"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

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Issue 68

Contents

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

Editorial

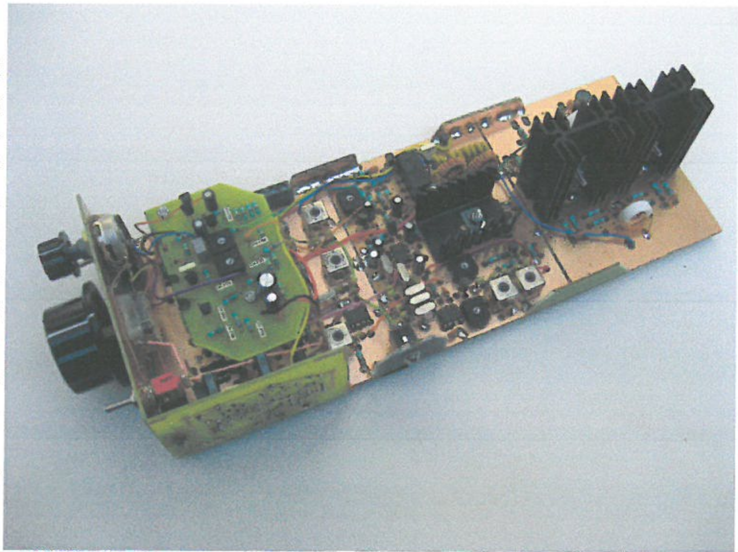
We are hearing more now in the media about Digital Britain and it makes me feel distinctly nervous - especially the bit about the closing down of our current analogue radio services. I refer particularly to the proposed demise of Band 2 FM analogue transmissions and the AM ones in the medium and long wave LF bands. Apparently we will have to equip ourselves with so called 'Digital' receivers more properly known as DAB receivers. I think I have also heard that our DAB is not a world standard either. I am delighted that Rob Mannion G3XFD, Editor of PW, has been leading a national campaign to continue with the analogue services. There is a good note by him on the Southgate ARC website.

We are urged to become more green but the change to DAB is certainly not that! The radios consume about twice as much power as their predecessors, and of course considerable resources are used to build the new radios - much more than building an analogue one. DAB radios are prone to aerial problems and are not liked by the motor manufacturers. And where will students learn about the analogue fundamental building blocks of radios? This is a real problem - a student at a recent Bath Buildathon had never built anything electronic despite studying for an MSc in advanced radio techniques. Can one home build a DAB radio? I think not! But some amateur radio kit gear will still be analogue! Tim G3PCJ

Kit Developments

No fully new kits since last time, but I have been trying out a number of the latest versions of replacement accessory kits. My version of the basic Tone and Parrett 1.5W SSB 80m phone TCVR now has a Linear for 10W, the new Mini CW kit, and the new Mini AGC. The latter is especially useful with the Tone as its simple audio output stage can't deal with really big signals, that crop up suddenly as you tune across 80m! The picture right has all these extras hung onto my favourite open style of construction!

I am pleased to report that a couple of builders now have their Digits working too!



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

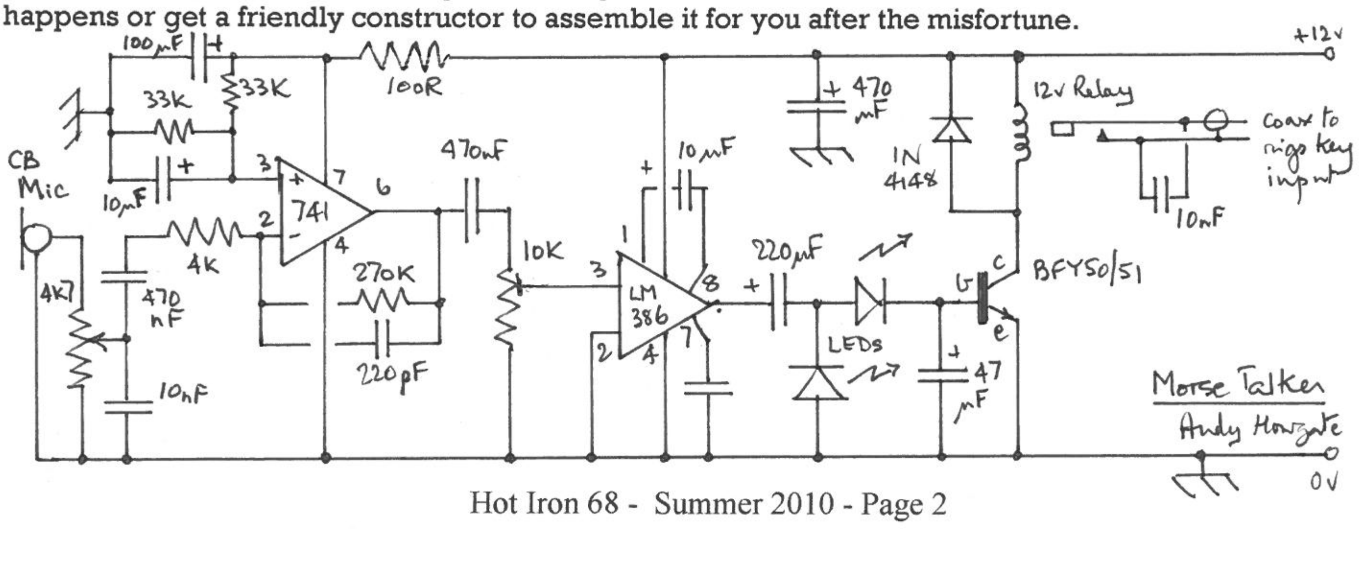
Morse Talker by Andy Howgate

The article in Sprat 141 by Michael Rainey AA1TJ set me thinking about those people who had lost the ability to use a morse key due to arthritis or some other affliction. Morse is often taught by the sound of the characters ie C may be written and spoken as Dah di Dah dit so one could use the voice to send morse by talking it. A few hours on the bench yielded the circuit below. The Morse Talker as I have called it, was used initially to key the side tone of a rig without transmitting; however I used a morse decoder which was listening to the side tone - the result I am pleased to say had the morse decoder reading what I was sending thru the morse talker circuit, now I figure if the morse decoder can read it then on air it should be read OK by another operator.

The circuit is rather crude and basic stuff using components likely to be in your junk bin or parts drawers. A standard CB mike can be used - the circuit is a high gain amplifier driving a pair of LEDs which will illuminate and rectify the audio from the amplifier stages, which when smoothed, turns on the BFY 51 transistor operating the small relay that keys the transmitter. When using your voice to talk morse in Dahs dis and dits, you don't even need a side tone. Another advantage is that there is no conversion from thinking morse to a movement of the hand, and you are less likely to get cramp or be stiff or tired, hi hi!

There are other uses for this circuit. One may use it to send pre-recorded morse tones either from a computer's sound card output or a tape or digital recorder. To test the Morse talker circuit I used an old Datong morse tutor with the output fed to the morse talker simply because I wanted to test the reliability of the relay so it was left running at something close to 20 wpm for several hours without any problems. Another very amusing moment was to place the microphone close to a rig's speaker with the rig tuned to a morse signal, the morse talker's relay now keying the Datong's inbuilt oscillator and then wearing a pair of headphones to listen to the morse tones coming not from the rig but from the tutor's oscillator. The thing is one has the almost perfect audio filter but that is not true in a real sense, the tutor's in built oscillator is producing morse tones which is a facsimile of the original as taken from the rig - inevitably one needs a filter ahead of the morse talker circuit and whilst this use is not perfect for morse reception, I am sure it could be developed further.

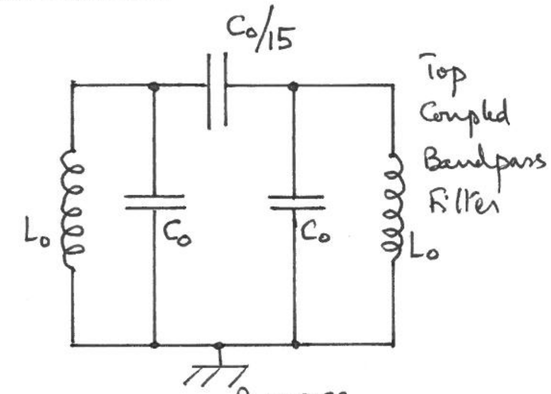
There is a few things that needs to be observed for the keying wires from the relay to a rig - I used mini 50R coax and the relay and all associated wires needs to be kept well away from the amplifier especially the preamp and it maybe prudent to put it in a cheap alloy box. Setting up is easy - the 10K preset is adjusted for the suitable sensitivity required and the 4.7K pot is taken into consideration allowing for adjustable gain when the device its completed and lid is on. A standard inexpensive CB type dynamic microphone is used with an impedance of 500 R. Although not shown on the circuit the microphone line can be switched inside the CB mike but one must be aware switch noise may trip the relay and or a noisy PTT button may also cause a pip to be transmitted. The Hyperbright LEDs can be mounted thru the box and will give an indication when the morse talker is keying nicely, one may also send morse using the light display pretty much as we may have done as children with a torch but if no illumination is wanted, then a pair of IN4148 diodes will do in place of the LEDs. All one has to do now is talk in normal voice the rhythmic morse sounds of Dahs dis and dits, it does not take much effort and you may find you can run away with the lip and tongue a bit to quickly till you get tongue tied hi hi. But at the end of the day it can be good fun using it. One final thought, one may have to assemble a Morse Talker before an affliction happens or get a friendly constructor to assemble it for you after the misfortune.



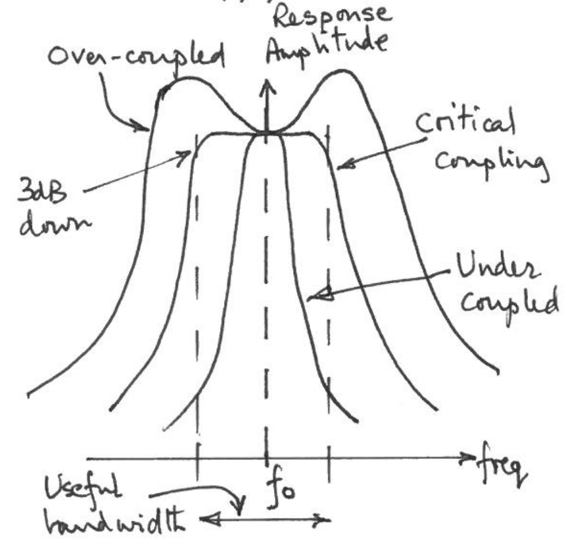
Bandpass RF Filters

Craig Douglas G0HDJ sent me outline details of his proposed 'VFO' for his new 15m rig and explained that he had spent some time considering what filters to provide. The basic design of the LO chain is a 5 MHz actual VFO mixed with a 16 MHz crystal oscillator to produce 21 MHz for the RX and TX. This needed a filter on the output of the SA602 to select 21 MHz and reject the other main mixer product at 11 MHz. Initially he considered a high pass filter which would reject everything below about 18 MHz, but the snag with this is that the higher unwanted order products above 21 MHz would still get through and might cause a spurious response in the RX.

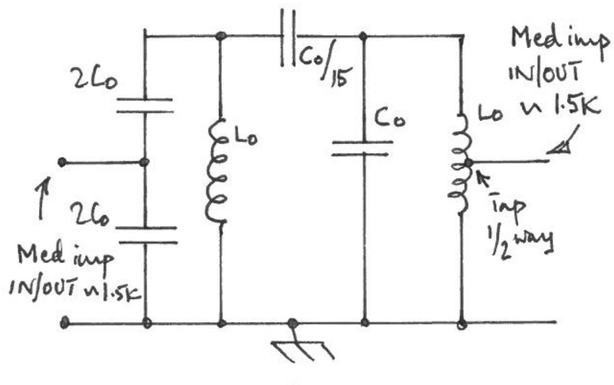
My own preference would be for a bandpass design centred on 21 MHz. Often a pair of top coupled parallel resonators as shown right is sufficient. Ignoring the input and output aspects just for the present, the question is how to size the top coupling capacitor. (There is also an inductively coupled version but most people prefer using Cs to Ls, so it is not often used!) If the coupling capacitor is very small, little signal will go from one resonator to the other, leading to a peaky response that can be imagined by superimposing the humped response of one tuned circuit on top of another identical one!

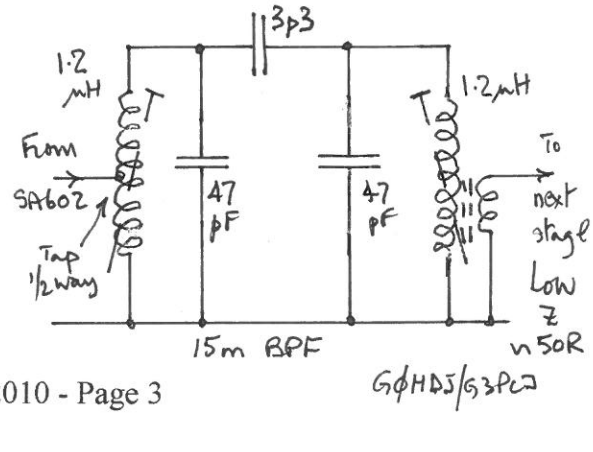


Alternatively, if the coupling capacitor is 'large', then they become 'over-coupled' which leads to twin peaks separated by a slight trough. In most situations the ideal response is a near flat top with the shoulders being just large enough to encompass the desired operating band - this is called critical coupling. In practice, small deviations from this ideal shape are not too serious as changes in propagation conditions or other factors are often much more significant in determining the effectiveness of the filter. Often a good slope on the sides of the response is more important for high rejection outside the pass-band. You can do some maths to get an exact size related to the wanted bandwidth, but you will often not be far out if the coupling capacitor is roughly one fifteenth of the value of the resonating capacitors.



Coupling in and out can be done either by capacitive or inductive tapping. In both cases, the aim is to prevent the external impedances (from the driving or load circuit) causing a severe reduction in the effective Q (or tuning sharpness) of the resonant circuits. In many applications, the Q will be sufficiently high if the 'transformed' external impedances equate to over roughly 5KOhm across the whole of each resonator. If capacitors are used then two equal double value capacitors in series will retain the same resonant frequency, but allow a load of one quarter of that 5K, or 1.25K for source or load impedance. Similarly, a mid inductor tap will have the same 1:4 impedance transformation effect. (Think of turns squared ratio for transformer impedance transformations!) You can also use a separate winding with half the number of turns. Taps nearer ground (or smaller input windings) will suit lower impedances, or taps nearer the top for high impedance. In Craig's case, for matching to the 1K5 output impedance of the SA602, this leads to the design right if using TOKO 3335 inductors of nominally 1.25 uH. The purists might object but this approach but it's a jolly good starting point if you don't like maths! G3PCJ





Radio in World War II

As part of my researches associated with my friend's war time bunker, I have recently read three books that I can thoroughly recommend:-

1. Between Silk and Cyanide - A Code makers War - Leo Marks - ISBN 978-0-7509-4835-7
2. The Secret Wireless War - Story of MI6 Comms - Geoffrey Pidgeon - ISBN 1-84375-252-2
3. Colossus - Bletchley Park's Greatest Secret - Paul Gannon - ISBN 978-1-84354-331-2

Most people will now be aware of the immense contribution made by all the teams that came together under the general heading of code breaking at Bletchley but these books brought out several new aspects for me. The involvement of radio amateurs is well recognised, in many spheres and I already knew of the role of Voluntary Interceptors, which had been explained to me by my late good friend Eric Godfrey G3GC who was one, and who managed to combine this with working for Alan Blumlein in the EMI research labs at Hayes. Often much of the HF morse traffic that they logged was received on very simple regenerative TRF receivers - often with only 2 valves. This logged CW traffic was sent by post originally to Box 25, Barnet, where it was analysed and passed to Bletchley for breaking of the coded messages into clear text. Encryption by the German Enigma machine was eventually understood sufficiently well for a very large proportion of these manual morse messages to be fully readable. As the war developed, the value of this intelligence required a quicker response and several dedicated HF receiving stations were built, and connected by land line to Bletchley for quicker analysis.

As the German armed services spread over Europe, the traffic became too large for plain manual morse and automatic methods were developed. Telex type services using typewriter style direct entry keyboards to paper tape were widely used but these also had to be made secure. These transmissions used high speed tone modulation of an HF carrier, and highly directional large aerials with relatively low transmitter power. A special receiving station was built at Knockholt in Kent to capture these signals which were relayed by land line to Bletchley. The German firms Lorenze and Siemens made coding machines that used a form of automatic rotor wheel encyphering - a bit like a more complex version of the Enigma manual machine! These non morse messages proved extremely hard to decipher and required far greater specialist processing power at Bletchley, where statistical text analysis methods became more important. The Post Office research station was heavily involved and eventually, with the development of suitable valved circuits instead of relays, produced Colussus. This staggering machine was the fore-runner of the European computer industry and was many years ahead of what was being done in the USA. At the end of the war several of these were in use, together with many other forms of 'processors'.

Of course, enemy transmissions were just one type of HF traffic; there was also a large listening and transmitting operation associated with our underground agents in occupied territory. The establishment at Whaddon, near to Bletchley, made very large numbers of so called 'spy' sets throughout the war that were used for this purpose, and also in our embassies abroad. Examples of the common models (like the Mk III) are still in use at special events. There seems to have been a very strong dependence on American receivers where portability was not important - HROs and AR88s being almost universal. The UK designed and made transmitters were all crystal controlled and seldom more than a crystal oscillator followed by a power output stage, that could also often double the frequency. The familiar 6V6, 6L6 and 807 beam tetrode valves feature strongly!

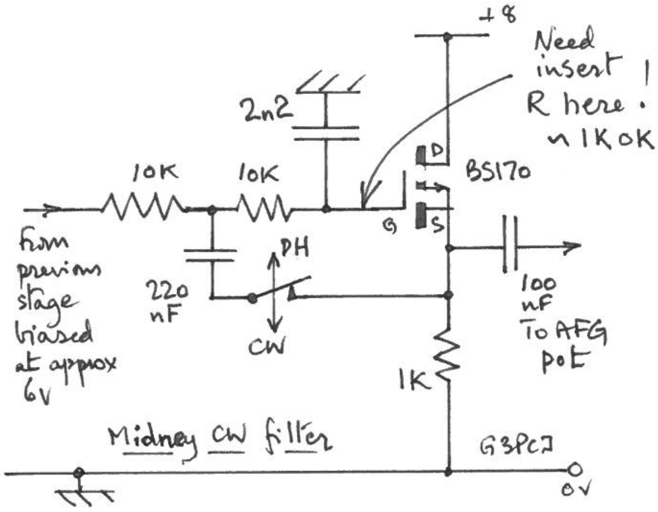
Having decoded and assessed the overheard information this had often to be sent back to Allied forces without revealing how the information had been obtained! This again called for an elaborate system of dedicated HF transmitters and receivers. As the Allied forces began to move into Europe, the pace of movement was often such that further specialist mobile HF cars or vans were provided for important commanders. Many of these vehicles were equipped at Whaddon with much the same equipment that was used for communication with agents in the occupied territories. Many famous people were involved in all these operations - too many to list in this article!

Another radio aspect was propaganda broadcasting to the German Services and their wider population. In the second half of the war, this had been developed to a fine art and used the Aspidistra transmitters at Crowborough in Sussex; the first installation needed a labour force of 600 men and was completed in about 9 months. American transmitters were purchased that could produce 600 kW on Medium Wave; the site also had at least two 100 kW short wave units.

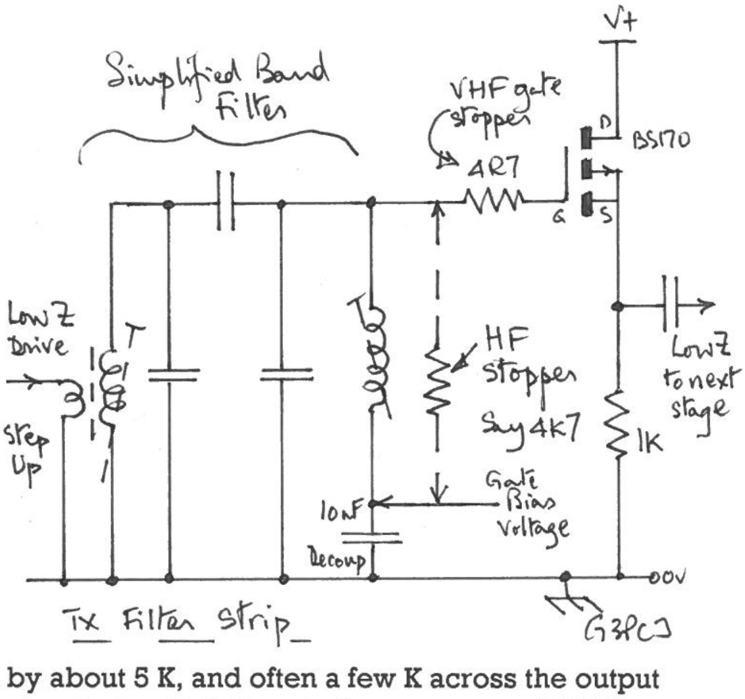
Fascinating as this is, it has not yet explained the workings of Auxiliary Unit's TRD! G3PCJ

Beware of 'buffers'

No - I am not branching into railway matters, despite I K Brunel being one of my heroes! This warning is about emitter or source follower buffer stages. Valuable as they are for driving a lower impedance load than the existing source can stand (with near unity voltage gain); they can lead to unexpected results, as I have found out to my cost on a number of occasions!



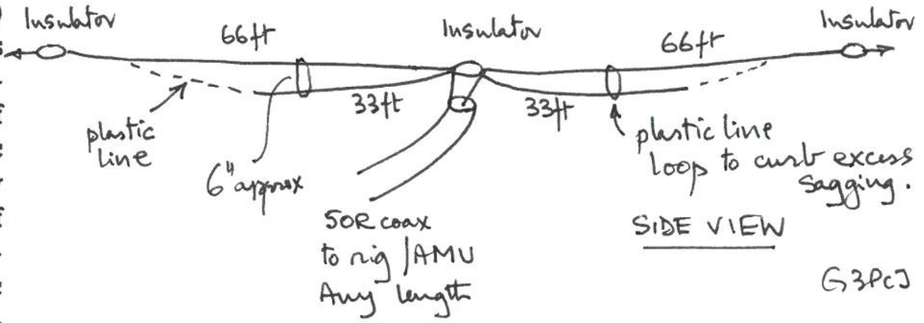
Many years ago, I had a problem with the audio CW filter in the Midney. It is a single BS170 stage arranged as a common source follower, in a Sallen and Key low pass filter; it had a toggle switch to open the feedback path for the wider phone bandwidth - see circuit on the right. This circuit has an appealing simplicity for changing the audio bandwidth! Initial listening tests showed that it was not passing the audio signals smoothly. Investigations with a signal generator and scope (equipped with normal divide by 10 probe) showing it working exactly as expected! Eventually, I found that it failed the finger test - ie prodding around with ones fingers - initially hoping to find a poor joint! In fact the extra damping from my finger (resistive and or capacitive) was curing the problem. My test gear didn't (and could not) show it up, but the stage was actually oscillating at VHF! Applying the scope probe stopped the oscillation! The source follower had sufficient output capacitive loading (from source to ground) so that it was forming a crude Colpitts oscillator using its internal gate to source capacitance! The cure is simple when you have deduced the problem - add a low value gate stopper resistor in series with the gate input to the MOSFET - at the point marked R in the above circuit! In MOSFET audio stages this can be any convenient value up to a few K as it will not affect the audio bandwidth - I used 1K. The same problem can also occur with bipolar transistor emitter followers; but this time the base current requires a low value resistor to avoid altering the bias conditions, so add a few tens of Ohms to reduce the gain at VHF to below that required for oscillation.



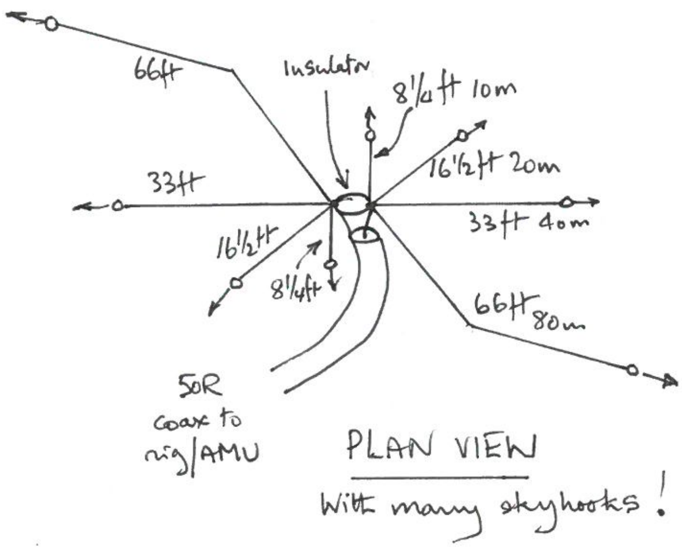
One can also fall into a similar trap with RF circuits. In a linear transmitter RF output line up needing a bandpass filter, one approach for achieving the desired gain is to use the inductive voltage step up possibilities of the filter input 'inductor'. One then has a higher RF voltage which needs 'buffering' so that it can drive the following lower impedance output stage - hence a source or emitter follower is needed. The threat of VHF oscillation is still there but there is another problem from the resonant circuit at the input to the buffer stage. Give this too much Q and it will oscillate at the wanted signal frequency!! Much the same oscillator circuit is at work (the darn Mr Colpitts again!), but because it is active at the intended operating frequency, you cannot just add a gate stopper as above! You need to reduce the Q of the tuned circuit. This needs to be done with care as its there to reject unwanted signals and heavily flattening its response will ruin that effect. Parallel tuned circuits still exhibit useful Q when they are loaded by about 5 K, and often a few K across the output resonator will kill any oscillation at the signal frequency but not totally ruin the response. G3PCJ

Nested Dipole antennas

Charles Wilson kindly sent along some notes based on articles that originally came from QST. The first is for a multi-band dipole antenna. It is actually the 'nested' form of dipoles connected to a common coaxial feeder. The authors version had four dipoles for 80, 40, 20 and 10m; but the 40m will also work (and match) well on its third harmonic so this array will also do 15m. Coincidentally, I had decided to use nested dipoles for the main HF antenna on Jul 18th for QRP in the Country. I wanted only 40 and 80m operation and had started with salvaged BT telephone 'drop' wire which is hard drawn copper in a twin split-able figure of 8 PVC configuration. I intended to have each arm 65ft 6 inches long for 80m, and to cut one conductor at 33 ft and remove the outer section for 40m. But I wondered what effect the high capacitance between the two wires would have - would it be lossy or ruin the resonances hence needing changes in lengths? To avoid any chance of problems, I thought it best to separate the wires of each dipole by a few inches. How to do this and keep everything light? Searches in long abandoned cupboards produced some thin plastic line originally intended for an electric strimmer head. Nice and light but strong enough to pull the shorter dipole up to a few inches below the main 80m one. After splitting the wires, I found this did droop a little too much, so a couple of loops of this plastic string part way along (and secured in plastic with PVC tape) cured that! As a warning, if this is to be a permanent installation, you need to find a way of securing the ends of the plastic string because it will eventually undo and slip along. Lots of clove hitches help but a judicious melting of the plastic might secure one turn to another!



The QST version with four dipoles got over the inter-wire capacitance problem by laying them out horizontally over all points of the compass! The author had trees or buildings suitably dotted around his garden and even bent some of the wires to make them fit. Its very simple - all the wires on one side are joined to the coax inner, and all the wires on the other side to the coax screen. Given the good match between dipoles and feeder you might even get away without the need for an AMU! G3PCJ



Very Smart Brendon!

Many Brendons have been built but not too many like this which will even go into the US 75m band by using a 4 MHz ceramic resonator!! Built by Jim N7JS.

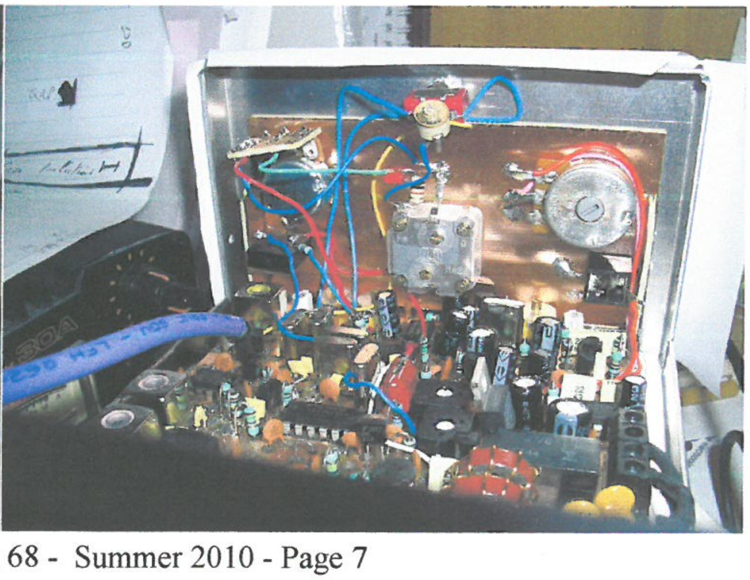
Snippets!

Rechargeable Batteries A couple of interesting notes recently. Firstly in Radcom May 2010, where Richard Newstead G3CWI extols the virtues of Lithium Polymer batteries. Their price has come down in recent years making them now an attractive alternative to lead-acid gel cells, especially for portable use. A quirk is that the single cell voltage is 3.7 volts, so a common pack is of 3 cells producing 11.1 volts nominal. Many nominal 12v rigs that are favoured for portable operations like the FT817, will run comfortably on this, albeit with slightly less RF output power. You can also use four cells for 14.8 volts and reduce this with a silicon diode or two, which you can short out when the cells get a bit low. The main advantage of LIPO cells is their higher energy density - such that the same energy is held in about one third the weight and nearer a quarter of the volume! But beware - they can deliver (or accept!) seriously high currents if allowed to do so! Consequently it is suggested that they should be charged using the specialist chargers and the actual battery be in a fire proof box or be outside!

The second note in Technology First (from Farnell) explains that Lithium is the lightest solid metal and has an intrinsic negative potential larger than all other metals, so that depending on the other electrode, the cell voltage is between 1.5 and 3.6 volts. As explained above, the energy density in weight and volume terms is unrivalled currently. Lithium based cells include poly carbon mono-fluoride (Li/CFx), manganese diode (Li/MnO_2) and lithium thionyl chloride ($Li/SOCl_2$) often abbreviated to LTC. Cell construction is important - spiral wound cells are used to reduce their impedance owing to the higher surface area of the anode. Typically spiral LTC cells have an energy density of 800 Wh/litre and service life of about 8 years. In contrast bobbin wound ones have an energy density of about 1420 Wh/l and a lower self discharge rate such that service life can be up to 25 years theoretically! This makes them very attractive for low consumption applications such as domestic meters for gas supply. Apparently over 3 million have been deployed worldwide! A recent development is a hybrid construction that can take or deliver extremely large currents;100s of Amps to over 1000A!

Customer Feedback

Ted Williams G4NUA writes: 'I built the 20 metre version of the "Fivehead". As you suggested in your write up, tuning can be a bit tricky on SSB, being of an age where the hand is not so steady, this was very much the case. Having been in the TV trade many years ago I remembered about varicap diodes, and decided to have a go. I decided to start by connecting a 100K pot to the 8 volt supply and standing the earthy end off with a 56k resistor, this in turn gave me a voltage swing of approximately 5 volts, 8v to 3 volts. During a discussion with G3XBM he suggested the use of a red LED as the varicap, with a suitable RFC and a couple of decoupling capacitors this seems to work well. I placed the LED and the RFC as close to the variable capacitor as possible and was then able to mount the pot on the from panel (see photo). Each of the 3 sub-bands when switched give me a swing of approx 60 KHz per switch position, the varicap diode give me an additional swing of about 1 KHz. In passing I removed C150 the fixed value for a variable cap, this allowed me greater control of the frequency spread, so I now have a nice overlap between 14.125 and 14.340 KHz. Many thanks for a great project TED G4NUA best 73'



QRP in the Country

This is going to be a ***real radio field day***! To be held here at Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ on July 18th and all radio enthusiasts are welcome. Entry is free! Homebrew radios is the theme! Gate opens at 10 am. I hope that all west country members of the Construction Club will be able to come!

There will be many attractions, including:-

Special event station GX3CMH/P operating SSB, CW and AM on 40 and 80m
G3GC replica 1935 CO/PA 807 TX and associated RX, VFO, modulator etc
WS 19 HF sets and WS17 VHF 6m operational on phone/CW
Informal home built competition – bring your entries please!
Construction and advice clinic
Displays of Walford Electronic kits
Display of antique domestic radios
Award of Bath Buildathon Competition prize by Rob Mannion G3XFD - editor PW
Competitions, with Bring and Buy stalls
Several West Country Club stalls with PW and the RSGB in attendance
Farm tours (1 mile walk) led by my wife Janet
Local food (barbeque) and beer for sale

In the event of poor weather, all will be under cover in the cattle sheds! For further information please contact me Tim G3PCJ at walfor@globalnet.co.uk. Here is some of the kit that will be on air (I hope!).

Subscriptions!

I regret it is that time of year again! How time passes more quickly as you get older. The next issue of Hot Iron is the first of the membership year and I need to receive your payment of £7 for UK members by Sept 1 2010. Overseas membership costs £9. The price remains unchanged despite the threat of a rise in VAT! 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! You will get bored of me writing it all each time! Any article or note, about your experiences, hints and tips etc. are especially welcome. Allow for about one side of A4 ideally with some sort of picture or diagram. And I am very happy to attempt to answer member's questions. If you don't feel too confident about producing material that is fit for publication I will do my best to turn it into reproducible form! Hope to see you July 18th! Tim G3PCJ