"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

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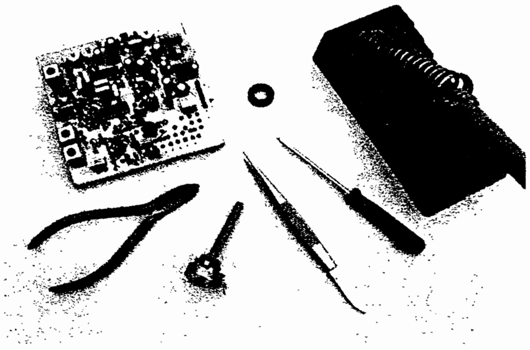
Contents

Editorial



The days are getting longer, warmer and dryer—thank heavens! On the farming side we are at last able to do a little field work. But often this is also a busy time of year for kit builders for reasons which I cannot fully explain! I had thought it was catch-up time after the excesses of Christmas but maybe not! I am pretty certain its more to do with temperature and many builders having shacks at the end of their garden! I must admit that even here, in the main part of our house, that outside temperature does have an effect on my willingness to experiment—it certainly has an effect on my brain cells. The list of possible interesting projects never seems to get any shorter though; I suppose that is because its easy to think up the outline or specification of a project but quite another thing to be able to tick if off as completed! Having read an article recently about the K2 TCVR, having many of the processor based facilities found in much higher priced black boxes, I remain convinced that rigs and kits highly dependent on software are best left to others. I am sure most builders like to understand their rig and feel confident about mending it if required.

Kit Developments

The new ***QRP Antenna Matching Unit*** is now fully out. All bands 10 to 160m, and suitable for all likely balanced or unbalanced loads. It includes a resistive matching bridge which drives a LED matching indicator or an external meter. Normally £32 but £30 for Construction Club members. I have also ***reduced*** the price of the Wurzel, the Compton and the Butleigh to £35 each. The **Fivehead** superhet phone TCVR is now also working well on all bands 20 to 160m, £80

Last time I mentioned a new small CW direct conversion TCVR for 20, 40 and 80m - for various reasons I have had to change the name to the ***Triwell*** which was suggested by our member Andy Howgate; it reflects the three bands and lots of water of which there is plenty in Somerset! It is proving quite challenging to get right! Much head scratching over the best design for RF front end and AF filters. It's a little way off yet but let me know if you are interested.

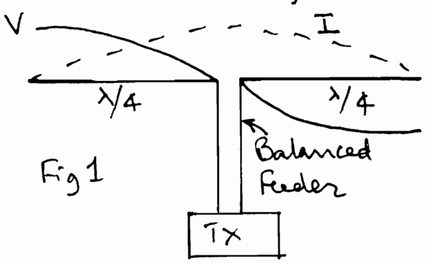
I am sad to note the 'demise' of Kanga. I use that word cautiously since I have not yet heard whether John Fletcher has sold the business to others or what has happened. I hope it is not the end since it is sad to see another UK kit supplier disappear. A variety of 'styles' is good for all of us and helps to keep competitors on their feet! Tim Walford G3PCJ.

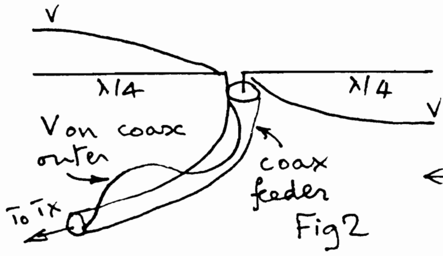
Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £6 per year with the first issue for each year appearing in September Those people joining later in the year will be sent the earlier issues for that year Membership is open to all and articles or questions 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

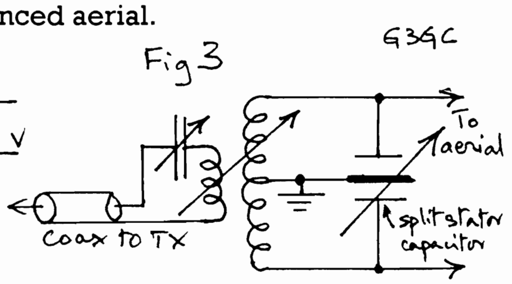
Unbalanced TX outputs and balanced aerial inputs by Eric Godfrey G3GC

A fundamental principal in engineering is that any balanced system should not be connected to an unbalanced system, and vice versa, without some form of network transforming the balanced system to an unbalanced one. So often this principal is ignored by amateur radio enthusiasts with the consequent reduction in the expected performance. This particularly applies to the connection of an unbalanced transmitter (coaxial output) to a balanced aerial such as a centre fed half wave dipole.

Let us first look at the consequences of making a direct connection of the coaxial feeder to the balanced aerial. Fig. 1 shows the voltage and current distribution on the two arms of a half wave dipole properly fed with a balanced feeder/transmitter set up. Fig. 2 shows the voltage distribution on the same aerial but now fed with coaxial feeder direct from the transmitter. In the first instance because the feeder is balanced there is no (or negligible) radiation from the feeder and each side of the feeder forces similar currents in the two dipole arms with the consequent well known figure of eight polar diagram in the plane of a half wave dipole. Fig. 2 shows the distorting effect on the voltage distribution in the aerial caused by connecting the unbalanced coax to the balanced aerial.

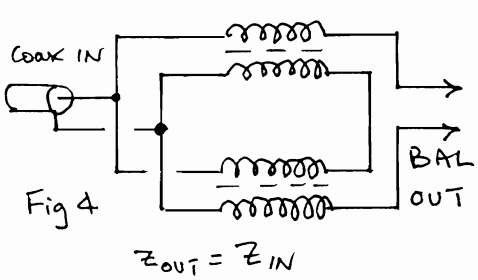


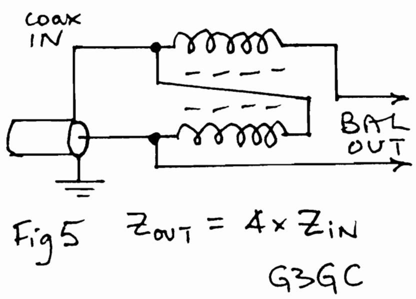


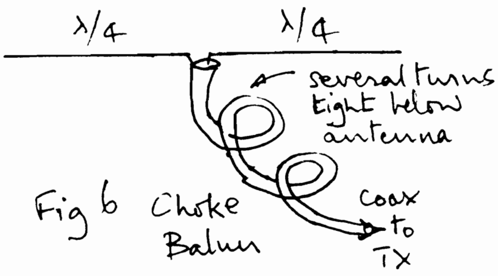


In Fig 1 each side of the two wires, which carry equal and opposite currents, of the balanced feeder have the same length of aerial wire connected to them. In Fig 2, these two feeder wires are replaced by the coaxial inner conductor and the inside of the coaxial outer conductor. Thus the inner conductor current feeds one arm of the dipole whilst the inside of the outer conductor not only feeds the dipole's other arm but also the outside of the coaxial feeder to which the dipole arm is connected. Consequently the current on this side has to be shared between the dipole arm and the outer of the coaxial feeder, not only reducing the amplitude in the dipole arm but also setting up other undesired currents and voltages on the coaxial feeder from which they will radiate. How the currents are shared will depend upon many things and in particular the length of the coax. Consequently the radiation diagram of the aerial, although displaying some of the characteristics of the figure of eight, is virtually unpredictable. However, one thing is certain it will not be the theoretical figure of eight. The current on the feeder will cause radiation with random polarisation depending on its orientation at any particular point.

There are a number of different ways of achieving the change from the unbalanced to balance configuration and I will just mention just a few here. Probably the best way is by using a balanced tuned circuit connected to the aerial and link coupled to the unbalanced transceiver as shown in Fig. 3. This not only makes the change from balance to unbalance but also, by the adjustment of the various Ls and Cs, is able to match differing impedances. Further brownie points for this type of unit are that it uses a parallel tuned circuit at the operating frequency which will reduce the emission of harmonics on transmit. On receive this tuned circuit provides extra selectivity ahead of the receiver which can be useful on 7 MHz against the high power broadcast stations just further up the spectrum. Another approach is to use special RF transformers, often wound on ferrite, to make the transformation, Figs. 4 & 5. However there are a number of problems with these which include losses in the ferrite, a nominal fixed impedance transformation ratio and the fact that they only work properly when terminated by the correct load impedance. This is most unlikely particularly with multi-band aerials. A further approach is to coil up the coax feeder for a few turns just below the feed point to form a 'choke balun' - Fig 6.







Mounting Digital readouts

(I have held the following notes by Janos Ladvanszky HA7XN over from last time. I can also report that one or two UK Bristol owners have sucessfully tried out his suggested modifications to the Bristol's LO chain. G3PCJ)

The other modification I would mention is a tip for mechanical attachment of the LED display to the front panel. My objective was making a construction that allows an easy replacement of any LED ICs if necessary, and an easy removing the wires connecting the freqmeter to the display if necessary. The outline is shown in Fig. 2.

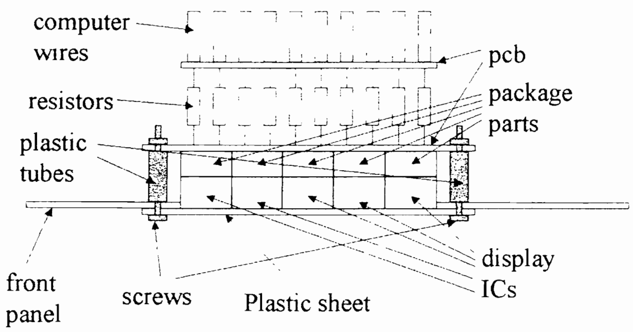


Fig. 2. Upper view of the display attachment

The face of the displays is covered by a plastic sheet that is fixed to the front panel by four screws. Display ICs are hold by IC package parts that are made from a DIL 14 package each (In the UK we know these as IC sockets! Ed). These small packages are soldered to a pcb and this pcb is fixed to the inner side of the front panel by the same four screws previously mentioned. The 3.3k series resistors described in the user's manual of the freqmeter, are soldered to the pcb and their other ends are soldered to another pcb. To the other side of this last pcb, the connectors are soldered, to which a seven-wire computer cable is connected for every seven-segment ICs. One additional wire is necessary for the decimal point. I note that construction of this display attachment needs patience, especially cutting the DIL 14 packages.

A hint: When I started experimenting with Bristol, first I used an energy saving bulb in my lamp. It turned out that this bulb produces a 20kHz signal with very rich harmonic content that can be detected in the lower bands (up to 7 MHz). So please take care if you use energy saving bulb.

Finally I wish similar success to those who perform the same modifications. Other minor modifications that I made are available from me at the e-mail address Ladvan@axelero.hu

(There is another arrangement where the LED segment resistors are mounted directly on the counter PCB, one end being inserted directly into the PCB hole allocated for each segment wire. The segments are then connected directly to the tops of these resistors protruding from the PCB. In both cases, there is no restriction on the length of the wires, since they carry only DC. While the electrical scheme used for my counters does have lots of wires, it has one massive advantage over the approach often used for driving LEDs where the drive signals are multiplexed. That approach is often used with a microprocessor controller and the fairly low frequency LED drive signals have relatively sharp rise and fall times. These are full of harmonics from LF upwards and these are inevitably heard by the receiver without great care on layout and shielding! In my design the digital logic is CMOS and confined to the counter PCB; the reference oscillator frequency is also much higher with its harmonics outside any amateur band. G3PCJ)

Cdr Bayntum Hippisley– follow-up!

A friend of David Hunt has kindly done more extensive research in Norfolk and interviewed Mr Dyker Thew, a local journalist, who had observed Cdr Hippisley first hand. He reports:-

"Hippisley arrived in Hunstanton with several members of his unit at the beginning of WW1. Others joined them until the unit was about 30 strong. No local people were employed as civilian staff. All wore naval uniform and were billeted in the town, with the exception of Hippisley who took over a wooden summer house in Old Hunstanton as his quarters. This became known as the "Hippisley Hut". Hippisley moved between his various sites in his Humber car, which was the only transport available to the unit. Thew described Hippisley as dapper, lightly built, of medium height and very active. He looked invariably smart in his uniform, and was "in command", confident and outgoing. He was also entertaining and amusing. Held in high regard by the townspeople, especially the ladies, he was believed to work very hard. At no time was he visited by his wife or family during the war, nor was he known to have returned to Hunstanton after the armistice. Thew was convinced that the Hippisley Hut was not used for any part of the unit's work. He had passed it often throughout the war but had seen no mast nor wire aerial, nor was it guarded as were all the other unit sites as the war progressed. No unit designation was ever displayed on any of the sites, nor did one become common knowledge at any time. The unit personnel were referred to locally as "the wireless men".

While Thew never learned anything directly of the unit's work rumours often circulated in the town, especially after particular successes. He instanced the installation of a direct Post Office line to the Admiralty, and the first reporting of the Battle of Jutland. Some of the rumours were confirmed a few days later by reports in the national press. Although these official reports never mentioned the Hunstanton unit, the townspeople were satisfied that it was "their" unit which provided both signals intercept and direction finding to the Admiralty. They were also convinced that DF had been invented by Hippisley's unit. Relations between members of the unit and the townspeople were very good. Billeting allowances were generous and were paid promptly. In what spare time they had the men played football, both for and against local teams. They were also seen at concerts and the cinema.

INSTALLATIONS

On arrival in Hunstanton the unit established itself in the lighthouse, taking over the existing Marconi wireless station which had been installed in 1911/12. A workshop was set up with lathes, benches and other mechanical engineering tools, in a wooden building which had been the Professional's hut adjacent to the 9 hole golf course. Hippisley then took over the three clifftop shelters, around each of which he formed a temporary building. A single slim vertical mast, some 50 or 60 feet high, was erected at each of these, wire guyed for stability. This appeared to be the only aerials, no horizontal wire aerials being visible. About a year before the end of WW1 a much larger site was established behind the town E of the Lynn Road, where more masts were erected and temporary buildings constructed. The earlier sites remained in use. Mr Thew could recall no details of the use or staffing of this later site. At the end of WW1 Hippisley and his unit dismantled all their equipment, restored the three clifftop shelters and departed in a very short time. No intercept site was re-established in or near Hunstanton before, during or after WW2, as far as Mr Thew had been able to tell.

AIR DEFENCE

To counter the Zeppelin threat a number of Sopwith biplane fighters were deployed to an airfield at Sedgeford, a few miles SE of Hunstanton. In 1915 the Admiralty sent HNS Cricket, a "Monitor" gunboat, to the Wash where it was anchored off the end of Hunstanton pier. It remained there until the end of WW1, providing anti-aircraft fire to supplement the Sopwith fighters. There being no other obvious reason for its presence the townspeople concluded that these air defences were for the benefit of the wireless unit.'

MAP REFERENCES

Hippisley's Hut TF685422, Workshop TF681423, Lighthouse TF676420, Cliff Shelter TF674419/673415/673413

It seems that when I was there, looking for the 'Hut' expecting to find something with the radio equipment, I was actually looking for their mess room! I did find all the other buildings but dismissed them since they did not look like the beach hut with radio that I was expecting! G3PCJ

Transformers and matching!

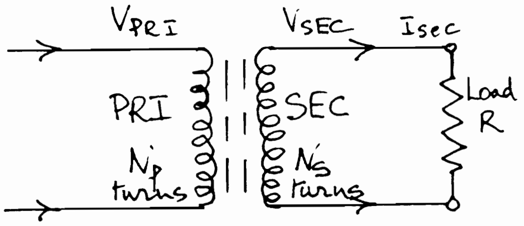
Andy Howgate asks about the toroidal version of these devices which are frequently used where a broadband RF transformation is required. Fundamentally they are like an ordinary laminated iron transformer for 50 Hz! The ratio of the number of turns on the secondary compared to the primary directly tells you the change in voltage. For example, if the secondary has half the number of turns that are on the primary, then the nominal output secondary voltage will be half that applied to the primary—this is just as true at 50 Hz (for the mains transformer) as for the RF transformer wound on a ferrite ring. Similarly, if the secondary has three times the number of primary turns, then the output voltage will be three times that applied to the primary. The power dissipated in a resistance R connected to the secondary will be $(V_{sec})^2/R$ but the secondary voltage is N times the primary voltage where N is the turns ratio, so the secondary power can also be written as $(NxV_{pri})^2/R$. The power into the primary is $(V_{pri})^2/Z$ where Z is the apparent input impedance of the transformer (with the load R connected to its secondary). Assuming just for the moment that the transformer is perfect and does not have any losses, then in the power available from the secondary must equal that input to the primary. Hence the two power expressions must have equal values or $(V_{pri})^2/Z = (NxV_{pri})^2/R$. This can be juggled around and V_{pri} eliminated to show that:-

$$Z = R/N^2$$

This tells us that, for our second step up example where N was three, the transformer input impedance is one ninth of the load on the secondary. For the first step down example where N was a half, then N^2 is 0.25 so that Z is four times the load impedance R.

A transformer works equally well in principle with the power flowing in either direction; thus what is a step up transformer one way is a step down one the other way! All of the above applies to any conventional transformer for 50 Hz or 5 MHz. For general RF work, the winding capacitance should be low and its inductive reactance many times (min 4) the circuit impedance connected on each side. This often requires a quite high inductance from small numbers of turns so the transformer core has to be made of high permeability material. For RF work in the 2 to 30 MHz range, the ferrite mix number 61 is suitable. Hence such transformers are often made with half inch diameter FT50-61 toroids. Sometimes the mix 43 material is used for broadband low frequency transformers.

Note! Ferrite cores are made of a dusty dark grey unpainted material. They should not be confused with painted powdered iron cores such as the red T68-2 or yellow T50-6 used in HF tuned circuits. Ferrite is generally not suitable for tuned circuits. Beware also that cores made of other ferrite material, e.g. those intended for low frequency mains filters etc, also look the same and cannot be distinguished just by visual examination. Only use cores that can be positively identified! G3PCJ



$$\text{Turns ratio} = N_s/N_p = N$$

$$V_{SEC} = N \times V_{PRI}$$

$$P_{LOAD} = V_{sec} \times I_{sec} = V_{sec} \times \frac{V_{sec}}{R} = V_{sec}^2/R$$

$$P_{LOAD} = \frac{(N \times V_{PRI})^2}{R} = \frac{V_{PRI}^2}{Z}$$

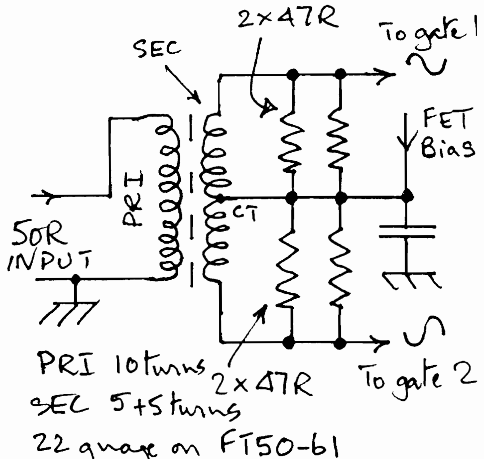
where Z = primary input impedance

Re-arranging & eliminating V_{PRI},

then $Z = R/N^2$

G3PCJ

As an example, the circuit below shows the broadband input transformer of the new 10 Watt linear amplifier. The design requires opposite phase RF signals, hence the centre tapped secondary. The load presented by the transformer (with following resistors) on the preceding stage is nominally 50 Ohm.



INPUT OF 10 WATT LINEAR

G3PCJ

The Dundon top-bander - By Paul Tuton G0UBV

For the last two or three years, Tim's occasionally asked what kind of new kit I'd like to see and my reply must have become monotonous "...an AM top-band transmitter". Nothing much came of this until last year, when I'd acquired a Dundon kit more or less at the same time as Tim's regular "what kit" question. Following my predictable response, Tim finally caved in with a compromise. Why not modify the Dundon? So that's how it started. With some design suggestions from Tim and a bit of ingenuity from both of us, I now have almost 8 watts of high-level AM between 1960 KHz and 2000 KHz. Here's a summary of how it was done.

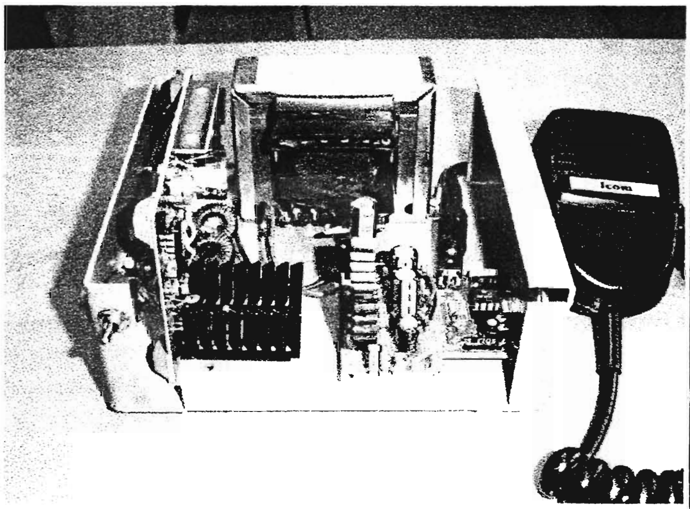
First of all, I got the basic Dundon working with an 1843 KHz crystal and an output filter to Tim's spec. Fine. About 1.5 watts output. I didn't really fancy applying high-level mod to the Dundon's 2 x BS170 PA and anyway, I was hoping for 5 Watts. So out went the BS170's, replaced with an IRF510. That meant changes to the bias and I pinched the design from the Highbridge, complete with drive-level adjustment. It meant a bit of track-cutting and fiddling with the heatsink, but was quite easy. It worked first time with the output up to around 3 watts on a 12 volt supply.

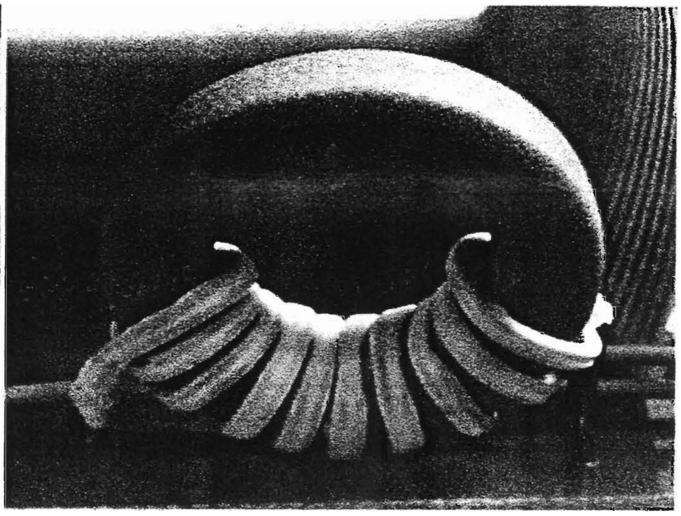
Coincidentally while I was building the TX, I'd been given a heap of old Practical Wireless magazines. The July 1979 edition featured a "VMOS Top Band Transmitter" much as I'd always had in mind. The specified modulator transformer was "A speaker matching transformer rated at 10 Watts, with a winding resistance of not more than 1 Ohm between the 0 Ohm and 16 Ohm taps." The PA power supply was fed through the transformer (0 and 16 ohm taps) with the modulator output applied to the 3 Ohm tap. The other winding of the transformer was not used. This was much the same as the design for the modified Dundon except that Tim suggested using a 230v to 15v-0-15v mains transformer. PA power being fed through the 15-0-15 secondary, with mod applied to 0v centre-tap. I didn't have either transformer type, so I took the plunge and ordered a 30 Watt line-matching transformer from Maplin. This hefty object exceeds the specifications in the P.W. project, and has secondary taps at 0 / 4 / 8 and 16 Ohms.

For the modulator itself, Tim sent me one his new LM380 audio amps. With the audio amp plus electret microphone, the Dundon and the transformer all lashed together on the bench, initial dummy load tests looked promising. Monitored audio in the receiver downstairs was impressive. Subsequent air tests confirmed the results, with astonished locals commenting on the excellent

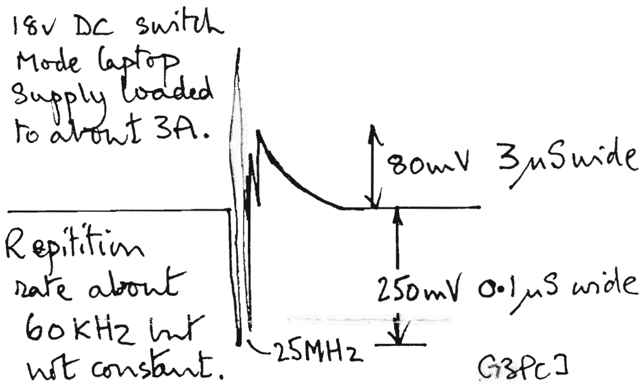
Snippets!

Paul Tuton has recently built one of the new AMU kits and recommends binding the two wires of the bifilar transformer together with plumbers PTFE tape before putting the turns on the toroid. An alternative is twisting the wires together. See the photo on right. His AM rig is on the left.





Both Paul and Andy Howgate have suggested using the 18 volt output 'wall-brick' type PSUs often supplied for laptop computers. Their small size makes them highly attractive! The sketch right shows the output ripple waveform when loaded to 3 Amps but somewhat to my surprise, it did not cause any interference on the receivers that I used with it! Clearly good L and C filtering of the incoming supply is important. The repetition rate of these spikes is not constant and varies with DC load. It also runs very cool! G3PCJ



Somerset Contest

As usual the purpose is to encourage the use of home built gear! The first prize is a £50 voucher for Somerset Range gear. Peter G3XJS is again kindly doing the hard work on behalf of the GQRP Club. The rules have been changed to allow more bands etc. Either TX or RX or both must be home made. When: Sunday 23rd March, 0900z until 1200z. Mode: Any mode is permitted (including cross mode). Freqs: Around the normal QRP cw and ssb frequencies on 80/40/20/15/10m. Call: "CQ HBC Contest" (ssb) and "CQ HBC Test" (cw). Exchange: rst/serial/power (eg 579/SC021/3W). Serial must start with any random number of your choice, not less than 100, and increment by one throughout the Contest. Stations not in the Contest may send any serial (eg 001). Scoring: Any station may be claimed once per band. QSO's with QRP stations score 2 points. QSO's with QRO stations score 1 point. Final score is the total number of points (there are no multipliers), BUT deduct 25 points if you did not build either the TX or RX yourself. Entries to G3XJS by the end of April, with log sheets showing times, bands, stations worked, reports sent/received, and points claimed. Please supply details of equipment used, power and antenna(s), together with a declaration that your station was operated in accordance with the Contest rules. In the event of a tie, Tim will draw the winner from his hat!

Yeovil QRP Convention

Note the new date! June 8th 2003 at the usual Digby Hall, Sherborne. The usual attractions etc! Talks on the G5RV Antenna, Summits on the Air, and the Inside workings of the GQRP Club! There will be no formal morse tests this year but assessments (for M3 licencees) will be available by prior arrangement. The usual array of radio related traders and a large bring and buy stall. The Construction Challenge is to produce the highest output TX (on 3560 kHz) which runs off one AA cell. It should have no more than 2 active components, no i/c s. YARC will supply a 50 ohm dummy load and meter. In the case of a tie, the number of components will be taken into account. G3ICO

Megohmmeter by Gerald Stancey G3MCK

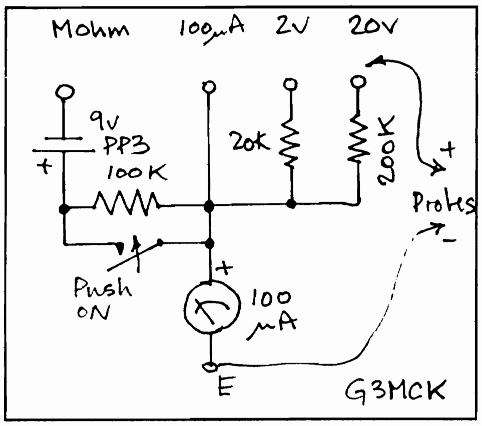
Recently I needed to measure, or to be more exact estimate, the values of some resistors that were in excess of 2 Megohms. What's the problem you ask. Well my DVM only goes to 2M. The solution was easy—a return to basics! I had a 100 micro-amp meter and a PP3 battery. Put them in series and 4.5 micro-amps will show on the meter (Ohm's law). Not much but enough to show that I wasn't looking at an open circuit. Higher resistances will show a proportionally lower current.

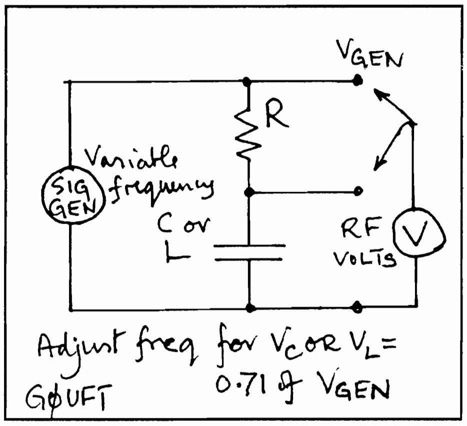
As it stands, this test set has one dangerous drawback. If the resistor being measured turns out to be less than 100K you will blow the meter! This danger can be avoided by putting a 100K current limiting resistor in the circuit. This resistor can also be used to check the actual battery voltage. I have found new PP3s up to 9.7 volts. You use the measured value in your calculation.

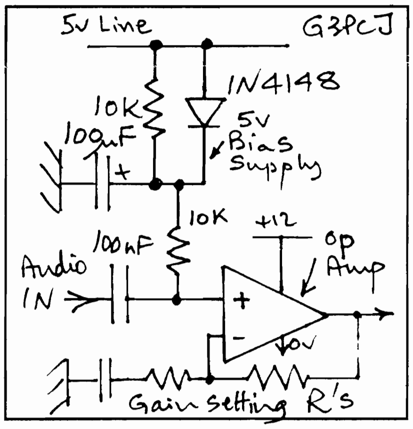
For example. Touching the test probes together show the battery voltage to be 9.3. When the probes are put across the unknown resistor 3 micro-amps flow. From Ohms law the total resistance is found to be 3.1 Megohm. Ignoring the internal resistance of the meter and battery, we reduce the calculated value by 100K for the current limiting resistor making the unknown 3 Megohm.

The basic test set can be improved by increasing these very small currents which make it impossible to make accurate Megohm readings. Either fit a more sensitive meter and or use a higher battery voltage. In either case, alter the value of limiting resistor to protect the meter. A minor improvement is to fit a momentary 'on' push button across the limiting resistor, this is only pressed if the initial reading is below full scale and it avoids having to subtract the limiting resistor after working out the total circuit resistance.

Having got so far why not add a few more sockets to the test set. One going direct to the meter, the others going to the meter through 20K and 200K resistors. (Use your present meter to select them.) You can now measure 2 volts and 20 volts and with access to the basic meter for other uses. Most amateurs have a multi-meter already but you will find a second analogue one like this very useful. They not affected by RF fields and you will find it much easier to observe changes in readings than can be done with a digital meter. Finally it's a simple low cost project which can be built with confidence and nothing succeeds like success! See the circuit left below.







Measuring C or L without a bridge by David Proctor G0UFT

See the circuit in the middle box above! Connect a signal generator across a known R in series with the unknown. Measure the signal generator's RF voltage and adjust its frequency f till the RF voltage across the unknown is 0.71 of that from the generator. Then the reactance of the unknown is the same as the resistor, hence for a capacitor C = 1/6.3Rf or for an inductor L = R/6.3f
For example, if R = 1K & f = 235 KHz, then C = 680 pF or R = 2K2 & f = 3.5 MHz, then L = 100 /uH.

Quick charging of bias filter capacitors

DC receivers often have very large capacitors to filter the bias supply of the first audio op-amp stage to remove hum. They takes ages to charge up and often cause the receiver to squeal when first switched on! If the feed resistor is not part of a voltage divider, the solution is to put a diode across the R; this causes the capacitor to charge quickly to within one diode drop of the bias supply and then slowly rise with the full filtering to the full bias supply volts. In the example shown above right, an op amp running on 12 volts takes its op-amp input bias through the big CR filter from a subsidiary 5 volt line. The op-amp output is thus correctly biased to near mid supply. G3PCJ