"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

Summer 2009
Issue 64

Contents

The Walford Electronics website is also at www.walfordelectronics.co.uk

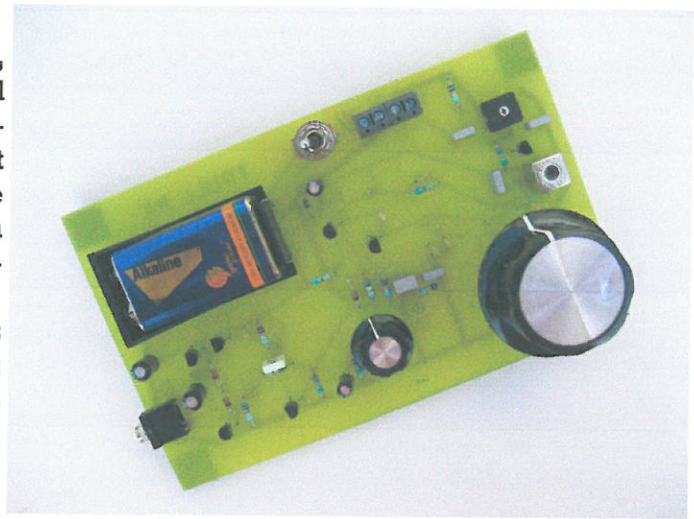
Editorial

I had sat down to tell you about the Plank (see later)! But its a typical Sunday morning (or was) on the farm! Raining cats and dogs and the phone rings. Neighbour thinks one of our cattle is in the river! (This is the Yeo which is about 10ft deep in the middle and 30 ft wide with very steep banks covered in weeds and nettles.) Another neighbour calls and we set off to investigate which is a 5 mile round trip as there are few bridges here - find it has swum down stream about half mile and then back up again to be near his mates who are still in their field. Luckily it is able to walk along the bank edge most of the time, with water nearly over its back; it is a quiet and strong South Devon, but the bank is too steep for it to be able to climb out. It goes further upstream where the vegetation is very high and not possible to get any sort of vehicle nearby to pull it out! Two of the rescue team return to other side and await instructions. After two hours shouting in the rain from the far side we get it to turn around so it half swims back alongside its mates; it is just about within reach of being lassoed with a rope and hauled by the truck! I am stuck on the other side unable to do much except offer wet encouragement! Tension goes on and it slides half up the bank with its hind legs still in the river when the rope snaps! Luckily it does not slide back in, and after a 15 min rest it is encouraged to climb out and ambles off with its mates. All six of us retreat home to dry off. 5 hours later I cant tell which one it was! That's farm life. Tim

Kit Developments

I have just added the **Trull, Chirnside, Willet** and **Washford** to the website. The Trull (right) is the MW regen TRF for novice constructors, with variable gain RF amp and LS drive that I mentioned last time. See later article too. The Willet is the simple DC RX for 20, 40 and 80m while the Washford is the matching 3 band crystal controlled 1 Watt CW TX.

I am about to build the first **Brue** - this is a single band (normally 80m) 1.5W CW TCVR; with several improvements over the Brent - LS drive and separate VFO. I am also actively designing what I think will become the Mendip - 3 band phasing CW TCVR! Tim G3PCJ



Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 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 © G3PCJ

Doodles from Doncaster - by Richard Booth G0TTL

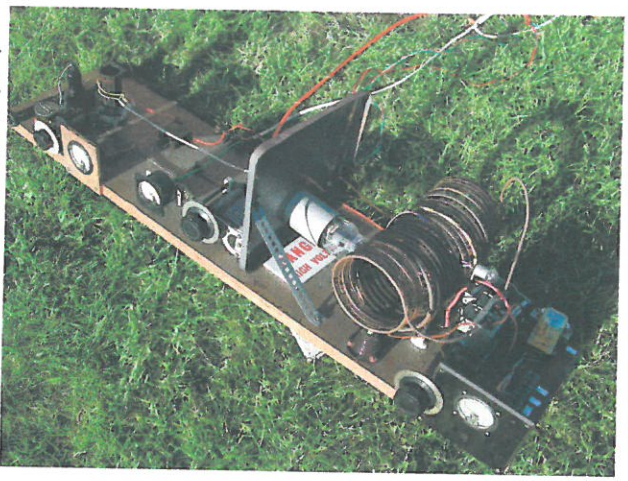
More PCB accessories. Last time I reported using hairspray as a cheap alternative to PCB lacquer. Andy Howgate G7WHM has now got me to try floor polish! No ordinary floor polish though, this stuff is called "Klear", intended for wooden floors and is manufactured by Johnson and Johnson. One coat wiped over the PCB with a soft cloth is ample and having now used it, I will never buy another can of "proper" PCB lacquer. Solder through is a breeze, with no spluttering or nasty smells and the board retains a glossy look and texture even after several attacks of the iron. It dries in 10 mins, is water resistant, cheap and without waste.

If like me you were born with the drawing ability of an arthritic crab, you will need some computer software for your PCB layouts and circuits. I use the simple, easy to learn "Design Works Express". The free version is more than adequate; it has the same libraries and functions as the professional version but is limited to 1000 connections. Most of the component symbols are included, even valves and many RF bits. You can create your own symbols and save them in a library for use later. To develop PCB artwork I use "PCB Wizard 3" which has a small price tag and is designed for use by students. Again this is easy to use, I never bother with the auto routing preferring to do everything manually. I use the software as a drawing package only, but with the big advantage of component layouts and pads to hand to drag and drop as you please. Just remember the golden rules of making boards for RF work. Short tracks, minimal parallel signal paths and plenty of copper for the ground connections. Have a look and I am sure you will find it useful.

All QRP'ers should have a magnetic loop antenna! There are many reasons why I favour compact loop antennas, but recently I have been using my loops as a spectrum analyser. Given their very high Q or narrow bandwidth you can use it to test the output of your transmitter for spurious signals. All you need is a reliable clean transmitter on the frequency that you wish to test your suspect. Tune the loop for the best SWR with that transmitter and take note of the reading, which ought to be near unity if you have a well made antenna. Then simply plug in the transmitter and repeat the test. If the SWR now reads a good deal higher than previously the likelihood is that your transmission is dirty; the unwanted out of band signals are being reflected by the high Q loop and heating up the capacitors in your transmitter low pass filter (if it has one!). This came in very useful recently as I have been working on a DSB transceiver that uses a diode ring as the receiver and transmit mixer. Problems occurred on speech peaks or whistles - the mixer appeared to go a little berserk, making a lot of hash and general rubbish into the transmit PA. The SWR meter was flicking up and down quite a bit so investigation was in order. The culprit case was my Op-Amp microphone amplifier stage. The 50 ohm input port of the ring mixer is much too low impedance for the output of the TL071 device to drive directly. The cure for this problem was to add a series resistor in the signal path to give the Op Amp something to drive, and to increase the overall gain to compensate. Adding 1K in series with the amplifier stage worked well. No more noisy signals on the scope and the output spectrum is clean enough to maintain a 1:1 SWR on my 80M loop (which has a useable bandwidth of about 10 KHz without adjustment).

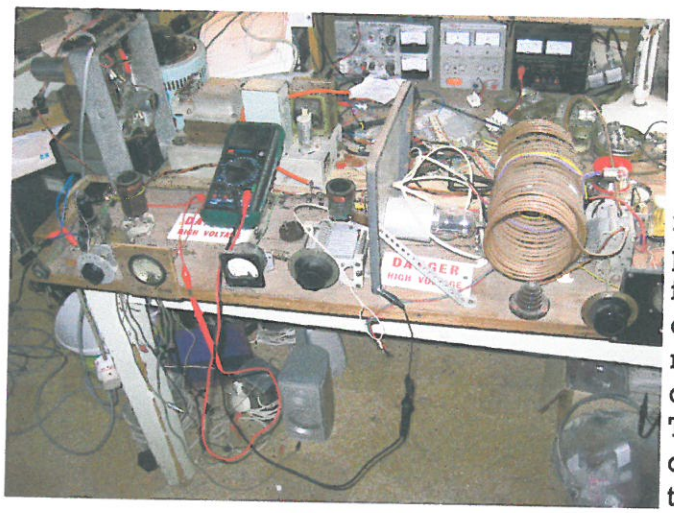
Interesting Signals. After living here 10 years I have finally installed a few antenna feeds into my office. I wondering what transmissions are about on HF apart from broadcast, Volnet and amateur signals. I was very pleasantly surprised! Ever since the "good old days" of the cold war I have been fascinated by signals that we are not supposed to hear. I thought all this sort of thing had gone digital or transponded by satellite and had not listened away from the established bands. Happily that is not the case and a tune around 4 MHz during the late evening yielded many things of interest. There is a lot of analogue HF still in use for shipping, espionage - yes even number stations, beacons, news relays, military, air sea rescue, over horizon radar (baby woodpeckers?) even ship to shore communications in Russian! Have a tune around on 2,4,5,10,13 and 16 MHz and you might just drop on something intended for a much smaller audience. Most nights around 4.725 MHz USB at 2330 hrs BST there is a number station to listen to - go down another 100 KHz and several days of the week around the same time I have picked up a very English AM mechanical female voice droning out strings of numbers and cipher keys - not quite as scary as the old East German transmissions of the 1970's but it still managed to give me a thrill! Also on the 4 MHz band there is an 80 KHz wide OTH radar signal that sounds very strange, have a listen on 4.510 after dark and see what you make of it. Around 4.100 there are shipping and trawlers to be heard using USB, also air sea rescue and the oil / gas platforms. I could fill a whole edition of Hot Iron with times and frequencies but have a listen yourself; they are there! Until we meet again, agent 00X...

Refurbishing the Plank

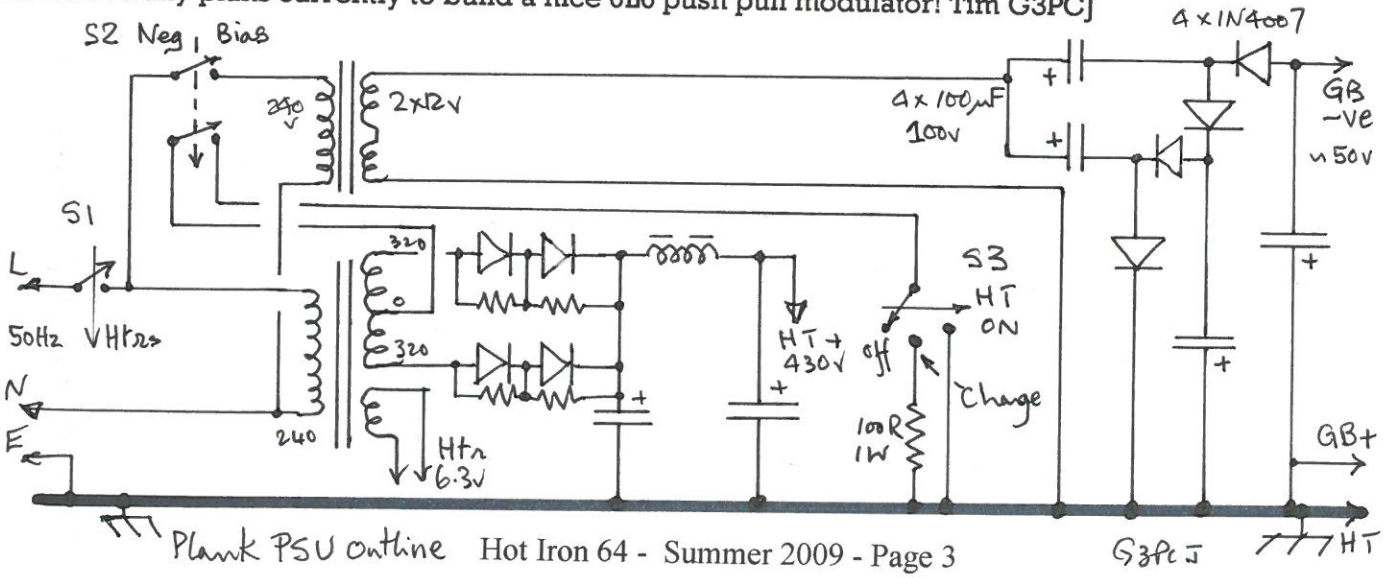


I know that many amateurs are very interested in valved projects and many years ago, I had the pleasure of seeing the late Eric Godfrey G3GC demonstrating his replica late 1930's transmitter. It lay in his attic for many years and I was able to salvage it for future demos - seen as recovered on right. It consists of a 6K7 crystal oscillator driving an 807 PA with keying of the oscillator and manual TR changeover. As can be seen, the PA tank coil is small bore copper tuning in a balanced form with link output coupling, all with plenty of tuning knobs and metering! One end of the tank coil connects to the 807 anode and there is a stiff wire 'gimmick' capacitor in the biscuit tin lid screen to adjust the neutralisation from the other end of the PA tank.

When clearing Eric's attic I collected up all the old valve type PSUs that I though might have gone with the plank. Examining these, I came to the conclusion that it might need all three that I had found - to provide 6.3v for the heaters, +250v for the oscillator, –50v bias and +350v or more for the 807 anode! After gingerly applying low mains volts to these PSUs to 'reform' their electrolytics, I was at least able to fire up the oscillator stage! I recalled last seeing it operate on 40m but to my surprise the tanks all resonated on 80m for which I only have one crystal which is not in the CW part of the band. So I think I shall change it all back to 40m for which it was originally built as all the coils have had sections added. The photo alongside shows it lashed up to some of the PSUs on my bench to get the oscillator going!



Next task was to tidy up the PSUs for easier demonstrations! My aim was to have one unit provide the heater supply off the main transformer which would also provide the main HT at over 400v. The 807 is rated at 100 mA and 700v max on the anode to give about 50W out. But I didn't have anything for the –50v bias supply. The easiest way to obtain that was with a voltage doubler from a small modern mains 2 x 12 volt transformer. The circuit below shows how I have arranged the switches so that the HT cannot be on without the bias supply - to protect the 807. I have also added a resistor in the HT negative line to limit inrush currents at switch on - this is shorted for full power. The bias supply will also power a manually controlled 48v 4 pole relay used for applying power to the 807 during transmission and to operate the aerial change over circuit. I also have a 40m crystal that might suit AM operation, but I don't have any plans currently to build a nice 6L6 push pull modulator! Tim G3PCJ



Mulit-band Trull by Andy Howgate G7WHM

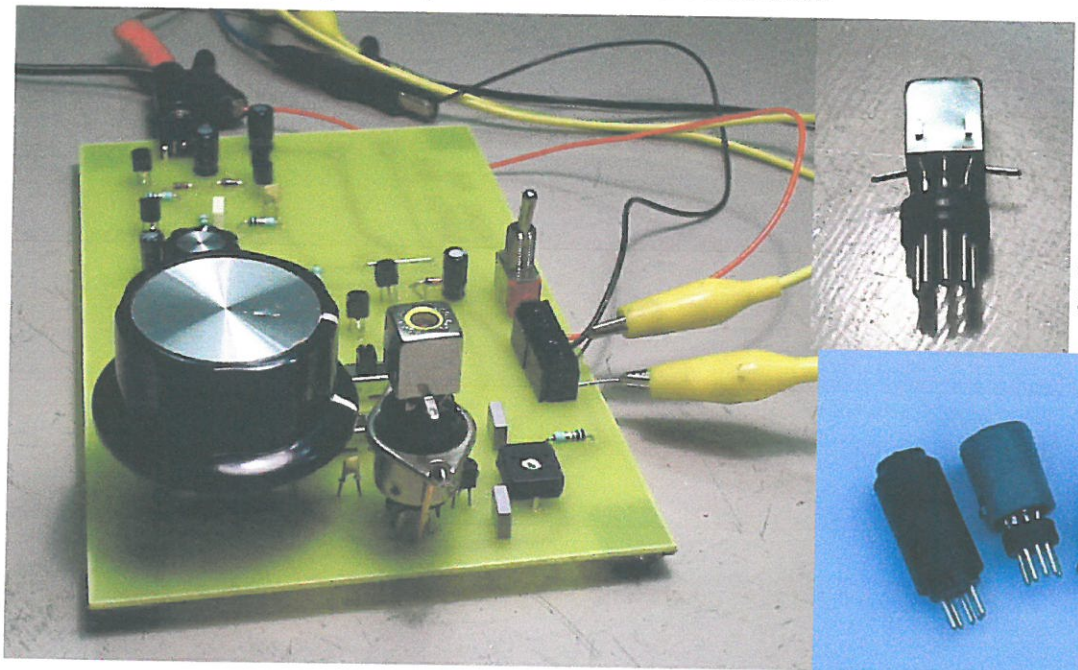
No sooner had Andy received his Trull than he said it needs some variants! He writes:-

"Having just assembled the Trull regenerative receiver, and having read the notes in the manual and comments from another Construction Club member Richard Booth G0TTL about its use on the HF bands, it made me realise that a pluggable inductor could be deployed to use other TOKO coils, thus making this little receiver a multi-bander. As ever using what is at hand, I removed the 3336 TOKO coil carefully so as not to damage any tracking and fitted 5 single wires to a chassis mount DIN socket of the type which has 5 connections. With the use of a pair of pliers, the DIN plug tags can be bent to match those of the TOKO coil. After fitting wires to the DIN socket, these wires were pulled down to the existing TOKO drilling holes and soldered into place. Then some stiff copper wire was stripped out of some mains house wiring and used to connect the earth tracks of the TOKO pads to the mounting 'ears' of the DIN socket so providing a bit more rigidity. The whole was then checked so that when the din plug is pushed into the din socket the correct connections are made.

Points T and S then had a miniature slide switches fitted by enlarging the holes and breaking the tracks so that the switch makes or breaks the T and S connections allowing capacitor variations for the desired tuning range. The slide switch has an extra connection so that through experimentation another pair of capacitors can be fitted giving yet more variations on tuning range. The TOKO coil on its DIN plug could also have some suitable value of capacitor fitted across the secondary winding to aid with finding a particular frequency; so with the TOKO inductor core being adjustable I would expect it possible to have the radio working on most of the interesting parts of the spectrum. I used a TOKO 3334 for initial tests on 40 and 80m but I dare say a TOKO 3335 could also be added with another DIN plug for higher frequencies. As yet, and this is perhaps the more time consuming part, the next stage is to play with capacitor values to get the very best and useable frequency coverage for the TOKO coil used. A point worth mentioning is that the DIN plug shroud can be positioned over the TOKO coil tightly so that the cable exit tube can now be used to change the tuning coil.

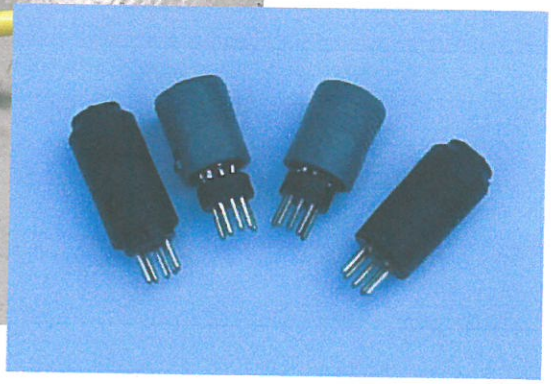
The rest is down to the experimenter to have the radio working as many frequencies as he chooses!"

Andy sent along these photos of his multi-band Trull:-



Above - Early Trulling trials!

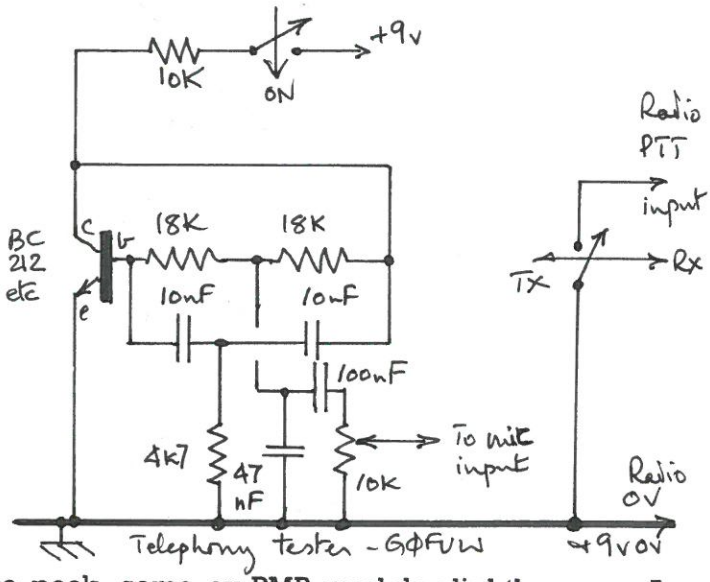
Left - Coil assembly before sliding the DIN plug cabling cover over the TOKO can.



Below - Four coil assemblies giving coverage from 1 to 20 MHz!

A Simple Telephony Transmitter Tester by Steve Hartley G0FUW

Most voice transmitters require a steady audio signal to be fed into the microphone socket during testing. This can be achieved by whistling or saying 'aaaahh' but I find that I run out of breath just as I am making the final adjustment of a preset or trimmer. Most annoying. This little circuit was devised for use at the first Bath Buildathon where we had twelve first-time transceiver builders and we needed some consistency for multiple transmitter testing.



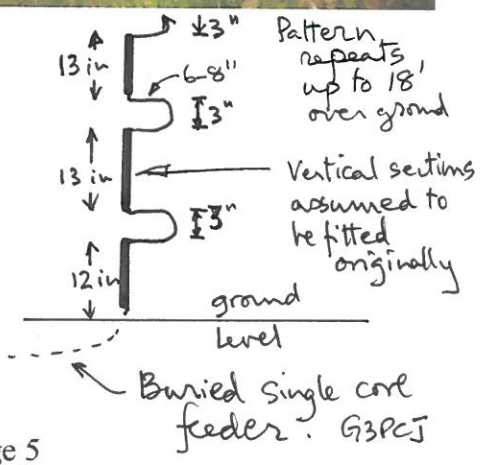
The tester is based on a simple 'twin-T' audio oscillator that is often promoted for Morse code practice (e.g. see RSGB Cookbook p284). Using the component values shown produces a signal of around 600Hz. The pre-set resistor allows the output to be set to emulate your microphone of choice. Typical CB type dynamic microphones develop 20-40mV peak to peak, some ex-PMR models slightly more. A quick check into an oscilloscope allows the tester to be set to the correct level – alternatively use with a power meter and a known transmitter/microphone to compare.

A switch is included to activate the push-to-talk control and to switch the audio oscillator on and off to prolong battery life. My original used a double pole double throw switch but in retrospect two separate single pole switches would provide more flexible switching options. Whilst this circuit lacks the sophistication to provide proper two-tone peak envelope power measurements it is ideal for setting up homebrew voice transmitters. You could build one into a sideband transmitter to provide a steady carrier for antenna tuning or even key the audio for CW transmissions.

The Wartime aerial Conundrum!

The radio installation at my friends wartime bunker continues to be a mystery! With better weather I have now had the opportunity to properly examine what remains in the two remaining aerial trees. The Northern one has a twin conductor cable running up a crack in the bark of the tree and then does a dog-leg around to the opposite side of where we suspect the aerial to have been suspended. It was for near 50 MHz operation and all is entirely logical!

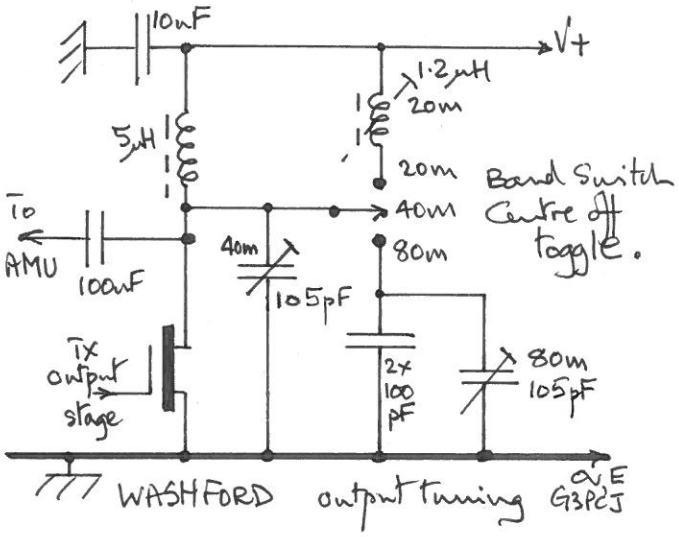
The South aerial tree has many remnants of single, but also some twin, conductor RF unscreened cable protruding horizontally from the trunk of the tree. The lowest of these is about 12 inch off the ground and the highest at about 18 ft up. In between, there are many pieces of protruding cable as in the photo above. A couple of these have been excavated in the tree's trunk and found to be in the form of loops or hairpins. They are spaced about 13 inches apart, and that pattern (of hairpins 3 in wide and 13 in apart) MAYBE repeated all the way up the trunk! There is no evidence of any remaining vertical elements and the longest of the extant cable protrusions is about 4 in outside the trunk. The diagram is what it MIGHT have been like electrically. The nearby feeder cable is the single core RF cable that I have shown in earlier issues!



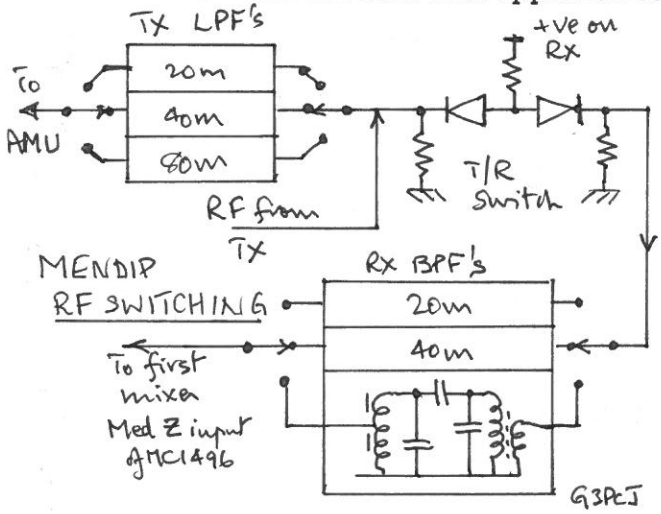
What sort of aerial is it and for what frequency? G3PCJ

Output design options for the Mendip

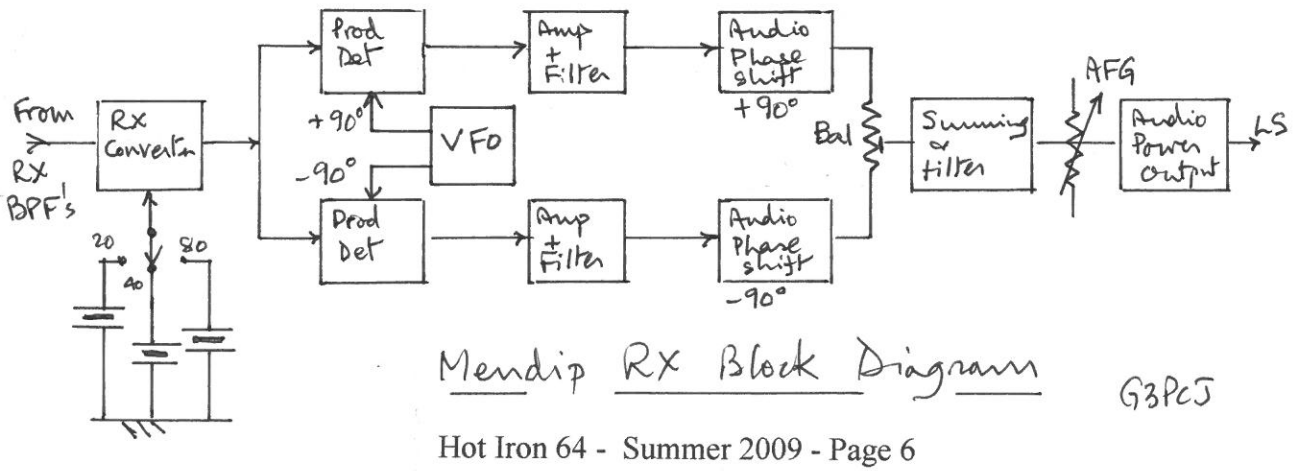
The Mendip is the probable name for the 20, 40 and 80m phasing 5W TCVR. It needs to have full break in operation and the minimum of relays and resonant circuits to be a viable kit. I have toyed with the idea of a parallel resonant TX output stage tank like that in the Washford; but at the 5 W level it might be a little awkward to wind the toroid and also to tune up. A single resonant circuit would hardly give enough attenuation to harmonics which becomes more important as the output power is raised; hence the decision to use relay switched dual half wave filters for harmonic filtering and a broadband 1:2 transformer to obtain the desired 5W on 13.8 volts supply.



The next consideration for full break in operation is how to connect the aerial to the receiver input circuits. In the simpler 1.5W rigs like the Brent, it is feasible to have the first resonator of the RX band pass filter directly connected by a low Z winding to the aerial, with the top coupling capacitor to the second RX resonator limiting the RF current through clipping diodes across the second resonator during transmission. But at 5W this scheme is a bit more risky due to the higher RF voltages! High speed relays could be used but they would chatter and not last so well as an electronic TR switch. The next best approach seems to be a double diode TR switch but its drawback is the 6 dB or so loss of incoming signal. Atmospheric noise levels on these HF bands are such that this 6dB loss could be tolerated if the following stages don't introduce any more loss! That tends to rule out a diode first mixer because they usually have a further loss of about 6 dB. I did consider using CD4066 electronic switches in the RX band pass filters but fear there might be further losses so propose to stick with more relays for band switching. Hence we come to the scheme shown left. This does at least have the advantages of being able to optimise the bandpass filters for each band, with much less chance of overloading or unwanted signal losses!



The rest of the RX can be fairly conventional for a phasing rig! Band changing is by switching the crystal oscillator into the first mixer above, which is likely to be a 1496 for better signal handling ability than the 602. The signal emerges at about 5.5 MHz into the two phasing detectors driven by the VFO RF phasing networks. The audio stages have filtering for CW bandwidths followed by audio phase shifters and subtraction to obtain only the wanted sideband. Tim G3PCJ



Mendip RX Block Diagram G3PCJ

Sundials - by Gerald Stancey G3MCK

For thousands of years man has used the sun to indicate time. They used a vertical stick or pillar which indicated the direction of the sun or, from the length of the shadow, the altitude of the sun. This simple device showed midday, ie when the sun was due south, and the by the length of the shadow the time of year was indicated. Of course the 'dial' had to be calibrated by observations over a few years but they had plenty of time to do this.

The snag with such a simple dial is that it will not indicate hours as we know them. To explain this let assume that Tim and I agree to meet for a coffee when the sun is due east. We both have shadow sticks so we will make the appointment. We agree to meet again in one month when the sun is due south east and again we make the appointment in a timely manner. However because the sun's movement is not uniform we will not be meeting at the same time as indicated by a clock.

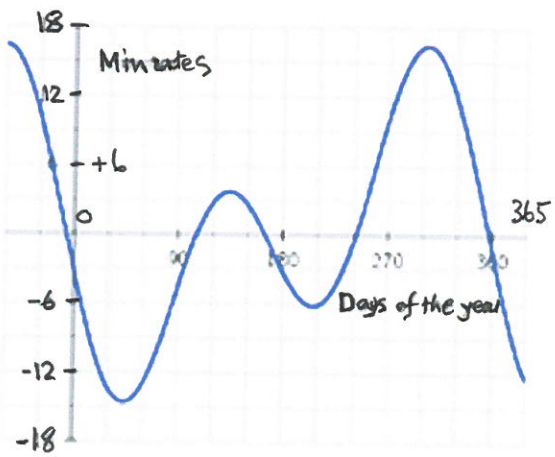
In the fourteenth century the modern sundial was invented which gets around this problem. The key to its operation is that the edge of the gnomon - the triangular bit of metal that sticks up from the dial plate, or out of the wall in the case of a vertical dial - is parallel to the earth's axis of rotation. In other words it points due north and its inclination to the horizontal (in degrees) is the same as the latitude for which it was made. This means that a dial is made for use at one latitude. However if you have purchased a dial when on holiday in Italy (latitude 42 degrees) and want to use it in Somerset (latitude 51degrees), there is a simple fix. Just jack up the dial plate so that the edge of the gnomon slopes at 51 degrees to the horizontal.


This one is at Hampton Court

The effect can often be seen with south vertical dials when the wall on which it is mounted does not face due south. Here the dial is often canted out from the wall so that the dial plate does face due south. Another solution is to allow for the direction of the wall when designing the dial markers but this gives the dial a lopsided look as the six o'clock line now slopes instead of being horizontal.

If you compare the time shown by your watch and a sundial, it is unlikely they will be the same. To get agreement you have to make up to three corrections. Firstly, during summer months you must correct for the change from GMT to BST. Secondly, you may have to correct for your longitude. In the UK, time is measured with respect to the Greenwich meridian of zero degrees longitude. Yeovil being west of Greenwich is therefore slow in terms of sun time. A correction of four minutes of time for each degree of longitude has to be made so for those in Somerset a correction of 12 minutes is needed. For those living on Greenwich meridian no correction is required.

Finally you have to correct for 'The Equation of Time'. The earth moves in an elliptical orbit round the sun and the earth's axis of rotation is inclined at about 66 degrees to its orbital plane. The effect of this is that the sun is rarely due south at midday. The graph shows that this is not a minor correction. Above the horizontal axis the dial appears fast and below it, the dial is slow. Many dials gives this data either as a graph or as a table on or near to the dial. If they don't, you will have to consult either a book on dialling, astronomy or Whittaker's Almanac. But beware! Some are calibrated for BST assuming there is more sun in summer - they need correction in the winter. There are dials where the plate can be rotated or changed for this correction! On some modern dials, the longitude correction has either been built in or allowed for in the Equation of Time.



This is just a short intro to a fascinating hobby!

Solder Smoke!

Steve Hartley first drew my attention to Bill Mears who runs a monthly web blog on radio matters. Each bulletin lasts about half an hour and is full of topical chat about radio matters, both on his own experiences and of those sent in by his listeners. Currently he is based in Rome but he covers radio topics from all over the world. The most recent talk included quite a bit about listening to extremely weak signals from milliWatt transmitters over trans-oceanic distances! Real QRP! I have much enjoyed his talks over recent months and am pleased to hear that he enjoyed Steve's report on the Fifth Somerset Supper - see my notes below!

Its well worth a listen! The web address is :- www.soldersmoke.com

Radio and Trains!

This year, the Somerset Supper had the added attraction of the Somerset and Dorset railway! Diners brought their electronic construction projects for an informal display and the competition was judged by George Dobbs G3RJV. Apart from members of the local Yeovil and Blackmore Vale radio clubs, several radio personalities were present - Steve Hartley G0FUW, Rob Mannion G3XFD, Robert van de Zaal PA9RZ, Chris Rees GU3TUX. Stewart Hunt F5VJJ kindly brought over some wine from France!

The supper was held in the old Court Room at Lower Farm near Somerton, and afterwards George had the difficult task of judging and presenting the prizes. Commenting that it was like judging a gardening show because he was bound to both make and loose friends, he awarded first prize to Richard Booth G0TTL for his dual band

transceiver. Runners up were Gerald Stancey G3MCK with his valved CO/PA CW transmitter, and Chris Rees GU3TUX with his portable AMU. Unfortunately Chris's entry did not feature the parts from last year's consolation prize - Gerald promises to put his sweepings off my bench to better use next year! Later David Sedgman demonstrated his very extensive 0 gauge model railway layout which is based on the nearby Evercreech Junction of the Somerset and Dorset railway. Below left is Rob Mannion playing trains and right is Richard Booth receiving his Somerset Cider Brandy from George Dobbs (holding the rig).