"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

Summer 2013
Issue 80

Contents

The Walford Electronics web-site is also at www.walfordelectronics.co.uk

Editorial

Summer is now truly with us - what a great improvement on last year! I really must get my big aerial up again - I had a 160m half wave di-pole fed by open wire line slung between trees and a building with the house propping up the middle, but it came down in a storm and I have been using a roof mounted dipole which happens to be resonant at near 7 MHz. Owing to some criticism about unsightly wires, I need to re-arrange it from the house over to a different building which is about 100 ft away; thus it could take a 66 ft top element easily but I am then faced with end feeding it and perhaps not so good for all bands! This makes it need open wire line to one end in the format known as a Zepp. I have never like this owing to one side of the line at the antenna being unconnected - what does the RF do when it comes across this? Shoots back and goes all over the place! I would much prefer a balanced scheme, or even off centre fed so that it is N quarter waves on some higher band such that on the lowest band there is at least a length of radiating wire on both sides of the feeder, even if not fully balanced or resonant all the way to 160m! Please one of you keen aerial experts or experimenters, tell me what I ought to erect!

Tim G3PCJ or walfor@globalnet.co.uk

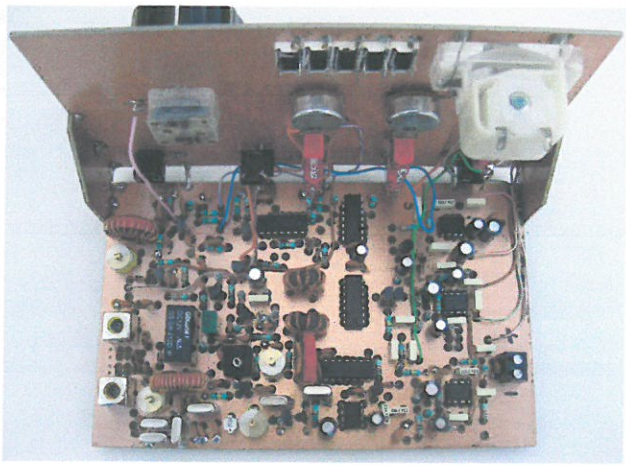
Kit Developments

Last time I mentioned the **Cadbury Castle** (all 4 bands 20 - 80m 5W CW TCVR) that I have offered to PW. I will be making up some early models shortly, so let me know if you wish to have a crack at one.

The **Lydford** (any single band 20 - 80m phone SSB 5W) has been kindly proven by Brian Pilcher & Steve Davies; Keith Woodward's is not far behind so I am now happy to take orders. Ask me for details and discounts!

I am also pleased to report progress at long last on the **Minster** Mk 3! Its been some years getting there but I have the RX (right) working well on 20m. Minor troubles with AGC etc now overcome! I am part way through writing the TX words and have etched the PCBs for the RF Extras kit that will give it a 'two chosen bands plus a plug band slot' for all other HF bands capability.

I also have new simple FiveFET regen! Tim



Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £8 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ or walfor@globalnet.co.uk © G3PCJ

Testing Electrolytics by Peter Thornton

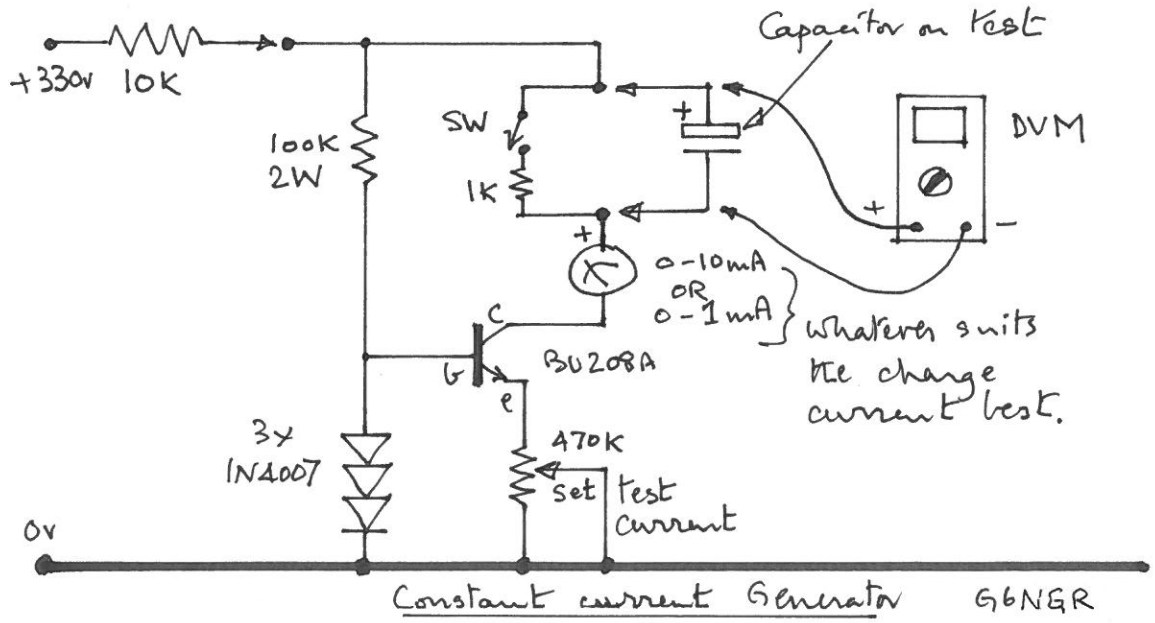
Here at G6NGR all sorts of daft problems land on the bench, and a recent problem had me scratching my head. I was trying to find the source of "noise" on a 300 volt 150mA dc supply, which showed up when reviving a valve receiver. I like to keep a reliable HV power supply to hand for valve jobs. I couldn't find the source of the noise: very obtrusive, not mains hum. I replaced all the decoupling capacitors in the receiver, but still "no go". I turned my attention to the power supply; old faithful, seen service man and boy. I changed the main electrolytic capacitors; problem solved! So just what had gone wrong, with proven good performers, the trusted workhorse electrolytics?

Most folk know about the "ESR" of electrolytics – it means "Equivalent Series Resistance" – a phenomenon in that shows as a resistance, gradually increasing during the electrolytic's working life, until the electrolytic is all but useless; ESR is not the easiest figure to measure! And that's not the only problem (as I found in my HV supply) that they suffer. How about checking the value? Are they still 330uF? Here's how to check those little rascals, and see if they are still up to service. The basic formula for a capacitor is 1 Farad, fed 1 amp, for 1 second, will show a terminal voltage of 1 volt. That's the definition of a Farad. So, I knocked up a "constant current" source (below) from my odds-n-sods box. Don't omit a means of discharging the capacitor on test SW1. I set the current in the collector to a convenient value to give a reasonable charge time; do this by closing SW1 with no capacitor connected and adjusting the emitter resistor.

Now, if my capacitor is 1micro Farad, 1 amp will make 1 volt in 1 micro second. Measure the voltage after a known number of seconds, apply a little grey matter, and out pops the capacitor's value. The maths: Q = CV; Q = iT. Therefore CV = iT; C therefore equals iT/V (Q = charge, Coulombs, C in Farads, I in Amps, T in seconds, V in volts). I found my capacitors had a value of 190uF (330uF marked). But that wouldn't explain the "noise", but would cause an increase in mains hum.

I put a 1mA (or 10mA if more appropriate) meter in series with the capacitor. Sure enough, a steady current as the cap charged up. I expected the current to shut off when the capacitor was "full" – but no! Some current still flowed: a sniff, but still a current. I upped the supply voltage to 330v dc, via a 10k-ohm resistor; 20 volts below the rated capacitor voltage of 350v dc. Whoa! The current was jumping about, no steady value. The capacitor was leaking almost to the point of breaking down, and the leakage current spikes were creating the noise. Job done!

You can use this method to test and check the polarity of unmarked / flea market purchased capacitors. An electrolytic, charged the wrong way, leaks like a colander! Oh, and it's important to use a 10M-ohm DVM to measure the capacitor voltage; the DVM must pass minimal current. You can use this set up to test diodes, transistors (or anything else, come to think of it) that you suspect leaks. The current even if the device on test is a short circuit, can never exceed the set current – so your milli-ammeter is protected.

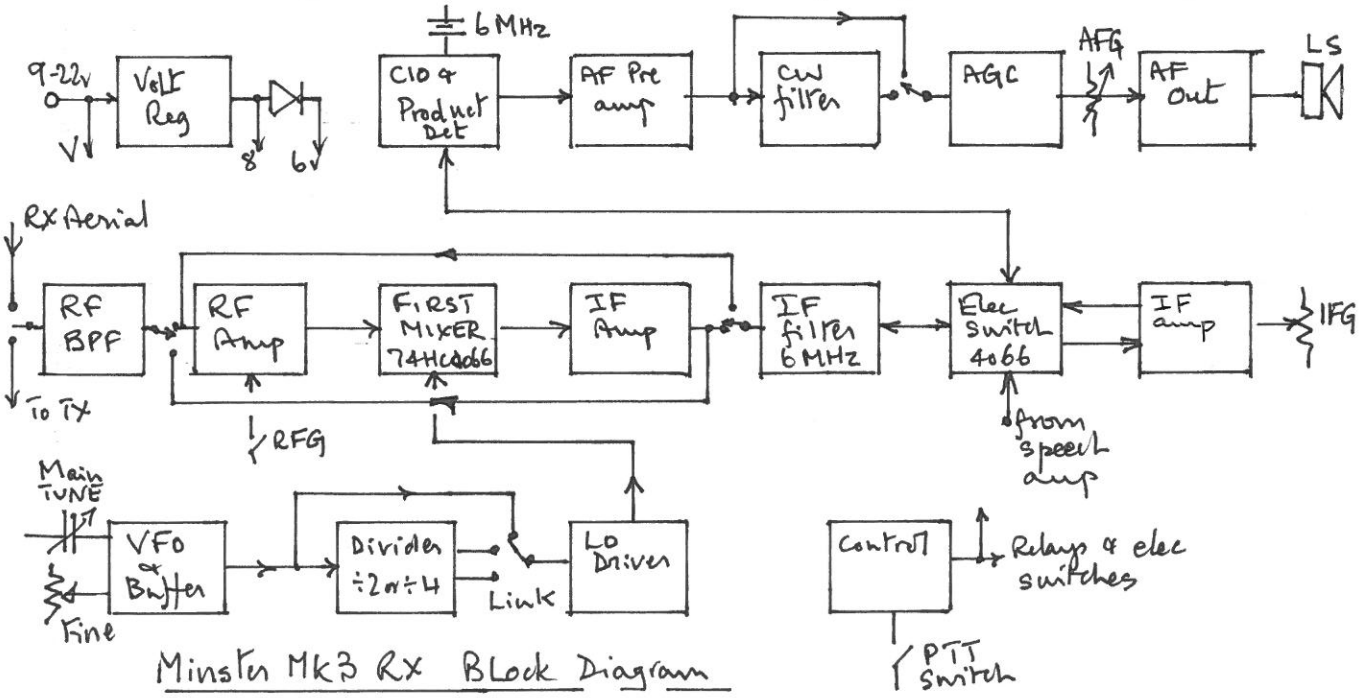


Minster Mk 3

Now that you and I can see (on front page) that there is progress, I think I might risk describing the main elements of the RX! In most transceiver projects, it is the RX that is most challenging and the Minster Mk 3 is no exception. The plan is to make this sufficiently different from my other phone superhets that it becomes top of the **Somerset** range; accordingly it has CW and audio derived AGC included in the RX. The basic TCVR is for any single band 20 - 80m but with the optional RF Extras unit adding another single band in that group, and a slot into which a card can be installed for any single band. There will be three band kits with a crystal for the desired band; band groups are 10 - 17m, 20 - 40m, and 80/160m. The IF is 6 MHz using my standard 5 crystal ladder filter. Another very important feature is to have a strong first mixer to avoid BCI, with enough sensitivity (and low noise) to make reception on 10m viable - these features rule out using 602 or 1496 style mixers - instead it has four 74HC4066 switches in a quad doubly balanced low impedance configuration. This is similar to doubly balanced diode mixers like SBL1 except that switches are used instead of diodes - these can be driven by much lower power logic signals.

An SSB transmitter has to use basically the same functional blocks as a RX but with the signal flowing in the opposite direction. This is easily done with 4066 switches directly connected to the inputs and outputs of 602 mixers (as in the Lydford) but not with 50R circuits of the balancing transformers in this RX! It seemed sensible to add a 50R 10 dB RF amp (with switchable gain) and another 50R 10 dB post mixer amp in the RX path - both are also useful in the transmit path. Electronic switches are not ideal for this task so a relay is used to reverse the flow through the RF amp, mixer, and post mixer amp. They change to IF amp, mixer and RF amp! Another little difference is the need to change impedance up/down from the 50R of the mixer/amp circuits to the 1K5 approximately of the IF filter - this is done with a 6 MHz LC network. To boost RX sensitivity a bit more, I have also given it a post IF filter tuned JFET amp whose gain can be controlled by a front panel DC control! The RX block diagram is shown below. In the basic form, the VFO frequency changes with band but inclusion of a dual digital divider makes life easier on 40m for the 1 MHz LO! For multiple bands with the RF Extras, the VFO is near 4 MHz with crystal mixing & LO BPFs.

In transmit, the RX literally ejects the low level SSB out of the RX antenna terminal! The TX stages are all broadband with a DC controlled variable gain stage to cater for slight variations in gain between bands. The RF final is an RD06 FET because this is a bit easier to drive to 5W on 10m than would be an IRF510. The RD06 is followed by band dependent low pass filters with all the usual TR switching and also a resistive antenna matching bridge as standard. G3PCJ



Minster Mk3 RX Block Diagram

G3PCJ

On line discussion forum?

I am very new to ham radio and especially electronics and kit building but I am not new to discussion forums! They are a great way of getting help when you need it, sharing ideas and building a sense of community. My first kit was the Yeo which is a basic kit but if you have never built anything before it can still be a bit of a challenge. I got stuck a few times and had to try to find help from all over the place. None of the people I talked to - although they were very knowledgeable - were familiar with Tim's kits so they were of limited help. It would have been great to talk to people who had built that kit before and could offer relevant advice.

If there was a forum connected to 'Hot Iron' I could have uploaded my questions maybe with a photo or two and got an answer so I could get on with the build more quickly. It is also nice to show off your completed work and chat about what you have learned from the experience. I know I could have emailed Tim and asked his advice but when you are very new to a subject you don't want to keep bothering people with countless questions at odd hours of the day and night.

Years ago the airwaves would have been filled with discussions on rig building and home-brew projects and people would have passed on their knowledge to the greater community that way. Unfortunately the average ham operator these days is just that, an operator and discussions of home made equipment is not so common on the air.

If there was a place where we could all discuss the projects we are building, suggest modifications, test ideas and generally chat about home-brew ham radio the way it used to be, newcomers like myself would progress quicker and in turn be able to help others to benefit from this fascinating pastime.

If anyone thinks that having a 'Hot Iron' discussion forum is a good idea then please let me know using the email address below. Simply setting up a forum though is not enough. The only way the project will work is if you the members log on regularly and contribute to the discussion.

Knowledge is one of the few things in life you can give away but still retain.

Thank you and I hope to hear from some of readers shortly, Paul M6ASG studio@skarekrow.co.uk

Comment from Tim G3PCJ - this is a great idea and I hope that enough Construction Club members will take advantage of Paul's offer to make it worthwhile. I will of course continue to be available as and when needed!

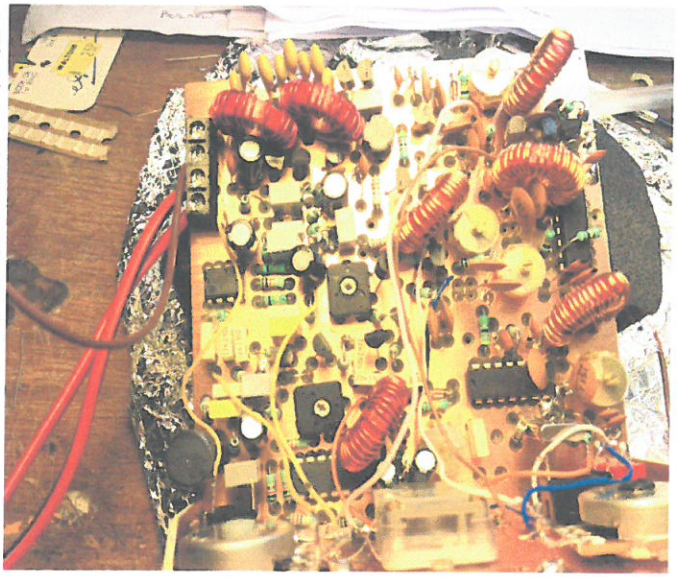
I am quite sure the gentleman on the right is not Paul since it is definitely not a Yeo that he is having difficulty with!! Wait till he comes to the surface mount varactor diodes that are the only sort that I can obtain at sensible prices now!

Building the Berrow

During 2012 I decided to get to grips with homebrew for CW, something I have never really been happy with. I am not very experienced with building but prepared to give it a try. Prior to tackling the Berrow I had done a few things decades ago - a Lake ATU, a Lake RX, an Oxo and so on, small stuff and not very difficult. I chose the Berrow (single band CW true VFO DC TCVR) simply because it was the newest shiniest kit from Tim Walford's stable! Tim suggested I'd be okay but to bear in mind that as an early-builder I was rather a guinea pig for the instructions. This fact has given me far more "learning experiences" than any one kit has the right to give. I enjoyed it and the instructions were, on the whole, very good. Would I build another Walford kit? Yes!

Opening the packet was an eye opener for me...cor! What a lot of bits! I went though everything first to make sure I had the lot! Remember I am very inexperienced so had some small difficulty identifying what was what, and the parts count helped where I struggled. Despite my inexperience all the bits went together. I had great difficulty identifying some parts and as a result, and since building this radio, have now also built a C and L meter (Clara) and am looking into building an antenna analyser (the VK5JST) one so that I have a GDO as well. I don't have a scope!

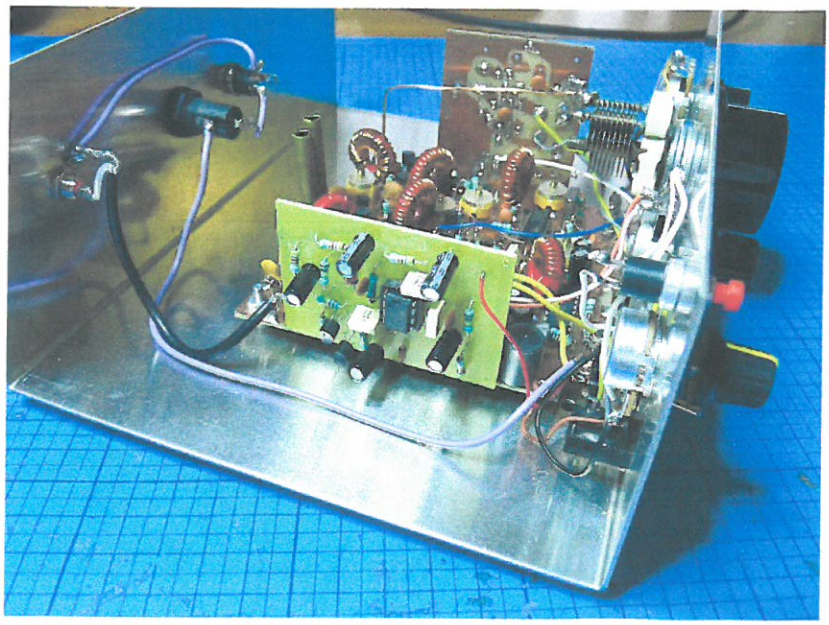
The test stages all worked fine, although I had made one or two errors of my own and a couple that were the result of typo errors. My friend Jim, G4NWJ, had almost as much fun helping fault find as I did building it in the first place. Eventually we got the voltages and frequencies all spot on! The great day came at last, the radio was back from Jim's shack and hooked up into my aerials and...nothing. No output. Grrrr Back to Jim's. Somehow a logic chip had died, changed it, and we then had 1.5 Watts of RF! Back home again and my first call was answered by Guy, F8GFA in Anger and I was delighted! Twice now I have worked with homebrew gear - initially an Oxo 30 years ago and now the Berrow. The sense of delight never diminishes . I learnt a huge amount from this project, it was immensely enjoyable and I was sad when it all came to an end! The photo right is part way through the build.



A quick look through Tim's catalogue provides much to whet the appetite; I do like chocolate, especially Cadbury's...

73 David Perry
G4YVM

(David, my apologies for having to shorten your original note quite severely. Tim)



Here is another Berrow built by Philip Thompson G4JVF, this time with the AGC kit nearest camera and what I think might be a keyer beyond the air variable. This is the one that has been tried on all four of its normal 20 - 80m bands! It also has the two chimney heat sinks! I am awaiting Philip's reports of experiments with higher bands when he has nothing else to do! G3PCJ

Home build electronics lament.... By Peter Thornton

It had to happen; ever since I stopped using "ZTX" (Ferranti) transistors in "E-Line" packages (the Collector was *always* at the "Z"), I had a circuit that showed all the signs of having a transistor installed the wrong way round. Lousy gain, drawing mA's with no base drive, yes, this surely is "wrong way-itis". That's what no text book tells you: a silicon transistor WILL work (just) if installed the wrong way round!

So: check the pin-out. 2N3904, here we go: looking at the "flat", E-B-C. But that's how I'd installed it - I HAD got it the right way round. Back to the data sheets: here's a Philips 2N3904. Looking at the "flat" - C-B-E! Wait a minute...! Take a look at the various data sheets for 2N3904's. Different manufacturers use different pin outs! I decided to check my little store of 2N3904's. I found a mixture of C-B-E and E-B-C; and some C-E-B!

After that episode, I test every device for polarity and orientation. My "el-cheapo" LCR meter has test sockets for testing Hfe in bipolar transistors; I use this to find the collector. The highest Hfe reading is the right way round. If you don't have a gizmo with Hfe test sockets, you CAN use a multimeter to find the collector, despite almost everybody telling you it's not possible.

Promise not to tell anybody else, and I'll tell you how to do it... Take a 47K resistor, and solder it to a 12" bit of thin pvc covered flexible wire. Twist the end of the wire round the +ve prod of your multimeter for NPN (-ve prod for PNP), and set your meter to "diode test". By the usual method of diode testing a transistor, find the base and if the device is NPN or PNP. Put your prods (any way round) on the two leads now known to be C and E, then dab the 47K resistor on the previously identified base lead and note the meter reading. Reverse your meter prods, repeat the 47K dabbing. Note the meter reading.

The connection that gives the lowest reading (i.e. the highest Hfe) identifies the collector: it's the lead on the +ve prod for NPN; -ve for PNP. Higher Hfe = higher collector current = lowest reading.

The only snag - and it's Catch 22 - you need three hands...

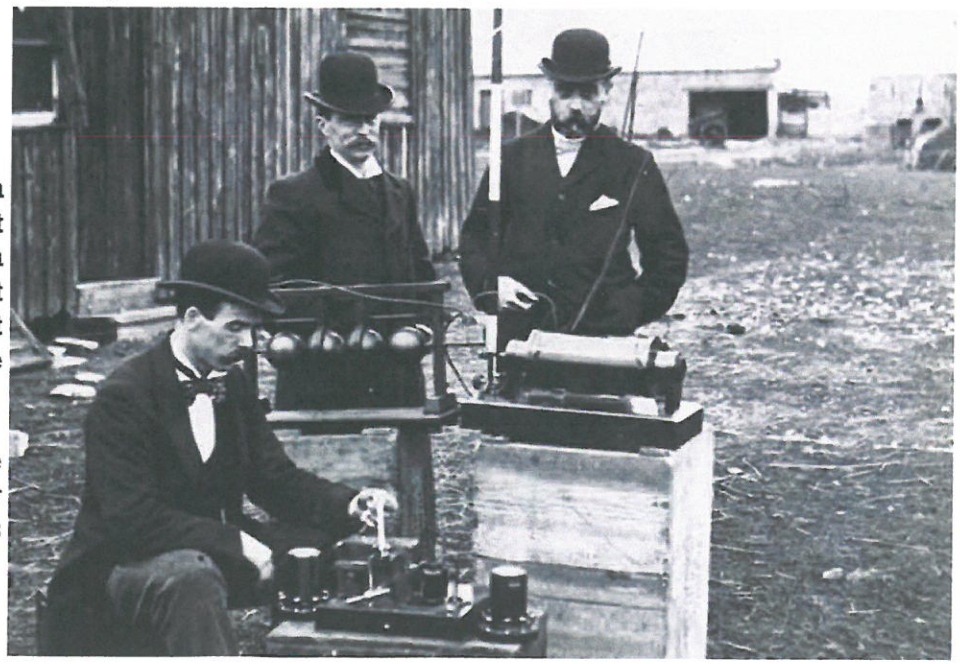
Snippet! Paul Coddington has been kindly trying out my 10W Linear with the alternative RD06 FETs instead of the normal IRF510s which do struggle above 20m. The PCB is laid out for either. Paul says it is working OK on 20m but there is a suspicion that his low pass filters are not right for the higher bands and is investigating! More later I hope. G3PCJ

Competition!

The three old gents.

Robin G3TKF of the South Bristol Club has kindly lent me this photo for a caption competition after he used it - it produced a comment about my grandfather here at the farm many years ago!

I offer a small prize for the best new caption in my judgement! E mail entries by Jul 20th please! G3PCJ



The FiveFET

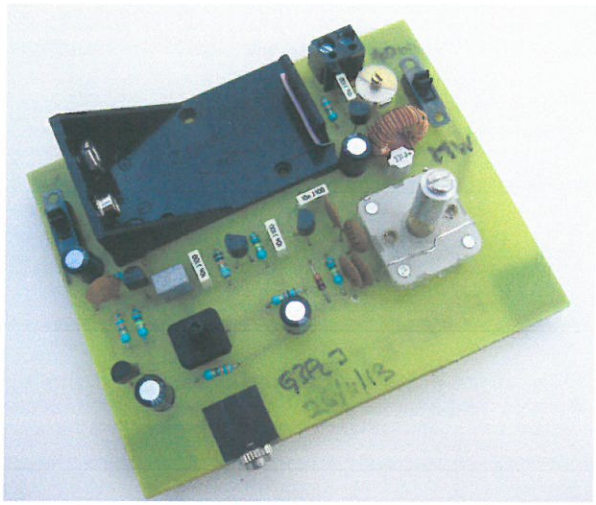
Members will know that I have long admired the performance that can be obtained from the very simple Regenerative style of receiver. Hence my almost continuous doodling with semi-conductor versions of these classic valve projects that were so widely used between the First and Second World Wars.

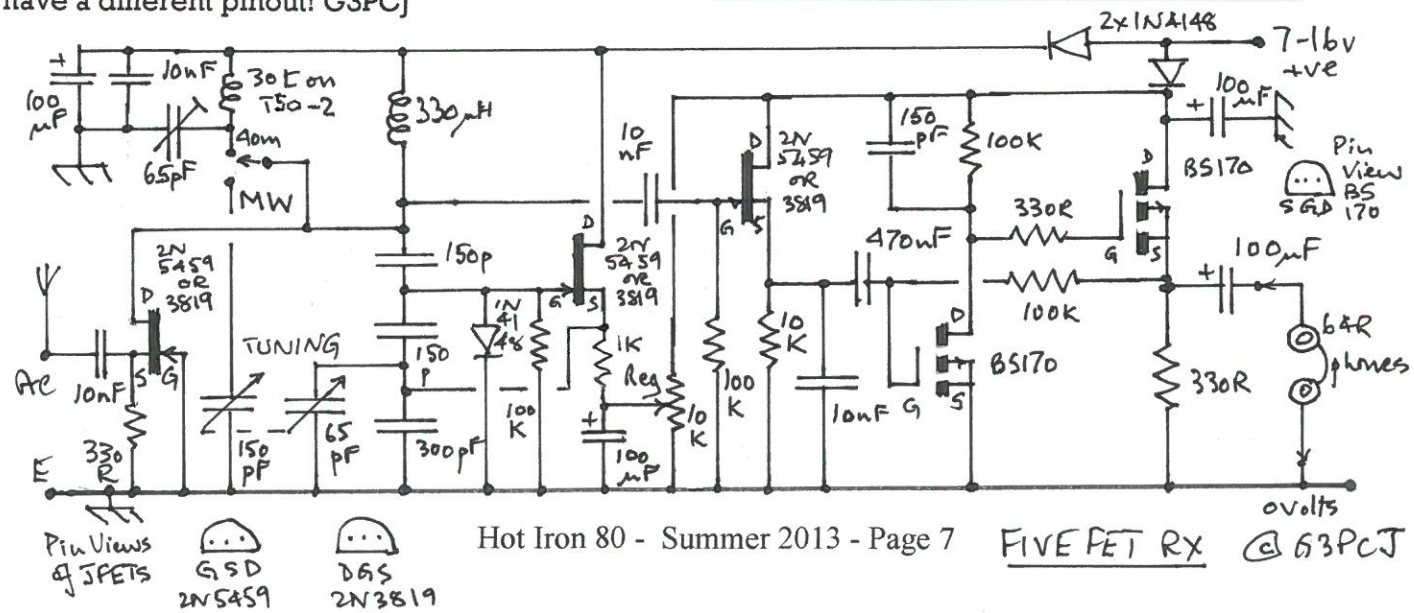
Their origins lie in the straight Tuned Radio Frequency receiver which often had a RF tuned detector followed by audio amplifiers. In the search for better sensitivity, just adding more audio amp stages had a finite limit so somebody tried an RF amp as well. This was often given an extra set of tuned circuits to improve selectivity so that it then looked rather like a tuned grid - tuned anode oscillator; this is exactly what it proved to be! Eventually a way was found to just prevent the RF stage oscillating, and lo and behold, both gain and selectivity then shot up!

The worst challenge nowadays is to overcome the lack of high impedance phones because most builders only have modern lightweight 32R phones or a small loud speaker. Luckily stereo series connected 32R phones can be driven at low levels by MOSFETs like the BS170 in a source follower configuration. Adding another BS170 in common source form can give it high audio gain with the added advantage of a very high input impedance. They can be readily arranged as a DC feedback pair to set the bias currents.

These audio stages need to be proceeded by a detector and here the Infinite Impedance version using a JFET like the 2N3819 is suitable; it can be connected directly in parallel with the main tuned circuit with suitable audio filtering in its source lead. While this stage can also be made regenerative (so potentially saving one device), I have not found control of the point of oscillation to be so good as when separate stages are used. Hence my preference for another JFET to act as the regen stage, or Q multiplier to give it one of its other names.

The final addition is an RF amp because it is no longer considered acceptable to connect your aerial direct to the regen/detector stage when it is oscillating as required for CW and SSB reception. Adding a grounded gate RF amp JFET provides a degree of isolation between aerial and regen stage; it can also do the large impedance step up between a low Z aerial and the high impedance of the tuned circuits in the regen/detector. This also makes providing 3 bands easier when using simple single winding inductors! So a simple five FET circuit is easy, with MW (for ease of getting it to work on short aerials) and one other amateur band, normally 40m, for a good introduction to the airwaves. I shall very shortly be releasing this kit at £24 but am happy for Construction Club members to have it at £22 + £3 for P and P. Early version on right! Note that 2N3819s are getting scarce so this kit actually uses the alternative 2N5459, but beware it does have a different pinout! G3PCJ





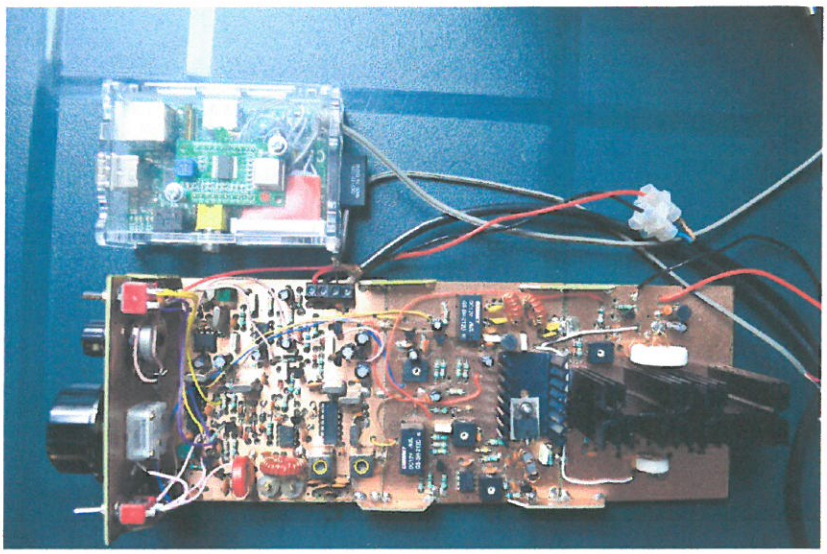
FIVE FET RX © G3PCJ

Test Box Competition!

I am sorry to report that nobody responded to my request for suggested facilities and circuits! So the prize remains for another day - or the Three Old Gents competition on an earlier page!

Interesting combination!

Another challenging little project on right built by Simon Dowson. The obviously homebuilt section is a Bridgwater and Burnham 1.5W SSB TCVR but with the 10W Linear added on the rear. Then above it is a Rasberry Pi micro computer controlling a Direct Digital Synthesis chip as an alternative to the Bridgwater's VFO. While I am not too keen generally on computers mixed up with analogue radio gear, this combination does make sense because the Pi is not out of proportion to the rest of the rig. If it had a Cray computer alongside, I would not be showing it here!



Amateur Radio in the Country 2013 July 21st.

I hope all of you living in the West Country have made plans to attend here at Upton Bridge Farm, Long Sutton, Somerset TA10 9NJ! Plans are well advanced now with a good number of stall/ display takers - but there is room for plenty more still. So if you have something interesting to show off or sell then please bring it along! (Let me know beforehand so I can arrange the necessary facilities.) The night before party is nearby (walking distance), in a friends grain store barn. The theme is a Caribbean Night Out complete with a live band, hog roast etc... Those staying nearby overnight have to come as it will certainly be good fun! We should be able to accommodate a few campers in the field close to the barns where ARiC 2013 will be held. Please encourage your local Clubs to put on displays etc.. - plenty of space! Let me know your plans please.

Time to remind you that the informal **Construction Challenge** this year is to produce a decent sidetone oscillator. It will be 'judged' by Graham Firth G3MFJ of the GQRP Club. The task is to build and demonstrate a sidetone oscillator for a CW TCVR. It might also act as a keyed audio generator for morse practising. It has to feed modern series connected 32R phones presenting a load of 64R. The output should be free of thumps when the key is operated! Nominal frequency to be about 800 Hz and to run off a 12 volt supply. It is to be keyed either by ordinary contact closure, OR by sensing the RF from a 1.5W transmitter. This latter aspect is to make it both more representative and a bit more interesting as a technical challenge! Construction style is not important as long as it works! Graham's decision will be final! Tim G3PCJ

Subscriptions!

I regret it is that time of year again! The next issue of Hot Iron is the first of the membership year and I need to receive your payment of £8 for UK members by Sept 1 2013. Overseas membership costs £12. If you wish to pay via Paypal this is fine, but please add an extra £1 for their fee. All I need is your fee and name/address. To keep it interesting your contributions are essential! Any articles about your experiences, questions, hints and tips etc. are especially welcome. Hope to see you July 21st! Tim G3PCJ (My apologies for being slightly late in publication, farm and elderly relatives held it up!)