"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

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Contents

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

Editorial

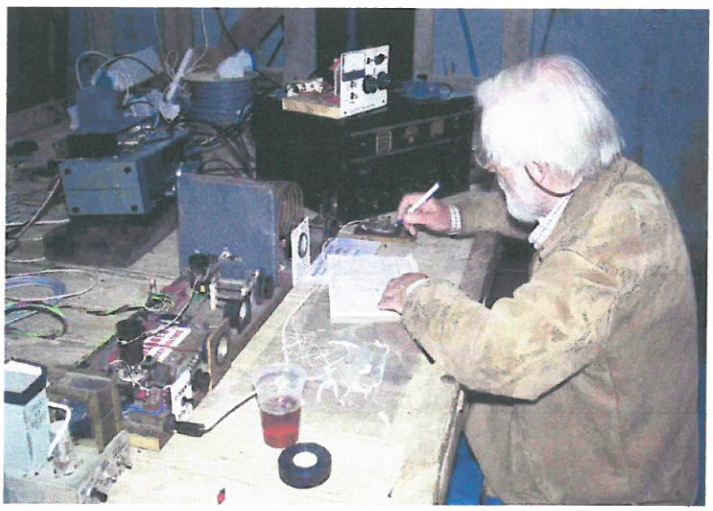
Another start to a Hot Iron year - the 20th I make it! Without the support and encouragement of you readers it would have died long ago, and I must say a special thank you to our various writers. It takes courage to put pen to paper but its not really all that intimidating so I encourage any of you who think to yourselves that others might be interested in what you do, to jot it down for everybody. It is as satisfying to have somebody else say 'I took up your idea', as it is top be able to say on air that you made the rig yourself. Perilously few are able to say that because factory made rigs are now cheaper in real terms than they have ever been, but being able to say you found the drop down menu for changing the rig's clock does not somehow have the same satisfaction as turning off after the first contact with a new homebrew project!

Having spent many years shuffling designs for semi-conductor rigs, I wonder if I ought to tackle a valved project. The two obvious snags are the safety aspects of high supply voltages and finding a way of mounting valves that is suitable for reproduction in a kit. Jack of all trades Peter Thornton G6NGR suggests using 'Terry' clips screwed to a wooden rail to hold the glass bodies horizontally with push on female connector sockets for the individual pins! The simplicity and low cost of that appeals to me - I do dislike time consuming and expensive metalwork! Tim G3PCJ.

Kit Developments

The very difficult weather has prevented much work on the new projects. Three Burtles have been built but not without a few tribulations which suggest the original wide choice of bands was too ambitious! A Mk 2 version is probable!

Meanwhile we were lucky with QRPiC 2012 - the weather was actually fair and there was a jolly good attendance. G3ROO & his mates came down from Dover which was a grand effort. Plenty of variety of projects were on display, but rather like getting authors to write (as above!), getting Clubs to display their activities is also a challenge. Here Ivan G3KLT exercises the Plank! A good time was had by all! 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 © G3PCJ

A 1968 dummy load by Peter Thornton G6NGR

I was very fortunate to be an apprentice at Ferranti Electronics during the 1960's. One department that fascinated me was the Klystron Dept. The klystrons were not two ha'porth things, they were a yard long, and had 40kV on the anodes! My job was to make dummy loads, as these often burnt out during tuning. They had resistors in a "star" pattern around a central connector. They had to be "spot on" or they lit up with blue fire!

The trick was the mounting of the resistors. Obviously, you can't fit 20 plus resistors on the pin of a co-ax or BNC socket; so I was shown how to fit one resistor to the pin and out to the circular wall, the rest using the previous resistor's lead as the next anchor point. This way the resistors are spaced evenly with the shortest leads. See the diagrams.

I wanted a dummy load to test a 40m DSB transceiver I'm building for S.O.T.A. expeditions this summer – so put a "Ferranti" one together, in a round sweet tin. The list of materials is:

A round [sweet?] tin;

20 off 1k ohm 3 watt carbon resistors;

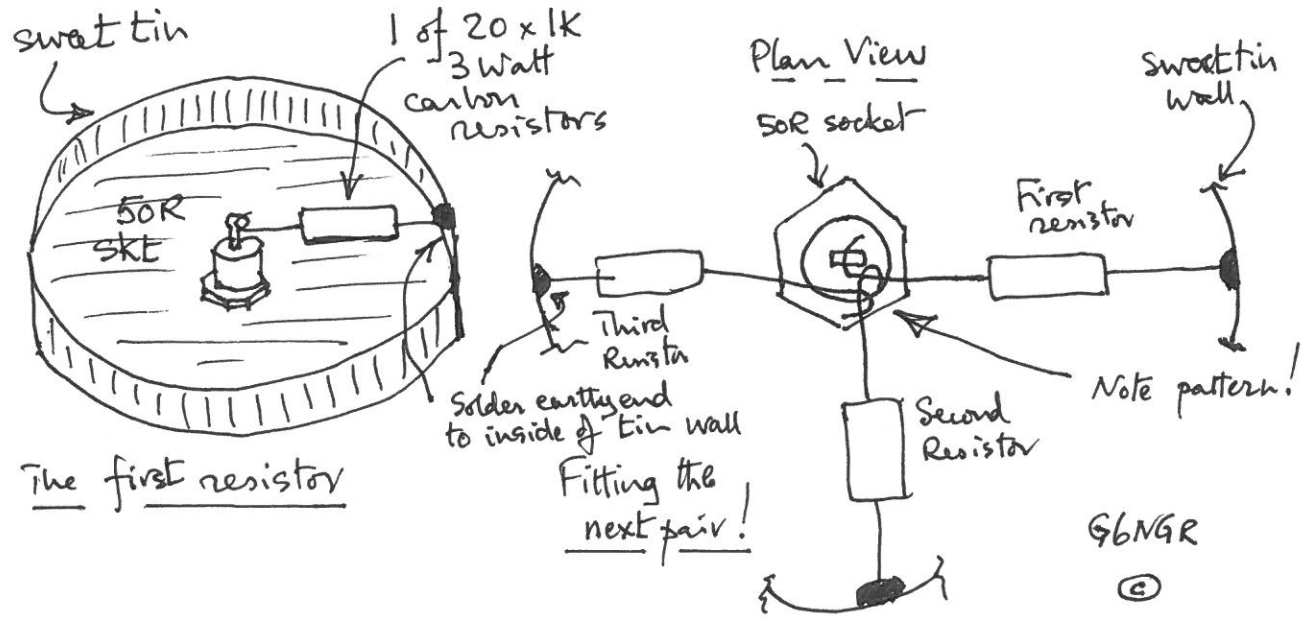
A BNC, co-ax or N type [or RCA phono?] socket. And that's it!

Start by mounting the socket at the centre of the sweet tin base. Fit the first resistor between the BNC pin and the outer wall at three o'clock; the resistor body closer to the outer wall, they are quite bulky.

Now here's the trick: fit the next resistor, at "six o'clock", by hanging the inner end on the *first resistor's lead*, tight against the BNC pin, and the other end to the outer wall. Similarly, nine and twelve o'clock. Fill in the "gaps" with the other resistors; it's easiest if you make the resistor lead joints as near a right angle as possible, picking up a previous resistor's lead.

I fitted a 1nF / 1 kV ceramic capacitor from the BNC pin to a 3mm bolt through the sweet tin base, insulated through with a transistor mounting plastic washer, and earthed the bolt via a 1N5211 Schottky diode. This makes measuring the power a doddle, the diode handling up to 70 volts peak RF [~100 Watts]. For safety fit the sweet tin lid and secure with a couple of dabs of solder, and don't run it on your best coffee table – it gets HOT!

The load will run 50W continuously, 100W CW / DSB. If you want to run high power continuously, seal the BNC socket threads with silicone, fill the tin with engine oil and thermally bond the sweet tin to a heat sink. Job done!



12v DC to 240v Inverters

Peter also mentions the use of these car cigar lighter units, that are now about £20 from the likes of Maplin etc, as an insulated source of sinewave 240v 50 Hz that can directly feed a HT supply rectifiers for valves producing over 300v DC!

The 10 part RX Challenge (at QRPiC 2012)

Steve Hartley G0FUW kindly agreed to assess entries for this construction challenge - the task being to design and build a RX for any band using no more than 10 components with an optional single integrated circuit and a single supply regulator if wanted. Steve reports:-

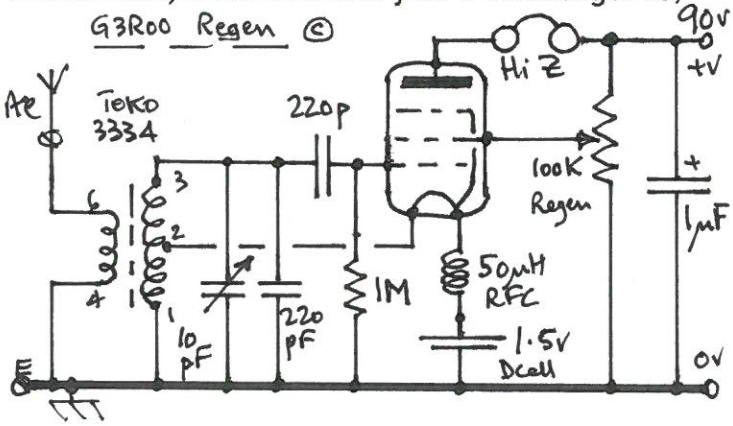
Prior to the event there were a number of questions like 'does it really have to be ten parts?' and 'will I be disqualified if there are eleven parts?'. Tim's view was that it would be better to have a number of twelve part entries than no ten part receivers. There were suggestions of parts being hidden under IC sockets etc.! Judging this was not going to be straightforward!

I pondered over what test equipment to take with me to test the sensitivity, stability and selectivity but ended up in good QRP minimalist style with a crystal calibrator. My unit has a neat feature that switches the calibration signals to provide a continuous string of dots and this is extremely useful when testing receivers, although a guy listening on a nearby rig and oblivious to my receiver testing seemed confused when he was picking up my 'e-e-e-e-e-e' signal across the band!

So, to the Challenge entries. We had five receivers from four builders, but Tim graciously ruled his own effort out of the running; a kind of construction check log with a fantastic 'Wallis & Grommitt' reduction drive/dial. In fourth place was Craig, G0HDJ, with a little one FET regen that had been in July 2012 PW. Third was Peter, M0PKH, with his NE612 based DCRx which worked but with some instability on the audio tone. Pete won a box of chips and other 'sweepings' from Tim's workbench. In second place was Craig's second effort called the Bakers'/Engineers' Ten, which I suspect meant that it had maybe one or two over the ten limit but it worked very nicely. Craig won a copy of SPRAT on DVD.

And the winner is....Ian, G3ROO, with his DCC 10-40V valve regen powered by a 'rack' of 9V PP3 batteries. This little radio was an absolute dream to use with smooth regen and really superb audio. Ian won a bottle of a local Somerset alcoholic beverage. The circuit of Ian's receiver is shown below. I certainly enjoyed judging the entries and the guys that put in entries had certainly taken the challenge very seriously. (I was even offered a bacon sandwich on arrival by one of the entrants, who shall remain nameless, but it wasn't Ian). Here's to next year's Challenge! 73, Steve, G0FUW

Ian's circuit is a classic! I regret I don't have a note of the valve type but I am sure he will be happy to explain for anybody who wishes to contact him through me G3PCJ.



Ian G3ROO on left, then Craig G0HDJ, Peter M0PKH and assessor Steve G0FUW on right, with entries on the trailer.

Regen TRF RX developments!

This style of receiver continues to be of much interest because its performance is tremendous for the relatively small number of parts that they can be made with. As Ian G3ROO's circuit on the previous page shows, a 10 part RX using valves can be very effective. Some designers might argue that a semiconductor version can be equally effective but there are plenty of other builders who have condemned Regen TRFs as the work of the devil! They can be, and often are, challenging to use even when well conceived!

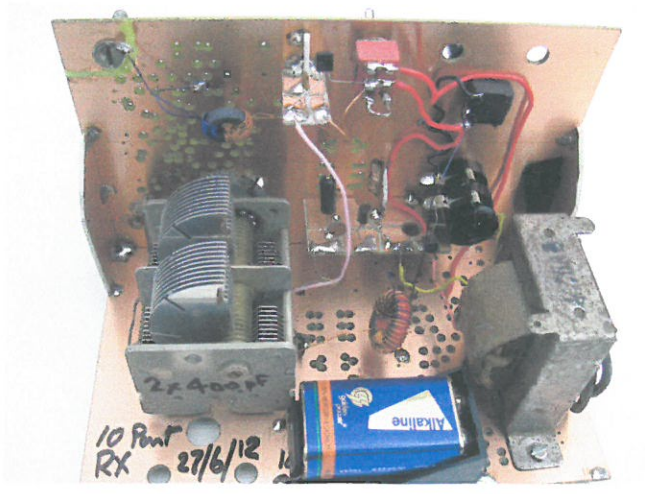
In the 1920s, receivers tended to have an RF stage (or two) before an envelope detector which was followed by multiple audio stages. These were often plagued by RF instability and soon someone (I suspect a Mr Armstrong) decided a little bit of positive feedback could be a good thing provided it was controllable. The effect of adding positive feedback is that it increases the Q or selectivity of the tuned circuits so also increasing the RX's gain or sensitivity. If this feedback is just insufficient to cause RF oscillation, then amplitude modulated signals can be received; if it just a little bit higher and enough to cause RF oscillation, then morse and SSB (or DSB) signals can be heard. The important matter is thus how to control the amount of RF feedback in the tuned stage(s).

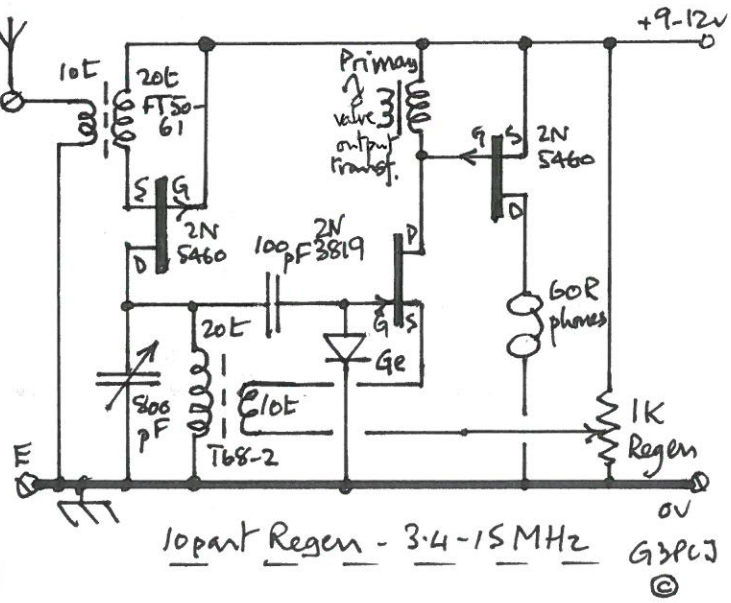
In early designs, the gain of the regeneration stage was controlled by adjusting the amount of RF feedback by some form of 'attenuator' in the feedback path - often a variable capacitor in series with the feedback or tickler winding associated with the main tuning inductor. This has the distinct disadvantage that it alters the tuning as the feedback is altered, so making the RX extremely difficult to use because of the interaction between the two controls.

From about the 1950s, the concept of Q multipliers as an adjunct to conventional superhet IF stages became popular, leading eventually to Regen TRFs having their own separate regen stage which is in effect a controllable oscillator coupled to the RX's tuning circuits. Soon it was realised that oscillation, or not, could be controlled by altering the regen (or oscillation) stage bias - altering the stage gain by changing the bias was a huge step forward as 'the controls' were not in the RF parts of the circuit - thus the interaction between the controls was almost eliminated. This is the approach that I have used for many years culminating in the current Cary RX. See later! But.....!

Perhaps the regen detector and oscillator stage could be combined with DC control of the device gain to control the point of oscillation - like the G3ROO RX? This is the approach that I tried with the Littleton RX in the last Hot Iron; but could it be taken further? My attempts at a 10 part RX showed that it was indeed possible to go appreciably further but the circuit below is not viable for a kit because it is a bit unpredictable and uses obscure components. I was keen to increase the RX's overall gain to obtain a reasonable output level into modern medium Z phones so the RX had to have multiple stages. I also wanted an RF stage for isolation between aerial and oscillator stage to prevent radiation when copying CW or SSB. Two design approaches are worth considering to reduce the part count - depletion mode FETs (that have a useful standing current for Vgs = 0) & of both types (2N3819 are n, 2N5460s are p), with transformers (RF and audio) for impedance matching and biasing. I hope these notes will encourage experiments by others. Tim

(Below is what Steve G0FUW refers to as the Wallace and Grommit RX.)

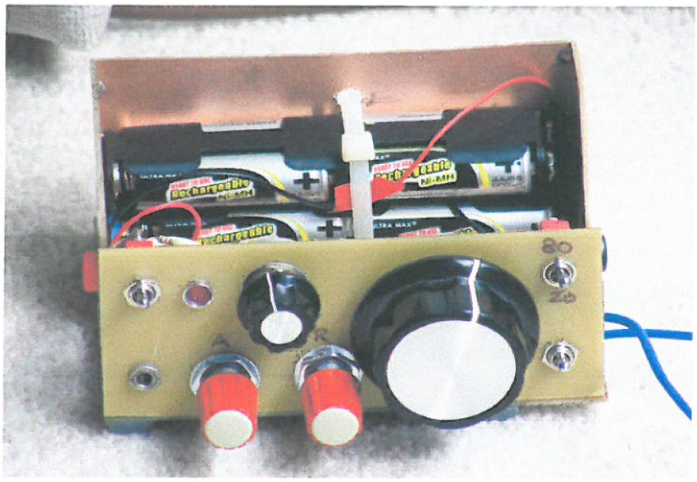




In praise of the straight set - The Cary

When Tim brought out the Cary, I jumped at the chance of building one, as I, like many others, were brought up on straight sets with reaction. My father built me one when I was 10, with a Mullard DL35 and a 9V grid bias battery for the HT. Then thanks to F J Camm I built many of my own from bits I got from ex-govt. equipment, and eventually a 1-V-1 with mains valves and Denco plug-in coils, on which I did serious SWLing.

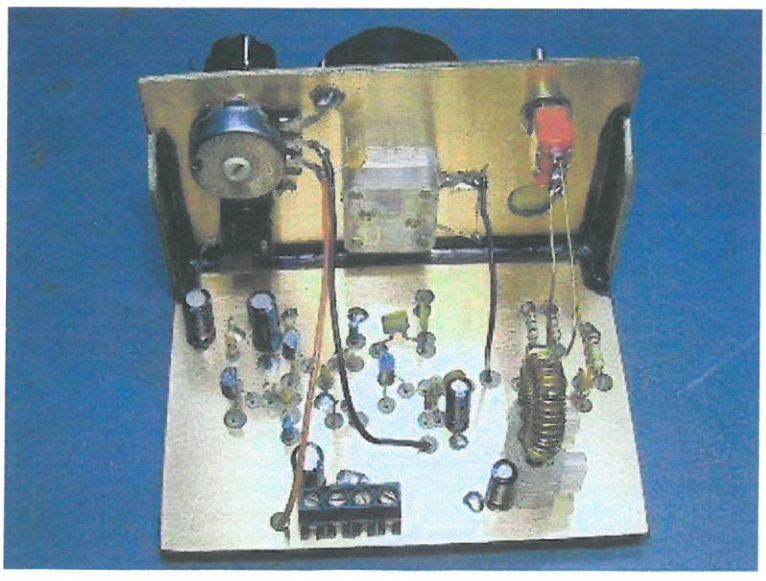
I put the Cary together (not many components but a clever design with the smoothest reaction I have known) and it worked OK. Then I found that it had great possibilities as a portable Rx to put in hand luggage. I dispensed with the PP3 and fitted 8 AA size ni-cads which made it 2cm wider, but this gives 50 hours working. The wider front panel, let me fit the RF gain and AF gain pots (very much operational controls on a straight set) plus an LED indicator and a switch for a simple LPF (one Capacitor). With a small frequency range I set 20m to 14.00-14.07MHz, 40m to 7.00-7.04MHz (the CW ends) and 80m to 3.70-3.81MHz to ear-wig on some phone QSOs. It does drift but very little, so it would be ideal with an XTL TX.

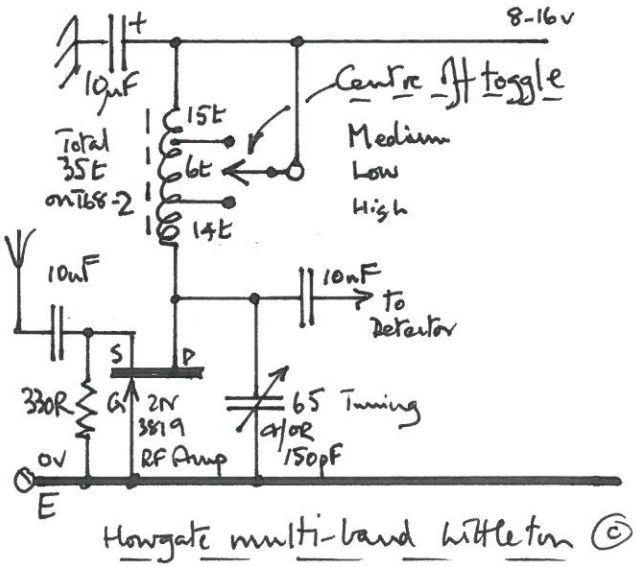


Once you have got used to "driving" a set like this again, it is a very sensitive device and will give lots of pleasure. I suppose that I should put into a sturdier metal box and give it a larger tuning C with a 5:1 reduction drive. To all readers who were brought up on these sets – I recommend the Cary – just like old times! It would n't appeal to the many push button memory superhet operator, because you have to "drive" the Cary, which is what ham radio is all about to me! David Proctor

Andy Howgate's Mulit-band Littleton

Andy has built his own version of the Littleton using a mechanical style that I have seen somewhere before! At first the rig would not work properly and was a scratchy as a fleas nest! It had me seriously worried for a while - what had I got wrong as mine worked very well? Andy's mark 2 version worked properly when the pot was replaced with a new one!! He has made his multi-band by using a centre off single pole toggle switch to short out turns on the toroid which is the main tuning inductance - something like the circuit on the right.





VFO Ideas for multiband CW rig

Experiments, and experience, with the Burtle single band CW rig made me doodle more on the possibilities for multi-band direct conversion CW rigs. I had hoped that the Burtle could be built for many different bands using a frequency mixing approach based on a crystal (and its harmonics) combined with a lowish frequency VFO that might need doubling for some bands. It proved to be a bit ambitious! However, if a VFO is ever to drive a transmitter, then crystal mixing is THE way to avoid chirp and also to obtain good frequency stability on the higher bands. (Chirp is usually caused by RF from the TX output stage getting back into a VFO operating on the same frequency.) Use crystal mixing and then one only has to worry about supply voltage changes during transmission making the VFO alter! The main target bands are 20, 30, 40 and 80m. To achieve easy setting up, avoid all harmonics that might come near the desired output and use a doubly balanced mixer such as the SA602. Keep the VFO below about 6 MHz, preferably operating at about the same frequency for all bands, and ideally do all this with a single set of parts!! Somewhere along the design process using digital techniques has to be considered because such circuits are usually more dependable for most builders! Also bearing in mind the harmonic relationship of 20, 40 and 80m one can obtain a 40 or 80m signal from a 20m one by plain frequency division in a 74HC74 chip. Here are some possible schemes and comments:-

VFO	Xtal	Mixer BPF	Lower Bands	Comments
5	9	14	By division from 14 for 40 and 80m	9 not standard crystal. Needs 400 KHz VFO swing. 30m not done!
6	8	14	Ditto	8 xtal cheaper! VFO still needs 400 KHz swing. 30m possible (with extra BPF) if crystal also divided to 4.
5 or 6	9 or 8	14	Ditto plus tripler from 80m sq wave for 30m using third harmonic	Similar to above but VFO swing has to be even wider to get to exact 30m spot (13.468/4 x 3 = 10.1)
2	12	14 and 10	40 & 80m by division from 14. 30m has own BPF	2 is a bit low for easy VFO! 12 is not a standard xtal. Might need triple tuned BPFs to remove unwanted mix.

Schemes 1 and 2 don't appeal as they don't lend themselves to 30m easily which is an important band for CW operators. In scheme 3 the 20m BPF has actually to pass from 13.47 up to 14.40 which is an uncomfortably large bandwidth if reasonable rejection is to be obtained for the other unwanted mix. Scheme 4 only has to have a 14.0 to 14.4 BPF for 20, 40 and 80m while the 30m BPF has only to pass 10.10 to 10.15; these should be OK with double tuned tapped resonators to avoid the unwanted mix which is only 4 MHz away. Scheme 4 is also probably slightly easier to set up and can easily have all four band outputs available simultaneously for external band selection.

(The single band Burtle type CW rig needs to be a bit different (to avoid cost of second BPF) and is more likely to be a variant of scheme 2 with the crystal divided instead of 20m output.)

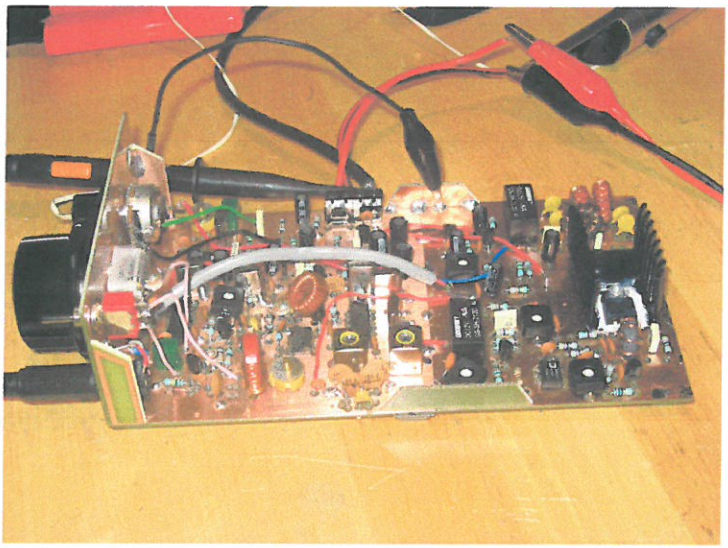
What of the RX and TX to go with this LO unit?! The digital LO output can easily drive a strong doubly balanced product detector (as outlined for the Minster in the last Hot Iron). When used with a resonant AMU you might even get away most of the time without a receiving RF BPF! Follow the product detector with plenty of audio gain/LS drive and narrow filtering for CW. RIT is easily incorporated in the VFO circuits.

The TX could be a 1.5 or 5W multi-band digitally driven - perhaps starting as a single band TX with on board single band TX harmonic filter for any one of 20, 30, 40 or 80m. It probably ought to have sidetone, muting and semi-break in TR changeover. For those wanting all four bands, an optional relay controlled 3 band LPF unit could be added. This looks worth investigating further as a viable medium price rig to achieve four bands CW operation! G3PCJ

5W from the Bridgwater / Burnham by Steve Davies

The Bridgwater / Burnham work together as a 1.5W SSB transceiver. I built mine for 40m, where it works very well. However, just 1.5W can make things a little difficult at times and after I explained this to Tim, he suggested I try replacing the PA RF choke (L3) with a 1:2 output transformer.

The transformer was made using 10 turns bifilar on an FT50-61 toroid. The centre tap was connected to the drain of the IRF510, with the other sides of the transformer connected to the output and the +Ve supply respectively. The mod took just 20 mins or so, and involved drilling one small hole and cutting one PCB track. On 13.8V the power out increased to about 4.5W, and this was via the diode protected main rig supply. On 16V, it gave just under 6W before any signs of clipping.



So – a very worthwhile and simple little mod, though it should be borne in mind the heatsink supplied was for a design output of 1.5W, and it does get rather warm at 6W, so care is needed. So far, it's been fine for SSB. Furthermore, it frees up my 10W linear amp for another project. Thanks to Tim for this project, the rig now works very well on its own and all that's left is to box it up! (I don't supply this version as the standard kit because the heatsink is not really adequate! Tim)

Brendon plus Linear Instability?

I am one of the many that thoroughly enjoyed building and using the Brendon DSB kit. Its a charm to construct and a joy to use. Whilst I was soldering in the PA transistor , I already had my eye on the 10W linear so I ordered it. I noted the comment in the Brendon Instructions that there had been a tendency towards "AM ing on transmit when using the linear and it was suggested to change the entry/return point from the point "L" to "L2". (Further down the filter chain). I tried this but with little improvement. The problem manifested itself like this: I would slowly increase the drive on the Brendon and at one point the carrier would suddenly kick in before I could get enough drive for the linear. Nice AM but not really what I wanted! Everything else inc bias etc was ok so what to do? It occurred to me that even though the idea of looping the RF to and from the linear and back through the filter on the Brendon board is a great plan it might just be the cause of the problem? (RF feedback and unwanted coupling?) So "why not put the filter nearer the Linear and Aerial socket? Worth a try.

So remove the following: all Caps 250 –257 and toroids L250 and L251. Mount them on a small board using the original circuit on Brendon Page 20 top left. Fit this somewhere near the Ae socket (I use a SO239). Take a screened coax lead from hot end of C202 (point L) and connect to the IN point of Linear amp board. (Remember E at both ends of coax as well!) Now it would be easy to take the output from the linear to the TX/RX relay on the Brendon but I wanted to avoid any possibility of looping back any RF! So solder a SPCO 12v relay at the Ae socket and connect the OUT point from the linear to one side of the relay and connect other side back to the RX "R" on the Brendon board. The centre connection of the relay is of course connected to the Ae socket centre. I used miniature coax cable for these connections. You can use point VT to power the relay so that it operates on TX only. This cured all the problems and now I have loads of drive and no instability! All the best Pete G4HAK.

Snippets!

Single atom transistor! Researchers at the University of Maryland report the fabrication of a transistor from a single atom of phosphorous embedded on a sheet of silicon. They started by covering the sheet of silicon with a layer of hydrogen, then used a tunnelling microscope to remove hydrogen atoms according to a precise pattern. They exposed two silicon strips plus a tiny rectangle of just six atoms; by then adding phosphine gas with heat it caused the phosphorous atoms to bind to the exposed silicon. In the case of the rectangle, only one atom inserted itself into the silicon! This resulted in four phosphorous electrodes separated by 20 nanometre with a single phosphorous atom between them, that acted like a transistor! No information on its cost, bandwidth or current gain!!

LeCroy promise of 100 GHz scopes LeCroy plans to acquire the specialist Teledyne Technologies who are big in very high speed mixed signal processing using indium phosphide semiconductors. These circuits are crucial for the front end digitising of analogue signals into a stream of digital data for subsequent display at lower repetition rates! Several scope manufacturers have recently released instruments with sampling rates of over 150 Gsamples/sec enabling real time bandwidths of about 63 GHz!

QRP in the Country 2012

A good throng of keen radio enthusiasts turned out this year and were not put off by the threat of rain which hardly materialised for a change! To improve the feel of the event, we held it in just one cattle shed so creating a comfortable squeeze! There were several Club stalls showing off their particular activities, individuals with displays of old and modern equipment, both military and civilian, factory and home made. Steve Hartley very kindly assessed the entries for the 10 part RX challenge as reported elsewhere in this Hot Iron. PW, the RSGB and a few component suppliers were also in attendance. Several individuals took the opportunity to make a little more space in their shacks by selling unwanted gear. Food and drink was from the farm and the next door brewery/ orchard! PW kindly presented a years subscription as the main prize for the raffle which my wife Janet organised in support of 'Send a Cow' (to Africa) - this raised the excellent sum of £103.

Amateur Radio in the Country 2013

Date fixed - Jul 21st 2013!

Note the change in name!! I had a bit of feedback that some Clubs and individuals were not quite so interested in QRP matters; so a wider title will, I hope, attract individuals and Clubs who have been hesitant before. My intention is to concentrate on all those amateur radio topics that do not depend upon a huge bank balance to buy the latest piece of expensive factory made kit! The hobby has a huge range of interests and there is plenty of space here for stalls and displays on a huge variety of themes. The date is a week later in the radio year which I hope will avoid some of the worse clashes! Please spread the word and encourage anybody who would like a stall to get in touch. G3PCJ