

# Hot Iron

Spring 2009  
Issue 63

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The Walford Electronics web-  
site is also at  
[www.walfordelectronics.co.uk](http://www.walfordelectronics.co.uk)

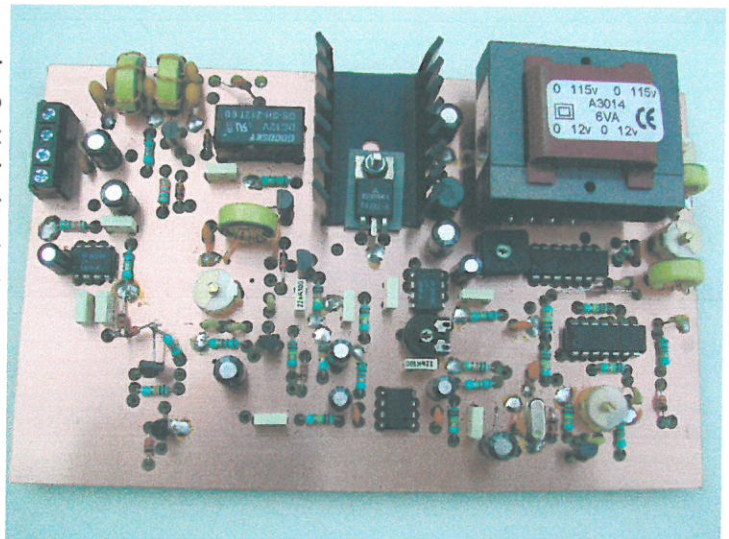
## Editorial

Altering the information to the left to say 'Spring' seems strange when we had an inch of driving rain and drizzle last night, with continuous heavy frosts forecast for the next few days! But the sun is now out and things are getting better - I just hope they were never going to be as bad as the pundits had suggested! Trade in this little business has been better than I feared it might be over the last month - for which I am very grateful - the orders from satisfied customer wanting something else are especially pleasing. But commercial life is strange - I note that one of my competitors says he sell lots of accessories but few complete rigs, whereas my experience is exactly the opposite!

The turn of another year shows the challenges ahead - in my case to drive down the sale prices while still providing good value for whatever customers have available to spend. I see a recent comparable product where the price can hardly cover the material costs, let alone the overheads of running the business so it's a real challenge! Often start up businesses supplying hobby type products fail to appreciate the overheads like insurance, stock finance, promotional costs etc and soon prices have to creep up! Time is often not properly costed and it makes it very challenging for those who are doing it as a living. I run Walford Electronics as a business but thank heavens I am not totally dependent on it! Tim

## Kit Developments

My assessment of the prospects for solving the snags in the Minster shows there to be a fair risk that it will become too complex and expensive. The target spec for the Minster remains but it is going to need several major revisions. Accordingly, I have pressed on with the **Willet** (simple DC receiver for 20, 40 and 80m) which is now available for £34 + £3 P&P; and I have just done the final PCB modifications of the **Chirnside** (early 6m version right). I have also drawn out the **Trull**, a MW TRF with optional regen stage and parts to make it also do 80 and 160m. This is aimed at novice constructors. Tim G3PCJ



**Hot Iron** is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics— is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

## **Brief Report on VP8YLE** - by Nicky Marriot M5YLO

This was my first experience of flying ..the long flight (Madrid to Santiago 13hrs) seemed endless. Three of us travelled together, staying in the same Santiago hotel & later joined by three more of the party. The WX was very hot - 30C. We took a tour around Santiago, with its many new buildings - I enjoyed that very much, and then dined together on Friday evening. We had to be up at 5am on Saturday, to catch the only plane to the Falklands. We met up with 3 more at Punta Arenas. From here it took 2 hours to fly to the Falklands, arriving at 13:30 local and were meet by Bob and Janet who took us back in a mini bus. The roads were very bumpy and made from loose grit... also very dusty! Our accommodation "Shorty's Diner" was a row of connected huts each occupied by one of the YLs.

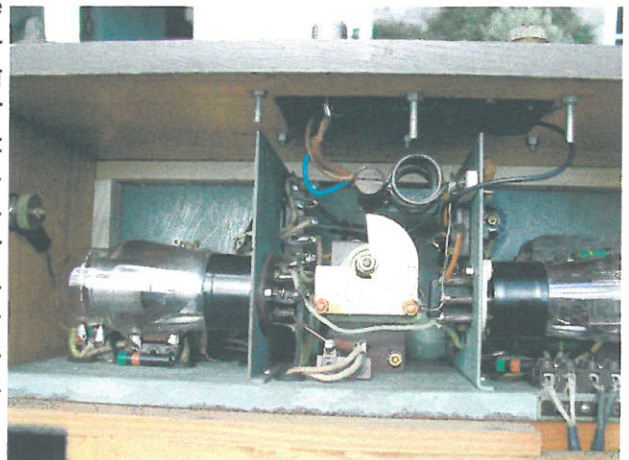
We had a nice meal at Bob and Janet's and got to know each other. On Sunday we walked around Stanley to find our bearings. In the morning I had to go to the hospital as my ears were ringing & my balance was not right, I had some tablets to settle them down. I started my first shift at noon on Monday and was pleased to make contact with the UK. Ruth and I were on a very early shift 4:30am the next day and worked Japan, which was great for me as I have not worked JA from my home QTH yet. At the end of the day I had made 329 contacts (more than I expected), later in the week I was pleased to make a sked contact with my local radio club Blackmore Vale ARS. It was good to hear the lads 5 & 5; the pile ups were quite mad calling all the time (with the best operators being Americans & Japanese). Most days we did 3 shifts of 3 hours each. With 2 hours off in between, I felt quite tired by the end of the week. The WX kept very good for the two weeks, with one day of rain & one very windy cold day - the rest of the time we had sun & we were in "T" shirts. On the second Wednesday we took a trip to San Carlos cemetery, Goose Green, Gypsy Cove, which took most of the day - it was 270 kilometres. We were very pleased to see the penguins. During the two weeks I gained much confidence in working the pile ups... we operated both numbers and split depending on conditions. I made a total of 270 QSOs of the 25,000 total (& 150 countries) with the VP8YLE call sign. I thank both Bob and Janet for the help given and making this YL trip a great success. Nicky.



## **The aerial feeder conundrum** - contd.

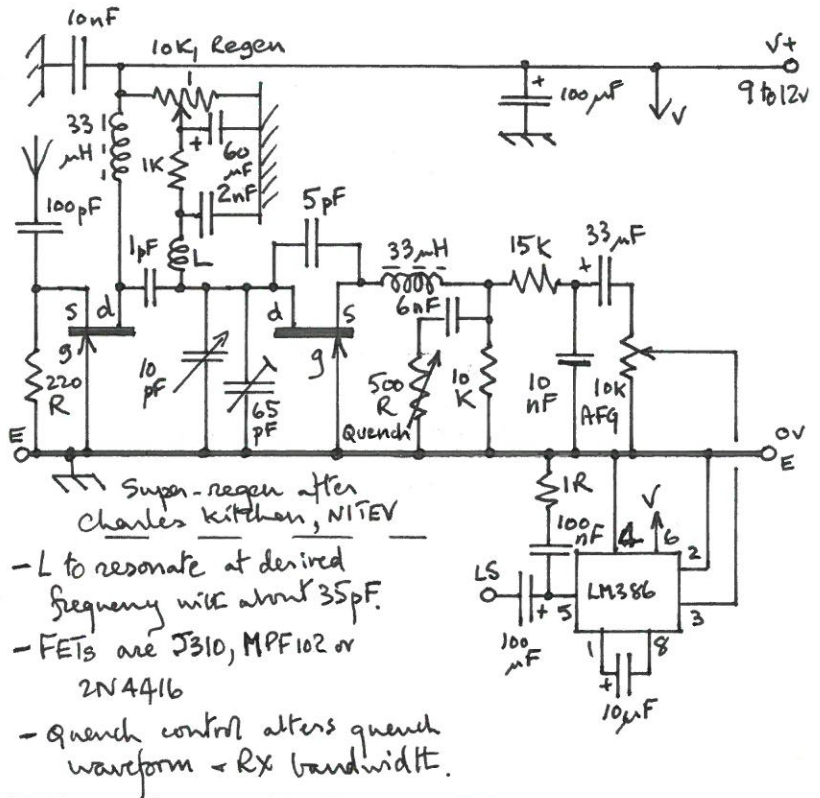
Nobody has come up with a really good explanation yet for the single conductor RF feeder that I have mentioned before (at my friend's wartime dug-out). The best suggestion so far, is that it was for a general purpose long wire aerial for medium or long wave domestic type sets; such a receiver might well have been used in a bunker to keep abreast of the national situation, but this explanation is not entirely satisfactory! It seems surprising that a specialist, scarce and expensive RF cable would have been developed and used for such a task that could possibly have been done with a simpler cable. The cable was buried in the ground for about 10 yards so something would have been needed to reduce losses and unwanted stray capacitance from the earth. When the weather improves I intend to examine what remains of the feeders and aerials in the trees.

One puzzle about a network of the simple WD17 sets (right) operating together has been explained satisfactorily. I was concerned that a net using such simple sets would be prone to marching up or down the band due to differences between transmit and receive frequencies. However the super - regenerative receiver has an inherently wide bandwidth - theoretically up to half the regen quench frequency which is usually many tens of KHz - hence they can all hear each other easily even if their transmit frequencies are appreciably different - see next page. My own 6m project - the Chirnside - is performing well; it has a Regen RX and AM transmitter. G3PCJ



## Simple Super - regen Receiver

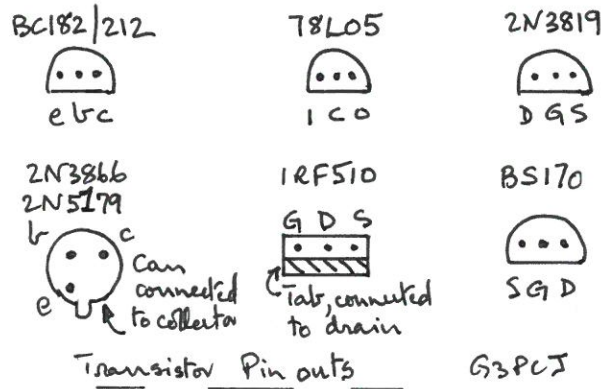
In the USA, Charles Kitchen N1TEV has generated many very effective and simple sup-regen circuits. That on the right is an anglicised version which I have adapted from one of Charles'. I have not actually tried it but I am confident the changes that I have made to his well tested circuits will work! This particular one has a grounded gate broadband RF amplifier feeding into a ground gate second stage. This is actually arranged as a form of Colpits oscillator but has two extra parts (labelled R and C) in the source circuit that turn it into a super - regen stage. Charles has also used grounded source RF amplifiers instead of the one shown here - whatever their form, their purpose is to prevent any of the oscillator signals feeding back to and radiating from the antenna. This particular version has been tuned in the VHF region but there is no reason why they cannot be used at lower frequencies. The advantage of the super - regen is that the adjustment of the regen control is not rather 'tender' like the conventional regen because the circuit action continually takes it into and out of oscillation at the quench frequency. (But modern regens are much better anyway!) This gives it very high gain and because the quenching takes place at supersonic frequencies, that effect is not audible. The drawback is that this is effectively a sampled data system, with a bandwidth of half the quenching frequency - typically a few 10 KHz. Thus the RX bandwidth is large enough to copy stations spread over a few KHz. G3PCJ



- L to resonate at derived frequency with about 35pF.
- FETs are J310, MPF102 or 2N4416
- Quench control alters quench waveform - RX bandwidth.

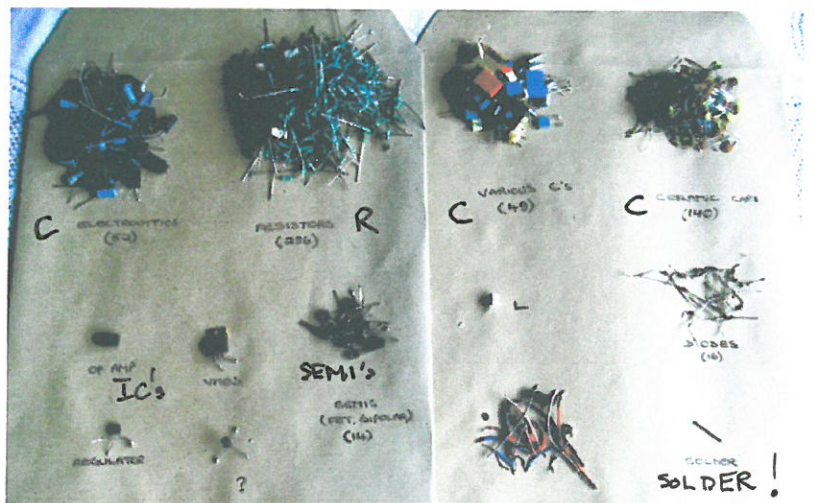
## Useful pin-outs

I have sketched on the right, the pin views of many devices that are commonly used in QRP projects. Note that JFETS like the 2N3819 can work equally well with their source and drain reversed - beware there are also two versions from different manufacturers that have the same 2N3819 number but do have different pin-outs - I have shown the more common version. G3PCJ



## What to do?

Chris Rees GU3TUX was awarded the consolation prize at last year's Somerset Supper, it was a collection of electronic goodies off my bench. He has analysed its contents (right) and wants to know what he should build with these parts but draws attention to the low quantity of solder (bottom right) that is available - about half an inch! Plenty of Rs and Cs, sufficient transistors and some wire! I shall have to rectify this for the forthcoming **Somerset Supper** - see back page. G3PCJ



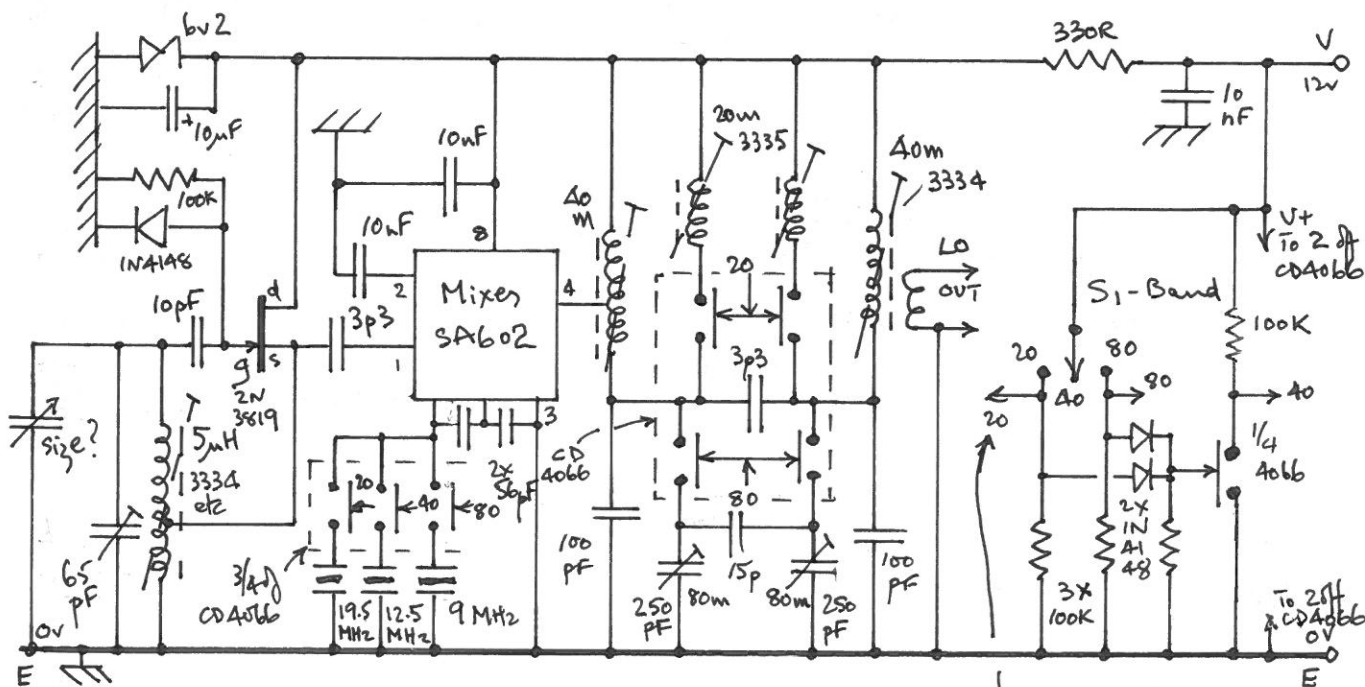
## The TRIBLO!

This 'project' is for a restricted version of the earlier All Band LO kit, providing for the three most used bands - 20, 40 and 80m. The aim is to have good stability, a common incremental tuning 'scale' and no transmit problem with chirp! It might form the heart of a three band direct conversion rig - most likely to be for CW. The easiest way for only three bands is a crystal mixing approach; this avoids the change in tuning scale when the lower bands are derived by digital division. It can also be an all analogue design which appeals to some people! That may have a benefit in less harmonics, unwanted mixer products and associated spurs! The choice of crystals can allow a lower VFO frequency which will improve stability. Because I happen to have these crystals my preference is indicated below, but it could be altered to suit whatever is to hand.

Band	LO Freq range	Crystal freq	VFO freq
20m	14.0 - 14.1	19.5	5.5 - 5.4
40m	7.0 - 7.05 (7.1)	12.5	5.5 - 5.4
80m	3.5 - 3.6	9.0	5.5 - 5.4

In this example, all bands actually tune backwards and the unwanted sum product is out of the way well above the listening band. The VFO harmonics are also out of any band. Ideally all bands need to all tune the same way, and subtraction of frequencies will generally be best owing to the very low VFO that would be needed to get below 80m; also, low frequency crystals such as 1 MHz are becoming like hens teeth at reasonable prices!

Band changing would appear to be possible with CD4066 electronic switches for these low power analogue circuits. Three of the four switches in one chip could be in series with the crystals to select them for the oscillator section of a Colpitts SA602 mixer; with the fourth switch doing the 'logic' inversion required to control them from a single pole centre off band toggle switch. A second CD4066 could alter the output double tuned band pass filter, by applying capacitors or inductors in parallel with the normal resonators for 40m, to give operation on 80 and 20m respectively. The 5.5 MHz VFO would be quite standard with normal tuning controls - coarse, fine/RIT as required. The circuits are sketched below without part values as it has not been tried out! I can supply the crystals if anybody wants to experiment. Tim G3PCJ



CRYSTAL MIXING VFO FOR 20, 40 & 80m

To 4066 control inputs for 20/40/80m

G3PCJ

## Doodles from Doncaster - from Richard Booth G0TTL

### Crystal Filters

Manufacturing processes in crystals continue to improve and there are now a good number of 20 ppm resonant frequency types available off the shelf for little cost. Bearing this in mind the good news is that testing crystals to get a reasonably matched set is no longer a necessity. Recently I developed a filter using four 10MHz (Rapid Electronics) types for use in SSB phone transceivers. The input / output impedance is about 1K which suits active mixers such as the SA602 and my personal favourite the 1496. Bandwidth is about 2.7 KHz and I have had no complaints on air so far! A similar filter was also developed for 9MHz this time to be used in a traditional 20/80M superhet, with a 5 MHz VFO. 9MHz crystal are custom made but I have plenty.

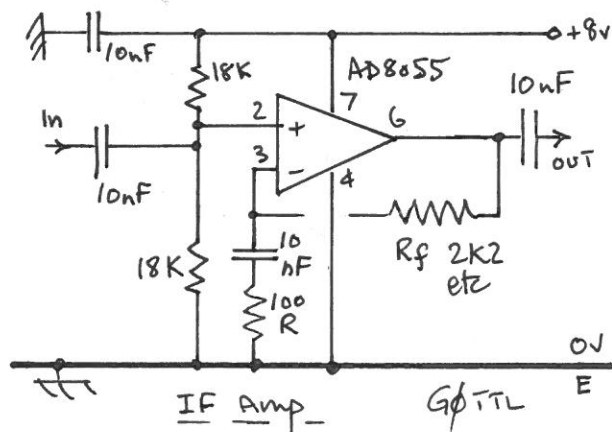
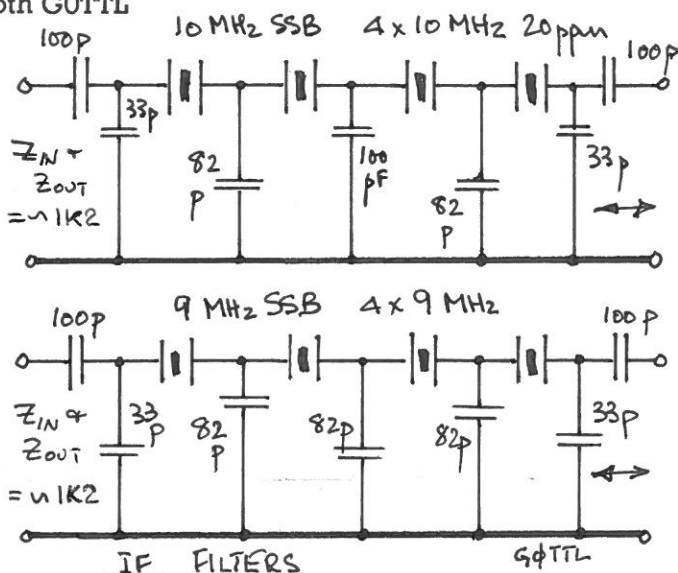
### Cheap PCB accessories

Several folk pointed out to me that they use ordinary hairspray as PCB solder through lacquer, rather than shelling out £6 a can for the proper stuff. I was a bit sceptical however if you are anything like me and only need to look at your shiny just etched board for it to start turning black, you ought to try this out. I am not recommending you use hairspray on your latest valve linear power supply or anything other than low voltage QRP projects, and only use it as a pre-construction lacquer. It is there to protect the copper clad from the atmosphere and finger prints, and not to improve electrical insulation! Do not go spraying it all over the components once they are soldered in place! To use, simply remove the etch resist either by polishing with wire wool or as I prefer to do wipe it off with standard car paint thinners. If the board is to be drilled I suggest you do that before removing the etch resist. Then give it a blast with your favourite brand, best buy I have found is Tesco's value spray at about 40p for a large can - yes it really does work. Smells like the hairdressers when you put the iron on it, my 18W Antex burns through it in no time at all. One of my efforts that I assembled over six months ago which is open plan still looks as it did the day I plugged the antenna in.

On the subject of PCB manufacturing another discovery I have made is that "Black Light" fluorescent lamps which are used in light displays etc to make white objects (especially clothes washed in fabric conditioner) highly illuminated have enough UV in their output to be used as exposure lamps with photo etch board. This is despite the main visible light output being right at the violet end of the spectrum. You can now buy the black light lamps in a 15W energy saving format which means a simple light box built out of MDF with a sheet of thin glass on top is a straightforward task. I have built such an item using a single lamp, the box is lined with silver foil. Exposure on my rough looking unit is about 5 minutes; you will need to experiment depending on the photo board type and the distance between it and the light source. A lid on your box lined with foam padding is a good idea so that some pressure can be exerted between the PCB material & UV mask.

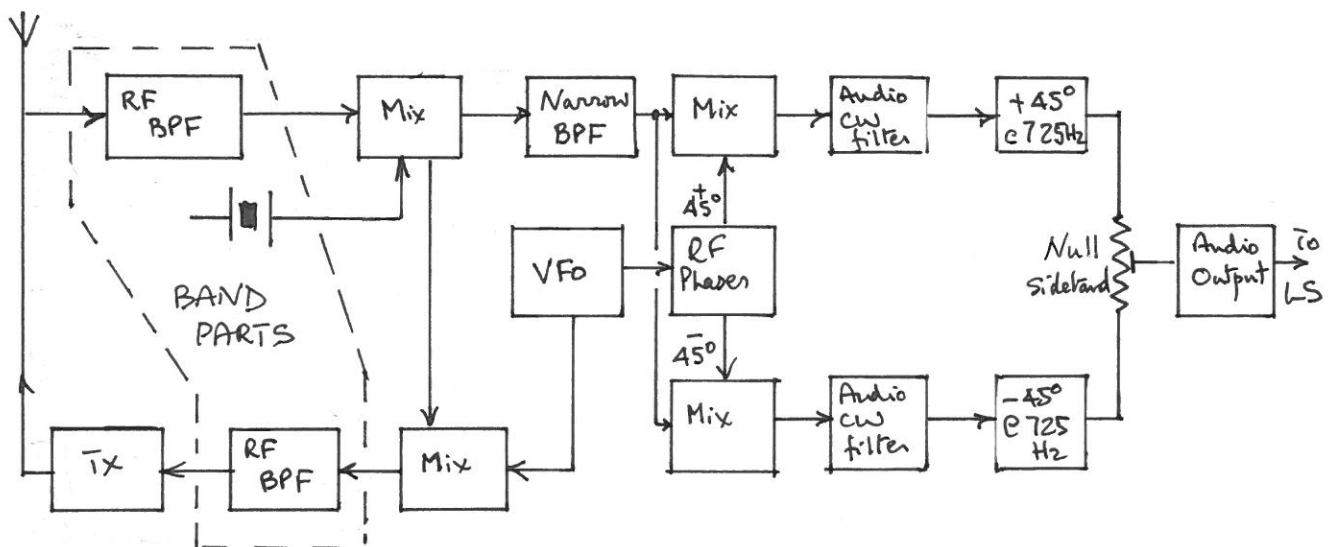
### Ultra simple IF amplifier

There are still several standard package wide band Op Amps available, one which is particularly good / cheap is the Analogue Devices AD8055A. With it's operating bandwidth high up the HF region, using it as an IF amplifier at say 10 MHz hardly has it breaking into a sweat. Simply configure it as a non inverting amplifier, no tuned stages are required as the input is straight out of your crystal ladder filter and the output impedance is sufficient to drive into a 602 product detector. The feedback resistor  $R_f$  should be something like 2K2 or 3K3 if you are brave and want maximum gain. Although I have not tried it at an IF of 6MHz this simple circuit could be easily added to WE superhets - it is essential though to keep any connections short and rigid. I will leave you to ponder over adding AGC!



## Concepts for a 20/40/80m CW phasing TCVR

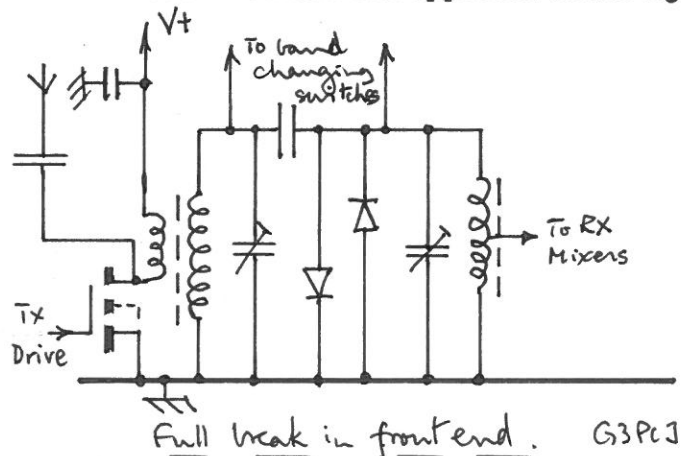
Over the years I have toyed with a 3 band CW TCVR project, a bit like a modern HW9! To make it different from other rigs in my current range, I had envisaged a 5W RF output and a decent single sideband receiver possibly of the filter superhet type. But these are a bit boring now! Another option was use the TRIBLO (see earlier) to drive a good direct conversion rig; however to make this have single sideband reception, it would have to be a phasing type design which is awkward for a such large LO range unless there is a digital VFO source running at four times the required LO - all of which is complex, risky and expensive! Another approach is to use a crystal controlled converter ahead of a simple narrow band DC RX with phasing type rejection of the unwanted sideband. This is the scheme sketched below - receive aspects in the top part of the diagram and transmit below. The crystal frequencies change for each band but the phasing receiver does not alter. Interestingly, the same crystal and VFO frequencies can be used as in the TRIBLO earlier! The necessary RF phase shifting ( $\pm 45$  degrees at LO) can be done with simple CR networks as the LO range would only need to be 100 KHz in a few MHz for the LO. The two phasing mixers then feed conventional audio stages with narrow audio filtering for CW, followed by audio phase shifters ( $\pm 45$  degrees at 750 Hz); the two audio channels are then subtracted to eliminate the unwanted sideband just before the AF gain control and conventional audio output stage.



OUTLINE OF PHASING TCVR

G3PCJ

For transmission, the crystal and LO need to be mixed and filtered to drive the RF output stage. It is probably easiest to duplicate the mixing/filtering for transmission rather than share the circuits for reception. I would want full break in operation with no TR relays! This creates an interesting challenge for band changing without losses in a diode TR switch! The approach on the right has been used in the Brent very satisfactorily and would appear to allow multi-band operation (by relays) without too many complications; it gives low reception losses and low harmonic output provided a proper resonant AMU is used. I also think it possible to use a similar band changing approach for the other low power band filters, using 4066 electronic switches instead of power hungry relays. Another 4066 can switch the crystals in their oscillator - see earlier article about the TRIBLO If anybody thinks this a worthwhile project let me know - costs are likely to be near £90. Tim



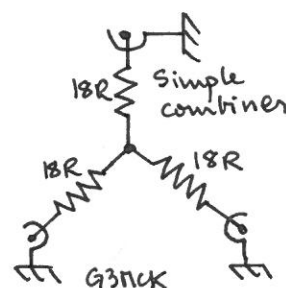
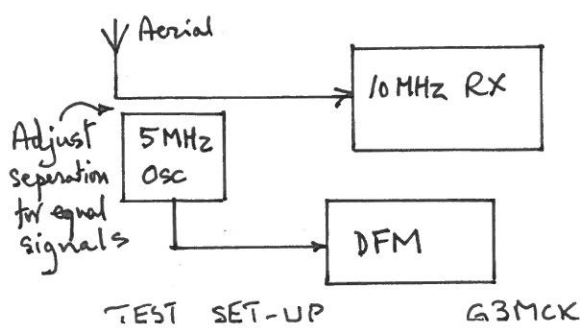
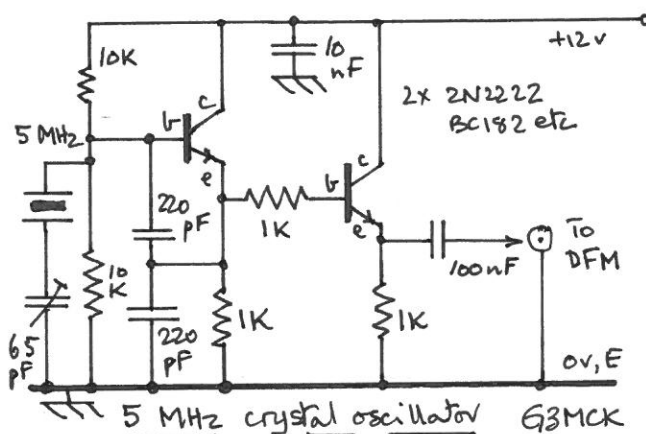
## How accurate is your Digital Frequency Meter? By Gerald Stancey G3MCK

These days a simple DFM is a common piece of test gear in many constructors' shacks but how accurate is it? First of all let us be clear about accuracy and resolution. Just because a DFM has eight digits, it does not mean that it is accurate to nearly one part in one hundred million. The number of digits is a measure of its resolution not its accuracy. The accuracy of a DFM is controlled by the accuracy of the oscillator that clocks it and for really high accuracy the home constructor has to use an off-air standard. This article is aimed at those who own a DFM, that is one that does not contain an 'ovened' crystal nor uses an off-air standard. According to professional friends, it is reasonable to expect a long term accuracy of about 10 parts per million (ppm) for an 'ovened' crystal and this is the standard for which I aimed.

The easiest way of checking out a DFM is to measure a known frequency and then compare the readout. I used several different methods of establishing an accurate local frequency and will describe the one that is easiest to implement. A future article maybe written describing the other techniques which I used out of interest and as a cross check. HF transmissions from MSF have long ceased along with other European standard but, happily, the Chinese Government provide transmissions on 2.5, 5, 10 and 15 MHz to an accuracy of about 1 in  $10^{12}$  - that is by my standard they can be called exactly right! These identify with the call sign BPM at H+29 and H+59 minutes. The 10 MHz transmission is easily received on most receivers that have a 10 MHz band. Experiments with a number of el-cheapo 10 MHz crystals showed that they drifted, however this defect was not found with a similar 5 MHz crystal. Using a 5 MHz crystal in the standard oscillator (box) also allows you to check against BPM on 5 and 15 MHz.

The test procedure is quite simple: set up the oscillator and DFM as shown right. By trial and error adjust the coupling between the test rig and receiver until the signals are at about the same level, then adjust the 5 MHz oscillator to zero beat with the BPM. When you get to the sub-audible area you will have to adjust by listening to the rise and fall of background noise. I found that this took a little practice but that I could get repeatable figures to better than 5 Hz, ie much better than 1 ppm. A better set up for comparing the two signals is to use a hybrid combiner. I used a version with a toroidal transformer but the simpler resistive star-match (right) should do for this application. At this stage you can either: be happy with what you have, or adjust your DFM clock (if possible) so it reads the correct frequency, or apply a correction to all future readings! The choice is yours and will depend on how accurate you wish to have your DFM. Note that it maybe impossible to adjust the DFM clock, so you will have to live with it and make corrections when necessary!

Lets looked at a worked example. Assume the DFM reads 5,000,015 Hz when the 5 MHz oscillator has been zeroed with BPM on 10 MHz. This means that all readings are high by 3 Hz per MHz or 3 ppm. If you have decided that your required accuracy is 10 ppm then you need do nothing else. On the other hand, you may wish to allow for this on all future readings. However, be warned, your DFM clock may well drift over time so that expecting to measure to this standard of accuracy should only be done immediately after checking against BPM. It is instructive to check a DFM over a period of time and you maybe pleasantly surprised at how stable it is. Finally, if you are happy with 10 ppm, then you only need to get agreement with BPM to 100 Hz - this is very easy.



## Items for sale as at 13/2/09

This equipment is for sale on behalf of a severely ill friend of our Club member Tony:-  
Spectrum Analyzer 141T & 8555A (5 Ghz to 18 Ghz Module), LF Oscillator Advance Model H1E,  
Power supply Thander TS 3022s, Digital Storage Adapter Thurlby DSA 524,  
Function Generator Farnell FG1 upto2Mhz, Eprom Eraser Stag SE15,  
Eprom Eraser UV140, Monitor Panasonic WV5370, CRO Iso Tech ISR620 2Channel 20MHz,  
CRO Gould OS4000 Digital Storage 2Channel, CRO Farnell DVT20 2Channel 20Mhz,  
CRO Telonie 121 (Very large display), BP/BS Filter Barr & Stroud EF4-C1 1Hz - 100KHz,  
Function Generator Jupiter 500 0.1Hz -500Khz, Universal Bridge Marconi TF2700,  
Counter Universal 5001, Frequency Meter Black Star Meteor 1000 5Hz- 1GHz,  
Mini Scope Comonedex RS232 (data monitor), Modem Tester Wandel & Goltermann 750/02,  
Interface Analyzer Convex 682 V24/RS232, Fluke Multimeter,  
RF Power Analyst Bird 4385 (19 in Rack) (2 off inserts 200-500Mhz), also many technical books  
Please contact Tony Marriot G0GFL Tel 01258860741 or [tm@io80vv.freemove.co.uk](mailto:tm@io80vv.freemove.co.uk)

I also have a 4m Transverter unit (Andover Club project about 1980) built by Jim Geary - complete with documentation. Free to a good home! Contact me - Tim G3PCJ

## *The Somerset Supper* *and* *Yeovil QRP Convention*

The Fifth **Somerset Supper** is to be held on the evening of Sat April 25th, the day before 25th Yeovil QRP Convention. The format will be a buffet style supper at Lower Farm, Kingweston, near Somerton TA11 6BA in the Old Court Room. As before, there will be a small display of items from each diner's home built radio equipment! This will qualify you for a **free** place at the supper table! Our guest of honour and judge for our informal radio construction display, will be Rev George Dobbs G3RJV - very well known as the Editor of the Journal of the QRP Club - *SPRAT*. **Places by advance booking only by April 19th so please tell me if want to come.** I hope to see it and you!

Jane and David Sedgman also do limited B and B/catering. The Sedgeman's website can be seen at [lowerfarm.net](http://lowerfarm.net) If you wish to stay overnight with them please contact them direct. They are 'four star' members of Farmstay UK and will do us proud! David may might also be persuaded to show us his large model railway installation, which is loosely modelled on aspects of the nearby Somerset and Dorset Railway.

The QRP Convention will have the usual programme of radio related lectures including one by George G3RJV, trade stands, bring and buy stall, and other excitements! I shall be there and am always pleased to see and display as appropriate any of my customers 'constructions'. Tim G3PCJ

