"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

Winter 2010
Issue 70

Contents

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

Editorial

For a while now I have been sending Hot Iron to Bill Meara N2CQR - he produces a regular blog which goes under the name of Soldersmoke - Global Adventures in Wireless Electronics. Every month or so he recounts his amateur radio activities and thoughts in an audio report lasting up to an hour - he has been kind enough to give Hot Iron several mentions and I can thoroughly recommend listening to his soothing tones, especially while hunting for some vital microscopic part that has fallen on the floor! Apart from his regular blog, there are now all sorts of subsidiary groups and items of interest - well worth a visit http://www.soldersmoke.com

Imagine my concern though when listening to the latest, to find that Bill nearly had an incident on the New York subway, when the lady sitting next to him on the train, noticed what he was reading and thought that Hot Iron was some sort of very different magazine! I just hope that the name is not putting off people on this side of the pond!

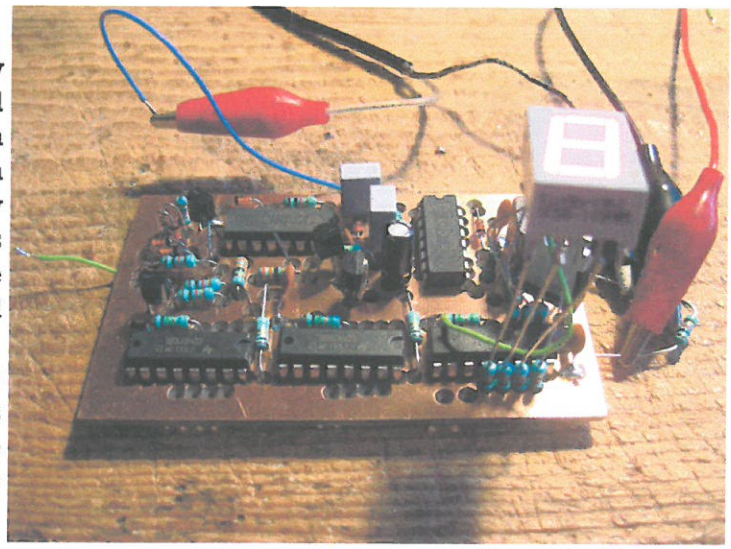
A reminder - note the date for next year now - QRPiC 2011 here at the farm on Jul 17th! I have some special guests coming! Do encourage your local Clubs to bring a stand.

Meanwhile, I wish you all a very Happy Christmas and good luck with whatever radio project takes your fancy! Tim G3PCJ

Kit Developments

The **Yeo** entry level DC RX is now available after a positive reception by Yeovil ARS. It does any band 20 - 80m with its own PP3 holder and a small LS! Much more than a toy! The **Radlet** unique CW trainer is also now available after trials by Andy Howgate. Details of both these kits are now on the website. The **Tone** 80m phone superhet and its associated **Parrett** TX have been reviewed in PW.

The most recent addition is a new **3 Digit** Kilohertz counter - the MHz numbers disappear left out of sight. Up or down to 60MHz. Suits my superhets. Undergoing tests right with just one of the 3 displays! 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

Saturn DC Receiver by Richard Booth G0TTL

Once you have finished eating all the mince pies, watched the Doctor Who special and completed building your latest Walford Electronics kit what you need is an excuse to go and find the radio bench. That way you can avoid watching more repeats on the telly or worse still, the omnibus edition of East Enders. DIY dentistry with a Dremel and Stillson wrench appeals more to me than that prospect...

Saturn. It has rings. Well this little receiver does too! A double balanced diode ring mixer is the heart of this project, which is a direct conversion receiver for the lower HF bands. It will work quite well up to 20M and you only need to alter the VFO and RF amplifier resonating components to make it work on your band of choice. The version presented here is for 80M which is always a good starting point. In recent years the prices for SBL-1 and the clone HPF505-X ring mixer have dropped dramatically and they can often be found for a few pounds on eBay. So having bought a load of them I thought it would be a good idea to make use of a few and hence the Saturn project came about.

To follow the norm, here is the circuit description. The antenna input is coupled to Q1, a grounded gate FET amplifier which is tuned to the band in use by the resonant circuit of C2, C13 and L2. The inductor is an off the shelf, ready made RF type of the sort that looks like a fat resistor. This gives good front end gain with a relatively high Q factor which helps to reject out of band signals. Q2 is set up as a unity gain buffer so that the low impedance input of the diode ring mixer does not load the RF amplifier stage. The VFO needs to develop a hefty sine wave of around 2V PP to drive a ring mixer of this type effectively. So in order to do this and maintain stability a two stage Colpitts style oscillator is used. The first part Q3 is a traditional 2N3819 oscillator with course and fine tuning (using a reverse biased red LED) as a varactor. Main tuning is by the variable 75pf capacitor connected in parallel with L1, the only hand wound inductor used in the Saturn. A T68-2 core is used for this purpose. Q4 is a voltage amplifier, using a J310 FET. This type was chosen over the 2N3819 as it has higher operating parameters and in practice just seemed to work better. Certainly looking at the VFO output on the oscilloscope it appears far cleaner with a J310 - 2V PP easily achieved. The VFO carrier is mixed with the RF input in the SBL1, with the resulting very low level audio frequency product generated at the output ports of the mixer. In order for the product detector to operate efficiently it needs to be terminated at an impedance of 50R in the audio spectrum. R11, C20 and C19 achieve this and help to reduce the audio bandwidth to something better suited to SSB reception. Q5 and Q6 operate as a bipolar variable gain voltage amplifier. Dynamic range is the key here, and hence the reason why a dual gang pot is used for the volume control. This avoids overloading of the audio stage with strong signals, due to the amplifier gain being lowered as the volume control is turned down. In practice this is much smoother and gives a big reduction in AF noise which you would normally get with such a potentially high gain stage. If a single gang pot is used the amplifier stage would have to be at full gain all the time, and under strong signal conditions this makes the receiver very noisy. The final audio amplifier is the plug it in and forget it LM380N-8 which needs no explanation. DC supplies to the VFO are regulated by an LM317LZ.

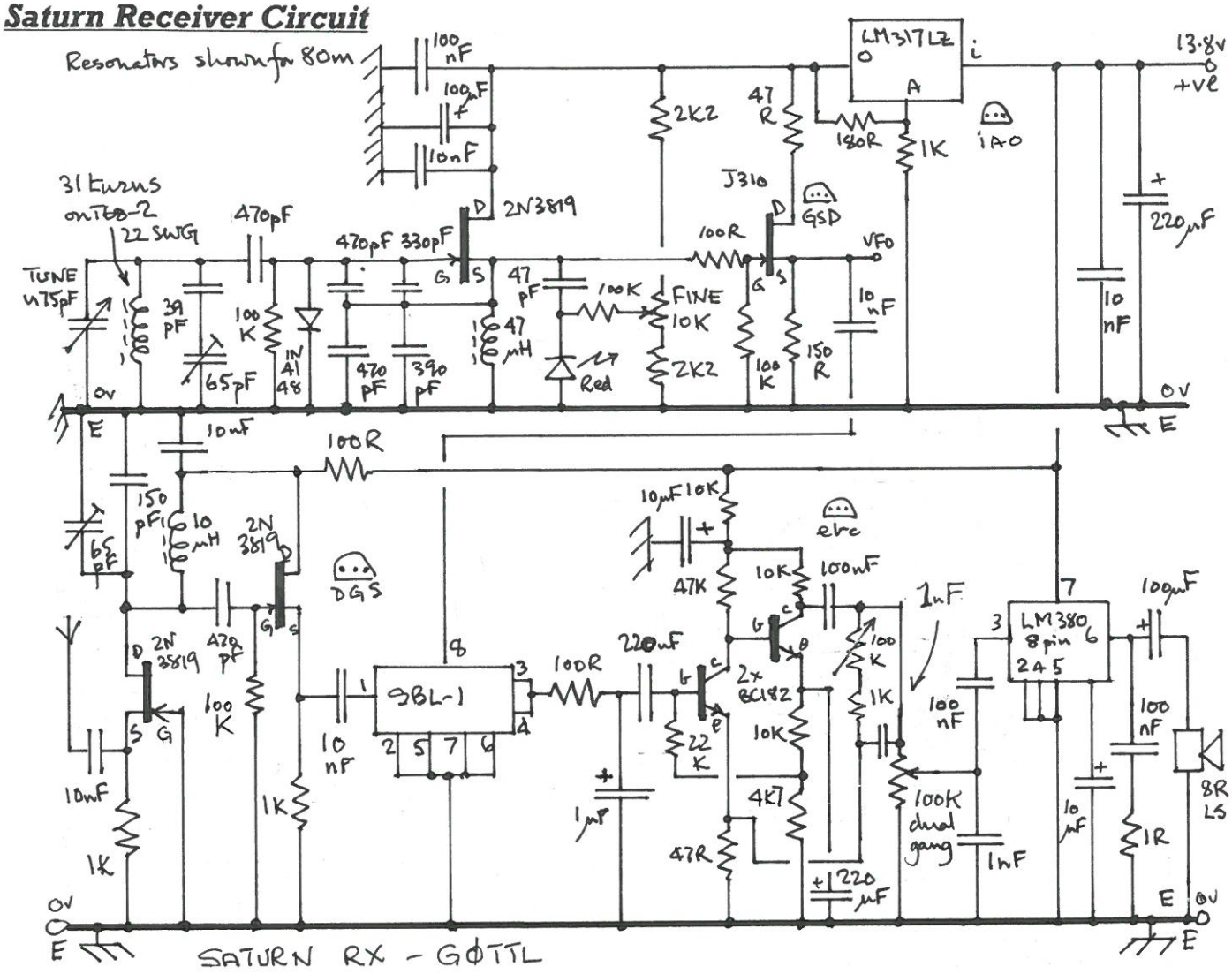
Construction is straightforward and the layout non critical, although I would take care with the audio amplifier stages and use screened connecting wires to the volume control pot. The dual gang 100K is available from Maplin. Everything else is available from Rapid Electronics bar the diode mixer which you will need to hunt around for. For the grand total of two 1st class "Large" stamps I will send you complete construction details including PCB layouts and artwork for the Saturn. This also includes details for operation on other bands. Ready made PCB's and components are also available on request.

There you go, a proper Christmas project. I hope you decide to have a go at building this little receiver which I think gives excellent audio quality coupled with a robust front end. I hope you have a very happy Christmas and all the best for 2011!

Richard Booth G0TTL School House, Old School Lane, Wadworth, Doncaster DN11 9BW

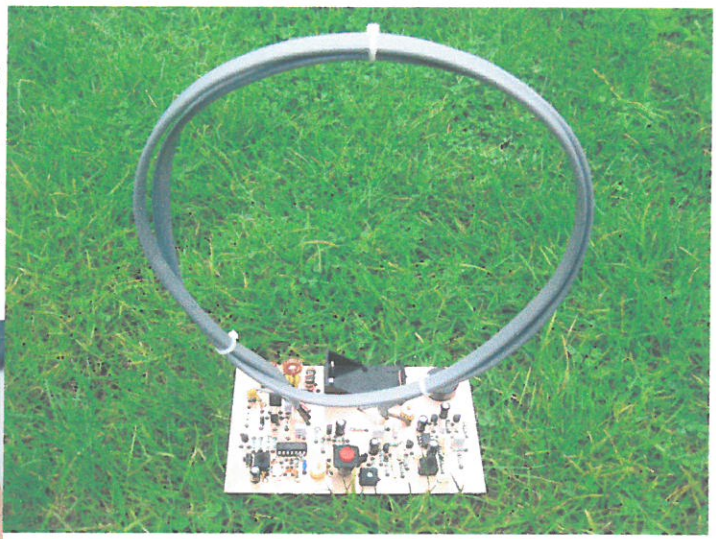
Circuit details for 80m on next page - G3PCJ

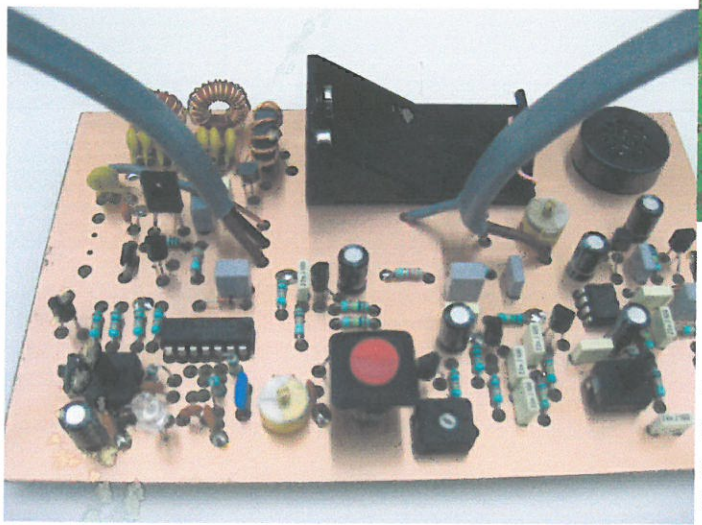
Saturn Receiver Circuit

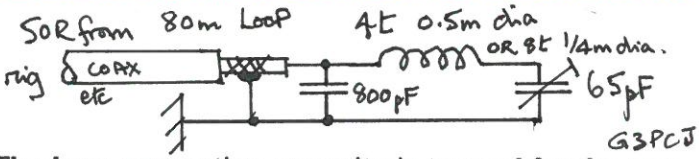


The Radlet

Here is what the final version looks like with its 80m loop aerial when extra small! The actual loop is made from four core mains (fixed) wiring cable, with the four wires connected in series. The loop makes a convenient carrying handle and should be good for local contacts! It is better when arranged as a single loop of 0.5 metre wide.







The loop resonating capacity is tapped for the normal 50R feed from TCVR. The PCB has a small speaker, push button for key, with presets for AFG and RIT. Normally 80m but with xtal to 20m. G3PCJ

My Ideal RX

Andrew wants help in achieving his ideal RX! (I regret I had to edit this down a bit - Tim):-
In a few months time I am hoping be on my travels again and this time the planned destination is Dubai. Hitherto I have had little time for amateur radio whilst on the move, but this time things will be different. The one thing that I do not possess (and would dearly like to make for myself) is a small portable receiver covering the entire HF region. Providing that I have AM, SSB and CW reception, then I would be perfectly happy. Ideally, this will be powered from either a 9v battery, with excellent selectivity & sensitivity, and sufficient output for a small pair of headphones.

I have a redundant DDS VFO that does 1 Hz steps to over 40 MHz. What about having this drive a low parts count NE602 DC RX with an LM386 audio stage? (Snag - no Am capability!) Most of my earlier projects have been single band but I have not tackled anything as potentially complex – and I am beginning to feel a little out of my depth.
Any design has to be a compromise, but I want a receiver that will allow me to make a few QSO's whilst the XYL is busy at work. What does the Hot Iron readership say?!! Comments and suggestions to me at **andrew_atkinson@hotmail.com** please.

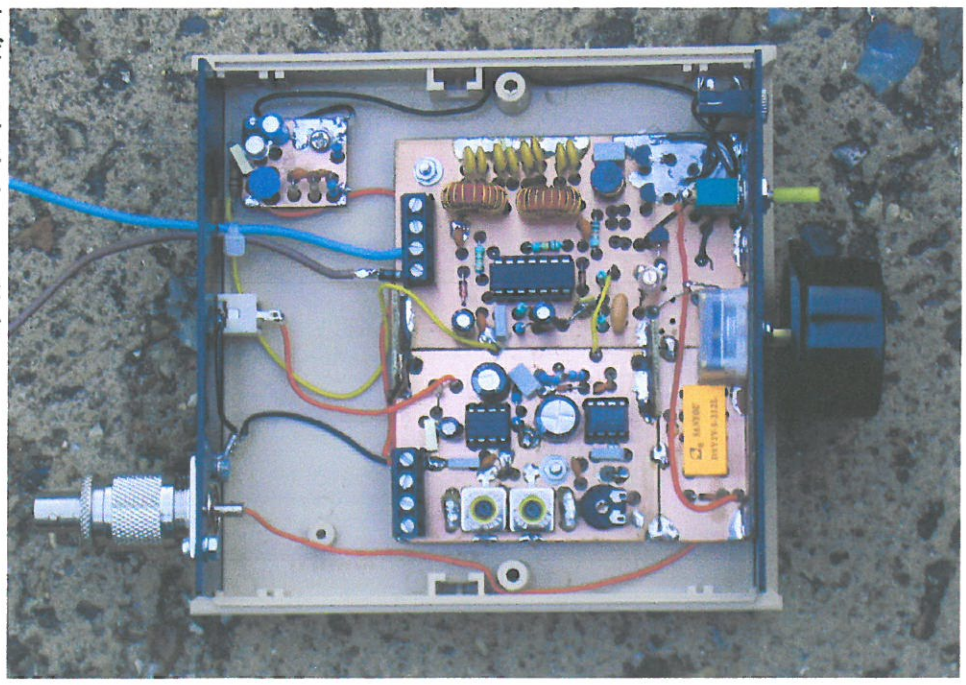
G3PCJ Comments - this is challenging territory for which one normally expects to pay many hundreds of £s!! I would suggest starting with a regen TRF as its easy to change bands (single resonator) has excellent selectivity for the number of parts, is simple and can provide excellent fun certainly up to 20m or even higher with good quality tuning parts. It can also do AM easily and has a very low consumption usually. What's more, it does not need a computer of any form to drive it! If a TX is also wanted, then perhaps the DDS does have a role driving a conventional CW TX. But consider the 'tuning of the filters' required to remove TX harmonics over that wide frequency range! This might need a linear TX to keep harmonics low and hope the AMU removes the rest. If AM reception can be sacrificed, then consider a RX with the DDS driving a strong diode mixer (with very little RF filtering for simplicity - perhaps only that of the AMU) followed by loads of audio gain. Tell us all how you get on Andrew - please!!

Howlette's Heinz 57 TCVR

Andy has been devising a new project which has come to be known as the Heinz 57 rig owing to the many sources from which circuits and ideas have been lifted! The bottom PCB is the DC RX which uses a twin tuned 80m RF BPF followed by a NE602 mixer. The RX PCB is a Howgate special layout. I cant see the VFO but I suspect it is derived from the 80m ceramic resonator in the Kilton TX but with tuning by the PolyVaricon instead of a trimmer. I think the switch operates the preset RIT. The RX audio stage is a LM386 arranged for high gain, with facilities to inject sidetone from the audio oscillator top left. The Kilton TX is almost standard! It produces 1.5W on 13.8 volts and has the circuits for semi-break in TR control of the TR relay bottom right.

Note the reversed supply protective diode in the lower of the two incoming supply wires!

A very neat little project which has given Andy much pleasure in devising.

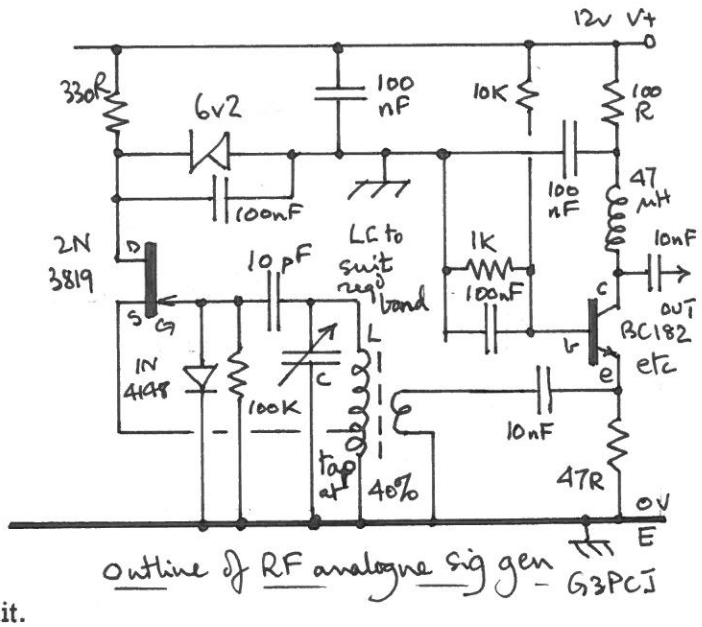


Ideas for Signal Generators

Steve Hartley G0FUV sparked this train of thought by saying he needed a source suitable for testing and setting up rigs at his forthcoming Buildathon; this is expected to be based on the Tone superhet RX (with 6 MHz IF) RX but adapted for 20m. The important thing is to understand what the 'source' is to be used for - at one extreme you might need an output level of a few volts into 50R for driving diode mixers, maybe with very high frequency stability for extensive tests over any frequency from say 100 KHz up to low UHF! That sort of spec is the realm of professional test gear which can sometimes be bought second hand but the drawback is that it often weighs half a hundred-weight! For Steve's purpose something much simpler can be used; restricted in frequency range to perhaps 10 or 20 MHz on the fundamental, with much lower level outputs that would suit direct connection to a working typical kit RX say 50 /uV RMS (or about S9 or –73 dBm). Good stability is desirable but a wander of 50 or even 500 Hz in 10 minutes is not going to matter because the tuning controls are often being readjusted for different tests.

Traditionally the oscillator would be analogue. It is desirable to keep the number of frequency ranges to a minimum to keep the switching simple, which implies a wide range on each setting leading to the need for a second FINE tuning control. A Hartley configuration for the oscillator is usually best as this does not require any feedback capacitors that would add appreciably to the minimum tuning capacitance. So with luck you can achieve about 2.5:1 frequency change on a single range; but if you need more than one range, then at least two wires to the inductor have to be switched!

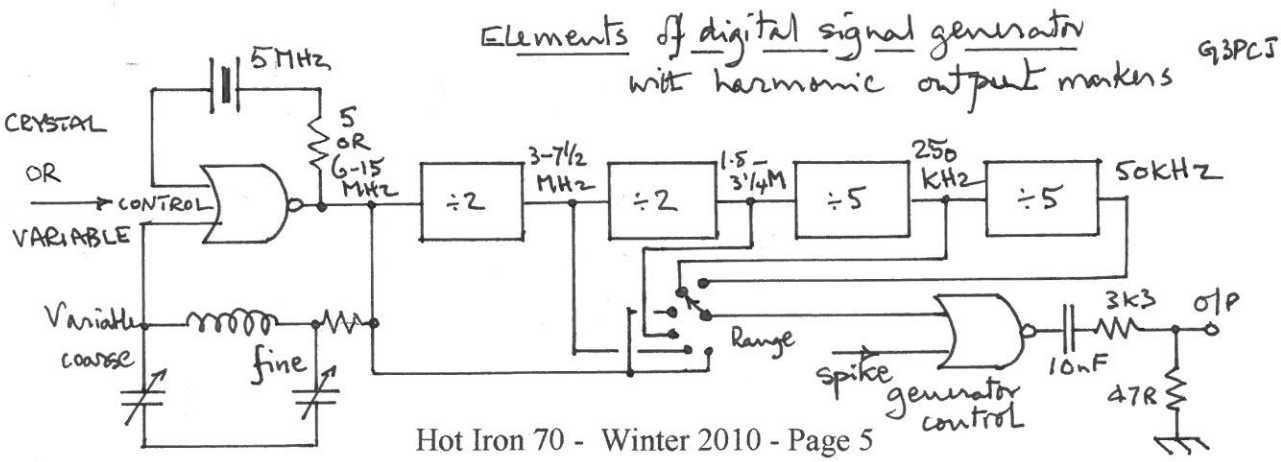
To avoid pulling by load changes, it is best to follow the oscillator by a grounded base stage with its high reverse isolation; and this can often be fed by a small low Z winding on the inductor. But this is another connection that might need switching! See the above outline circuit.



Outline of RF analogue sig gen - G3PCJ

If high stability is not quite so important, then consider a digital oscillator using a CMOS gate. They can work to beyond 50 MHz but for Steve's purpose, an upper limit of 15 MHz is adequate. Such an oscillator will produce a square wave that is rich in odd harmonics so signals would be available for all of the HF bands and higher. Digital dividers can easily be used to provide fundamentals on any lower band. Buffering for load isolation is easy with another gate, and if even harmonics are wanted as well as odd ones, then a spike generator is easily added.

The digital dividers of such a device can also be used to produce accurate RX frequency scale calibration markers - traditionally every 100 KHz. Add a 5 MHz crystal oscillator to the digital Sig Gen, and then it can produce 250 and 50 KHz markers! Very useful! Add a counter and it becomes a serious piece of test gear! I have laid out a PCB based on this approach and will report next time on its success! I have included holes etc for the MHz chips to be controlled by the 3D counter for a 5 digit readout. Prices - about £25 +£25 for the counter. Something like this:- G3PCJ



Rechargeable Batteries!

Last week we suffered yet another outage on our 50Hz supply for about 5 seconds - this is usually due to swans flying along the river into the local 11 kV overhead lines, causing them to clash and go bang! Instead it was my computer that groaned to a halt very quickly - despite the presence of a properly installed Un-interruptible Power Supply (UPS). These UPS usually have a trickled charged gel cell lead acid battery which feeds an inverter when the mains goes off. The inverter had worked for less than 1 second before the UPS shut itself down! Mr Gates cannot turn himself off that quickly!

Dissembling and monitoring of the battery voltage showed that it fell under load from about 12.5 to 10.5v in about 1 second but was quite happy at that level for tens of minutes thereafter! Clearly one cell was useless. A replacement battery was ordered and cured the problem. The old one was about 3 years old. I have often had a suspicion that trickle charging gel cells does them no favours and mentioned this to Andy Howgate. He recounts his experience:-

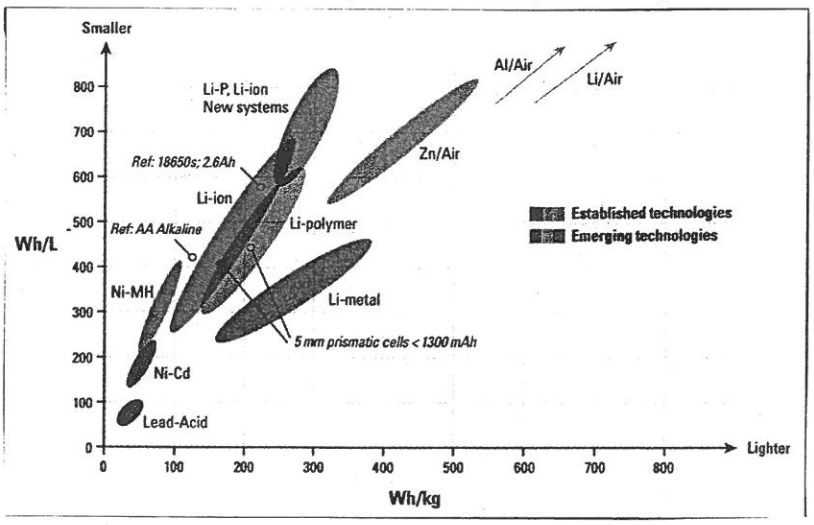
..... darn batteries - the most consistent form of failures in almost everything that uses them. Gel cells are troublesome and when they go low there is so little you can do with them; deep discharge ones are a real pain, I have yet to work out why they struggle to be charged once deeply discharged since they should be able to handle it, whilst car batteries should not handle it too many times when badly discharged but I have found a good car battery appears better and more forgiving. At least the tops can come off and one can empty the acid out and remove sediment and maybe add fresh acid unless the lead has oxidised but often a fresh lot of acid and a hard charge will get them back again.

Amazes me that battery technology has not improved in performance like electronics. Lithium Iron is good in phones and lap tops etc but when they fail, that's it, but they appear fairly resilient till the final failure. Metal hydride - many rave about them but they seem to just have a different characteristic. Having said that, a Nicad if cycled properly and of good quality they will go on for years. My battery operated drill is 10 years old now on its original battery (Ni-cads) but I run it so its discharged to total flat and then re-charge it to full. I never part charge or top it up. The trick is to put a cable tie on the handle so it can hold the trigger in and then run the battery till its dead. A Ni-cad will last years but not so long if its not cycled properly. The Hydride type suffer bad charging practice better but the charge durations and life is shorter and they end up similar to Ni-cads not charged properly. A poor Hydride does not take to being flashed with high current like a Ni-cad so once duff, that's it.

I not sure if discharging gel cells that have been trickled for a long while will do you any favours especially if 3 years old - expect to buy new ones! If you take the risk, you maybe alright, but 3 years is often the duty life for a back up battery in alarm systems so they are replaced just in case by the service companies. Usually the storage capacity has gone even if the voltage reads good.

I am no expert and just talking about my experience!

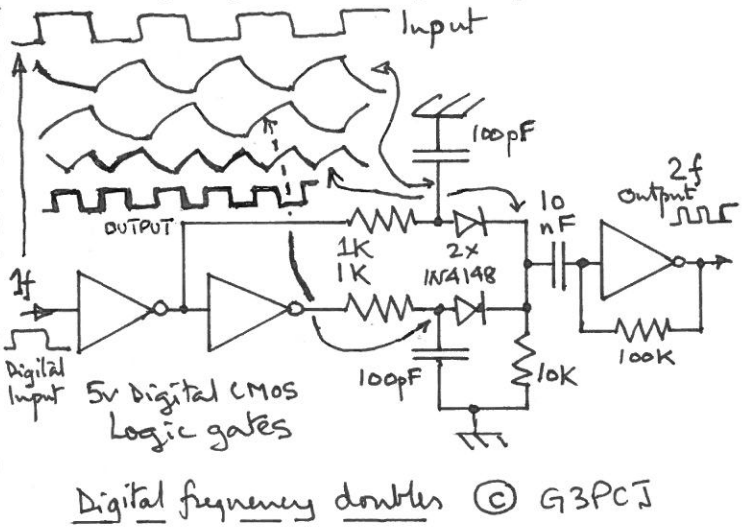
The IET recently had an article questioning whether electric cars would ever become serious alternatives to internal combustion powered versions. It suggested that the range of many small 'saloon' cars would drop from 600+ km down to 150 or perhaps 300 km for the best current offerings, while their weight increased by about 10 - 15%. There is a concern about battery life as it represents a large part of the vehicle's cost and will be far from pocket money to change! There was also a comparison of size versus weight for different chemistries which I hope can be read alongside.



Another intriguing suggestion is that when the new proposed 'smart grid' is in operation, the grid organisers should be able to draw out some of the energy stored in 'charged' vehicle batteries to help them over peaks in 50 Hz demand! This will require a pretty complex 'battery charger' me thinks! Just hope it does not lead to too many instances of only getting halfway to work the next day! What will be your excuse for being late to work?!! G3PCJ

Snippets!

Digital Frequency Doubler This idea might be useful in a signal generator, or possibly in a transmitter chain to avoid chirp caused by pulling of a VFO by TX currents at the same frequency. The intention was to avoid having to wind transformers, which are often used to obtain an anti-phase signal that is then rectified to give two output pulses per input cycle or twice the frequency. If a digital square wave is inverted it looks the same so you need to do something else! If you feed both square waves into an RC circuit to delay their peaks, you can then 'rectify' or 'add' them in a full wave rectifier circuit and pass the output into a further gate for squaring up again. The circuit right works over at least 3:1 frequency range from about 2 MHz up. The output does not always have 1:1 mark space but is at twice the frequency!



Walter Farrer G3ESP Walter was very nearly 91 but died following a fall at his home. He was a very keen radio constructor and experimenter, often making gadgets for demonstration at the Yeovil QRP Convention. I recall that he was one of the first people to realise the potential of ceramic resonators for variable HF oscillators which followed his earlier work on using multiple crystals in parallel to obtain a wider pulling range. Walter always loved explaining his thoughts and was very keen for all to benefit form his ideas - a sad loss for us all.

Capacitor Information Recently I have been searching for 150 pF ceramic capacitors with N150 temperature coefficient that are suitable for use in VFOs. I don't like having to pay about £1 each at the 100 off rate for polystyrene types, instead of the few pence that used to apply when you could obtain the ceramic plate types made by BCE –Sud. My search continues but I found a fascinating website devoted to capacitors http://my.execpc.com/~endlr/index.html Worth a look as there is a wealth of useful information - sadly I cant find the name of the author so I cant credit him with the work! Another site that's useful is from the RF Part Co http://www.rfparts.com/caps.html

Small magnetic loops When devising the loop aerial for the Radlet, I came across this website from Steve Yates AA5TB http://www.aa5tb.com/loop.html Its full of useful information and formulas for designing your own. As ever with any loop aerial, he emphasizes the importance of minimising the losses in the loop itself and the tuning capacitor. Usually it is the sliding contacts of a conventional air variable capacitor that is the worse culprit - a partial solution to this is to use a dual section air variable whose nominal max capacity is twice the value that you expect to need. You then connect one side of the loop to one of the fixed vane terminals, and the other end of the loop to the other fixed vane terminal. By leaving the frame and moving vane shaft contacts electrically floating , you are not including them in the loop because only the more electrically conducting solid shaft forms the link between the two halves of the overall capacitor.

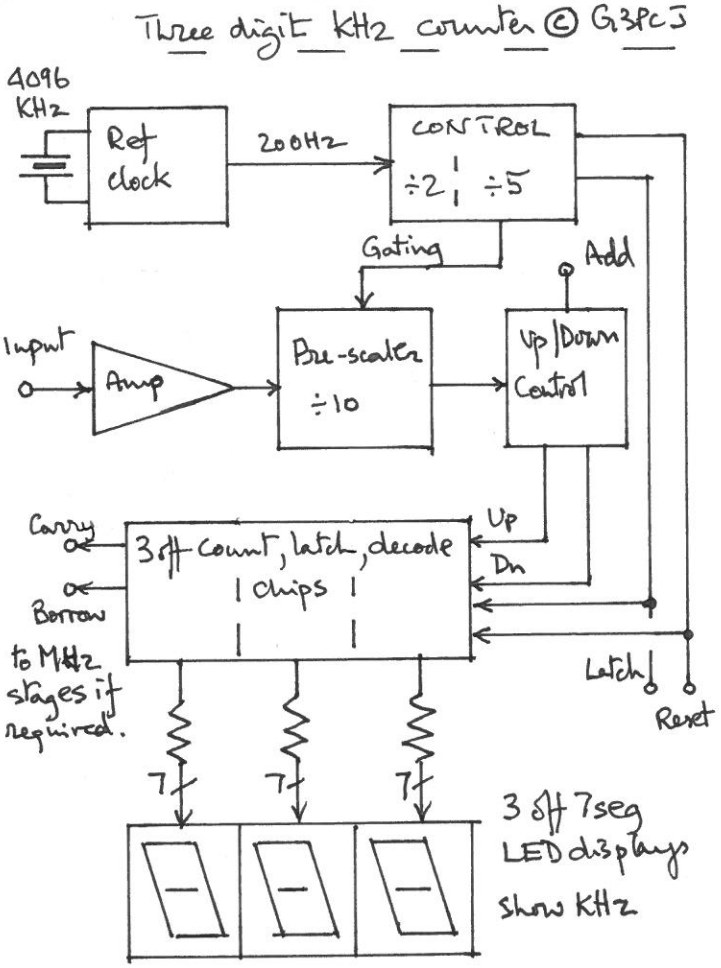
Most authors strongly advise checking the resistance of all loop joints, especially when using lengths of copper pipe joined by solder (or even compression) fittings. The resistance is usually pretty low even when poor, so a heavy current (ten amps or more - use a 12v battery with high wattage headlamp in series to limit current!) will be required to get a volt drop reading across each joint that will enable you to see the difference between the many (hopefully) good joints and the poor high resistance one!

Opinions vary about how best to feed the loop. Often a small coupling loop is positioned inside the main loop in the same plane but I suspect these are not easy to adjust nor keep in position! Much simpler is the 'gamma match' approach, where the low Z feeder is connected at a tap point part way round the loop away from the earthy point. The tap can be inductive, or capacitive as in the Radlet. For that rig, the losses caused by using mains cable are not important! G3PCJ

The new Three Digit Counter

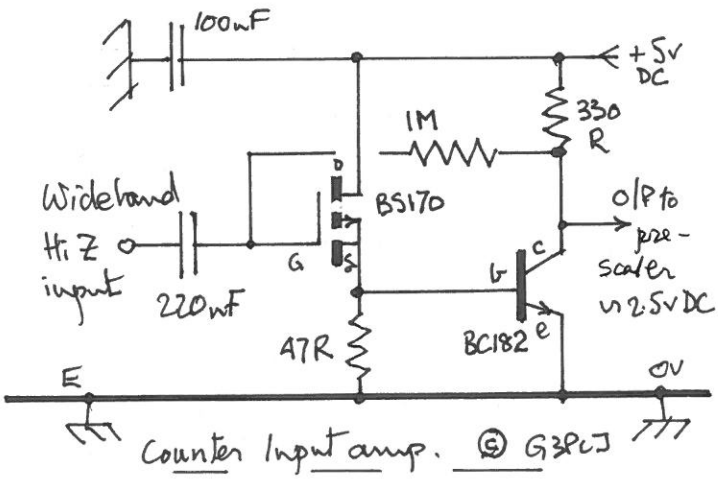
A digital frequency readout is about the most useful accessory that you can add to any rig! There are many offerings from kit suppliers and most modern ones are based on a micro-processor. However I think most readers will know of my dislike of such devices when in close proximity to a receiver. Computers, and their smaller microprocessor cousins, inevitably have a nasty electro-magnetic signature owing to the use of digital signals which are inherently full of harmonics. Often the cyclic nature of the software programmes will lead to continuous interference which tends to escape down the connecting leads - for supplies, or to/from the displays etc. It was the cyclic repeating of multiplexed (and relatively high current) display driving of 7 segment LED displays that gave such arrangements a very bad name. Although my designs have LED displays, the special counting chips that I use (CD40110), do not employ multiplexing - the wires to the displays actually carry DC and only change when the frequency is changed.

A full 5 digit readout has 35 wires and needs 7 or 8 chips for a counter that can take in the rig's VFO and 'do' the offset - rather a lot! My five digit design does the offset by also taking in the CIO and then adding or subtracting the frequencies. However if the IF is an integer number of MHz then the KHz numbers will be correct based only on the VFO or LO input. Luckily my rigs generally use a 6 MHz IF, so a somewhat cheaper 3 digit design is feasible. The block diagram is shown right; to make it suitable for additive or subtractive superhets, it has to be able to count up or down - preferably under remote control for use with a future multi-band superhet (The Minster!).



This design only needs 5 chips and a few discrete devices for the input amplifier; hence I have been able to get it all on a 50 x 80 mm as shown on the first page of this issue. In most situations the MHz figures can be ignored, but if wanted for a full frequency readout for something like a signal generator, then the two extra counting chips and displays can be controlled from the 3D logic. For a single band rig, the MHz displays can be hard wired using just the segment resistors. Such an approach can also be used for multi-band control but it tends to need a diode matrix to drive all the segments correctly.

I wanted to avoid using a digital gate as the input amplifier because there was no other need for gates. The amplifier needed to have high input impedance, a voltage gain of over 10, bandwidth of DC to several tens of MHz with the output biased to near 2.5v DC so that it could interface directly to the input of the first counter stage, which uses the 5 volt CMOS dual bi-quinary counter 74HC390 chip. The combination of a MOS input buffer (BS170) followed by the bipolar amp (BC182),when arranged as a feedback pair, automatically makes the output stabilise at near 2.5v - owing to their turn on voltages of roughly 2 and 0.6 volts adding together. This little circuit (as on right) works very well.G3PCJ



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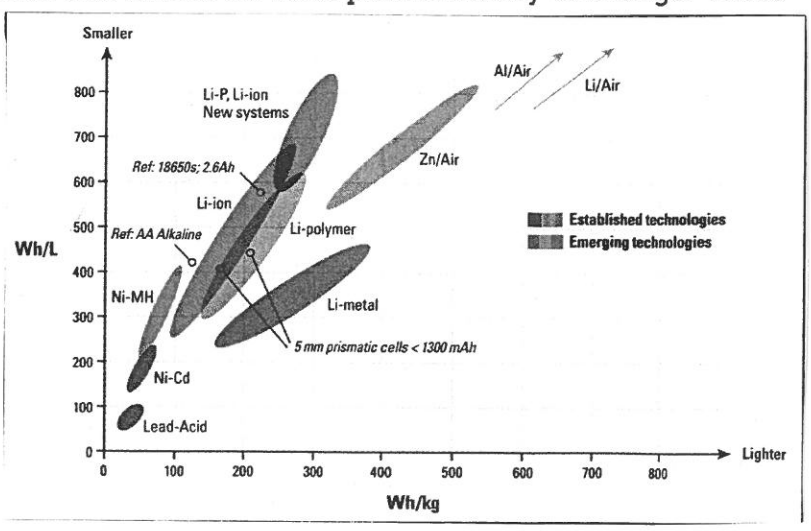
I am no expert and just talking about my experience!

The IET recently had an article questioning whether electric cars would ever become serious alternatives to internal combustion powered versions. It suggested that the range of many small 'saloon' cars would drop from 600+ km down to 150 or perhaps 300 km for the best current offerings, while their weight increased by about 10 - 15%. There is a concern about battery life as it represents a large part of the vehicle's cost and will be far from pocket money to change! There was also a comparison of size versus weight for different chemistries which I hope can be read alongside.



Another intriguing suggestion is that when the new proposed 'smart grid' is in operation, the grid organisers should be able to draw out some of the energy stored in 'charged' vehicle batteries to help them over peaks in 50 Hz demand! This will require a pretty complex 'battery charger' me thinks! Just hope it does not lead to too many instances of only getting halfway to work the next day! What will be your excuse for being late to work?!! G3PCJ