HOT IRON #117

CQ-CQ-CQ

Moving house - again - an apology

It seems only a few months ago I moved to my present home in North West Wales, on the Lleyn Peninsula, but, as ever, external influences have caused me to up sticks and sell my house here ready for a move back to the sun-drenched paradise that is Pennine Lancashire. I'm hoping for a quick resolution and move; no doubt Serendipity will throw the odd spanner or three in the works to derail my plans - that's life and there's nowt tha' can do about it!

Meantime I'm apologising (again) for a somewhat 'slimline' Hot Iron; I'm trying to expand the skills base as you'll shortly read. Hopefully all will settle once I'm ensconced in new Chez Pierre and I'll beg your indulgence until then!

Wanted!

Co-writers who can write about amateur radio. Wages? Nil. Hours? Long and frustrating. Why? Hot Iron doesn't cover to the depth Hot Iron readers deserve: SSB, CW and Digital methods, to name but a few, as these are of interest nowadays - though many "radio" topics might be universal, the more specialised topics, like digital methods of modulation, need an expert to keep abreast of, to keep Hot Iron of sparkling freshness.

It will be obvious to most readers my experience is broadly based on my industrial "working RF life" and my amateur exploits with A.M. - this being the de-rigueur telephony mode I was introduced to in my tender apprentice days: we never forget our "first loves". This has been my core interest in amateur radio - HF, VHF and GHz - with all the ancillary topics like power supplies, fault finding, antennas, and so on.

I'm concerned that Hot Iron is not covering the interests of many amateurs who would enjoy Hot Iron, so I'm seeking co-writers to help covering SSB, CW and Digital operations. If you'd like your ideas, thoughts and discoveries being spread throughout the World via Hot Iron, please drop me an email at equieng@gmail.com where you'll be made most welcome.

Explanation of terms...

...sometimes allocated to radio amateurs - thank you, Alan! - https://youtu.be/kwz-Md6OoyA

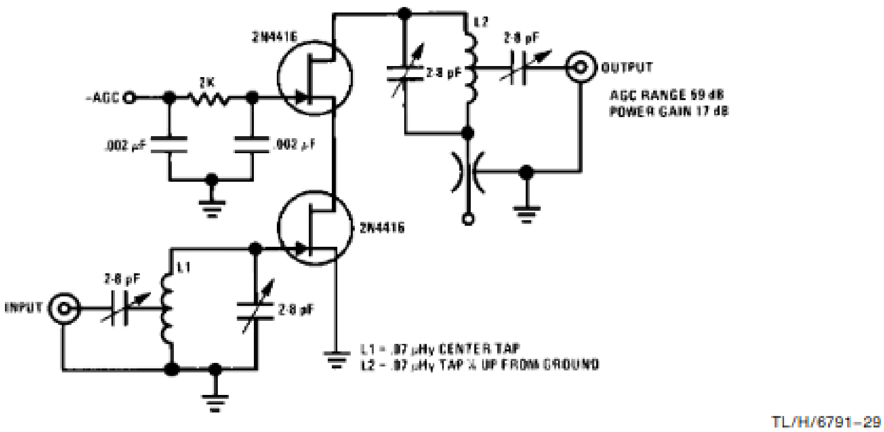
Receivers

http://dpnwritings.nfshost.com/ej/hybrid_mixer/ illustrates how "totem pole" series connected tube plus mosfet(s) in switching mode can be very good mixers. The series connection though, unless designed specifically balanced, cannot eliminate the carrier .

The cascode circuit is a very powerful and well behaved RF amplifier; it's also the basis of a potent mixer. The circuit isn't limited to two active devices: providing you have supply volts high enough you can stack 3 (or more?) devices, to accommodate Local Oscillator, AGC and "signal" inputs. An interesting variant variant to the series connection (unbalanced) cascode is:

https://www.researchgate.net/profile/Corrado-Carta/publication/254021688/figure/fig8/AS:668502918709248@1536394924012/The-two-circuit-topologies-simulated-A-single-balanced-mixer-B-cascode-mixer.png

...where you can see the origins of the Gilbert Cell SA602 / 612 mixer stages, which uses a multiple device cross coupled cascode / long-tail pair(s). Below is a proven rock solid design that I've used many times with easy success:



200 MHz Cascode Amplifier

This 200 MHz JFET cascode circuit features low crossmodulation, large-signal handling ability, no neutralization, and AGC controlled by biasing the upper cascode JFET. The only special requirement of this circuit is that I_{DSS} of the upper unit must be greater than that of the lower unit.

Transmitters

An interesting balanced modulator...

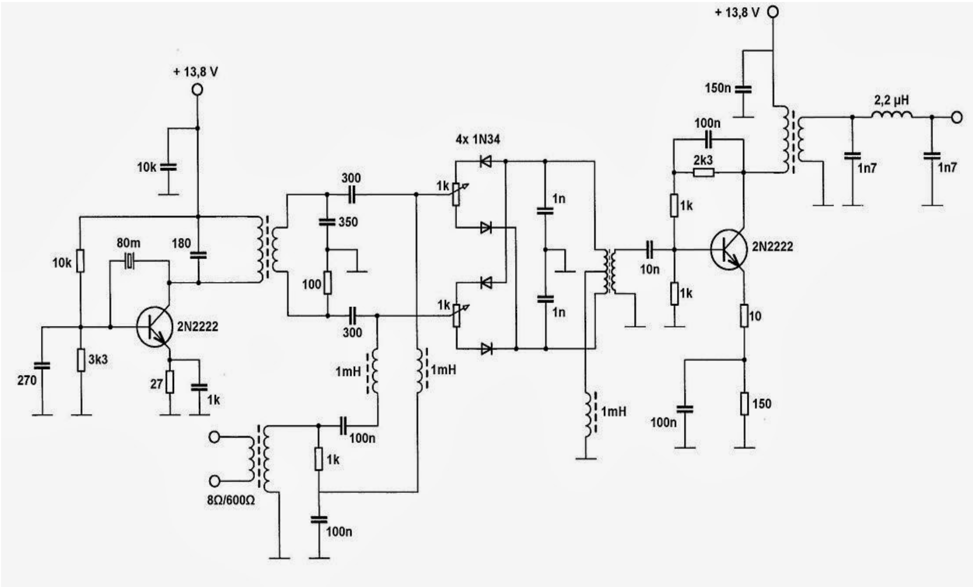
In automotive electronics systems, a "signal" bridge rectifier is often required, rather than the more common power supply rectifier. Fast low current diodes are easily obtained, but automotive electronics designers far prefer IC's for better reliability, easier assembly and test. Fast "signal" bridge rectifiers are available in SMT packages, and as such are perfect for balanced modulator work: they are fabricated on one piece of silicon, at the same temperature, gas flows and other processing: in other words, the diodes are usually well "matched" - thus ideal for simple DSB mixers.

The RH 02 bridge from Diodes Inc. is one such bridge, featuring diodes with 13pF capacitance, not very much more than a 1N4148 at 4pF - but assembled, and beautifully electrically balanced in a SMT package, see:

https://www.diodes.com/part/view/RH02#

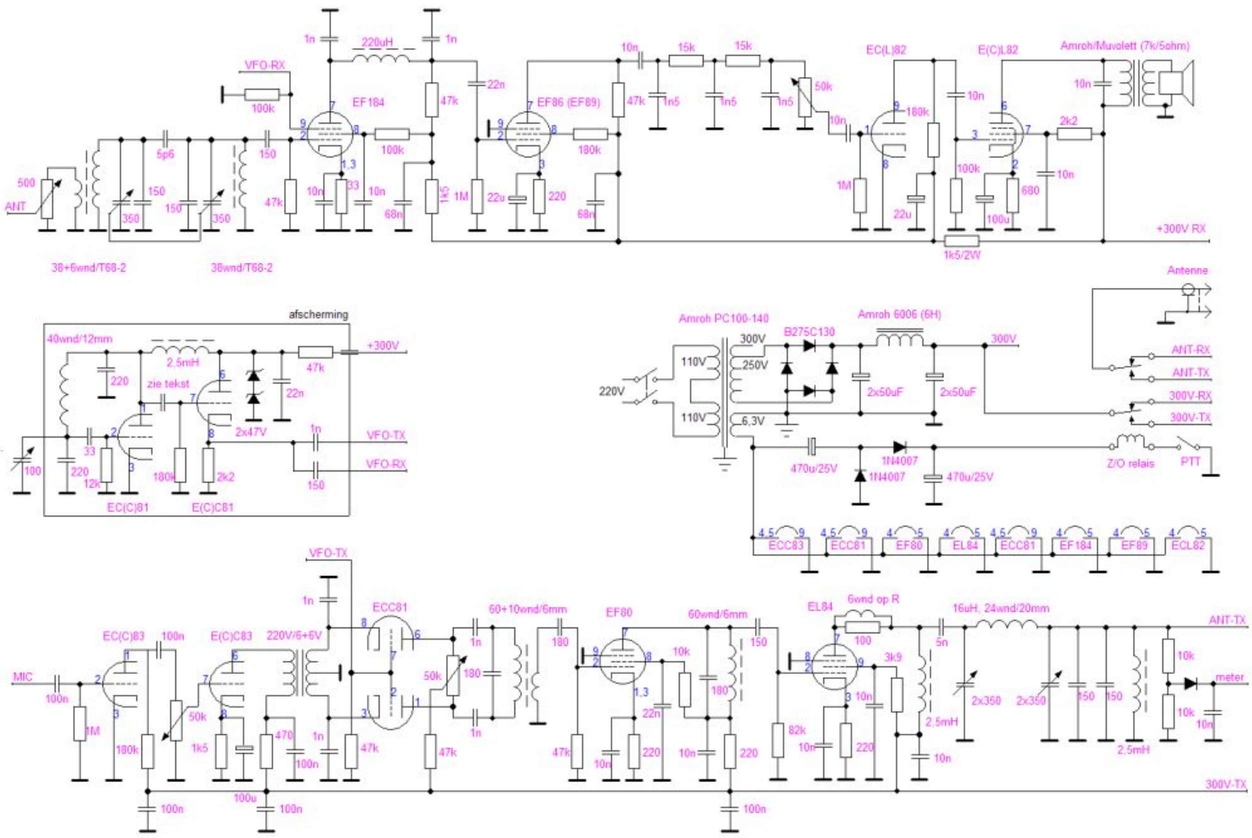
In simple balanced modulator jobs like the "Soldersmoke" (thanks, Pete, Bill & Co.) circuit below.

The RF from the oscillator and the audio (via RFC's are applied (effectively) to the "AC" ports of the bridge. Another option would be to use two SMT packaged dual diodes, and solder the two together to form a bridge, but that loses the inherent balance and matching that a full bridge on a chip offers.



An elegant design...

The all-valve DSB transmitter by http://www.pe1jpd.nl/index.php/80m-dsb-transceiver/ is shown below. It has some very attractive design features, yet maintains elegant simplicity, is an easy to reproduce design, and is readily adaptable to other (low HF) bands by implementing simple plug in (or switched, if you prefer) input filtering selectivity.



Note, for instance, the use of the internal screening available in a pentode to create the receiver mixer, right at the front end mirroring modern (solid state) practice. Neat!

Oscillators

Pulling crystals

You can use multiple crystals, but don't heave too far as their drift characteristics become very much worse, eventually losing sync and becoming a free running L / C oscillator. Ceramic resonators are better for pulling but aren't *quite* as stable as a crystal; note too that ceramic resonators fare better being pulled DOWN in frequency; it's nigh on impossible to pull 'em up and retain stability. See: http://www.homepages.ed.ac.uk/jwp/radio/projects/resonator.html#vfo

Note too that crystals - especially sub-miniature and tiny SMT types - are more susceptible to static damage; more than ceramic resonators. Having said that, quartz and ceramic are much more robust than semiconductors but it's something you shouldn't take for granted:

"Electrical parameters of piezoelectric crystals are deteriorated by excessive driving current or from high voltages that cause mechanical stress and movement to be generated in the crystal plate When the voltage is excessive, mechanical forces cause motion in excess of the elastic limit of the crystal. This results in crystal fracture, such as a lifted platelet. Such fractures, when occurring in sufficient number, will cause enough change to the operating electrical characteristics for the crystal to go out of specification or to cease operation entirely."

Let's make a few simple calculations, based on reasonable assumptions (and my memory). The capacitance of a human body to earth - assuming you're wearing your finest plastic or rubber soled shoes - is ~120pF. Typical static voltages range from 2 - 5kV or more, depending on floor coverings, air humidity and a few other variables so (guess) estimate at 3kV, the static voltage most people just about feel when discharged (or so the ESD trainer told me all those years ago).

The stored energy in this human capacitor is $½.CV^2$ = $½.[120pF \times (3kV)^2]$ = 540µJ.

Assume this energy is dissipated in 0.1 mS, therefore Power = Joules per Second = 5.4 Watts

This heating, in a "chunky" crystal, will most likely cause minimal damage: but on a tiny flake of quartz? Or, from a previous paragraph, would 3kV represent too high a voltage?

You might not see total destruction but more a "deterioration" - a wandering signal perhaps a sure indicator.

Power Supplies

Surges and a Commodore PET

Many years ago, I was called to a Commodore PET computer that wouldn't switch on. We had a few of these running simple test equipment, matching the forward voltage of varactor diodes for use in WG16 applications around 12GHz. The PET computer would start and run fine on another (switch mode) power supply, from an adjacent test station; the fault therefore surely in the individual power supply. This was duly "benched", a dummy load attached, and mains - as per the rating plate - applied. No Go! The power supply made a few desultory attempts at starting before cutting out and shutting down.

No circuit diagram, of course; so it was out with multimeter and dig in, seeking shorts, opens, burn marks, loose connections, and a myriad and one other thoughts as to why the thing wouldn't start. All electrolytics tested good; as did all semiconductors (no IC's, all discretes).

The switch mode supply was obviously trying to start, you could hear the transformer pinging, the indicator LED's flickered, the output tried to rise, but… something was shutting the thing down. No amount of load adjustment worked; it was only when I tried bringing up the mains input via a 60 watt tungsten lamp (yes, the old current limiting dodge) did the power supply wake up, and run, from virtually zero to full output, given that it was running via a 60 watt lamp. A switch, to short out the lamp, quickly fitted, and yes, the power supply ran - providing it was started via a current limiter - and delivered full rated output for a day's soak test.

A quick chat with Stan brought some light. He'd seen a 100 amp DC supply used in the electroplating shop do similar stunts; it took many tries to get the power supply up and running - the clue being it was designed for 60Hz, and we were on UK 50Hz supplies lower inductive reactance?). Stan had wired a 2R2 ohm resistor in series with the AC input; this had done the trick to get his power supply up and running, but was limiting the full power output. Stan rigged up a relay to short out the 2R2 ohm limiter once the power supply was up and running, to avoid any volt drop.

I couldn't do this on the PET; it was all plug and play via Molex style connectors, and I didn't want to modify the computer itself. So whatever I fitted to do the start-up current limiting had to go inside the power supply, which, fortunately, had a bit of room in the mains section. Stan again came to my rescue, he recalled thermistors fitted in series valve heater chains in TV chassis to do just this job: a quick look through the catalogues brought an answer: SurgeGard thermistors (see: https://www.mouser.co.uk/manufacturer/ametherm/).

So, the job proved successful: just as to the exact cause I can only surmise, but I reckon it was something to do with the 50 / 60 Hz difference. The unspoken, ruthlessly enforced rule in production plants is to "get it back on line yesterday", and for zero cost. The SurgeGard thermistors proved 100% successful and were widely used in a lot of other equipment, improving reliability noticeably across the plant. Job Done!

Audio

Noise Cancelling Headphones

"In order to create anti-noise, headphones must constantly monitor and sample ambient noise using tiny built-in microphones. They "listen" to the ambient noise around you, and then the onboard electronics take it from there. As well as your music, the headphones create sound that is exactly opposite to that sound wave to cancel it out so that all you should hear is the music coming from your headphones—and not anything going on outside.

Of course, this is all theoretical. In practice, noise cancellation is hard to do, and far from perfect. Constant noises like the low hums of jet engines on airplanes are easier for headphones to recognize and cancel when compared to sudden, random sounds like people talking.

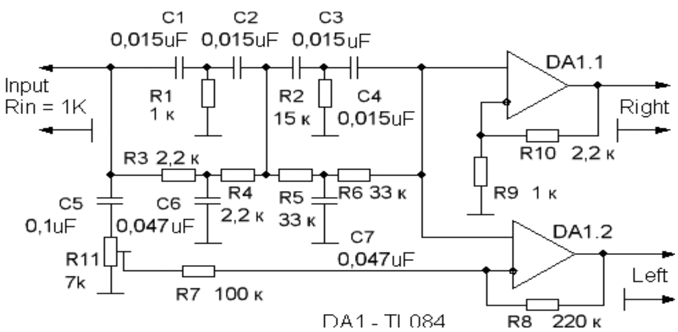
While the physics remains the same, some companies are better at active noise cancelling than others. But now that you know how it works, you can pick the pair that's right for you."

A noise cancelling scheme might be tried along these lines, and my initial thoughts were for CW only, but doubtless a scheme could be adapted to speech - the hearing aid industry has used this system for years and helped countless partial hearing people to enjoy a much better life.

Now a sideways slant: in a direct conversion "I / Q" receiver, it's an idea to present the I / Q signals as "Left" and "Right" signals to stereo 'phones - you get a "soundscape" in your head, thanks to the computer between your ears resolving spatial location from the different sound(s) in each ear. This trick is by no means new: it was (part of) a recording studio trick for "synthetic stereo" and if you want a sample of how powerful an effect this can be, listen to the "Sergeant Pepper" LP on stereo earphones. An amateur approximation - which can be very realistic - is to pass the mono output of a very simple direct conversion receiver through two audio filters, one high pass, one low pass, and present the filtered outputs to the left and right channel of the stereo phones. Set the filters to a cut off of about 800 Hz, but by all means try others ; also an idea is to try an all-pass filter to introduce a (variable?) delay in one channel, giving a slight "echo" effect.

You'll find an entire gallimaufry of techniques if you search for "pseudo stereo" or similar; below is a typical circuit:

http://zpostbox.ru/how_to_create_stereo_from_mono_signal.html



I would suggest an LT1113 dual op-amp here, it's much lower noise than the TL084, though the '084 is an otherwise excellent op-amp, I should add.

You can see the high and low pass sections; by adding an all pass section, as shown in https://www.allaboutcircuits.com/technical-articles/focusing-on-phase-the-all-pass-filter/

...you can add (variable) delay very simply to one channel; by switching in the "all-pass" filter section to either channel.

Armed with these, you'll hear Morse (and SSB…) spread across your head as a "soundscape", the background noise is spread too, which your ears and brain can actively cancel by the signal processing between your ears. A "chirpy" transmitter sounds truly wondrous!

Replacing a carbon mic with an electret

The simplest way to modulate a carrier - as was used in the very early days of wireless telephony - was to put a hefty carbon microphone in series with the power supply, or the antenna feeder.

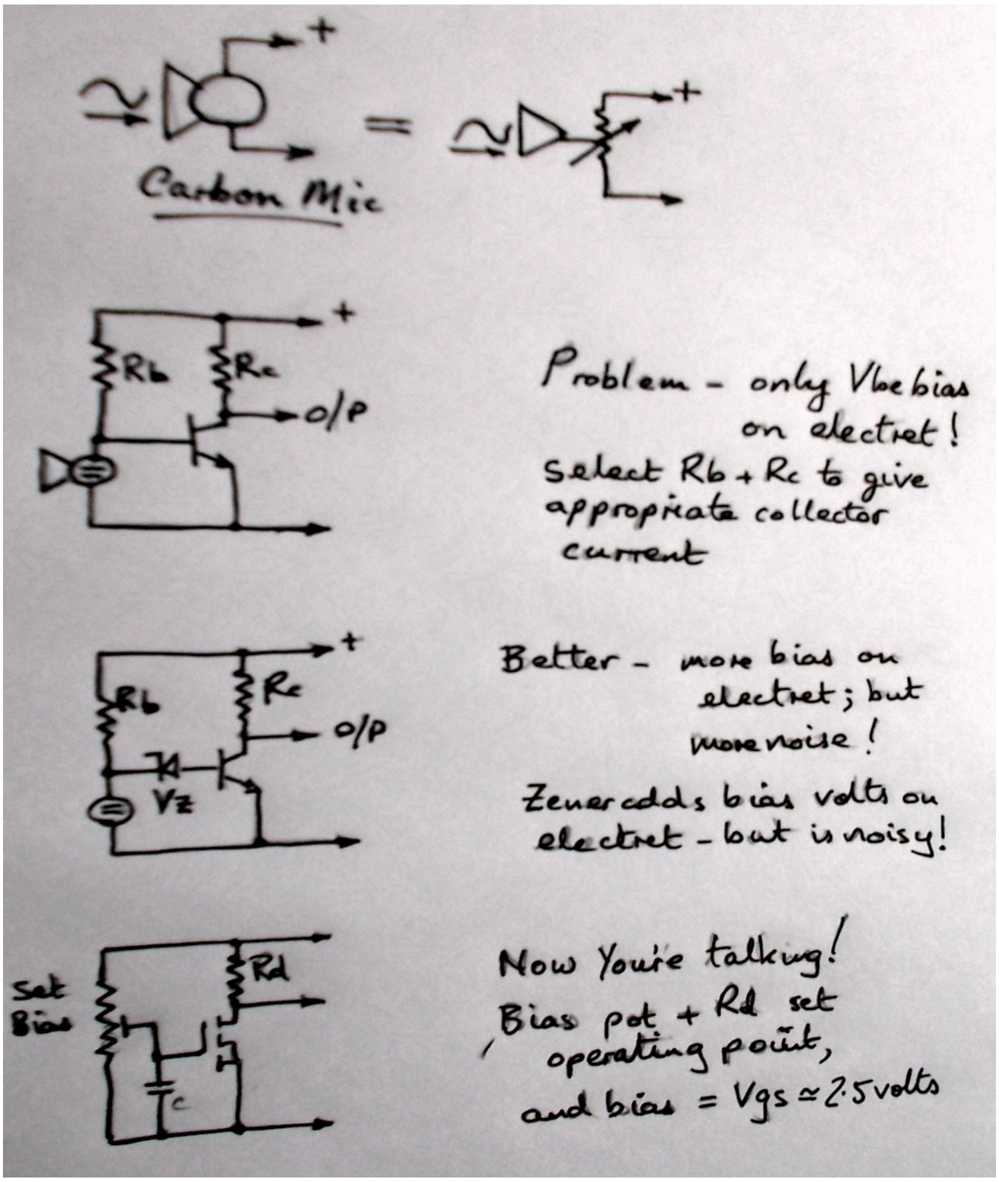
A simple telegraphy (CW) transmitter can be modulated by a carbon microphone in the power supply; not the most elegant, admittedly, but it will get you on A3E telephony with **any** CW telegraphy transmitter. If we take this principle, and bring it up to date by using an electret mic insert strapped to a power semiconductor - a power mosfet is a good choice - to modulate the power supply to the CW transmitter. Note, however, you won't get 100% modulation; you have to limit the negative swing to a (low) positive voltage voltage to keep the oscillator running.

A better solution is the "plug in modulator" where a modulating signal was applied to the keying input of a cathode keyed transmitter: a "plug in modulator" can be easily constructed with a power mosfet or search for BU, BUK, BUS, BUT, BUV, BUZ prefix transistors, all of which are high voltage types to do the job. Incidentally, these transistors, connected as a cascode (solid state tetrode) circuit - see previous Hot Iron notes on this topic, and below, by Dr. H Holden:

http://www.worldphaco.com/uploads/WORLDFETRON.pdf

{Which, for valve / tube fans, includes a remarkably low noise 12 volt to 250 volt HT inverter power supply.}

It’s possible to mimic a carbon microphone using a transistor (or mosfet) and an electret microphone by using an NPN transistor resistor biased collector to base, with the electret base to emitter. This only biases the electret with the Vbe of the transistor (or an N-channel mosfet would yield ~ 2.5 volts but you’ll need a pull down resistor, gate to source, for appropriate gate bias). More bias volts on the electret makes for better linearity and dynamic range - simply add a zener, in series with the base to do this easily.



Of course, you can get more bang for your bucks if you apply some gain compression and levelling: by keeping the output of the microphone amplifier roughly constant for any input level (or thereabouts) means a vast increase in speech power. You effectively get a lot more modulation for your money and that equals more miles of DX. To that end, see:

https://www.analog.com/media/en/technical-documentation/application-notes/AN-1326.pdf

...which can be obtained from our favourite online auction source ready mounted on a small pcb, with all ancillary components.

Audio distortion shrinks DX

The audio signal and it's surroundings are all part of the audio chain that modulates the carrier - even if that carrier is later suppressed - audio distortion prevents efficient and comfortable understanding of the recovered signal. Use only the highest quality audio processing you can, in the transmitter, and don't neglect damping curtains or similar in the shack. Think recording studio!

Similarly, it's well worth the effort to create a first class receiver audio chain: the audio is the link between your dandy electronics and your brain, via you ears (please forgive me, RTTY / digital operators…) .

Old faithful LM386 is probably the bare minimum, good for portable operators but not for the keen DX man. Only the best will do for deep signal reception, as well as quality "4 quadrant" filter / audio processing - which, by sheer necessity, must be analogue. Why? You're digging out a fraction of a µV of RF from thousands of miles away that's making it's way to your ears: adding in a digital clock signal, (essential for a digital filter section) no matter how well shielded and screened, is just asking for another source of interference and distortion that might make all the difference.

It has to be 'said' (groan) is it's far more pleasant listening to quality audio than a distorted mess!

Noise, op-amps& audio

741 vs LM308? The "better" LM308 op-amp has much better input impedance, bias current spec. and offset characteristics; but lower gain / bandwidth product and thus lower noise factor because the bandwidth is limited, which gives treble cut (heard as bass lift) when used in an audio amplifier.

So for speech it makes sense to use 741-style (5534 is a good example) op-amps for full audio bandwidths, and an LM308 for "narrow bandwidth" jobs like CW or "data" (tone modulated, and the like) applications and you'll hear and see, for those with digital waterfall displays, the difference.

Test Gear & Fault Finding

Cleaning circuit boards

One dodge I found whilst working on industrial bakery equipment (yes, your daily bread manufacture, that sort of "industrial") was that "contaminated" pcb's could be readily cleaned in a domestic dishwasher, using 60°C heat and half a dishwasher tablet. The pcb's, contaminated with indescribable grease, dust, and other extraneous "contaminants", came out sparkling, bone dry! Tested initially on trial pieces of strip board, soldered with wire links, but otherwise completely untreated, flux residues and finger marks clearly visible, the results were - to be blunt - excellent, and Megger testing within 30 minutes of the wash cycle finishing (to allow cooling and finish air drying, whilst not obviously wet straight from the dish washer) showed "infinity" ohms, track to track, 500 Volts and 1kV test potential.

I can hear voices raising clamour about water contamination, de-ionised water being absolutely necessary, corrosion from using the slightly caustic dishwasher tablets, and much, much, more: but I should tell you I continuously tested an oven pcb in a test oven running product continuously (the aroma of baking bread around the workshop!) for 9 months after dishwasher cleaning, with ne'er any problems at all, including a multi-lead flat pack controller chip, a plasma discharge display and associated HV power supply, and the push button front panel too.

Since an industrial oven pcb usually ran flat out for 20 weeks or thereabouts before succumbing to the blistering heat, grease, steam, "livestock" ingress and general detritus, I reckon 40 weeks testing without any problems being a fair trial: what's more, there are hundreds (if not thousands) of industrial bread ovens running on "dishwasher" pcb's to this day!

One caveat for radio amateurs: let no-one see you've bunged your grubby circuit board in with the plates and bowls, 'cos I'm not responsible for the ear bashing you'll get!

Keep in mind when doing "favours"

The fastest way to lose friends is to offer to fix a bit of gear, then either (1) discover it's beyond all hope of fixing ("all ye who enter here, abandon hope" should be printed on every micro-controller pcb…); (2) find it's going to need real money to fix; (3) slip during de-soldering a component and wreck a multilayer pcb; (4) be liable forever more for every little hiccup or glitch… the list goes on and on (and on and on and on…).

Said friend trusted you to fix his bit of kit, and you (most likely) have now got it for life, or become responsible for replacing it if it proves unfixable. That's why I very rarely offer to fix things for friends, and why professional repairers carry professional liability insurance, and use professional equipment for professional repairs. Fixing recalcitrant electronics part of an amateur's learning curve; you learn how to fix things yourself and thus how to "adopt, adapt and improve" your gear.

By all means offer advice, teach someone how to de-solder, explain how a multi-meter can't automatically diagnose faults, but as an amateur, think thrice before you take on a repair!

Cross head screws on electrical terminals

...Robertson "square" (Canadian) screwdriver bits fit very nicely in (most) electrical cross head screws - better than Philips or straight slots; but not *quite* as well as the "ECX" bits, which are designed for the job.

The moral, of course, is to get the best fit with whatever you have available, and go easy: you need a snug connection, but you're not torquing cylinder head bolts here! I once saw a demonstration of conduit earthing: one steel tube pushed against another, no threaded coupler; it passed 100 amps simulated fault current with barely a whisper. Moral: by all means earth all "extraneous conductors" but don't swing on earthing screws like Tarzan!

Battery Charger Blues…

Lead Acid & Gel Batteries

A few days after the lead - acid battery was created, the issue of charging cropped up: how to get the juice back into the cells. It wouldn't have been too long before it was discovered you couldn't bung in a huge current and recharge the cells very quickly. Too many amps cause plate buckling and a host of other problems, so the idea of 10% "C" charging (C being the amp-hour battery capacity) was applied - and lo! the battery liked that. Rates of 1% C proved even better, telegraph and telephone exchanges often used 0.1% continuous trickle charging, the cells gently gassing off and needing topping up with distilled water every few days.

The advent of gel batteries changed this: these gel batteries were often gas tight, for mounting in any orientation, so gassing of the electrolyte was taboo: the battery would explode if forcibly over-charged. Thus the design, common in countless million burglar alarms and the like, of a constant voltage, current limited charging circuit became de-rigueur. This results, in applications that drew little (if any) current from the gel battery, in a dud battery after a few years. What the actual cause is, I don't know, I suspect they needed substantial current to be drawn to keep the plates clean and active, but eventually the terminal voltage falls below that required to hold off the alarm bell and you've got a knackered gel battery and very annoyed neighbours).

NiCad Batteries

These batteries were very common in telephone exchanges and standby power applications: the didn't suffer as lead acid cells do, decaying when never asked to deliver substantial current. One thing NiCads didn't like was over-charging: they die the death of a thousand cuts and fade into obscurity. The telephone companies discovered that constant voltage, constant current charging at 0.1% - 10% "C" was appropriate; the lower rate particularly good in obtaining long battery life.

These were big, caustic soda electrolyte batteries, much like the lead acid units they replaced (but not weighing anywhere near as much) so when smaller sealed NiCads came along, they were welcomed in mobile and similar applications. These were notoriously short lived: the number of charge / discharge cycles very limited (and bearing little relation to the initial cost). As time went on the number of charge / discharge cycles increased, but the charging requirement remained: you can't used a simple unregulated trickle or rapid charger. The terminal voltage must be held constant, as must the charging current. The lower charging current the better, it gives better cell life.

A characteristic not often appreciated is that NiCads self discharge, at about 10 - 15% per month; cell life can be increased if cells are fully discharged then fully charged, as are most lead acid batteries.

Li-ion batteries

...are similar in charging requirement to NiCads. They follow a similar lifetime relationship too: they have limited charge - discharge cycles, but prefer not to be fully discharged or charged beyond 100% (i.e. not trickle charged). Automotive batteries are best kept between 20% - 80% according to some sources (https://blog.evbox.com/ev-battery-longevity).

A common problem with battery chargers is often a blown "0R0" (zero ohm link, otherwise known as a fusible link) or a thermal trip - usually a simple low melting point wire fuse embedded deep in the inductor winding that goes open circuit when too hot. Not that your device has got too hot: these components are known for going pop after a few dozen hours running, or heavy vibes (man).

Faced with a recalcitrant charger, it's out with a meter, "ohms" continuity, WITH THE CHARGER'S AC POWER UNPLUGGED and BATTERY DISCONNECTED then trace the input AC power feed, following the pcb tracks making sure the continuity is good as far into the charger as you can. Do the same for the DC output, back into the beast as far as you can.

Check the continuity of each of the "sense" and charging wires, and check a resistance exists across the battery sense wires - often a thermistor is embedded in the battery pack. If this goes open (or short) the charge control shuts off the charger (hopefully).

The fusible links can be replaced by surface mount fuses (or temporary very fine wire links, for testing purposes). The thermistor can be substituted by a 100 - 470 ohm resistor, again just for testing purposes, but it's been known for a resistor to be left in circuit and a weather eye kept on the battery temperature to make sure they don't get too hot on charge.

More about charging Li-Ion batteries, see:

https://www.homemade-circuits.com/simplest-safest-li-ion-battery-charger/

for some very useful, cheap and cheerful ways to do the job.

Pot spindle diameters…

Life used to be simple: pots, variable capacitors, rotary switches and the like came with one spindle size: ¼", or 6.24mm if you must *really* insist; the odd ⅜" shaft (oh, alright... some 10mm spindles too, but you could always drill out a ⅜" to fit) cropping up on things like Volt Stat / Variacs.

Then the Orientals stuck their little fingers in: 6mm became common, as did 5mm, 4mm, 3.5mm and a host of other odd sizes for reasons unknown (and unwanted). Nowadays of course, we don't often use tuning knobs and the like: digitals are here to stay as are their damned "up / down" buttons with the infuriating acceleration effect which causes you to shoot straight past your desired set point.

I personally believe every designer should be taught that simplicity is to be valued: customers (that's us, remember!) deserve less hassle, fuss, unwanted "options", "features" and the myriad of unnecessary bells and whistles the sales department insist we must have.

Viva simplicity, and build your own!

De-soldering multi-lead flat pack IC's

One trick mentioned previously in Hot Iron that can be very useful is to build a modelling clay "dam" around SMT IC's solder pads and flood the enclosed area with solder, gently (!!) lifting the aforesaid flat pack IC all the while. You'll need a fairly hefty soldering iron for this; 50 watts being a minimum in reality, to get a fair amount of the solder within the dam to melt.

Obviously a temperature controlled iron is de-rigueur; you don't want to lift the ever so delicate pcb pads. One approach to this end is to use two irons of lower wattage and an accomplice. A 'novel' method is to heat up the pcb over a hotplate, using a brass, copper or steel block just a bit bigger than the flat pack solder pads, and contacting the back of the pcb directly below the flat pack pads. Assuming of course, no IC's are on the underside! The whole idea is to get enough - but *only just* enough - heat into the job, so go easy on the hotplate temperature!

It's an idea to look out for metal clad power resistors at flea markets, radio junk sales, and the like: a single 250 ohms 250 watts, run via a 230 volt lamp dimmer will be superb as a hotplate, with the flat side upwards and the body mounted on stand-off studs in a thermally insulated enclosure; or perhaps a flat back heatsink running a bunch of 2N3055's in power tab packages, biased "on" to a few amps would do just as well, fed a diet of raw DC from a bridge rectifier. A bunch of 22 ohm, 25 watt resistors, mounted in a square formation, flat bottom 'uppards would do the job too; all you need is some way to get heat into the back of the pcb. It's not unknown (ahemm…) to heat up the aforementioned steel block with a blowtorch and sit the pcb on the hot block (well away from the flame, of course).

Another possibility is to set up an old die cast box (or a steel conduit box?) as a support, with an aperture in the lid just a bit bigger than the IC outline and a hot air paint stripping blower set on low heat (those things get stonking hot if you run 'em on full chat) set to blow hot air into the box through a side hole with the pcb stood off the aperture 5 - 10 mm to allow the hot air to exit - you're on your way to a DIY Hot Air Rework station!

I've seen this knocked up on-site to replace dud chips by using a vented box (conduit boxes are good, as are die cast boxes, etc.) over the top of the pcb, some light tinning of the pads, well fluxed pads and careful placement of the new (programmed) chip. As soon as the solder runs the heat is removed sharpish and the board cooled and tested. Soldering is a very tolerant means of connection, but soldering each pin individually with an iron sets up big stresses in the component - the hot air gun "reflow oven" solders all the leads simultaneously.

Antennas

Gin pole mast lifting

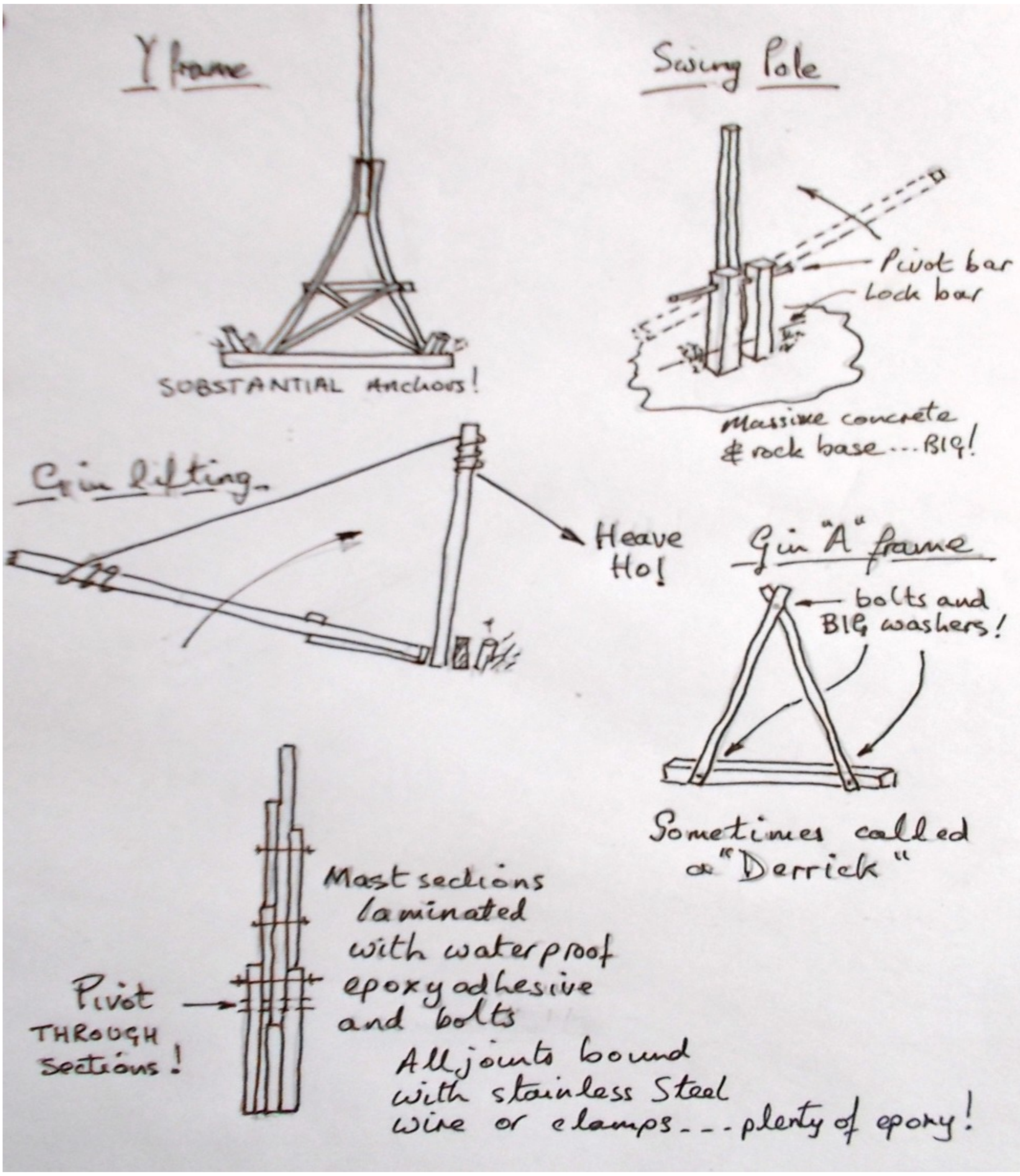
I have used Gin poles, A-Frames and the like to heft heavy loads (like 300kVA transformers and 100HP motors) and big tube sections (for toxic gas exhausts) whilst in the depths of night shifts, aided by a minimum of "hands to make light work". These simple mechanisms are as old as rope and knots; huge weights can be lifted and moved as the Gin pole approaches "top dead centre" where the 'velocity ratio' approaches infinity. Several caveats:

- The fixed lower point of a Gin pole or A-frame must be on solid ground and fixed mechanically as rigid in every direction except the desired pivoting angle;
- The initial "lift" should have the pole or frame at near as right angles to the actual element to be lifted, and have a secure anchor close by to tie off the "hauling" ropes;
- Use as many ropes to the side and top (for the "rocking over top dead centre" moment) and SOMEONE TO HOLD THEM WITH EARTH ANCHORS NEARBY TO TIE THEM OFF;
- Before engaging in a lift, you MUST have prepared the locking mechanism(s) of the mast, once upright, AND HAVE SOMEONE ON HAND TO SECURE THE LOAD;
- If using a "Y" frame mast, the lower "legs" of the Y must be of sufficient cross section and material to support the load mass above, even in the worst of weather, and sufficiently rigidly braced with cross members to eliminate bending or distortion of the legs;
- Use external "saddle clamps" to tie off mast support members. Stainless steel is far better than other materials in withstanding weather but whatever material you use, keep to an absolute minimum (ideally ZERO) the holes drilled in mast structure: they WILL weaken and break when you least want (or expect) it to;
- If in ANY doubt, follow George ("Rocket" locomotive) Stephenson's advice: "if tha' can fit mair metal, then fit it!" (roughly translated from the original Geordie lingo);

This, of course, flies against accepted construction and design nowadays, but keep in mind a Stephenson era locomotive runs every day in the Museum of Technology, Manchester, UK.

Moral: if in doubt, make it BIG!

A useful reference can be found online: https://www.towerclimber.com/gin-poles



For those 'long wire' devotees…

https://youtu.be/QLl9NCJvZjw

This (ancient!) video was filmed predominantly in Northern England that I am familiar with, being born within a mile or two of the more "interesting" scenes: nothing like the extremes of weather seen in some parts of Europe and North America, admitted, but a salutary lesson for those who want to build antennas appropriately for all *possible* weather conditions!