Hot Iron

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Editorial

As a first for Hot Iron, I am very pleased to include some colour photos with an article about the building of a pair of Bristols by our keen supporters Andy G7WHM and his friend Bob. They also very kindly produced the colour copies. It was the encouragement of Andy who kept me going during the long development of the Bristol. Being a major project, the transceiver alone took nearly a year of thinking, experimenting and laying out - despite many aspects having already been proved in other rigs! The various ancillaries took another few months so I was very glad to have that encouragement right from the start when it was little more than a few scribbles on a sheet of paper! Andy said something along the lines of 'That sounds good - I shall have one, and guide my friend to build another.' Bob's electronic construction experience was not large but with a willing mentor, he has now built and got working one of the most challenging kits on the market! It has been most helpful to me - as a sounding board for ideas and to find the errors which are inevitable in an instruction Manual of 36 sides. (£5 post paid if you want a look!) It also shows the value of doing things with others, either friends or through a Club. Another member Doug G7HYG has purchased one as pilot for his Club, and I am sure his guiding experience will enable others to succeed. Club Construction projects (at any experience level) do boost the morale of most Clubs so find your construction leader!

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Kit Developments

A little bit of recent publicity in Radcom over kit construction gave a welcome boost to sales of the Chedzoy regenerative TRF receiver which is really intended for very first time builders. It set me thinking again about the next step up and the possibilities of a simple 20/80m DC receiver, complete with front panel, audio filters and loud speaker drive. The result is a new kit called the Chinnock which has two separate conventional VFOs tuned by a polyvaricon capacitor. The matching transmitter is a 1.5 Watt CW 'crystal VXO' controlled rig complete with TR changeover, low pass filters and sidetone etc.. The design is quite simple and the article later in this issue has sufficient information to build your own version. East and West Chinnock are actually two villages between Yeovil and Crewkerne! Some early builders would be welcome; the RX is £39 or with the TX £59.

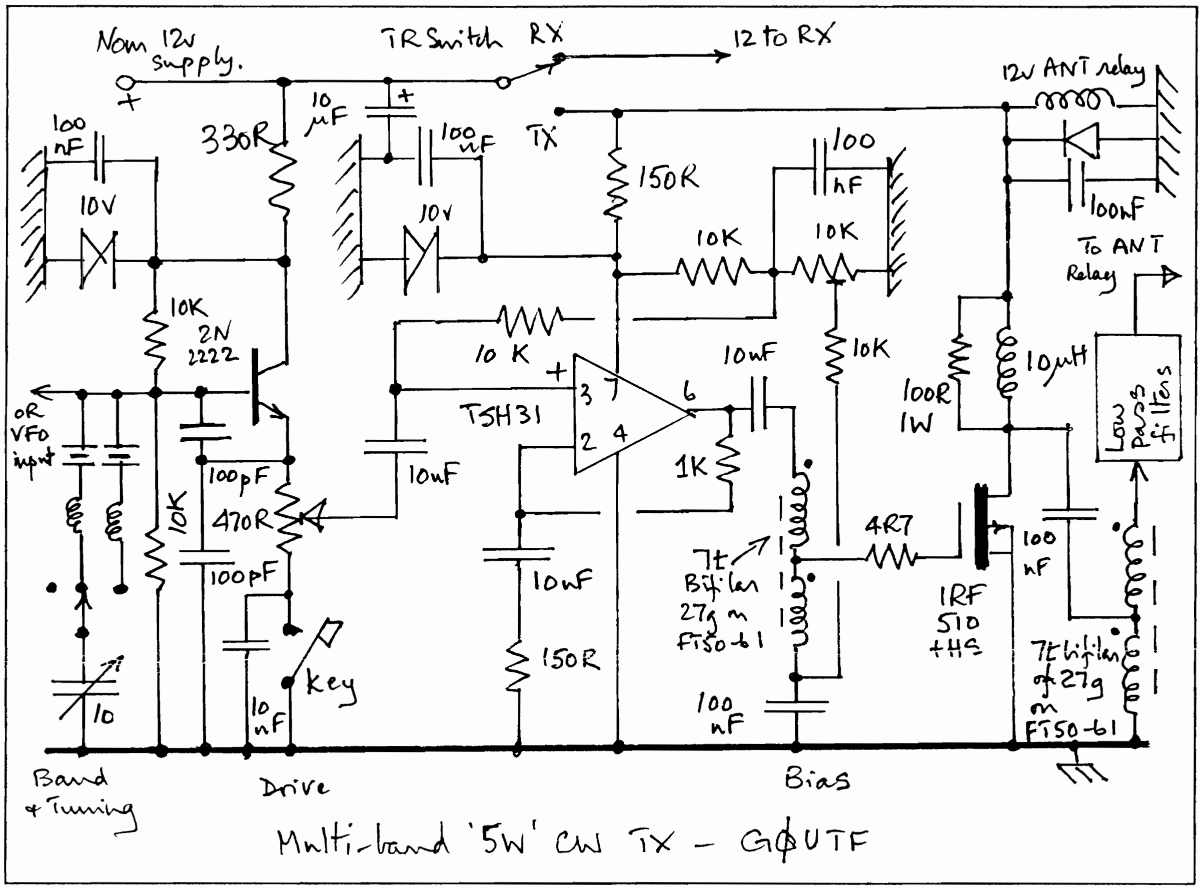
Another new kit is the Tone! As you might guess, this rig is for the data mode PSK31 which I mentioned in the last Hot Iron. (The Tone is a Somerset river.) For simplicity, it will be 80m only. It will be capable of double sideband suppressed carrier phone (for voice or PSK31) and CW. It will have a two pullable ceramic resonators and trimmers for the VXO, with nominal frequencies of 3.58 and 3.69 MHz to suit the modes available. I have done the PCB layout and etched it but have yet to build the prototype so its not yet ready for sale! Contact me if you are interested. Tim Walford. G3PCJ

Hot Iron is a quarterly newsletter for radio amateurs interested in building equipment. It is published by Tim Walford G3PCJ for members of the **Construction Club**. Articles on simple theory, construction, testing, updates on kits, questions and suggested topics are always wanted. Please send correspondence and membership inquiries to Upton Bridge Farm, Long Sutton, Langport, Somerset, TA10 9NJ. Tel 01458 241224 or e mail walfor@globalnet.co.uk The Walford Electronics website can be seen at www.users.globalnet.co.uk/~walfor Subscriptions are £6 per year for the UK (£8 overseas) from Sept 1st in each year.

Multi-band CW Transmitter by David Proctor G0UTF

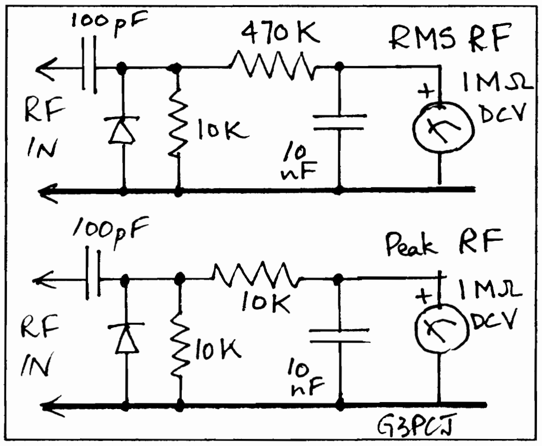
(David originally asked me a technical question about this rig which he has adapted from several sources, but I thought it worth publishing - albeit in a slightly simplified form. G3PCJ)

The rig comprises a multi-band VXO oscillator with a broadband 5 Watt TX with plug-in low pass filters from another well known kit producer! It has given me lots of contacts on 7, 10, 14 and 21 MHz using a range of crystals which can be pulled over several KHz and still be exceptionally stable; on the lower bands I use a normal VFO instead of the crystals. It only needs a communication RX to work all HF bands on CW. The TR changeover is conventional and controlled by a switch. In addition, the crystal oscillator stage is powered all the time so that pressing the key alone will produce a netting signal in the RX. I use a sidetone oscillator powered from the transmitter's RF.



RF Voltmeter

This simple circuit detects the peak value of an RF signal. It presents a load impedance of about 10K on the driving circuit so can be used without any loading effects on a 50R line etc.. It is actually a half wave rectifier and, when used with a 1 MOhm input DC meter, the 470K series output resistor causes it to show the RMS value of the RF signal. If the alternative output circuit is used the DC meter will show the peak value of the ac signal. The RF power can easily be worked out assuming you know the value of the impedance at that point. If the load is actually a 50R dummy load, the RF power in Watts will be the (peak voltage) squared divided by 100. G3PCJ



The Godney CW transmitter

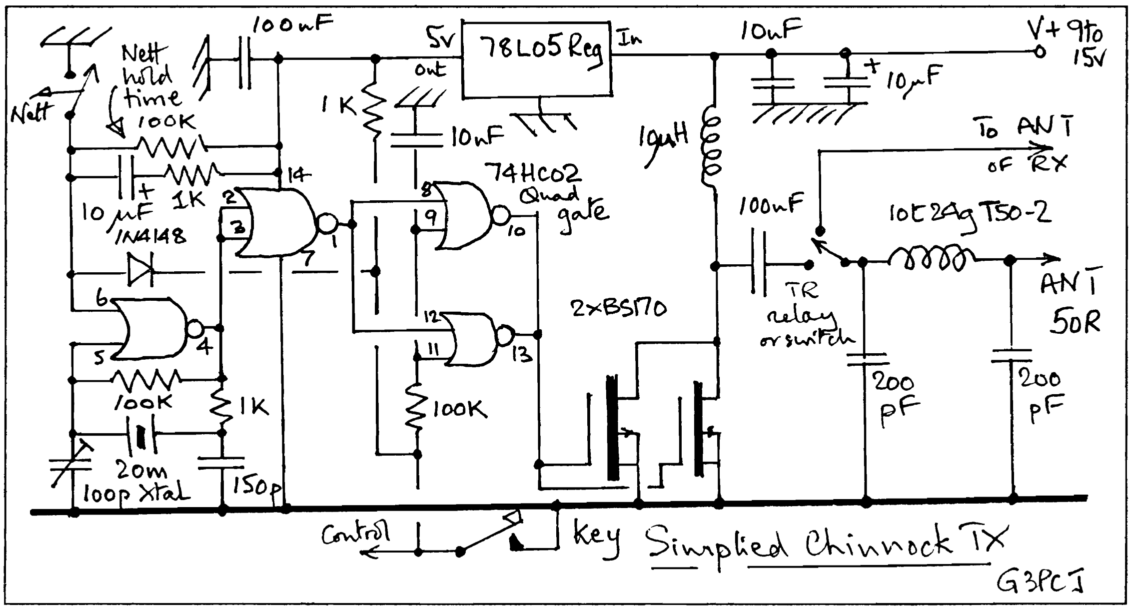
I have some of these kits which no longer fit in with the rest of my range and am keen to avoid resorting the parts. It is a three frequency 1.5 Watt 'crystal' controlled transmitter. An 80m ceramic resonator is included but all three can be any frequency up to 15 MHz. TR changeover and sidetone included. PCB 50 x 80 mm. Contact me if you want one - I am open to offers! Normally £29. G3PCJ

The Chinnock CW transmitter

Simplicity was **the** design point about this transmitter! Experience elsewhere had showed that high speed CMOS digital chips (74HCxx series) can operate to 50+ MHz so running on 20 or 80m would be a doddle! It had to be 'crystal' controlled to avoid chirp which would occur with a normal VFO operating on the transmit frequency. On 20m a crystal can be pulled about 5 or 6 KHz so this is not too much of a limitation. On 80m, a crystal can only be pulled about 1.5 KHz which is too little, so a ceramic resonator is used instead - this permits a much wider pulling range. This is because the ceramic resonator has a lower Q, measured in thousands, rather than hundreds of thousands for a crystal. The ceramic resonator Q is however still high enough to avoid chirp problems. A standard 3.58 MHz ceramic resonator can cover all of the 80m CW section. Their drawback is slightly worse temperature stability and a wide initial frequency tolerance - both tolerable in a simple rig.

To make an oscillator using HC chips is very easy, you only have to add a couple of resistors to bias it into the linear region of its operating characteristic, with the load capacitors for the 'crystal', and off it goes! The quad two input NOR gate allows for easy gating of the oscillator for netting purposes, with 3 gates left over for RF keying and driving the output stage. The BS170 MOSFET does perform well on 20m so I decided that two devices, operated in parallel, would handle the currents implied by a 50 Ohm load which will give 1.5 Watts output using a 13.8 volt supply. The BS170 has a gate capacity of about 50 pF but using two driving gates would halve the driving impedance and so charge or discharge the gate capacitance sufficiently quickly. Provided that the BS170 gates are driven with a square wave, and never kept steady at the logic 5 volt positive supply voltage, there is no need for any form of bias preset for the output devices.

The only other thing required is a low pass filter to remove the harmonics inherent in such a 'digital' oscillator and output stage. A three element half wave low pass filter is sufficient when used with a resonant antenna matching circuit. The maths of such filters is very easy - the reactance of each element should be the same as the feeder impedance (50R) at just above the operating frequency. Apart from the crystal, these are the only band dependent parts. It is convenient to fit the TR antenna changeover switch between TX output stage and the LPFs so that they also provide protection against BCI etc. on receive. The complete circuit (for the RF parts) is shown below; the Chinnock TX kit has a complete set of RF circuits for each band together with common RX sidetone, TR control, etc. G3PCJ



Somerset Homebrew Contest

Don't forget this contest with a £50 Walford Electronics Voucher for first prize! The objective is to encourage the use of home-made gear - especially in contests. The detailed rules are in Sprat but it is essentially the same as last year. Either or both TX or RX need to be home built. Any mode on 40 or 80m between 0900Z and 1200Z on Mar 25 2001. Beware clocks change the night before! Scoring favours two way QRP contacts but can be QRP/QRO!

The Grid Dip Oscillator and its uses by Joseph Bell G3DII

The name Grid Dip Oscillator derives from valved designs which used a meter to indicate the oscillator RF voltages by measuring the current in the grid bias resistor of the oscillator valve. Nowadays transistors are used instead of valves but the name has stuck! The instrument is primarily used to measure the resonant frequency of a circuit under test. When the oscillator's resonant circuit is coupled to another resonant circuit of the same frequency, it draws energy from the first so reducing the oscillator RF voltages and hence a reduction in grid or indicator current. As the GDO frequency is tuned through the frequency of the circuit being investigated, the indicator current will suddenly reduce, or dip, and then rise again when the frequencies no longer agree. Because the GDO usually covers a wide frequency range, consequently with varying oscillator RF voltages, it usually has a sensitivity control to adjust the normal meter indication. To be of any use , the GDO should be frequency stable. They are simple to make but do use sturdy construction and hefty variable condensers. The best accuracy is obtained when also coupled to a frequency counter. To those not familiar with using a GDO, the under mentioned points are worth noting:-

a) When using the GDO, keep your hands away from the coil as body capacitance can spoil readings.
b) Remove all extraneous metals and poor grade dielectric materials from near the circuit under test.
c) Before making a frequency measurement, adjust the meter reading to halfway up the scale.
d) When searching for a resonant frequency, tune the GDO from the highest frequency downwards.
e) Always use the lightest practical coupling between the GDO and the circuit under test for the final reading. Too tight or strong coupling, which is often necessary for initial searches, will cause the GDO frequency to be pulled by the circuit under test. Apart from an inaccurate reading, it causes a 'snap' action of the meter rather than the smooth movement of the pointer in and out of the 'dip slot'.

There are a number of ways of connecting the GDO to the circuit under test. The most common is by placing the coil of the circuit under test parallel to and alongside the GDO coil, i.e. inductive coupling; another method of inductive coupling is by means of a link comprising a couple or so turns at the base of the GDO coil and a similar number of turns at the base of the coil with capacitor under test. Inductive coupling is normally also used for a toroid where one or two link turns on the GDO coil are connected to a turn or two wound through the toroid and capacitor under test. Sometimes if slightly longer leads are used for connection between a toroid and its resonating capacitor, it is sufficient to insert the GDO coil between these leads. Alternatively, capacitive coupling is obtained when the turns of the coil under test are placed at right angles to the coil of the GDO. This is used for high Q circuits and devices. Direct capacitive coupling is obtained by winding a wire say twice around the end of the GDO coil and connecting it to one end of the test circuit coil. This has the effect of connecting about 1 or 2 pF between the 'hot' end of the GDO coil and the circuit under test. This method is mandatory when the test coil is shielded or inaccessible for inductive coupling. The disadvantage is that the small capacity affects the frequency accuracy of the GDO. Usually, inductive coupling is far easier to use as the degree of coupling can be easily adjusted - use a small separation of the coils for a strong initial dip and then increase the separation for a less pronounced dip for the final accurate reading. Having found a dip, it is always sensible to check that the dip is NOT present when there is no coupling to the thing being investigated. Here are some common GDO uses:-

Measuring a choke's self resonant frequency Knowing that a high power linear's anode choke is not resonant in band is rather important! The fundamental frequency at which a choke resonates is a function of its inductance and self capacitance. Thus a choke with its leads unconnected can be regarded as an LC circuit. Some chokes will exhibit several resonances other than the fundamental because of their geometry - often if they have multiple winding sections. To check the various resonances, start with the GDO's highest frequency range plug-in coil. Note the dips which occur as you progress downwards in frequency. Many chokes have a low Q so coupling maybe difficult; coupling can either be axially end on, or alongside, or with a link of a few turns over both coils with the link's ends joined together.

Inductance measurement This is measured indirectly by first finding out the resonant frequency when connected by short leads to a known capacitor. Known capacitors of say 47 pF, 470 pF and 4700 pF, will cover most amateur applications. Use the smaller capacitors for small coils. Place the coil/capacitor combination near the GDO coil and sweep the GDO frequency till a definite dip is found. Note the frequency and work out the inductance from this formula.

$$L(\mu H) = \frac{25,400}{f^2 \times C}$$

f in MHz & C in pF. G3DII

Checking mutual inductance The GDO can be used to measure the mutual inductance between two coils. Connect one winding across the known capacitor as above and measure its inductance L1. Disconnect the first coil and then measure the inductance of the other one L2. Then work out the mutual inductance from the formula right. Critical coupling between two identical tuned circuits occurs when the mutual inductance between them is the inductance of either coil divided by its Q.

$$M = \frac{L1 - L2}{4}$$

G3DII

Finding 'sprogs' Most GDOs can also be used as absorption wavemeters. Usually there is a switch which turns off their oscillator action but which still allows them to detect RF currents in a coupled circuit. Turn up the meter for the highest sensitivity. If you suspect there is an unwanted 'sprog' or oscillation (strange hand effects, unpredictable behaviour etc.) they are often at many times the circuit's normal operating frequency. Start sweeping down in frequency starting from the GDOs highest frequency range till you have confirmed there are no unexpected readings. Be aware that, for a working transmitter strip, you should find RF energy at the circuits normal operating frequency with possibly progressively weaker readings for its second, third and maybe fifth harmonics.

Sorting small value capacitors Kit builders often find it difficult to read the value (which was) printed on small ceramic plate capacitors and comparing size/numbers with the parts list isn't conclusive! The solution is to measure the resonant frequency when each is connected in turn to the same inductor. There is no need to know the value of this inductance, unless you actually need the capacitor's value - if so use the formula right. An inductance of a few µH, say 10 turns of stiff wire (e.g. 18 gauge) wound on a half inch diameter former, is connected in turn across each capacitor and the resonant frequency noted - using inductive coupling. The higher the resonant frequency, the smaller the capacitor value. Line the capacitors up in a line of increasing frequency along your workbench. Put those with the same frequency close together as it implies the same capacity. Then compare the sequence of capacitors/groups with the kit's parts list.

$$C(pF) = \frac{25{,}400}{f^2 \times L}$$

f in MHz & L in µH

G3DII

Audio Signal Generator

In the last Hot Iron I mentioned the possibility of a kit which produces high purity sinewaves based on a clock tuneable switched capacitor filter chip. It is now available for £24 + £1 P & P. There are 3 adjustable ranges covering 250 to 5000 Hz, with two fixed tones of 800 and 1000 Hz which can be output either singly or together for SSB transmitter setting up. Output amplitude is variable in three ranges up to 0.7 volts RMS. PCB size is 50 x 80 mm and it runs off 9 or 12 volts. G3PCJ

2001 Yeovil QRP Convention

Mark your diary now for this event which should be attended by all keen South of England constructors! As recently, it is being held in the Digby Hall at Sherborne on **April 22nd**. There is a full programme of talks, demonstrations, traders, competitions, morse tests and other attractions. There is also a Dinner on the previous evening which is open to all by prior booking with G3CQR who can assist with arrangements for accommodation if required. Do make yourself known to me if you do come - if you are thinking of purchasing a kit, give me a call beforehand to check its in stock.

You still have time to make an entry for the Construction Challenge. You have to build the most sensitive grid dip type oscillator that you can! It has to cover the 3 to 5 MHz range, not using more than two discrete transistors and must obtain the correct frequency to within 100 KHz. The maximum distance at which the operator calls the 'correct' frequency as the instrument approaches the test resonant circuit will be measured. The resonant circuit will be altered between competitors and the resonant frequency revealed after each entrant has had his attempt. Full details from G3CQR.

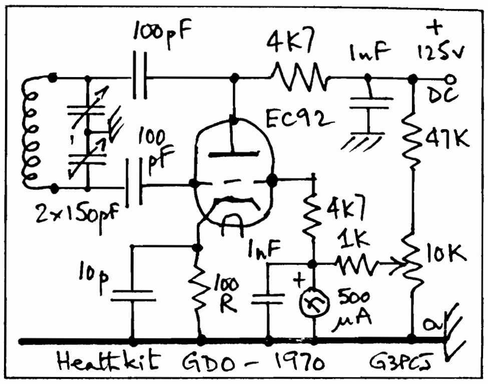
Snippets!

Craig G0HDJ recommends the following website for all sorts of interesting projects on crystal sets and old time radio projects. Some books are available from PW. www.midnightscience.com

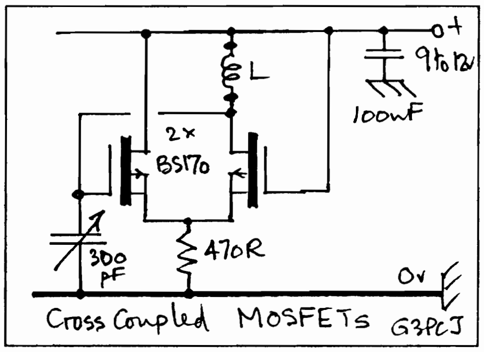
Eric G4ERN recommends doing electronic work on an insulating mouse-mat since it avoids unwanted shorts from offcuts of resistors capacitors etc. He also removes solder from through board holes while it is still molten with a wooden toothpick. They can also be sharpened to adjust TOKO coils.

Oscillators for GDOs

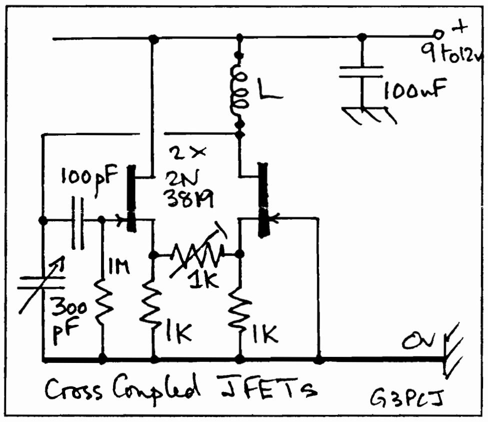
Most GDOs have to cover a very wide frequency range so need several plug-in coils. If these inductors have only two leads, it makes the plug and socket design rather easier! Hence the theme here is oscillators which use untapped inductors. The classic untapped inductor oscillator is the Collpits because the feedback is arranged by 'tapping' of the resonating capacitor. Unless a split stator variable capacitor is used, there has to be at least two fixed capacitors which leads to a limited frequency range for each inductor - hence the Collpits is not often used. (My 1970s valved Heathkit GDO does use the split stator capacitor Collpits scheme shown right!)



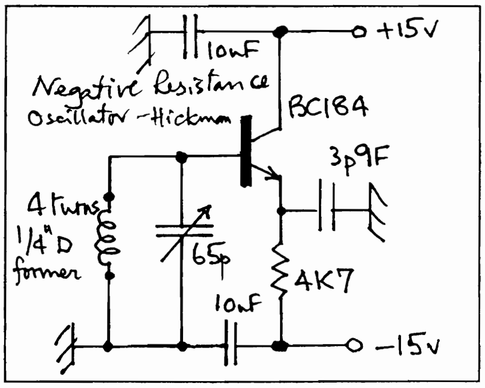
Decades ago Messrs. Franklin and Butler also devised untapped inductor oscillators using a pair of active devices in a differential amplifier configuration. They are variations of the same circuit - a very simple modern form is shown right using two MOSFETs such as the BS170. Owing to the roughly 2 volt positive gate bias requirement of these devices, a very simple differential amplifier can be used, but the relatively high gate capacity of the left hand device across the tuned circuit again limits the capacitance swing hence change in frequency for each range.



The JFET version of this is very satisfactory owing to the lower gate capacitance but it does need a few extra bias parts and a gate 'stopper' to prevent uncontrolled VHF oscillations! The circuit shown right uses a source resistor for each device so that amplifier gain can be controlled by the preset linking the sources so as to adjust RF levels for a meter. With the preset set to zero for strongest oscillation, it is essentially the same as the MOSFET version above. Increase the preset till it stops oscillating and it becomes an absorption wavemeter. A version of this is used in the RF signal generator kit covering 400 KHz to 50 MHz. Another version is given in the Circuit Ideas section of the Feb. 2001 Electronics World, this one has the advantage of also working with a crystal instead of a normal LC tuned circuit.



Another possibility is the negative resistance oscillator right written up by Ian Hickman in the Dec. 2000 Electronics World. I have not tried this out but its advantage is the single active device. In this article, the single emitter capacitor is quoted as being a few pF for an oscillator running over 65 to 165 MHz. I suspect that for operation on lower frequencies, it should be increased. Add a single device meter amplifier and this could be the one for the QRP Convention Challenge! I shall leave that to you!



Snippets!

Paul Tuton found a most interesting website giving information of many different types of capacitor. Have a look at http://www.interq.or.jp/japan/se-inoue/e_capa.htm

While talking to a local computer supplier, he mentioned that after every local thunderstorm, he always receives several modems to repair. As well as earthing your antenna when thunder is about, you should unplug your modem from the phone line, especially if it comes to you on poles. Maybe you should add a set of double pole relay contacts in the phone line, the 240 volt ac coil being powered only when the PC is turned on. It should be a largish one with excellent insulation between coil and the contacts. Make certain the relay frame is mains earthed. G3PCJ

A TALE OF A PAIR OF BRISTOLS

I can recall sitting in my radio shack with my friend Bob having a chat about radio when I suggested that perhaps we should both build a new rig from a kit supplier rather than gloat over the latest offerings from the Orient. To my surprise Bob thought it would be a good idea especially since he liked my six metre radio which was an earlier offering from Walford Electronics. We had decided pretty much at that time that we would build a Walford kit, the question was what to build and how much would it cost. After an e mail or two between myself and Walford Electronics we had decided to build the Bristol but unfortunately this rig was yet to be designed and made available as a kit. Since both Bob and I are B licence holders I must confess that a HF rig was really only useful to us as a receiver however we were also looking for amusement from a constructional point of view. Very early on we both purchased the Porlock six metre transverter with a view for fun on that band. Bob had very little experience in construction so we had to decide on a plan of action so that we both ended up with a working radio. The notion was for me to lead the way by assembling each section ahead of Bob. Surprisingly this worked very well - we took our time, corrected any mistakes and after a month we had the RX working a treat, the TX took a little longer. I had decided on a few minor changes to the kit, more cosmetic than anything else. The open plan construction would be changed to a fully cased rig with a 4 pin mike connector and all sockets etc. are located at the rear of the radio with the digital read out and signal meter both together for easy viewing. The finished result is an uncluttered facia.

The one electrical mod is the VFO pot which I have changed to a ten turn wire wound. I had found that this type of potentiometer worked well in my six metre rig - in actual fact the Fine tune pot could be omitted. In our case, it is fitted but will be changed for a drive level control at a later date. In truth, the case took as much time to do as building the kit. We wanted very little visible fixings so much so that we assembled a base board to mount the PCBs so no screws are seen on the underside of case. See the photos overleaf.

Fig. 1. Lid removed, two single band cards are fitted although 4 bands can be installed.

Fig. 2. Perhaps a better photo, the main radio PCB is nearest the front facia, the band cards which are mounted vertically, are plugged into the band card switching PCB, the five digit counter is to the right hand side of the TCVR PCB with the signal meter PCB mounted above the counter. The signal meter is clearly visible mounted in the facia.

Fig. 3. Front facia layout, on-off switch is on the right hand side of the case just out of view. This is a black flush mount switch, the 4 pin mike socket is mounted on the left hand side of case and is visible in Fig. 1.

Fig. 4. This is Bob's rig mounted onto the base board.

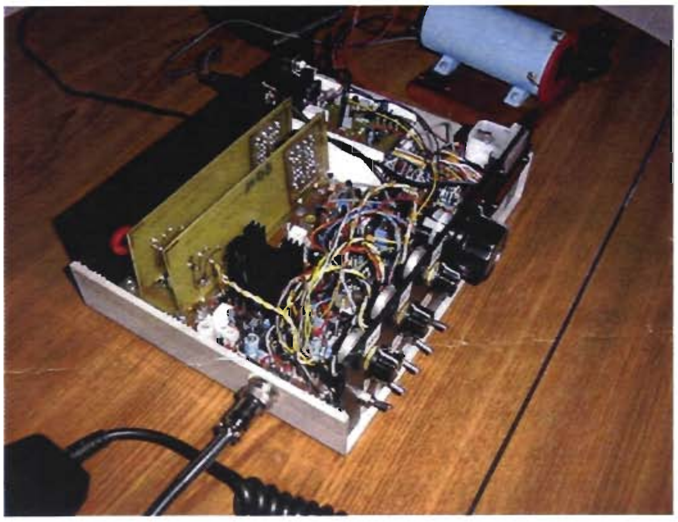
Fig. 5. Again Bob's rig with the base board now fixed to the lower half of the case with the all important constructional Manual as back drop.

By way of interest we have just recently tried some simple VFO stability testing. The rig was set to a predetermined frequency at room temperature, then turned off and left in my shack for 24 hours at sub zero. The rig was then powered up at this low temperature and we found the frequency was still set exactly as we had left it! Raising the temperature to normal in about an hour had no effect on the stability - we were both amazed.

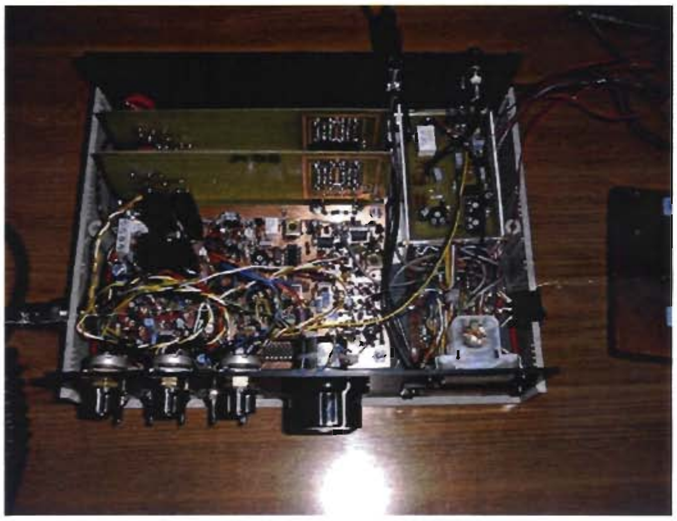
The future - we still have to assemble the Porlock and plan to have a good selection of band cards for both radios.

My thanks go to Tim Walford for allowing me to include this article with Hot Iron. Also my thanks to Bob M1CQR for his attention to detail while we were engaged as early builders.

ANDY HOWGATE G7WHM



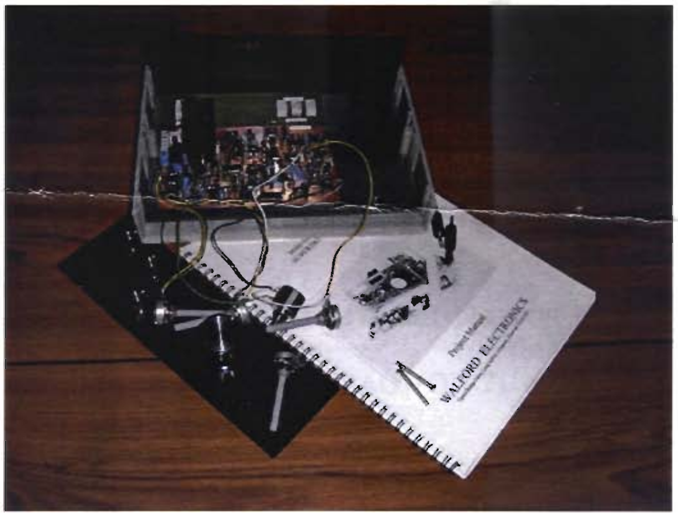
(Fig 1)



(Fig 2)

(Fig 3)

(Fig 4)



(Fig 5)