HOT IRON

"Journal of the Constructors Club"

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WELCOME AND CONGRATULATIONS - to you the founder members of the Constructors Club! I am very pleased that you thought the idea worth subscribing to and hope it will live up to your expectations! Thank you for your good wishes. This is intended to be a newsletter for the exchange of ideas and I positively want contributions from others with suggested topics or notes or questions etc.. To that end. I am grateful to receive intitial contributions from G3GC, G4GVM and G0HDJ. My intention is to have notes each quarter on a series of themes. Apart from some sort of editorial, I expect to have something on:-

- **Construction tips,**
- **Test gear,**
- **Project application notes**
- **Question corner.**

Others can be added as demand and space allow. The main emphasis will be on ideas suitable for HF gear; not because I wish to restrict it to HF but because its much easier to make HF gear work than VHF! My own interest is in designing equipment to obtain good performance for cost, so I wont include anything associated directly with operating. I shall also be glad to have contributions on antennas although this is a topic which I regard as a black art through my ignorance! If your contribution can fit into the above categories so much the better. **Construction tips** aims to show that its possible to build things without either spending lots of money or having extensive facilities. I have started this theme with a note by G3GC on the general setting out of a project. I have kept a lengthy note by G4GVM on etching your own PCBs till next time. **Test gear** will cover items that home builders will find useful in getting their gear working. The **Project application notes** will cover the building blocks of a new kit which will eventually be available from Walford Electronics. Since I have not yet completed the design , this is a little fluid now, but the aim is a resonably simple moderate performance direct conversion receiver/transceiver; it will be for CW and phone sideband reception but phone transmission will be by double sideband suppressed carrier. My aim is that the base rig be essentially broadband with a VFO/mixer giving coverage of 160 and 80m initially. I hope to keep the transceiver cost to around £75 but members of the Constructors Club will be able to acquire it in stages. Later additions will give other bands and extras such as digital readout.(I would love to know what sort of rig you want- cheapies, middling, or full featured superhets or phasing rigs.) **Question corner** is up to you - I am pleased to have something even for this issue! Thus there will be quite a wide range of topics and varying technical depth. Members will appreciate that unfortunately I may have to edit some contributions and that time and cost dont usually allow me to enter into individual correspondence - despite what you may have read about farmers and the EEC, we still have to work our land!

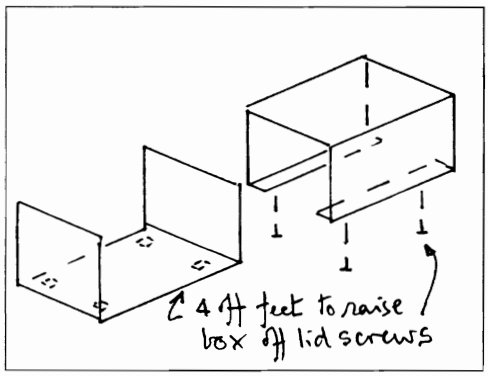
Tim Walford G3PCJ- Editor

Construction Tips

Mechanical Design. Many items of home brew equipment are often taken from a magazine and therefore will not need any basic mechanical design. Alternatively, if it is your own circuit then it will be necessary to do your own mechanical layout. in which case it is worthwhile putting something down on paper first. In doing so, be sure to think ahead to any problems that might arise in assembly and wiring. Will you be able to get at a particular part if some other part has been put in place first? Will it be possible to get at all test points with meter or oscilloscope probes? Despite your care. in practice there will probably have to be the odd change as you proceed with the construction but attention to detail at this time will pay ample dividends. Part of this layout stage will deal with the front panel. Here you should think of the appearance of the front panel and the logical arrangement of controls for ease of operation. Bear in mind that if you are left handed things might need an unconventional layout. Often some controls are put on the back panel and it is not uncommon to find a loud speaker placed in the side of the cabinet or lid. Neither is particularly satisfactory and if possible it should be on the front panel. At this stage it is also worth thinking about what finish and colour the final equipment will be. Should it blend with your current commercial gear (?homebrew house style. Ed.) or should it be different to draw attention to it?

Mechanical Construction. The type of construction will depend to a large extent on the size and type of project. As we are talking about home construction I will assume that the project has one or more printed circuit boards (PCBs). These will have to be fitted into some form of cabinet which may be either made

on the "kitchen table" or purchased from one of many suppliers. The latter will cost a lot more and probably may not be the right shape or size! The "kitchen table" version can be made to precisely your requirements, which will require some mechanical ability. (Not necessarily! In a later issue I hope to cover various less demanding mechanical techniques for projects and prototype units. Ed.) Assuming you are going for a metal box. the first thing is to decide which metal; the usual favourite is aluminium. Scrap metal merchants are a good source and it can usually be examined before purchasing. The best thickness is 18 SWG (0.048") which, while reasonably stiff, is fairly easy to bend. Bending is probably the most difficult part of home construction to amateurs. One of the best ways is to use a "workmate" as the wooden vice is of ample length and can be adjusted to hold the material firmly over the whole of any length likely to be required. One of the problems in bending is the apparent loss of material in making the bend. There are tables for the "allowance for bending" but for the amateur it is best to do a few dummy bends on offcuts of the intended material. Carefully mark out a length with precise dimensions to be bent at right angles and then check that you have bent a right angle! When bending the metal never hit the metal directly with a hammer or mallet, place a piece of wood where it is to be hit. Using this method you should be able to obtain a good bend without blemishes. If necessary the cabinet can be stiffened with aluminium angle. The cabinet is most easily made out of two U shaped sections attached to each other at right angles. Some means of attaching the two halves is needed. either by flanges on the bottom or chassis section or by wrapping the top U slightly around the bottom U which requires the bottom U to be slid into the top one. They can be held together with self tapping screws or bolts into threaded holes tapped into thicker angle section material.



Eric Godfrey G3GC

Meter Scales

Often meters used to make test gear dont have the desired scale. On some it is possible to remove the scale plate by undoing a couple of screws. After painting the back with matt white emulsion or spraying with car matt paint it can be fitted the otherway up: a new scale can then be put on with dry rub down line and number transfers to give a "semi professional" appearance. You can always revert to the original if needed!

Speaker Grills and Vent holes

Some sort of covering is needed to stop unwanted extras entering the equipment! Aluminium wire mesh which is used to repair car bodies comes in sheet sizes of 30 x 20 cms costing 60p at B & Q. It can be cut easily with scissors. Slighly larger and stiffer mesh is also a good covering for PSUs needing plenty of air.

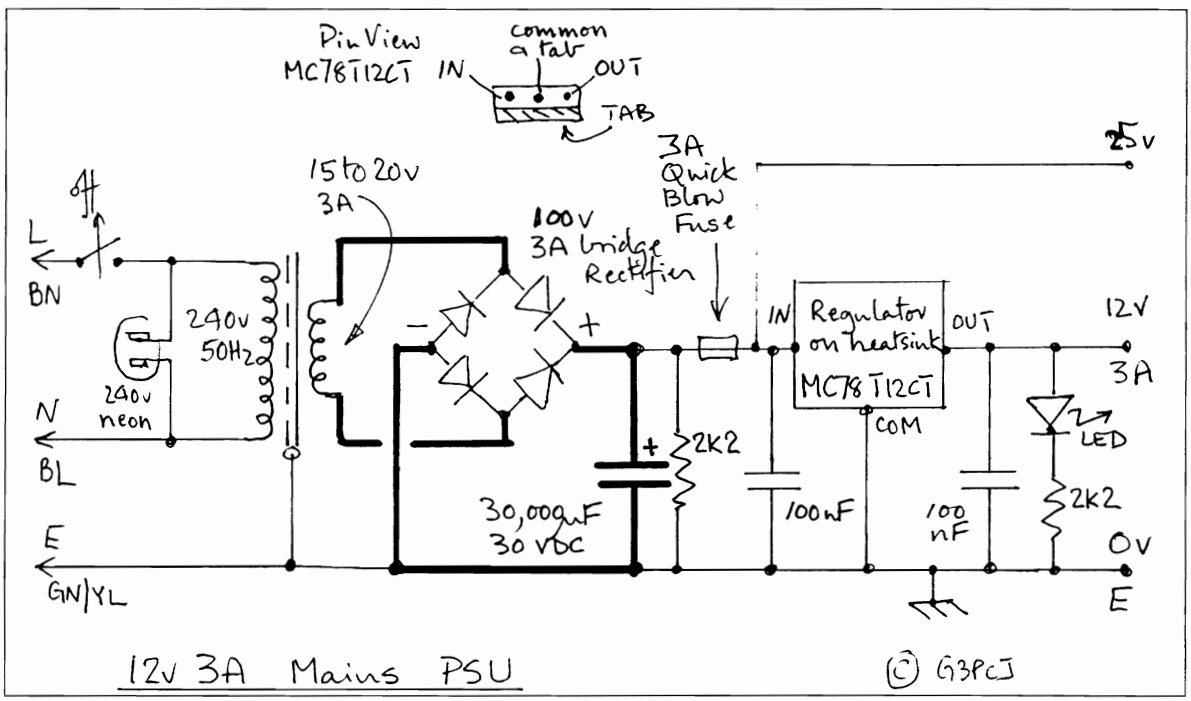
Craig Douglas G0HDJ

Test Gear

The most useful thing to have in the shack is a multi-meter . I find that an analogue one is more useful than a digital type because they are often smaller. dont have batteries that need turning on for every reading and can often be bought for a £1 or so at junk sales. (Often they can be checked before purchase by shaking to see if the needle moves atal and shorting the leads on the ohms range when it should go to full scale if the battery isn't flat.) Go for the highest sensitivity you can afford since this will reduce the loading on whatever circuit you are measuring - aim for a basic movement of 100 micro-amps or less since this will present a load of 100K on its 10v range. Most cheap instruments have AC and DC volts, DC current up to about an amp and resistance. I find that it is useful to also have a digital multi-meter as well to occasionally measure more accurately when that's important. but don't feel that they are essential; they are now available with all sorts of extra facilities such as capacitance or temperature or frequency measurement in the range £20 to £30. I suggest that its worth going for frequency despite their limitation to around a Mhz. They invariably have continuity testers which squeak when the circuit is complete and enable you to keep your eyes on the cable etc instead of flitting to the meter.

Undoubtedly the next most important item is a general purpose power supply. Most amateur gear is designed to work off nominal 12 volt supplies and while you can do a lot with the small non-spill lead acid batteries which are sold at rallies (ex burglar alarms etc.) a mains powered unit is soon desired! Its difficult to generalise on what's needed since test gear will not require any variable voltages but if its to power a rig there is much to be said for extra outputs up to about 25v - I try to design my gear to work with this wide range of input voltages so that the transmitter will be able to produce more output on the higher voltage; it also gives some margin of safety! Often I have lent gear to others for use with their PSUs only to have it returned with the comment that it worked fine for a few minutes then died; on investigation the PSU was not man-enough and shut itself down. Hence my suggestion to err on the large size with a 3 Amp continuous output. This ups the transformer size but its worth while. Again be guided by what you can obtain at rallies but look for a conventional one that's about a three inch cube and it will have a rating of about 60VA. The

circuit below using a fixed 12v 3A integrated regulator (type MC78T12CT) needs a minimum of 15 volts DC input. The bridge rectifier will drop a further 1.5v so you need 16.5v on load at the bottom of any ripple on the raw DC. The maximum input to the regulator must not exceed 30v offload so the secondary RMS voltage needs to be less than 30 divided by square root of 2 (=1.414) so a 20 volt secondary is the highest and 15 volts is about the lowest suitable. A good rule of thumb is that the ripple on the reservoir capacitor will be 1 volt for each amp of output current if the capacitor is 10,000 micro-farads. So look for 20,000 or 30,000 mciro-farads with a voltage rating of at least 30 VDC. This can be any parallel combination of smaller capacitors with the same voltage rating. Do make certain to fit a bleed resistor across the reservoir capacitor and I like to have a mains input neon and output LED but these are optional. What are not optional are protective boxes and fuses! Be very careful of the lethal mains voltages and make certain no straying fingers can get anywhere near the mains wires. The regulator can be reduced to a 2 Amp (L78S12CV) or even a 1.5 Amp type (L7812CV) for smaller loads and you will be able to use smaller values of reservoir capacitor and a smaller transformer. The regulator must be mounted on a heatsink and will get hot when supplying the maximum current. If the case is metal, bolt the regulator in the centre of the largest face having scraped away any paint and use an extra sheet of U shaped aluminium, say about 3 inches square initially, clamped by the same device mounting bolt on the outside of the case. The mounting tab is connected to the common or 0 volt pin and will connect Ov to the chassis but it is a good idea to make a wire connection as well. You should also connect mains earth to the case and to the transformer screen if it has one. (If the transformer has unmarked windings but is known to be for 240v mains, the highest resistance winding is likely to be the mains input. Cautiously apply mains with a 1 Amp fuse to this and measure the output voltages on the other windings starting with the AC voltmeter on a 250 volt range incase there are other high voltage secondaries!) The wires between transformer secondary and bridge rectifier and reservoir capacitor carry very high peak currents so these need to be thick and the output to the regulator should be taken direct off the reservoir capacitor to avoid any volt drop in these getting into the output. (As an aside its worth noting that transformers can be a source of interference if mounted near wideband audio amplifying stages so its a good idea to space them as far away as possible at the back of equipment.) The raw DC output at up to about 25 volts can be available on a separate terminal for high power needs but this output is unregulated and will have ripple on it depending on the load. Tim Walford G3PCJ



Question Corner

Ron Chisnell asks what is the best type of aerial for a short wave receiver for a flat dweller with limited space? What is a magnetic loop? The general aerial advice of get out as much wire and as high as possible maybe limited to curtain rails and balconies. Interference from mains wiring can also be a problem and loops are less susceptible to this. A loop picks up the magnetic (as opposed to the electrostatic) part of the radio wave. By placing a portable radio with a ferrite rod aerial in the middle of a tuned loop the received signal is usually enhanced, even without connections. The loop will need turning for best effect and must be tuned to the receiver's frequency. Experiment with a loop of solid copper wire wound round a cardboard box of about 50 cm cube. (Split mains twin and earth 1 mm lighting cable leaving insulation on it.) Connect the loop ends to each side of a variable capacitor of about 300 pF (ex scrap radio), try six turns for medium wave, four turns for 3 to 4 MHz and 2 or 3 turns for up to 10 Mhz or so. Keep the turns spaced at least 1 cm from each other. Tune the radio to a weak station, put in the loop, alter the loop capacitor and rotate for best effect.

Audio Power Amplifiers

The LM380 is often used, it needs few extra parts, can use a supply of 8 - 22v and has a fixed voltage gain of 50. The TBA820 will work over 3 to 16v with a fixed voltage gain of 50 and is cheaper but usually needs more external parts. I prefer the 2030 range since they will work on 12 to 36v supplies, are almost as cheap and can have their gain set higher. They can also be proceeded by a 470K gain control which makes it easier to follow an AGC stage. They are made by several manufacturers and come in vertical and horizontal versions, the latter allowing bolting to the PCB to act as a heat sink. The circuit alongside shows typical values for a stage driving a 4 ohm LS or phones having a voltage gain of 220 over the audio bandwidth 150 to 3000 Hz. The gain & bandwidth are set as for an op-amp; the gain is 1 plus R1 divided by R2. The upper bandwidth limit is when the reactance of C1 equals R1 and the lower when the reactance of C2 equals R2. R3 should be about R1 divided by 10. The network R4 and C4 help stop instabilities and R5 prevents ear shattering clicks when you plug in your phones! The bias voltage supplied through R6 to the positive input sets the output DC voltage , ideally to half the supply voltage but its often convenient to use another smooth internal rail, typically +8v. A logarithmic gain control is used to make the apparent sound level increase smoothly. The gain maybe increased to about 2000 max. by decreasing R2 to 120R but C2 will need increasing to 4.7 uF for 300 Hz cut-off. Sidetone audio for CW can be fed in at the negative input and will be unaffected by the receiver gain control provided the amp is kept live on TX! G3PCJ

Audio Pre- amplifiers

Its rather harder to generalise here but the circuit alongside is very handy. For phone it provides a voltage gain of 40 over the band 300 to 3000 Hz but can be switched to single pole audio filter for CW with a bandwidth of 145 Hz centred at 720 Hz. a Q of 5 and gain of 50. Any higher Q will tend to make the filter ring and sound funny. The switch can be front panel mounted (if the leads are short) or the contacts of a relay. The circuit also has a high input impedance and can use the same bias supply as the power amp. The design equations are on the circuit for those wishing to experiment. The 47K in series with the output is only needed for audio AGC and can usually be omitted but maybe helpful for RX muting if this is done by a short across the gain control. Do not turn off the supply to any audio stage as a means of muting. The SSB / CW switch changes over the network on the op-amp negative input and leaves both connected to the op-amp output but since this can easily drive both networks in parallel it doesn't matter . A FET input low noise op-amp is desirable, typically a TL071 or half the dual 072. Supply voltage can be up to 30v. G3PCJ