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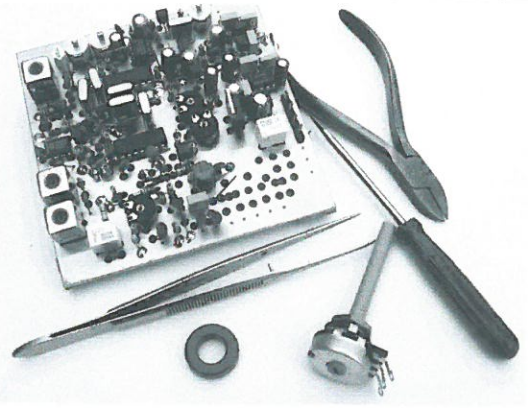
The Walford Electronics website is also at www.walfordelectronics.co.uk

Editorial



Some of you have been kind enough to compliment Richard Booth on his efforts in putting together the CD which all current members should have received by now. Thank you for those comments which I have passed onto Richard. He is a busy fellow with a young daughter, and not all that much time to spare on his several interest, so a big 'thank you Richard'

Recently I have been re-reading some of the excellent books published by the ARRL on technical and construction topics. They are thoroughly recommended. There is a different approach in the US. They go for superior technical performance despite an apparent increase in complexity; whereas most European designers strive for the best performance that can be obtained with a smaller number of parts - in effect seeking the best performance for a lower complexity generally. I have always tended towards the latter because often the extra performance (of US designs) is hardly ever put to the test! But see later about mixers!! Tim Walford

Kit Developments

The All Band VFO (ABLO) is available and will shortly appear in PW. I have been pleasantly surprised how stable it is, and of course, that applies to all bands! It has been invaluable on my bench already. I have also designed (and is available now) a new wide range (200 KHz - 30 MHz) Signal Generator in the small upright format for those wishing to sweep filters etc. The preparations for an all band CW rig using the ABLO have necessitated revisiting my mixers, so I have a new Product Detector with low noise audio amplifiers and filter for CW. This will go with the Pylle CW TX to form a TCVR, but the many LPFs that are necessary, have required small alterations to the normal dual LPF kit for cascaded control. I have also laid out a small single band Regen TRF called the Knapp (derived from the Catcott). The PCBs for the Knole are back but not yet assembled! Both the **Knole** and the **Knapp** can be used with either K series transmitters. The circuits for audio phase shifting (for a phasing RX) are also etched but not tried out! Details on all these kits will be on the website when they are available.

Meanwhile don't forget to let me know if you wish to come to the **Somerset Supper** - see the last page! First come first reserved and places are limited! 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

Germanium Transistor Troubles by Richard Booth G0TTL

As some of the readers of Hot Iron may be aware my day to day job is the running of "Past Times Radio" which amongst other things means I am regularly involved with restoration and repair work with what is now classed as vintage radio. Wood or Bakelite cabinets fitted with those funny glass things that glow and give you such a warm and cosy feeling. Transistor radios from the late 50's and 60's are becoming more popular again too, most likely due to their compact dimensions and many recent appearances on TV programmes.

Here in the UK, transistors found their way into the first portable radios in 1957. One of the earliest pioneers of this new technology was Roberts Radio as they launched the RT1. The early Mullard germanium transistors such as OC44, OC45, OC71 and 81 series were used by all the manufacturers to good effect and even to this day 99% of them are still operating to their original specifications. Nothing much apart from incorrect battery polarity or biasing faults will stop an OC44 transistor working. I have even had radios in for repair where direct ac mains had been applied to the 9V battery connections and some of the OC71 transistors survived! However not all things made from germanium turned out to be this reliable.

Around 1961 Mullard developed their new range of high frequency RF and IF transistors which were named the AF114 – 7, and OC171 series. Designed to have higher gain and lower noise than the OC44 series they soon became the industry standard transistor from 1963 until the late 60's when silicon devices started to appear. Just about all portable radios and early transistor communication receivers were fitted with them. So what was the problem? Well at the time nothing was apparent but 20 years into their life and many just stopped working for no obvious reason. 40 years on and this is even more of a common place problem.

How this happens could be due to impurities in the manufacturing process. Microscopic whiskers grow on the germanium wafer which eventually given enough time will either short the collector or base connection to the outer metal can or short the collector and base together. On an AF117 or OC171 transistor the can is usually grounded via the screen connection. This of course stops the transistor working. The same is true for other metal can germanium transistors to a lesser extent, such as the AC127, 128, 177, 178 which although lacking a direct screen connection, they are audio output devices and more often than not clipped into a grounded heat sink.

There is a temporary fix which sometimes works for AF117 or alike. Once you have located the suspect device (if you don't have a multi-meter to hand try tapping the metal can of each transistor with a screwdriver until you find the one that causes a crackle in the speaker - that will be the faulty item!) Snip the screen lead which really isn't required for anything other than VHF use and if you are lucky it will burst back into life. Make sure that no part of the transistor can touches any other metal work on the chassis. This is only a temporary repair though as sooner or later another whisker will grow and shut the transistor down permanently. Another thing you might find happens is that whilst tapping away at the transistor cans, the radio starts to work again. The impact shock quite often fractures the internal whiskers giving another few months of service before a repair is necessary.

The best option is to replace the faulty device or better still replace all of the AF117 or similar transistors. There are several good alternatives that are still available - don't be tempted to use "new old stock" 117's as they are just as likely to be faulty, either new or used. My favourites are the germanium AF124, 125 and 127 which have identical properties to the original devices, without any of the unreliability. AF200's also work well and are especially suited to "factory sealed IF modules" which were common in the 1960's. The pin outs are slightly different so care will be needed when fitting them. Unfortunately though like so many other semiconductors recently this series has been made obsolete. However you can still get them from many component sources including CPC.

Continued on the next page.

Germanium Transistor Troubles continued

Here's a trade secret! The repair mans friend, BF450. It's pnp silicon, very cheap and in many cases, assuming a fresh battery is used, will quite happily work in your transistor portable with absolutely no bias adjustments. Yes I know it's hard to believe but this odd transistor does work with germanium voltages. Some re-alignment is to be expected and won't work in everything but I found just about all of the popular portable radios of the 1960's will run on BF450's. One notable exception are the high quality, high gain Hacker radios which will burst into self oscillation without any resistor changes. Better to stick to using AF125's in this unless you really know what you are doing!

Audio stage transistors. As mentioned earlier, AC128's and their derivatives also suffer from the whisker syndrome. It's also worth noting that this type of transistor was fitted well into the 1970's or later whilst the rest of the radio will be silicon based. If you have a radio to look at, and the power connections and switch (and headphone socket) seem ok, but there is no noise out of the speaker try popping the output transistor pair out of their heat sink. If this makes the amplifier work, its time to get the soldering iron out and replace them. Luckily there are no problems getting new components at present and the best thing to do is replace the pair. Remember to put a smear of high temp grease on the new transistors before fitting back into the heat sink.

Finally I am certain that impurities in manufacture are to blame in the AF117 series as I have never come across a single faulty US made RCA germanium transistor of the same type. German made transistors also fair well in comparison.

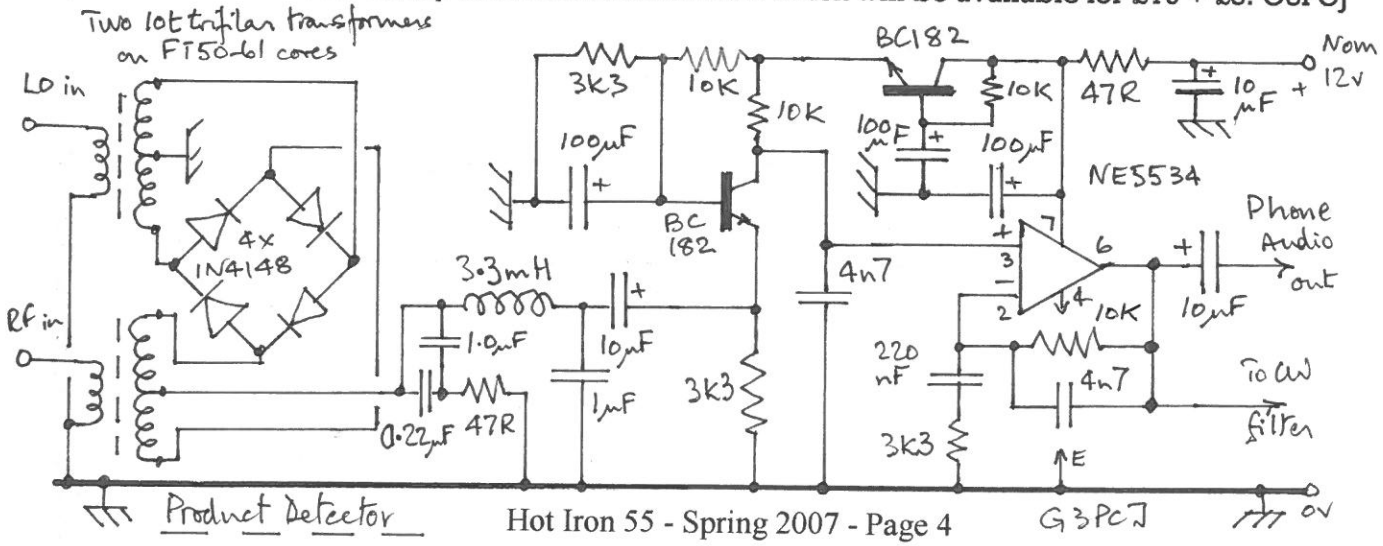
Memories are made of ..... (I just couldn't resist this - found in the Snailbeach District News! Tim)
According to today's regulators & bureaucrats, those of us who were kids in the 1950/60/70s and even the early '80s probably shouldn't have survived, because our baby cots were covered with brightly coloured lead-based paint which was promptly chewed and licked. We had no child proof lids on medicine bottles, or latches on doors or cabinets and it was fine to play with pots and pans. When we rode our bikes we wore no helmets, just flip-flops and fluorescent 'spokey-dokey's' on our wheels. As children, we would ride in cars with no seat belts or air bags - riding in the passenger seat was a treat. We drank water from the garden hose and not from a bottle and it tasted the same - strange how water tastes just like ...well ...water! We ate chips, bread and butter pudding and drank fizzy juice with sugar in it, but we were never overweight because we were always outside playing. Your Mother MADE ice pops out of dilutable orange drinks. We shared one drink with four friends, from one bottle or can, and no one actually died from this. We would spend hours building go-carts out of scraps and then went top speed down the hill, only to find we had forgotten the brakes. After running into stinging nettles a few times we learned to solve the problem (dock leaves). We would leave home in the morning and could play all day, as long as we were back before it got dark. No one was able to reach us and no one minded. We did not have Play stations or X-Boxes, no video games at all. No 99 channels on TV, no video movies, no surround sound, no mobile phones, no personal computers, no DVDs and no Internet chat rooms. We had friends - we went outside and found them. We played football and rounders every summer - sometimes that ball really hurt. We fell out of trees, got cut, and broke bones but there were no lawsuits. We had full on fistfights but no prosecution followed from other parents. We played knock-on-the-door-and-run-away and were actually afraid of the owners catching us. We WALKED, yes, walked to friends' homes. We also believe it or not, WALKED to school; we didn't rely on mummy or daddy to drive us to school - which was just around the corner. We made up games with sticks and tennis balls. We rode bikes in packs of 7 and wore our coats by only the hood (kind of like a cape - looked cool when you went really fast). The idea of a parent bailing us out if we broke the law was unheard of. They actually sided with the law. This generation has produced some of then best risk takers and problem solvers and inventors, ever. The past 50 years have seen an explosion of innovation and new ideas. We had freedom, failure, success and responsibility, and we learned how to deal with all of it. And if you are one of them Congratulations! (Well done living this long!) The majority of students in universities today were born in 1986, for them, there has always been only one Germany and one Vietnam. AIDS and CDs has existed since they were born. Michael Jackson has always been white. To them John Travolta has always been round in shape and they cant imagine how this fat guy could be a god of dance. They believe that Charlie's Angels and Mission Impossible are only movies. They can never imagine life before computers. They'll never have applied to be on 'Jim'll Fix It'. They cant believe a black and white television ever existed and they will never understand how we could leave the house without a mobile phone. If you smile when you read this, your probably over 40 years, but remember - you are not old - just very fortunate!

Mixer Experiments

I have been hatching a scheme for an all band CW DC rig for some while. The major problem of the LO has been solved by using the ABLO. The receiver product detector and audio stages are shared by all bands so no nasty switching there. However, conventional wisdom suggests that you cannot do without RF bandpass filters for each band - hence there is a big switching problem for a 'many band' rig. The concern behind this is that good filtering is needed to remove the unwanted signals that might cause either BCI or cross modulation. BCI is well known as 'un-tunable mushy noises'! Cross modulation makes itself known as whistles or spurious signals appearing at regular intervals across the tuning scale, often near a pair of huge AM carriers. Both effects are often found on 40m at night. An approach to minimise these effects, is to use a 'strong' mixer as the product detector. This means that it is less likely to suffer overloading from the strong signals which causes both nasty effects. My hope was that with a strong mixer, it might be possible to avoid having switched RF bandpass filters ahead of the receiver's product detector, relying just on the station's Aerial Matching unit to give sufficient out of band rejection.

I was prodded by Richard Booth into investigating the 'strength' of SA602 and MC1496 mixers, both of which use Gilbert Cells internally. I set up both with 1K loads, paralleled by 22 nF, and ran them on an 8 volt supply. I fed them with two signal generators near 3.7 MHz (without input matching) and wound up their inputs for 'maximum audio' signal out. The 1496 produced 2 v p-p for 0.3 v p-p of RF and LO of 0.15v p-p; giving a conversion gain of about 7. The 602 produced 0.8v p-p for an RF input of 0.4 v p-p and LO of 0.4 v p-p; giving a conversion gain of about 2. Hence the 1496 is roughly 2.5 times better on output overload aspects and 3.5 times better on gain! This is a very simplistic assessment and the actual circuit matching will alter these numbers. I also tried Richard's Clara design (more about this on another occasion) on 40m using a 1496 but heavily modified to avoid the RF filter - but it was overwhelmed nearly all the time. Hence that approach would not meet my multi-band rig objective - it needs an even stronger mixer! (After these experiments, my new **Knole** DC RX which uses the 1496, is to have triple tuned RF bandpass filters!)

Quad diode mixers are known to be strong, especially the form known as H mode, but that is complex and needs extra LO circuits. How would a conventional quad diode ring doubly balanced mixer do? The answer is very much better in terms of overload but it does attenuate the signal! Adding extra RF gain ***ahead*** of ***any*** mixer will aggravate its overload performance so the diode mixer has to have more gain ***after*** it. Because the signal levels are so low after a diode mixer, it is necessary to use low noise amplifiers to avoid them producing noise on all but the strongest signals. The mixer in/out impedances are usually 50R on all ports and poor matching to these will degrade its performance. Also, because the mixer output potentially contains a very wide range of signals - all the RF mixed down to baseband as 'audio' on either side of the LO's frequency, there is a very strong chance of overload of the first stage of the low noise audio amplifier. The cure for this is a diplexer which maintains a 50R impedance over a very wide frequency range while passing only the wanted audio frequencies into the next stage. All of this seems very complex and rather American, but if you want performance then you cant do without it! Using this approach, I find that for a very large part of the time, reception on 40m is untroubled by BCI using my 160m dipole and just the AMU for RF filtering! Adding a good CW audio filter completes this little project - most of the circuit is below. It fits nicely onto a 50 x 80 mm PCB which will be available for £19 + £3. G3PCJ



A good 'BRENT' at bedtime - by Victor Brand G3JNB

After a busy day, a CW QSO or two before bed is a sovereign remedy for insomnia, blocking out all those quirky items that can trouble your mental software when you need to zizz. Nothing too taxing, just a chat with a station or two before you pull the big switch. For a sensible conversation, 80m late at night is good but, at 100 watts, there is little sense of accomplishment. However, 1.5 watts to your bit of best bent wire, adds a lovely glow to your sense of well being as you QRT after working round EU.

The little BRENT rig is a real joy! It has a sensitive receiver, sidetone and optional full or semi break-in. Don't you just love the extraordinary clear sound of a DX RX? This one is great and I found no problem with the direct drive of the little Poly Varicon tuning capacitor and Tim's 750 Hz audio filter really peaks up the incoming CW above the QRM. The Walford kit arrived as my Christmas present from the XYL and I resolved to enjoy a leisurely build tempo. Having been quite spoiled years ago by David Howes and his PCBs with a printed component layout, I was a little worried to see the plain board with a veritable sea of holes. Once I got started though, the accompanying sketch layout proved excellent. To combat ageing eyes it was only necessary to poke a bit of wire through the board to check that the location was the right one and did connect to the appropriate point in the circuit.

Construction is divided into a dozen stages each with its appropriate testing of volts or sounds. Things went well and, somewhat to my surprise, there was no sign of Murphy. The little board was croc clipped to volts, key, phones and aerial tuner and a measured output of just under 2 watts loaded the wire. Now the real thing I liked about this rig is the VXO. I got a swing across much of the CW section of 80m and, for a couple of weeks, enjoyed bedtime Qs all round EU with many a two way QRP session as well as attracting the big boys. Only one station has reported my drifting and he has a very narrow filter but I think it was because I had just switched on as he reported that I moved back again ..HI! The keying characteristics are great for low power DXing with FB comments on the sound of the signal.

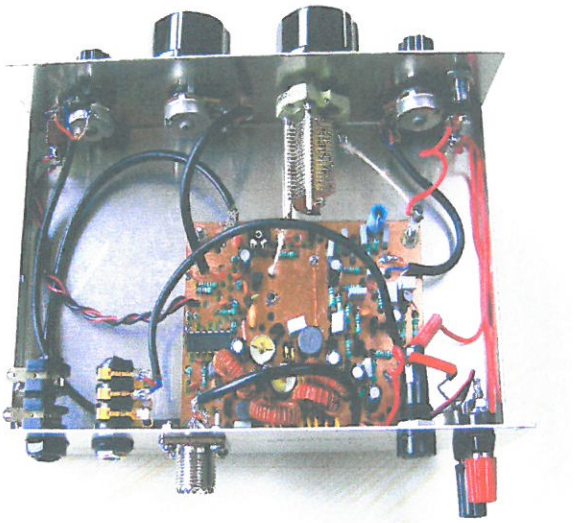
Now to pretty it up and put it into a box. You are all familiar with the golden rule the 'it won't work when you box it up'? Well, in my case it did actually work once I had drilled, reamed out and mounted the full size pots and terminals and bolted in the board. Except, that is, for the fact that I had sound in only one earphone. It was at this point that I lost my presence of mind! It was late and I just connected the braid of the screened audio lead to the phones jack to the spare terminal. Up came the full sound...that's great. I did wonder why the ear-pads seemed to be getting rather warm so I switched off. Turning on again, I could hear nowt! "I told you I would get you...so I did" chortled a familiar voice behind me. Yes, there lounging against the shack wall was our old friend and adversary Mr Murphy. With glass in hand and a fag dangling from lower lip, he gleefully pointed out that I had ignored Tim's specific instructions not to ground the headset and, "and to be sure, you have killed the audio output transistor!" How stupid can you get?

As it happened, Tim had popped in some reserve BS170s when supplying the extra components for the boxed model. So I gingerly lifted the PCB with its connecting leads and swapped the transistor. No heavy breathing from 'you know who', so I switched on. Bingo!

Continued .....

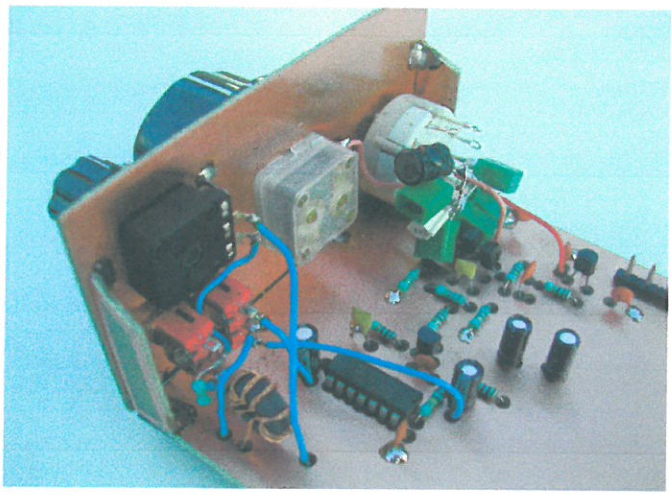
A good 'BRENT' at bedtime continued

Now things were back on track. I have had a beautiful, pristine Jackson 150 pF air spaced variable in the junk box for donkey's years. This now gives me a swing from 3502 to 3615 Khz. Instead of a slow motion drive, I am tuning it directly with the supplied big knob and have added a similar one to the IRT pot, which doubles as bandspread. Works great. The full break in was a bit too much so I simply paralleled a 2.2uF capacitor beneath the board cross the existing C. This gives me near semi break-in with just sufficient listen through to notice if that kilowatt station is continuing with his endless CQing ...HI! The sidetone was blowing my head off but I was reluctant to take the board out again. So, I carefully cut the lead to the appropriate resistor and 'stood it up beside an extra series 390 ohms, covering the botch with a piece of sleeve. The Brent is giving me a lot of fun and the sheer delight when you reveal to the big guns that you are working them with torch power.



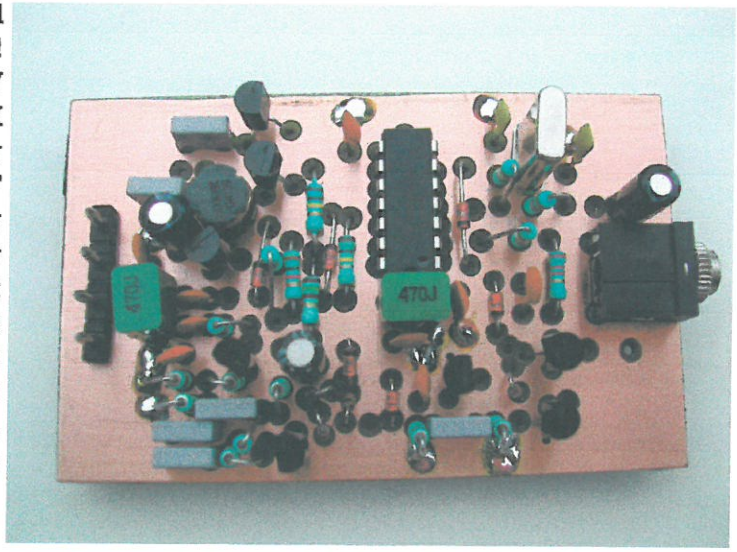
Signal Generator

At last the new Mk2 version is available! Development of the ABLO has allowed simplifications to concentrate on obtaining a wide frequency coverage. It now has at least 8 overlapping tuning ranges that cover about 200 KHz to over 30 MHz. The prototype does 180 KHz to 33 MHz but this will vary depending on your physical layout. It has an output for a counter as well as a variable output from a potiometer. The variable signal is switch selected from the nominal sinewave output, or a squared up version obtained from high speed CMOS inverter gates. It can drive 50R loads up to about +12 dBm or 2.25 volts p-p. Another switch can further attenuate the output by 100 times. Price £34 + £3 P & P.



Pylle

I made the prototype last weekend and didn't find any cause to alter the PCB!! (Almost a first!) This is the many band 1.5W CW transmitter that includes sidetone, RX muting and RIT, with diode TR switching (for full break in operation) and a receiving RF amplifier! It is intended to be part of a larger multi-band CW TCVR. It would normally take its local oscillator from the ABLO but it can also be used on a single band with its own crystal or ceramic resonator. It does not include any transmitter Low Pass Filters - use the new relay controlled dual band filters, which can be selected by the ABLO's bandswitch! Price £24 + £3 P & P. G3PCJ



How to make a circuit work on another band—by Gerald Stancey G3MCK

(I have included this in the 'theory' slot as its all about the simple maths of reactance! Tim)

You may often see a circuit that has been designed for one band and thought wouldn't it be nice if it had been designed for another band. This article gives some advice on how to do this by using a technique called scaling. Assume that you have the circuit for an 80m transmitter which you wish had been designed for 40m; what changes in component values do you have to make? Let us consider the components under a few headings.

Resistors. It is unlikely that any of these will have to be changed in value. However it is possible that one or two may have to be changed to alter a bias to get the right level of drive so bear this in mind.

Output filter. This will need completely redesigning and the simplest way is to replace it with one of the designs that is shown in a standard handbook.

By-pass capacitors. No changes should be necessary as there is usually wide tolerance regarding the values of the components that are used. The junk box king may take advantage of this and be able to use what is to hand. For example, if 0.1 /uF has been specified, then 0.047 or 0.68 /uF should be satisfactory. How we get to these figures will be dealt with next.

Tuned circuits. Here component values will have to be changed but the calculation needed is ridiculously simple. Going from 80m to 40m you are doubling the frequency, so you will need to half the values of all the inductors and capacitors that are directly involved with the tuned circuits. Yes, it is that easy! This is scaling. If you had been designing a 40m transmitter to work on 80m, you would have doubled the component values.

You will now see why 0.047 or 0.068 /uF can be substituted for 0.1 /uF in the previous section. You are aiming to get about the same value of reactance for the by-pass capacitor. This technique can also be used to redesign the output LPF but you may well get some funny values so it is better, as previously suggested, to replace it with a standard design as this will use preferred values.

Coupling capacitors. These are treated in the same manner as the capacitors in tuned circuits. When the frequency goes up by a factor of two, the capacitors should be halved; when going down, the values should be doubled. Usually their value is not critical and if in doubt err towards larger values rather than small ones. Do make certain that they are not actually part of the tuned circuit though!

Transistors. It is unlikely that an changes will be needed. (Except perhaps if the transistor is working near its high frequency 'practical' limit, when its gain is likely to decrease when going up in frequency. Such affects maybe masked by negative feedback in some circuits too! It's a bit more complex but worth a try!)

As with all things there are exceptions and simple scaling is unlikely to be applicable when the scaling factor is large. For example, scaling a 1.8 MHz rig for 144 MHz is definitely not on but scaling between near HF bands should not give any severe problems.

To summarise: the scaling factor is the ratio of the two frequencies. If you are going from LF to HF, component values get smaller and vice versa. Keep your wits about you and you shouldn't go wrong.

(The above approach is fine for 'straight' rigs, typically TRF, regens and DC receivers; and 'crystal controlled' transmitters. But do NOT change the frequencies of all stages in superhet receivers or transmitters because of the frequency addition/subtraction that takes place in their mixers. Gerald is also working on a note about transistor substitution. We look forward to it! G3PCJ)

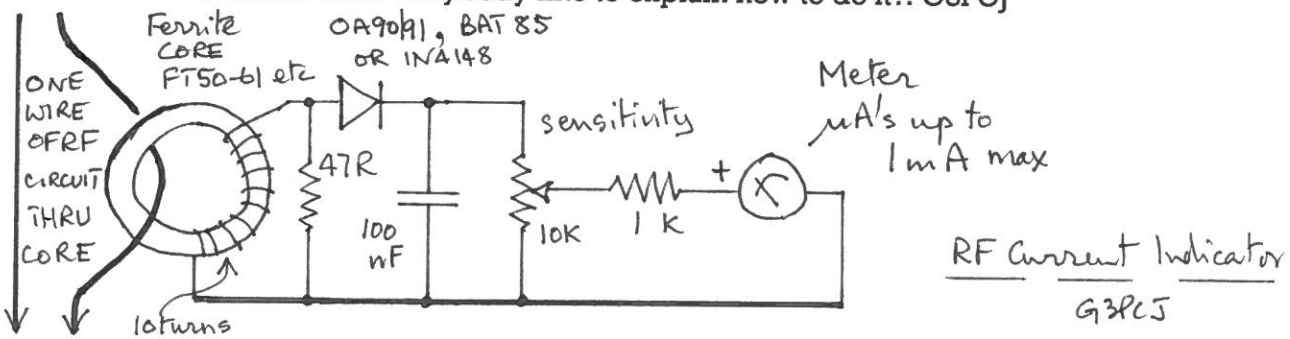
Sutton Band Cards I still have a few band cards which I would like to clear! £10 each, two or more £8 each, plus £3 P and P! G3PCJ

DDS chips I have the following surface mount sample devices surplus to my needs:- AD9857AST, AD9283BRS, AD9835BRU. I think they are all direct digital synthesizer chips needing control from a micro-processor. I also have a 50 MHz xtal oscillator to drive them. Anybody like to have a play? Free to a deserving home! G3PCJ

Antenna current indicator

Dave Buddery G3OEP writes that an antenna current 'meter' is a very useful piece of gear for adjusting AMUs and helping with antenna trials etc. In days when battlefield communication was mainly by HF instead of satellites, it was widely used by the military. (Many old timers like me, will have made their first DC mutli-meter using a moving coil micro-ammeter salvaged from a RF ammeter as used in many WWII transmitters.) I say 'meter' because calibrating such an instrument is notoriously difficult but it is excellent for giving relative indications - RF current increasing, or not, as adjustments are made. The modern version uses a broadband ferrite transformer to produce a small RF voltage that is proportional to the current flowing in the primary of the transformer. This primary is usually just the antenna 'lead', or one side of the feeder, or some other lead of an RF circuit, that is passed through the centre of the toroid! Very simple! The secondary winding feeds a small RF rectifier and DC volt meter. Such a circuit is sketched below. If you are working with RF currents below about 0.1 Amps, then you can thread the primary wire through the ring twice but this will have a more disturbing effect on the circuit under measurement. Note that it uses a *ferrite* toroid and not a powdered iron one! The latter just does not have enough inductance for HF work like this.

Recently, Sprat had a variation of this circuit that fed the resulting DC voltage down the antenna feeder back to the main operating position. This is an alternative to using field glasses out of the shack window! Another variation is to make the device 'clip-on-able'! This is done using exactly the same circuit but with the ferrite ring very carefully cut in half; the two faces of the core are then carefully ground for best fit against each other and glued to the arms of a clamp device rather like a clothes peg! The secondary winding is permanently wound onto one half of the core and connected to the indicator mounted on the clamp handle. I have not tried this myself and suspect that cutting a ferrite ring in half is much easier said than done - anybody like to explain how to do it?! G3PCJ



The Somerset Supper and Yeovil QRP Convention

The third supper will be held on April 14th 2007 in Sherborne for locals and those staying overnight. This is the evening before the Yeovil QRP Convention. I will be having a stand with most of the new projects mentioned recently in Hot Iron on display/for sale. This year the **Somerset Supper** is being held in the **Antelope Hotel** at the top of Sherborne's High Street - 7:00 for 7:30 pm sit-down. Their dinning room has a far more convenient layout and is smoke free! A three course meal, without choices will make it rather easier and quicker to serve! (Alternatives are available for those who have special dietary needs.) There will be a small display of items from each diner's home built radio equipment! This qualifies you for a ***free*** place at the table! The display will be judged by **Ben Nock G4BXD**, the well known contributor to PW who specialises in World War 2 radio equipment, who will award a small prize. He is also staying for the Convention. Places by advance booking **only** by Mar 31st so please tell me if you want to come, how many, and any special dietary needs. Hope to see your item of gear (anything that you can transport easily!) with brief description and you! Tim G3PCJ