"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

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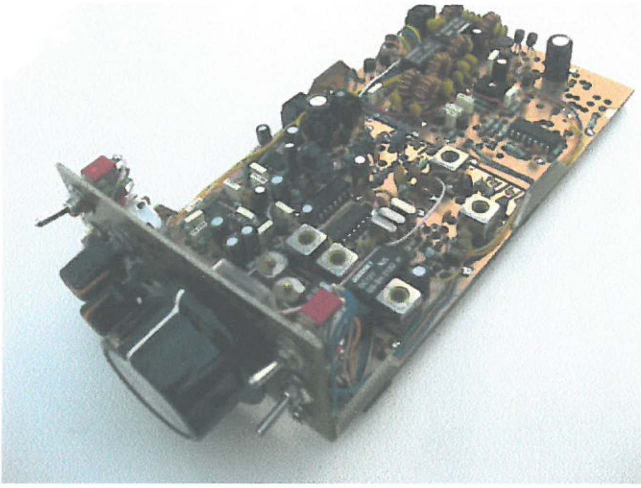
Editorial

There has been some debate in amateur radio circles recently about where the hobby is heading! Pretty contentious stuff and I hesitate to join in! On the one hand we have Peter Cochrane suggesting in Radcom (Feb & March 2014) that the hobby is lacking an adventurous spirit with fantastic opportunity to be had by using the huge untapped potential of ultra high RF frequencies and the power of modern computing engines to achieve extraordinary filter performance which is behind spread spectrum technology. This is the view of a professional electronic engineer but who was inspired to enter the field by his early experience with amateur radio. At the other end we have people who like doing things with their hands, who don't have all the skills to design modern high tech kit but who do enjoy using it, and are also able to use their more 'mechanical' skills associated with antennas and the like. There is another large group who love restoring, and keeping working, much older equipment - often with glowing things! So where does the kit builder come into this picture – I am bound to say 'right in the middle'!! It is an unavoidable truth that the world is fundamentally analogue, and most of the signal processing techniques that underpin radio technology are also essentially analogue. The projects offered by nearly all the world's kit suppliers, are mostly 'analogue' and hence they offer that fundamental understanding of how radio communication works. These simpler 'analogue' radios can be understood, built and altered, without having a degree in advanced signal processing! This is not to decry or deny the many advantages that computing can bring to the hobby in multiple ways – be it in operating convenience, or in the actual radio technology. Commercial radio equipment (made in quantity, will increasingly use these computer techniques for advanced signal processing, but for those who want to understand the basics and conduct simple experiments, the world remains basically analogue! Tim G3PCJ

Kit Developments

Sales of Minsters are starting to happen! Meanwhile the Marsh and the Mells (right) are working and about to be put on my website. The Marsh is a three band DC RX with a proper VFO that also drives the Mells CW TX. Let me know if you are interested in building an early model.



Meanwhile, with encouragement from Steve Hartley G0FUW, I am working up the Rode and Rudge aimed at Buildathon events/constructors. These are a simple phone superhet RX and TX with relay switching and an IF of 10 MHz to make the VFO easier for any band of 20, 40 and 80m. Tim

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"Roaring Mick" 80m Transmitter by Peter Thornton

At first glimpse a "Mickey Mouse" transmitter – but this mouse roars!

Please let me introduce "Roaring Mick", a design by W9SCH, Charles Rockey* - one of the most capable, no-nonsense radio amateurs ever. Initially, "Roaring Mick" looks like a keyed oscillator transmitter, which we're told is completely unacceptable on today's HF bands. Don't be fooled; "Roaring Mick" has some very subtle design features which make "Mick" ideal for the service I have in mind.

Before I explain why I'm working with "Roaring Mick", let's run through the design to see the subtleties W9SCH implemented. Take a look at the winding details of L1 and L2, the grid and anode coils. L1 is twice the turns of L2; yet both the parallel tuning capacitors are similar values. The grid circuit resonates at *half* the frequency of the anode tuned circuit.

Similar calculations for the anode show tuning for 80m; but how is the frequency doubling achieved, grid to anode? W9SCH's first trick: the oscillator section uses the screen grid as a virtual anode - note how the screen grid is connected directly to the B+ rail, no resistor or decoupling capacitor. His second trick: he sets up the half frequency VFO with a tuned circuit of special characteristics. Note too the resonating capacitor is large compared to the valve and stray capacitances; the VFO is, therefore, stable, as the very high C to L ratio swamps the drift causing strays, and high C:L ratios create high Q as capacitors are much less "lossy" than inductors.

The electrons flowing from the cathode to the screen grid and anode pass through the control grid but the flow is non-linear as the control grid acts as a virtual anode. When the control grid swings positive during oscillation, electrons flow from the cathode to the control grid, setting up a voltage drop across the 100k grid resistor and the 47pF capacitor auto-biasing the grid negative. This rectification causes a non-linear anode current - perfect for doubling in the anode tuned circuit. Since the coupling between the grid and the anode is purely by the electrons, there is NO interaction between the control grid and the anode circuit – perfect isolation plus power gain. Now we have 80m power in the anode, the link winding L3 feeds the antenna.

Why did I choose to build "Roaring Mick"? I need a robust transmitter as a test bed; and "Roaring Mick" will withstand gross mismatches, dead shorts, indeed, any amount of abuse an experimenter could cause. The experiments I want to run include:

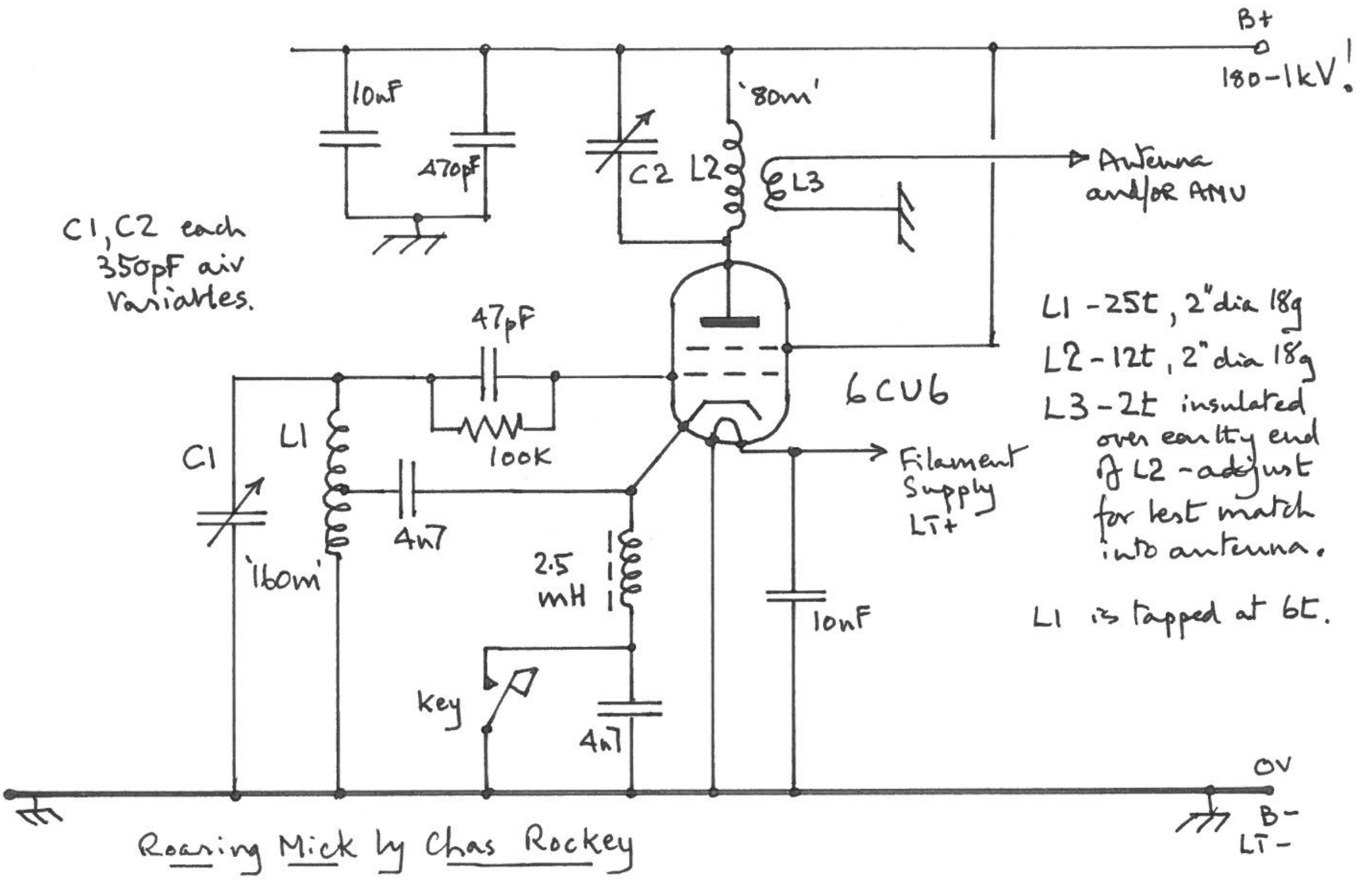
- Make the simplest, cheapest, "bomb proof" and safe 80m transmitter to drive *any* antenna and survive *any* fault conditions without damage
- Eliminate ALL variable capacitors as they are as rare as hen's teeth
- Adapt "Roaring Mick" for EL34's - probably the best beam tetrode ever made
- As far as possible "home made" using items readily available and cheap parts
- Test if a simple VFO is adequate for 80m service, CW and AM
- Adapt a ceramic resonator to run in a valve "VFO" oscillator without over-heating or damage
- Run A.M. phone using a MOSFET for cathode "efficiency" modulation

- Design the cheapest, safest power supply to run "Roaring Mick" to at least 50W output

I am hoping to give you my version of "Roaring Mick" in due course in a later Hot Iron!

* Chas Rockey W9SCH is unfortunately recently SK. His designs are no-nonsense with subtle electronics; he had great respect for radio engineers of bygone days, who had none of the technology we take for granted. He sent signals across continents and oceans with the simplest equipment, including.... tuned bedsprings. Now that's amateur radio!

This is the original W9SCH circuit:-



Peter has set himself some pretty challenging objectives! The avoidance of air variables is tough! He has a scheme for the anode adjustable inductor but I await with interest the VFO variable inductor! It is hard enough to make a fixed value stable L, but this task is much worse because it involves some mechanics usually! There would be a strong case for a 2 MHz ceramic resonator in the grid (VFO) position but pulling them down far enough for the AM usual frequencies might also be a bit too far! My own intentions to do some valve project starting with a regen RX have come to a temporary halt owing to the output stage transformer problem. I suppose I shall have to reconcile myself to using a small mains transformer instead – but any transformer with iron in it goes against the financial grain! Some would suggest using a semiconductor output stage like a LM380 or 386 but they don't glow! Enough rambling, too many other interesting ideas for the present – Tim G3PCJ

The Super FiveFET

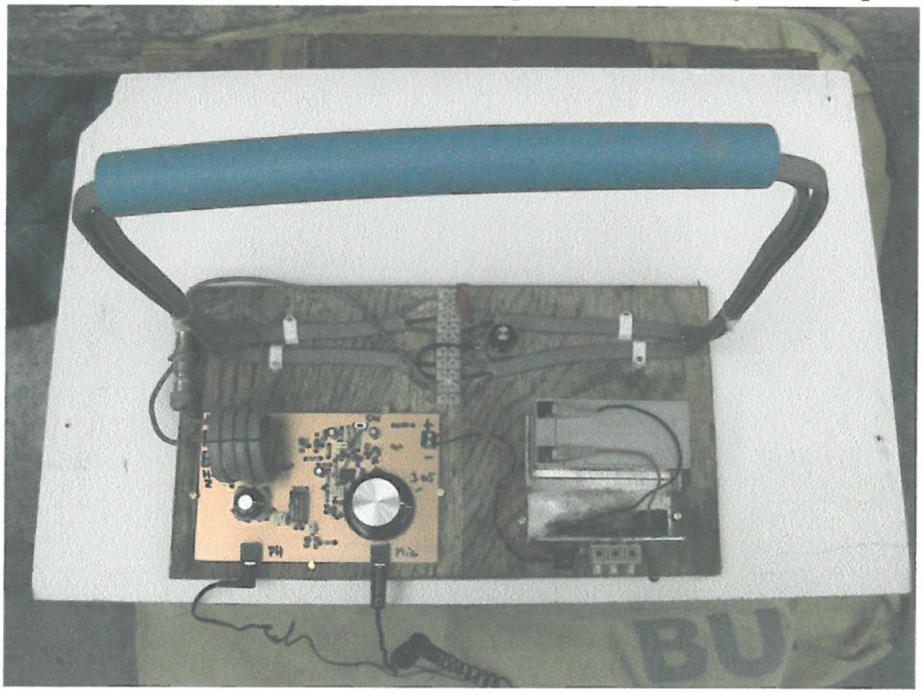
Ian DJ0HF/G3ULO has sent along some comments and suggestions – "I know that you consider the FiveFET an entry level Regen receiver but it impressed me not just with it's sensitivity but also how stable the oscillator was when confronted with strong SSB or CW stations. Most Regens tend to pull resulting in distortion on SSB and chirp on CW unless you attenuate the input signal but this effect is almost absent with the FiveFET. Also the coils are simple single winding coils. On that basis I decided to add coils for 5 bands 80/60/40/30/20 and see what else might be covered by accident in the way of broadcast bands etc. A quick check with a freq/LC program indicated that the coverage could be quite good.

I used simple chokes (from China) as the extra coils with a band-switch; the coverage then became 3.4 - 4.3 MHz with 15uH for 80M, 4.9 – 6.25 MHz with 6.8uH for 60M, 5.7 – 7.3 MHz with 5.0uH for 40M, 8.2 – 10.5 MHz with 2.5uH for 30M and 11.7 – 15.2 MHz with 1.1uH for 20M. So it has almost continuous coverage from 3.4 to 15.2 with a few small gaps. I could probably have added 160M but haven't done so.

I put the board in a plastic case and mounted the controls on the front including the Band switch, plus some other additions in the form of a Fine tune, Fine Regen control (very useful) and a pot in the antenna input as an RF gain. I put a photo on my website at www.spencerworld.com/Ian_and_Julie/Hobbies/Amateur_Radio/FiveFet_Regen/fivefet_regen.html As you can gather, what started out as a simple receiver to show my Grandson has developed into what I consider to be a really useful little receiver!"

The Wick or Mark!

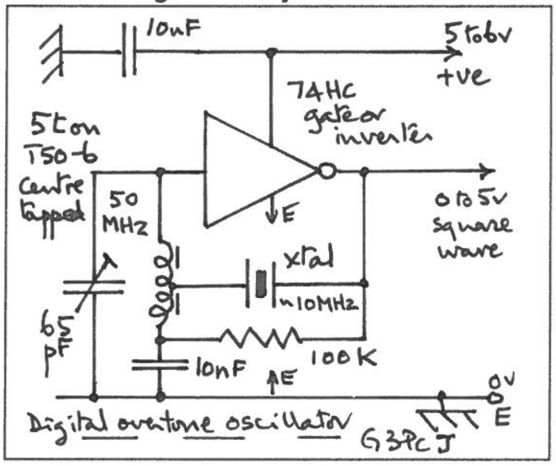
In the last Hot Iron I mistakenly called the Wick a Mark at the top of the note about it! For the Yeovil ARC QRP event at Sherborne, this year I put the Wick on a wooden board and was able to demonstrate it across the hall to a Brendon! Both are double sideband suppressed carrier phone TCVRs and both were using 80m loop aerials! The photo below maybe a bit poor but it shows the Wick with a loop aerial made of two complete turns of semi-rigid 1 mm mains triple and earth cable. They are threaded through the piece of pipe to form a carrying handle. The wires are connected with a chocolate block, using one wire turn for the low Z input from the Wick. Only five turns in series were needed for the main loop (resonated by a PolyVaricon) due to the high inter-wire capacity of the mains cable. G3PCJ



6m CW overtone TX

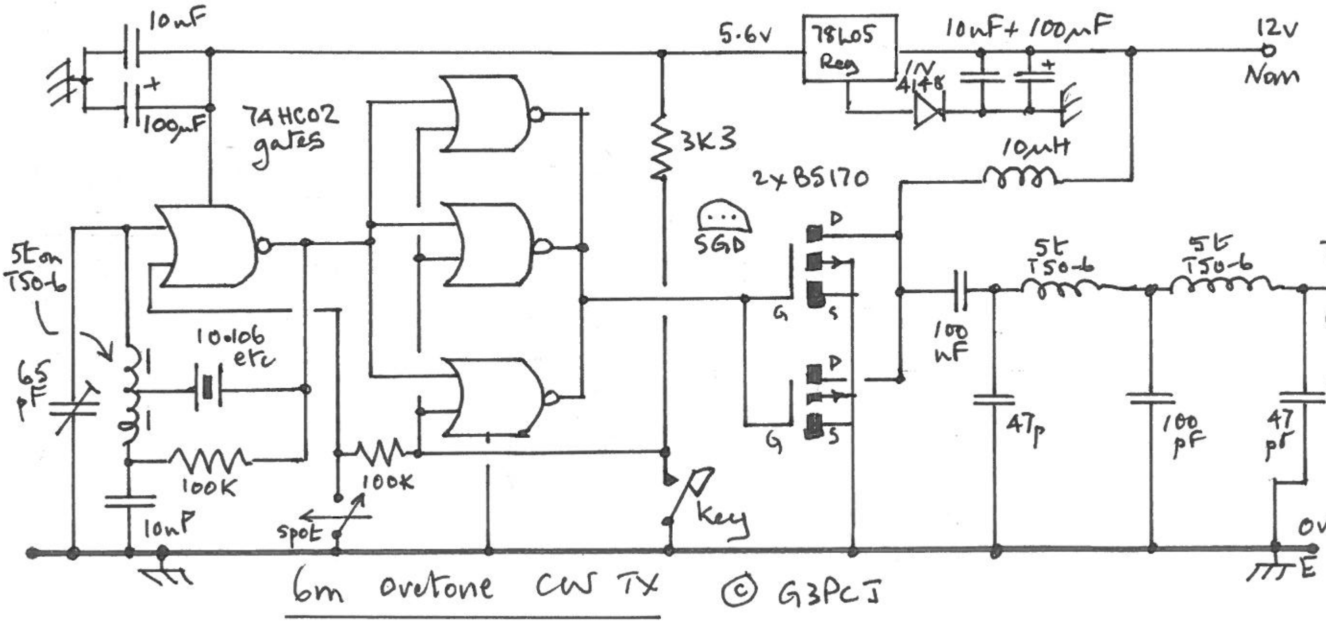
Over the years I have tried several ways of generating signals for 6m – I have to admit with only mixed success! Last year Peter Thornton pointed out to me that the fifth harmonic of the usual 30m QRP crystal on 10.106 MHz gives 50.53 MHz which is a good spot on 6m for all sorts of modes. One might also try pulling an ordinary 10 MHz crystal up a bit for CW! This led us both into overtone oscillators which I have always felt to be a bit of a black art; meanwhile Peter had a 6m overtone oscillator circuit that refused to work on any overtone for me!

So back to basic oscillator and crystal circuit ideas! At the back of my mind was the intention to drive the TX output stage digitally from 74HC gates which will just work on 70 MHz, especially if the supply is increased by a volt to two above the normal 5 volts. The crystal has to be in the oscillator feedback path and will exhibit low impedance (or pass signals) at its fundamental and odd harmonics. So how does one reduce the gain away from the desired harmonic? Often this is done by plain impedance loading of the crystal but that's the bit that seemed risky (or the black art) to me! Better to have a conventional resonant circuit tuned to the desired harmonic. Not as hard as you might expect with a plain inverting 74HC series gate! To avoid the tuned circuit interfering too much with the crystal, the latter is connected to a tap about a third to half way up the inductor. The DC feedback to ensure the gate amplifies in its 'linear' transition region is best applied to the earthy end of the coil to avoid the feedback resistor loading the tuned circuit. With care the 30m QRP crystals will run at 6 or 4m but layout does need to be good!



Using this approach in a 'digital' CW TX is straight forward (again with good layout)! One quad NOR gate of a 74HC02 can be the oscillator, with the other three driving a pair of BS170 MOSFETs, it will produce just over a Watt on 6m. The twin pi half wave filter gets rid of any harmonics and you could even contemplate amplitude modulation if that takes your fancy. The main parts of a CW TX are shown below but I leave the TR and sidetone for your creation!

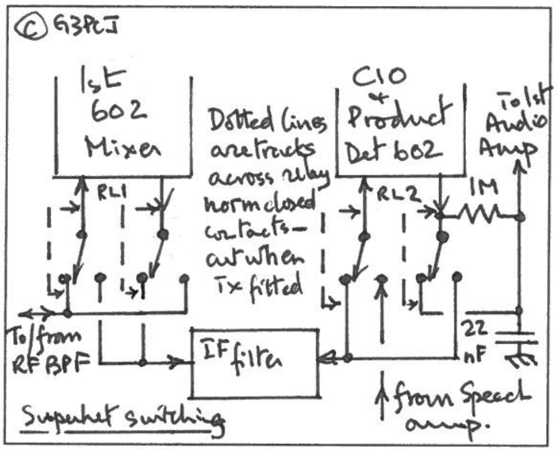
What RX could one use with this? AM will be easy with a regen and, if built well, might be stable enough. DC and Superhet RXs need something more advanced but one might be able to use the same gate oscillator to also drive a receive mixer. The question is then how to pull it a whisker for a beat note etc! I have not attempted that yet – suggestions please! Tim G3PCJ



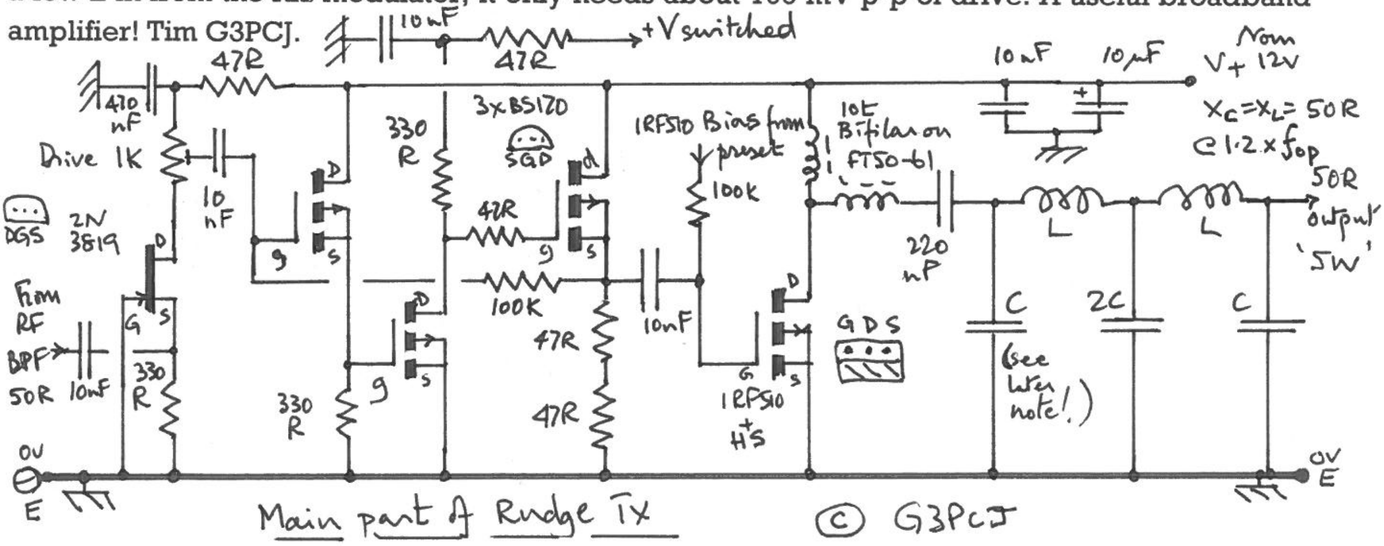
The Rode and Rudge

Steve Hartley has requested an easy build simple 20m superhet RX for his Buildathon events. My usual 6 MHz IF makes 20m not too difficult with an 8 MHz VFO; but 40m is hard because it needs either 1 or 13 MHz for the VFO. Thirteen is too high for good stability and 1 is too low for an easy VFO inductor! Hence we need another integer MHz intermediate frequency that can avoid these; using a 10 MHz IF needs 4, 3 and 5.5 MHz VFO for 20, 40 and 80m. These are the important bands and the lack of 30m can be tolerated when most interest is likely to be on phone. Richard Booth kindly made some suggestions for a four crystal IF filter which has been successfully tried by Philip Lock, so we have the makings of a new simple superhet RX.

While Steve's constructors might not get round to also tackling a TX on the same day, it would be nice to have a matching SSB TX provided it does not complicate the RX design. So I have suggested using relay switching of inputs/outputs of the two mixers, instead of the 4066 electronic switches that I use in other designs like Lydford and Minster. It is easy to add the tracks for these and include a shorting track across the normally closed contacts so that the RX would work without the relays being actually present. Those tracks would be cut when the relays are added as part of the TX construction stage! See this concept of the Rhode RX above!



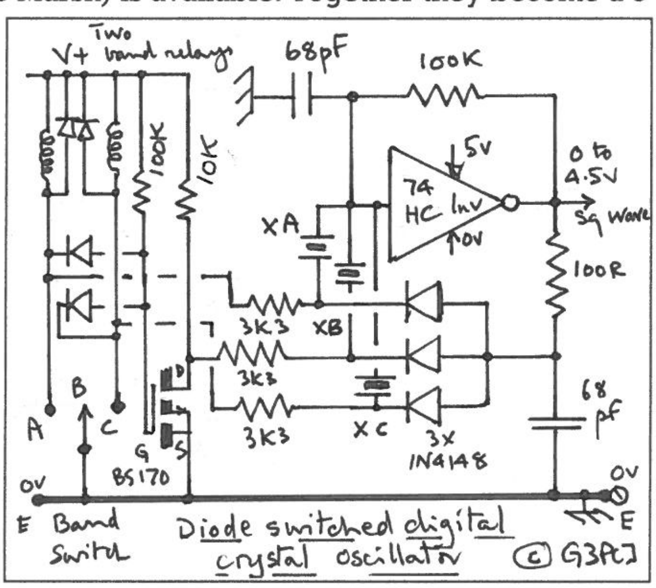
The Rudge TX PCB would have the speech amp, and all of the normal RF amp chain and transmit low pass filters (for any single band 20 – 80m), with its RF drive normally coming from the RX generating SSB on transmit. Interestingly, this only needs a 602 style mixer or modulator (as an alternative RF source) to make it into a simple double sideband suppressed carrier phone TX that might go with the Yeo or FiveFET simple RXs. Hence the need to keep the Rudge TX circuit simple to allow space for the optional 602 modulator. I had planned to use a high speed op-amp in the TX strip but three BS170 discretes both cost less and need less space! This TX amp is a development of my standard self biasing MOSFET pair that is so adaptable! By adding a buffer stage on its output it has good gain, a high Zin and a Low Zout. It easily drives the 150 pF capacitance of an IRF510 5W output stage on 20m; and when a grounded gate JFET is added for a low Z in from the RX/modulator, it only needs about 100 mV p-p of drive. A useful broadband amplifier! Tim G3PCJ.



The Marsh and Mells

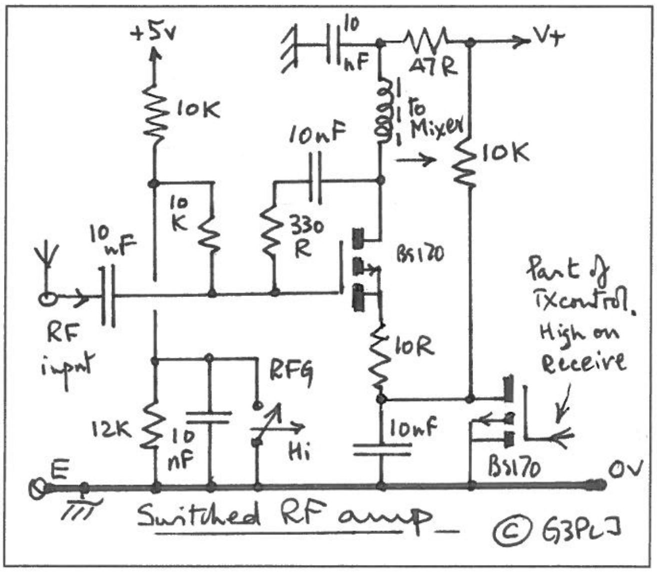
Last time I floated some ideas for a new multi-band DC CW TCVR. The RX is now called the Marsh, and the matching TX is the Mells (photo on front page). The frequency scheme for the RX is a 2 MHz nominal VFO which is subtracted from band crystals of 5.5, 9, 12 and 16 for the 80 – 20m bands. The rig can be built for any three of these bands. The low VFO frequency gives excellent atbility. The RX has a low gain RF amp to prevent LO radiation and is flowed by a product detector using a pair of 74HC4066 switches to drive into a low Z audio amp, which is followed by conventional audio filters and output stage. Owing to the use of this strong type of mixer, it is expected that with just your good AMU, there is unlikely to be any sign of BCI – this saves the nasty complications of having to also switch a set of receiving bandpass filters. So band switching, by relays, only has to alter the inductor and capacitor combinations in the LO filters that follow the dual JFET LO mixer. After these filters the LO is squared up for driving the product detector and any associated transmitter.

The Mells 1.5W CW TX is basically a crystal controlled TX but with the ability to be externally driven if a suitable LO source (like the Marsh) is available. Together they become a 3 band CW TCVR with full break in TR control. The Mells (with three crystals) might alternatively be used when paired with the three band Mark regen RX. The sketch right shows the method of switching crystals in the Mells' oscillator stage – it is slightly different to the normal method of diode crystal selection but is a more dependable circuit. The diodes associated with each crystal are turned on when the band relays (to select the relevant LPFs) are grounded so the extra BS170 detects the middle band when no relays are activated.



If necessary, the Mells can be used in single band form with one of the LPF relays instead acting as TR relay.

The Marsh does not need a TR relay because its RF amp can be switched off by taking the input BS170 MOSFET source to the supply voltage under control from the TX. The Marsh has a Fine/RIT control for selecting reception sideband and adjusting the beat note after the main tuning is adjusted to zero-beat the other station. On pressing the key, the Mells' controls automatically remove this small tuning offset to make it transmit on the other station's frequency. I would like an early builder or two for the Marsh/Mells combination – let me know if you are interested please. Tim G3PCJ



Snippets

Linear experiments Paul Coddington has done a little more work trying out the VHF versions of the RD06 MOSFETs made by Mitsubishi. His previous info was with the HF versions. He appears to now have over 10W from the standard 10W Linear to over 30 MHz with about the same gain as at HF; however there are some uncertainties about the response of the harmonic filter(s) that he has been using – they may have had a corner frequency a bit too close to the 10m band edge! He plans more experiments when other matters allow more time! We await a report!

IRF510s and half wave filters The recent experiments with a new design of TX driver for the Rudge's IRF510 output stage, threw up a design point that I have overlooked - MOSFETs do have significant inter-electrode capacitances. The more powerful the device, the larger these are. For an IRF510, the usual concern is ability of the driver to move the 150 - 200 pF of the gate fast enough; I had forgotten the drain output capacitance which is typically about 100 pF when using a 12 volt supply! In a TX with a tuned output matching network, when tuning for maximum smoke, one automatically compensates for this effect – but not so with half wave filters. You need to reduce the first filter cap (nearest the IRF510) by about 100 pF if it is directly connected without any RF transformers for 1.5W out. With a 1:2 transformer for 5W out, the reduction required should be less but, experimentally, I still find that a first 20m filter cap of only 100 pF instead of the ideal 200 pF lifts the output appreciably (without worse harmonic output). It also calms the driver circuit greatly – less nasty squiggles! This could be changed on 20m Lydfords.

Windings in parallel Peter Thornton highlighted his bad experience years ago when paralleling two nominally same voltage windings on a mains transformer in order to extract more current than either winding could supply alone. During a soak test, the transformer became seriously hot **without** any load! It turns out that traditional transformers made with E and I laminations, seldom have identical output voltages from the same number of turns – this can lead to high circulating currents (and much heat) from even small differences in output voltage! Apparently the modern ones are often bifilar wound with much less variation between windings and can thus be paralleled! If in any doubt, test with a 60W bulb in series with mains input to prevent any damage from high circulating currents. The problem does not usually affect toroidal transformers.

***Mark** 3 band Regen* To fill a little space, this is what it looks like! It can be used with three band crystallised Mells TX!

Subscriptions!

It is that time of year again! Hot Iron is a quarterly newsletter for members of the Construction Club, published by Walford Electronics. This coming year, the fee is held at £8 for UK members and £10 for overseas. The year starts on Sept 1st 2014 but for anybody starting part way through the year, back issues will be sent as required. To keep it interesting, please let me have any questions, notes, ideas or suggestions for articles etc etc.. I need your contributions to make it interesting for everybody else! Copyright is retained by me, Tim Walford G3PCJ, unless specifically noted otherwise.