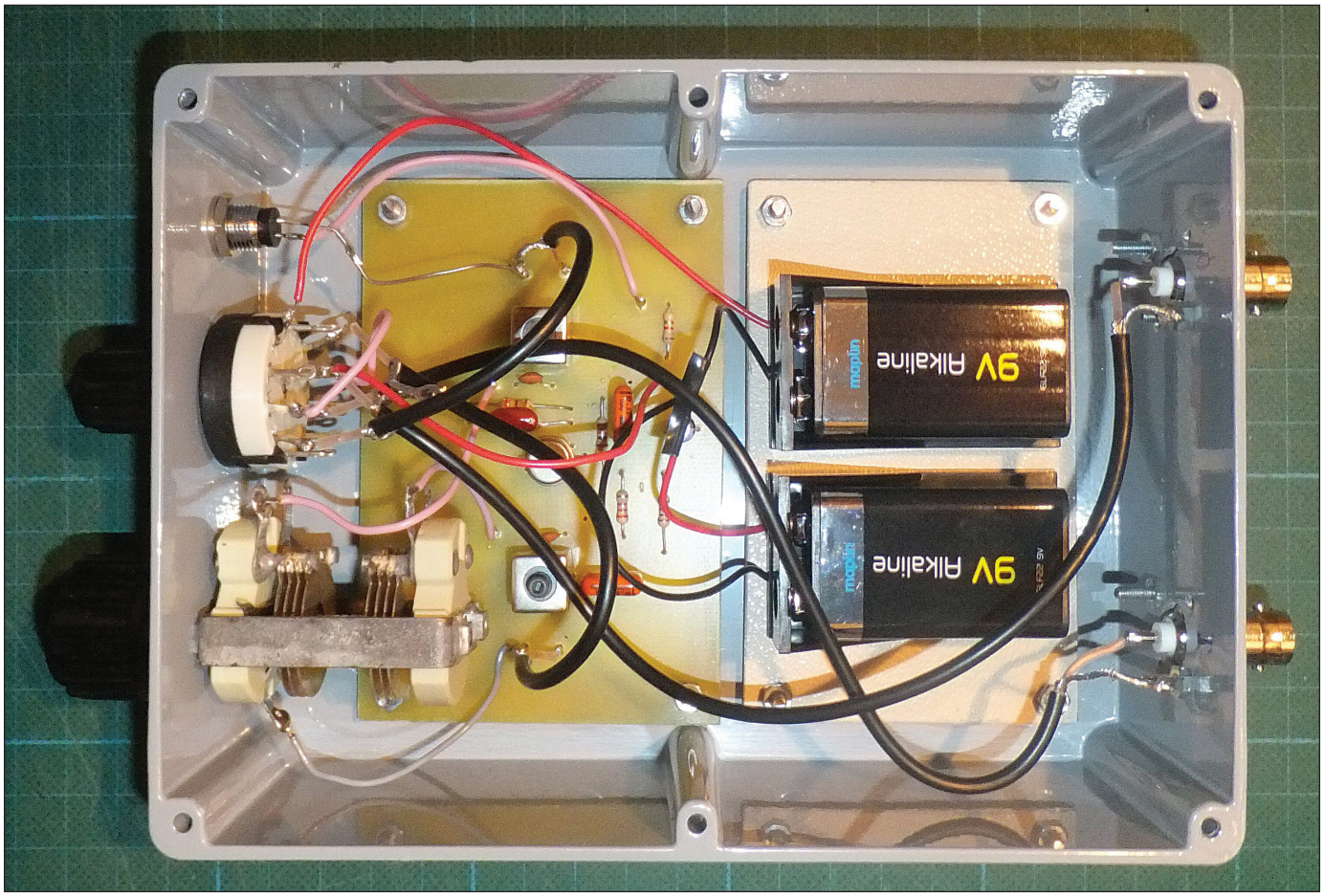

Fig. 2: Inside the cascode preselector. The two BNCs at the rear are for the antenna and radio.

transistor circuit where each transistor amplifies the signal in a slightly different circuit configuration, together creating a more versatile amplifier. A conventional common base transistor amplifier, for example, has a wideband response but unfortunately it has a low input impedance that limits its application. If we start with a common emitter amplifier but follow it with the common base circuit, we can create a circuit that has a wideband amplifier with high input impedance. The stages are in cascode, that is to say, stacked 'above' one another in series rather than in cascade ('behind' one another) as in a standard amplifier chain.

Developed in the 1930s, the cascode name is derived from its initial application to create a pentode circuit from two triodes: *"CASCade triodes having similar characteristics to a pentODE".* The arrangement produces high gain along with wideband high frequency response. There is also little internal coupling between the input and output so the circuit is very stable. This circuit is often used in transceiver designs to create high performance, high gain mixers. Note, though, that a standard dual-gate MOSFET preamplifier is a sort of simplified cascode amplifier but has lower gain and less input/output isolation than a two-transistor cascode circuit.

80m Band Cascode Preselector

The 80m cascode preselector described here provides a much-needed bit of RF gain to my homemade direct conversion receiver. The first stage of our FET cascode amplifier is a common source amplifier followed by a second stage with a common gate configuration. The first provides a high input impedance and gain while the second stage provides buffering (isolation) between input and output along with good bandwidth. I have chosen 80m band coils but the circuit will, of course, work well for other bands with suitable tuning coils.

The Circuit

The circuit diagram is shown at **Fig. 1**. The two transistors in the cascode need to have similar specifications. I used a U257 (bought on eBay) that contains two matched FETs in one device. I used two commercially made tuned circuits for the amplifier (the same inductors as used in the RSGB 80m band PSK centenary receiver – 45μH, from Spectrum Communications) but you could wind your own (and coils for other bands). I made my preselector for the SSB DX end of 80m (3.7 to 3.8 MHz) so you could simply rely on the ferrite tuning core slugs to tune the preamplifier. However, I also included a two-gang low capacitance tuning capacitor (50+50pF or so). Each gang was wired to one of the tuned circuits so that I could peak for maximum gain (the common is wired to earth/case). If you want to cover a greater range of frequencies, you can use a larger value dual-gang capacitor.

Because the cascode circuit is very stable, the layout for the 80m band preselector is not very critical. As with all amplifiers, you should try to keep all the component leads as short as possible and keep the input away from the output. Finally, because the transistors are effectively in cascade series across the supply, a higher than normal voltage is required, for example 2 x 9V = 18V instead of 9V. I used a wafer switch to bypass the preselector when not wanted and also to switch the power on/off.

The photograph, **Fig. 2**, shows the internal layout that I used.

Setting Up

Once you have double-checked all the components and their orientation, apply 18V and measure the current flowing into the circuit. If all is well, it will only be about 10mA. Connect an antenna to the input and the cascode output to the receiver. Tune the radio to the part of the band you want to focus on (in my case 3.75 to 3.80MHz) and set the tuning capacitor to midway. Now adjust the tuning cores for maximum signal at the radio.

Fig. 3: The cascode preselector (left) installed next to my homemade direct conversion receiver (right). The large knob on the preselector is the tuning capacitor while the smaller knob turns the power on/off and bypasses the unit.

Note that the ferrite tuning slugs in the two coils may not peak at exactly the same position on the two coils (this is normal). If you move frequency a little, the dual tuning capacitor should allow peaking of the cascode amplifier. I used BNC sockets for input and output. Unless you have the correct D-shaped hole punch to make the correct holes, I recommend you use four bolt hole BNC sockets. The nut fixed sockets always become loose after a while and are a nuisance.

Results

I have been using a single FET 2N3819 preselector for many years and found it to be effective but the cascode amplifier described here is better. I have made a short video on my YouTube channel that shows a very simple audio test that compares the two preselectors side by side, switching them in and out of circuit so you can hear the improvement and compare results.

The photograph, **Fig. 3**, shows the assembled preselector in use next to my homebrew direct conversion receiver.

Links

Please visit my YouTube channel for videos on (i) tackling noise on the shortwave bands and (ii) for a simple audio test comparing a single FET with the cascode preselector: search *"jonathan hare + 80m band"* on YouTube.

Updates and additions to this project can be found on my website: **www.creative-science.org.uk/g1exg.html**

Jonathan's YouTube channel can also be found at the following URL: **www.youtube.com/channel/UCwAIQLeXp-274212Tnfz9sg**