HOT IRON #113

End August / Start September 2021

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CQ-CQ-CQ

Questions which crop up time & time again...

I have had questions recently about "coil dope" for securing turns of a coil, and proofing against moisture. A lot of the questions were about the "dope" coating lowering the "Q" of the coil; a few concerned making the coil assembly rigid to withstand mechanical vibration, electrical properties or other environmental influences.

Those of us of a "mature" age will recall "Q-Dope" coil coating - a liquid form of polystyrene - and was (is?) produced by General Cement in the USA. See: https://forums.qrz.com/index.php?threads/home-made-q-dope-or-transformer-varnish.267610/, where the comment by WA7PRC sums this up. None of the amateur (or professional) electronic supply houses I approached in the UK had Q-Dope: they only had "impregnation" varnish, which isn't for this job - it's for motor windings & the like where coils **don't** have to maintain (near as possible) a constant inductance or high "Q". This doesn't mean they don't exist in the UK; I just couldn't find them!

I've seen industrial RF coils where every turn was secured to the former by multiple carefully tied silk or cotton threads; some with flat clamp bars, or moulded covers to secure every turn. The whole point was that the coil had to be of stable construction, be that inductance or mechanically, to withstand vibration & environmental factors. The application of epoxy resin as a coating is frowned upon by some as it's thought the inter-turn capacitance will be increased by the ε_r of the resin, thus lowering Q. This may well be so; I've never had chance (or need!) to test this hypothesis. Others have tried varnishes of various types, mostly meant for wood finishing, sometimes thinned or straight out the tin. They are designed for *wood* finishing, not the electrical stress which amateur coils might be asked to cope with & have a remarkable propensity for flaking, discolouring or possibly catching fire when used on non-wooden (coil) substrates.

The whole point of the coating - if for turn securing, environmental resistance & lowest additional capacitance in an amateur context - is that it must be thin in both initial viscosity and final thickness, yet mechanically & environmentally capable when dried thoroughly. You're looking for a coating of just a few microns thick: make it yourself from Acetone (nail varnish remover) into which clean polystyrene packing has been dissolved. Thinly coat the the coil to aid evaporation of the acetone solvent to leave a clear, micron thin coating that will withstand electrical, mechanical and environmental stress, the same as the venerated "Q-Dope" of yesteryear.

Annealing Toroid Cores

There are questions about making stable inductors with toroid cores and enamel insulated copper wire: I open or close the turns once I'm within spitting distance of the desired value and leave it at that. Some amateurs, though, recommend annealing the wound toroid "to reduce the mechanical stresses and stabilise the inductor". Knowing that toroid cores, ferrite or iron powder, are manufactured using very high temperatures and are coated with high temperature coatings to withstand 200°C or more & annealing copper involves quenching copper heated to 800°C or more in water (the exact opposite to iron or steel, oddly) any so-called "annealing" in an amateur context must be - well - inapplicable!

I decided to put this topic to bed once and for all. Those wonderful people at Amidon, World leading toroid inductor manufacturers, gave me this reply about annealing toroid cores - with or without windings - below:

"*Dear Peter,*

You are correct: annealing will not have much effect on a core in most situations, but it can have an effect, both positive or negative, depending on the situation. An anneal at 200C may work on select materials, normally those that are coated where it may release stress of the coated cores so long as it does not ruin the coating, it is a dangerous slope with time and temp on Epoxy and Parylene to relieve the coating stress vs. damaging the coating and core. Also, on cores with a high Curie temp, the anneal is likely to not do anything at all to the core. Ferrite and iron powder cores are fired at much higher temps than 200 so it really is not doing anything 99% of the time.

Best Regards
Amidon."

For those amateurs who are in the remaining 1% of the time, please carry on annealing: that's your choice. I'll follow Amidon's advice, thank you!

Radio amateur examinations (1)

Here's another point that crops up time and time again: how do some licensed amateurs achieve a Radio Amateur Examination "pass" when they have (in some instances, blatant) lack of knowledge about RF technology, even in it's most basic form? Whilst I appreciate that tube ("valve" in the UK) technology might not be as relevant to modern amateurs as solid state, the immediate lack of RF knowledge some licensed amateurs display is staggering.

I have noted this before and had some remarkable emails from trainers and tutors about RAE candidates, which clearly illustrate how radio amateurs are rapidly becoming appliance operators, with zero (or at best, very little) interest in building their own equipment. Yes, I have heard many of the (partially) viable reasons why aspiring amateur operators should have no technical knowledge whatsoever: just as in photography or any other "appliance users" cases, the operator need know absolutely nothing about the technology and it's implementation behind his pastime.

This however leaves the aspiring "amateur" radio hobbyist in a conundrum: how does operating even the best technology teach anything about radio? yes, propagation is a fascinating study - but is only one part of one percent of the vast range amateur radio encompasses! Since all else has been catered for in this appliance operator's "station", all he has left is a conversation with distant others; which the wonders of email has resolved almost, if not completely for conversing with anybody else on the planet, and in complete (ahem...) privacy too. Why spend thousands of £'s or $'s for technology to do what a half decent refurbished computer can do, and not as well?

No: the future of amateur radio - if it is to survive, which I think it will as most "appliance operators" soon lose interest in futile blethering - is in construction, design, development and exploratory technology. The route to such things, if not already instilled from years working with electronics - is kits. Many kit providers are available for every aspect of amateur radio desired, be it transmitters, receivers, local oscillators, keyers, and all the rest. The kit builder is guided through the technology, he / she builds a carefully tested and tried design: this is indeed a magnificent stepping stone to designing his own circuits by following the kit designer's logic. It is well worth studying the kit's circuit diagram and working out just what every component contributes to the whole, it is the passport to designing your own circuits or adapting an existing circuit to a different purpose. Hark my following words well, though, those who would alter a working, functional design: change only one thing at a time, make copious notes of what you've done so you can always return to the original state of affairs. Ignore this and wander aimlessly in a wilderness!

Radio amateur examinations (2) - Safety Issues

From an old friend of mine...

"*Hi Peter,*

Thanks a lot for the latest hot edition, and I fully agree with your comments about people working on high voltages. When I was teaching RAE and later, Foundation, Intermediate and Advanced courses, I nearly always found that most beginners thought that putting a bigger fuse in was in some way making things better because bigger must always be better, and I always tried to explain to them why the opposite is true. I personally think they should teach such basic info in schools, as I'm sure it would greatly reduce the number of house fires and electrocutions."

And here's an interesting slant from another reader...

"*Good afternoon Peter,*
Reading this month's Hot Iron I note your comments about passing the amateur exams with little or no electrical knowledge and how are they passed. Firstly let me say that I am / was a qualified assessor, I became one because of the way I was taught, or lack of teaching, by the assessor who taught me. I did very few of the practical tasks and I know of others who didn't do an awful lot. The assessor said people didn't care about learning only about getting a pass! Indeed, I know of 1 M0 who didn't do any studying for the advanced exam, guessed the questions he didn't know and scraped a pass.

On my courses, 100% pass rate, everyone did the practical exercises, made antennas and circuits, some have gone onto building kit. What has surprised me about amateur radio is how few people actually build or repair kit, I tried to get a construction class going when I was a club committee member but there was very little interest, club wouldn't buy any basic kit like soldering irons but happily spent money on the club contest and special event station. In the end I left and training ground to a halt.

So no, I'm not surprised at the lack of electrical knowledge or even basic knowledge of setting up and operating a station from my experience. It's easy to buy a black box, hook it up to a pc, buy an antenna and go digital, and there's always the next better than ever transceiver on the horizon according to the marketing people so why bother building?"

I know for sure, from the emails I receive and requests for information, that the bulk of amateur radio operators are appliance users. I feel very sorry for them; they are missing > 99% of what amateur radio is about (in my opinion). Radio technology is a lifelong learning curve, something new every day, week and year that opens up new horizons - if you're willing to explore mentally how you can make something elegant, functional and useful.

For those who can't be bothered to think, wanting Plug-N-Play instant - but short term - gratification, then go ahead: buy the latest £2000 + transceiver, the latest FireRod Super Signal

Grabber antenna, the latest 128-bit computer to interface. It's your money, your lack of imagination, shortage of knowledge and ultimate dissatisfaction.

What does frighten me is the lack of fundamental education. The "dumbing down" of vast swathes of society is showing all the more, with Elf-N-Safety being the new Stasi Secret Police, with more intrusion into our privacy via State legislative interference into our private lives.

The reason I like building bits of radio gear is not to natter endlessly about whatever the latest pressure marketed lump of technology can magically (or cannot, more like) deliver: that route is Quixotic, merely tilting at distant windmills with no ultimate ability to knock 'em over.

No, I build bits of gear to have a quick call to whoever is listening to be sure my idea works, then I'm off and away on my next project, having learned from my previous construction successes (and failings). "Continuous improvement" I believe it's called?

Tim's Topics

Tim has told me about his latest kit receiver, and his notes are below, verbatim:

The Bratton Regenerative Receiver

I wanted a RX to go with a new small AM TX (using MOSFET gate modulation) called the Bradney. Conventional AM RXs tend to be superhets but they would be too complex for this TX so I reverted to the much older concept of a regenerative RX. The key functional block in a Regen is an 'amplifying stage with feedback' operating at the reception radio frequency using a tuned filter circuit, whose gain is controllable so that it can either just not quite oscillate, or is actually oscillating at low level, depending on the type of signal to be copied. At this critical point the selectivity (or Q) of the tuned circuit is very much increased resulting in much better rejection of unwanted nearby signals and increased gain/sensitivity for signals on the nose of the tuned circuit. Provided this filter stage feeds an amplitude detector it can be used to copy amplitude modulated signals, or with the tuned stage just oscillating to provide a local oscillator signal, it can also copy CW or SSB. Hence the Regen RX circuit, which is relatively simple, is a very useful and versatile functional block well suited to simple AM RXs in particular.Over the years I have tried many arrangements of Regens and undoubtedly it pays to separate the gain-controlled oscillator stage from the detector stage. The oscillator stage can be prone to overload by strong signals which, on CW can lead to a rough sounding beat note as the oscillator is pulled from the slightly offset value to try and agree with the incoming frequency. The cure is to have an RF gain control to reduce such high amplitude signals, and then provide more audio gain. Using Junction FETs in the RF stages makes the circuit design much easier! The circuit shows 2N5459s for TR1-3 but 2N3819s (with different pin out) can also be used. The RX has a grounded gate RF amp with the important tuned circuit as its drain load. This approach avoids more complex inductors needing a low impedance winding for the aerial input, and also reduces radiation by the RX when the oscillator is working for CW. This particular RX is for 80 or 160m, hence the relatively high values for the inductance L1 (38 uH, tapped at just below half way) and tuning capacitors C5-7 (all 150 pF, with C5 omitted for 80m) but it can be easily adapted for other bands. The 65 &/or 150 pF sections of C1 connect to any one of points X, Y or Z for the tuning range desired. The source resistor of TR1 is the RF gain control – as a pot (short leads) or preset - aerial to the slider. The tuned circuit is coupled lightly to the oscillator stage TR2 - another JFET, arranged in the Hartley configuration with gain control by some extra variable positive DC bias to the FET source from the Regen potentiometer. An increasing positive source voltage, cuts off the JFET so reducing its gain. The third JFET TR3 is an infinite impedance amplitude detector which is also lightly coupled to the RF amp tuned circuit; the R and C values at its source have a compromise time constant to hold the peak positive RF voltage between RF cycles, while following the audio modulation peaks and troughs without affecting the audio bandwidth. (I also tried a JFET buffer stage feeding a full wave diode amplitude detector but it was no better than the simple infinite impedance detector.)

The remaining stages consist of a pair of small BS170 MOSFETs in an audio amplifier TR4 (gain about x10), followed by a buffer TR5, with DC feedback to control the DC bias point of both stages, feeding the logarithmic AF gain control. The amplifier drain load R11 has two capacitors C14/15 which can be connected in series for phone bandwidths, or in parallel with a lower bandwidth for CW. Finally, there is an LM380 audio power stage IC2 which has a fixed voltage gain of x50; it can drive phones or a small LS. A stabilised supply is preferred for the early stages, hence the use of a low drop out regulator for IC1 to enable operation on down to 9v if required.

The performance of this RX has far exceeded my sensitivity expectation! A few feet of wire produces band noise which I initially thought must be something hooting unintentionally - but I cannot find anything amiss & our noise levels are low! The photo shows the prototype which was subject to various detector experiments and eventual simplification – hence the spare holes if you look carefully! Over the years, I have done quite a lot of experiments to see if I could make a Regen stage sufficiently frequency stable when going from just not oscillating (for AM) to oscillating hard so it could drive a transmitter for single knob transceiver tuning; but it was all too tender and not likely to be repeatable even with a frequency converter stage to avoid chirp or pulling from RF feedback from the higher power output circuits!

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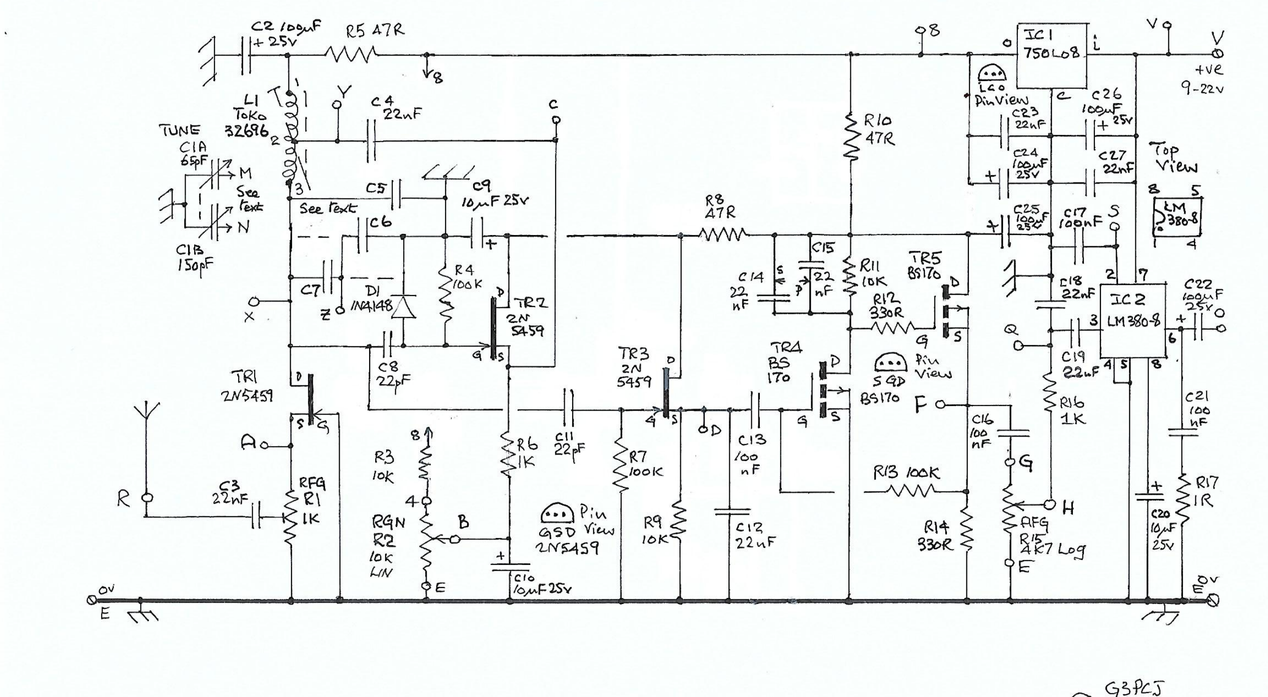


FIG 3: CIRCUIT OF BRATTON RX

My grateful thanks to Tim for his notes and drawing, and we wish him every success!

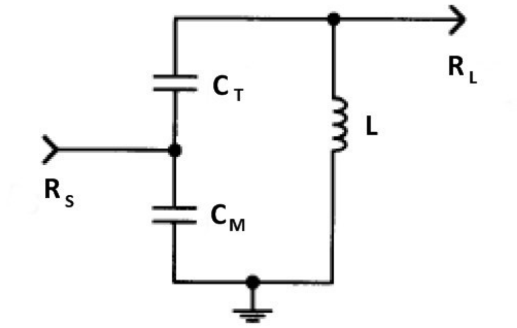
Receivers

The Underutilized Capacity Tap from Tom, K4ZAD

The Franklin Receiver article in Hot Iron # 105 states, “You’ll have noticed an anomaly in the Franklin diagram (*Fig. 3.8*): the 10nF capacitor to ground below the tuning capacitor VC1 effectively shunts the antenna signal to ground.”

However, the Fig. 3.8 input circuit that the receiver designer chose is logical when viewed as a “Capacity Tap,” connection of the antenna. When viewed this way the 10 nF capacitor is a component of the turned circuit and is the means transforming the antenna's low impedance up to something much higher and better matched to the TR1 gate.

Assuming reasonable L/C ratios and inductor Qs, here's a formula for computing the approximate capacity tap transformation ratio where the source is a low impedance (R_S) and the load (R_L) is a <u>much-higher</u> impedance and C_T, the tuning capacitor, is in series with C_M a <u>much-larger</u> capacity-tap capacitor.



$$R_L \approx R_S(1+(C_M/C_T))^2$$

In the Franklin receiver circuit of Fig, 3.8 in Hot Iron # 105: VC1 is C_T in the above formula and C2 is C_M. Using 175 pF as a mid-range value for C_T and 10 nF (10000 pF) for C_M gives 10000/175 or 57 for this ratio. Adding the 1 and squaring yields 3364 as the total transformation ratio. So, if we assume a 200 Ohm antenna load (R_S) it will be transformed to 673K Ohms (R_L), a light load on the gate of TR1. It's similar to a light load provided by a small antenna input capacitor connected to the top of VC1/L1. The same 200 Ohm R_S and a C_T of 365pF yields a 156K Ohm R_L.

When designing a tuned circuit for mass production it's worthwhile to determine the proper placement of a tap on the inductor because, in production, inductor taps cost little and they help reduce the parts count. However, when design time and small-lot construction time are more important, a capacity tap is often a better alternative. The simple formula make it easy for Hot Iron enthusiasts to use capacity taps. I have found them quite useful especially when I needed to match to on-hand, but untapped or unsuitably-tapped inductors.

You can read more than you probably want to know about capacity taps here:

> https://analog.intgckts.com/impedance-matching/tapped-capacitor-matching/
> https://www.qsl.net/va3iul/Impedance_Matching/Impedance_Matching.pdf

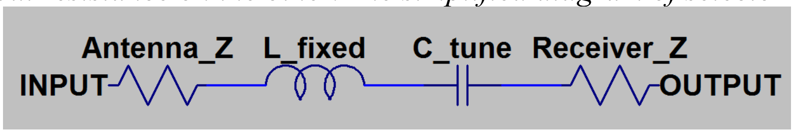
{*Thanks Tom: much appreciated...! GW6NGR*}

Pre-selectors...

A very welcome article about simple circuits with very significant purpose...a simple RF preselector for HF, by Alan Victor, W4 AMV:

"A tunable RF filter for HF is an excellent way to improve sensitivity and reduce distortion. The preselector, selector, is applicable to modern SDR receivers as well older boat anchors. The unit I constructed is used on an old National HRO radio and is quite flexible in its design.

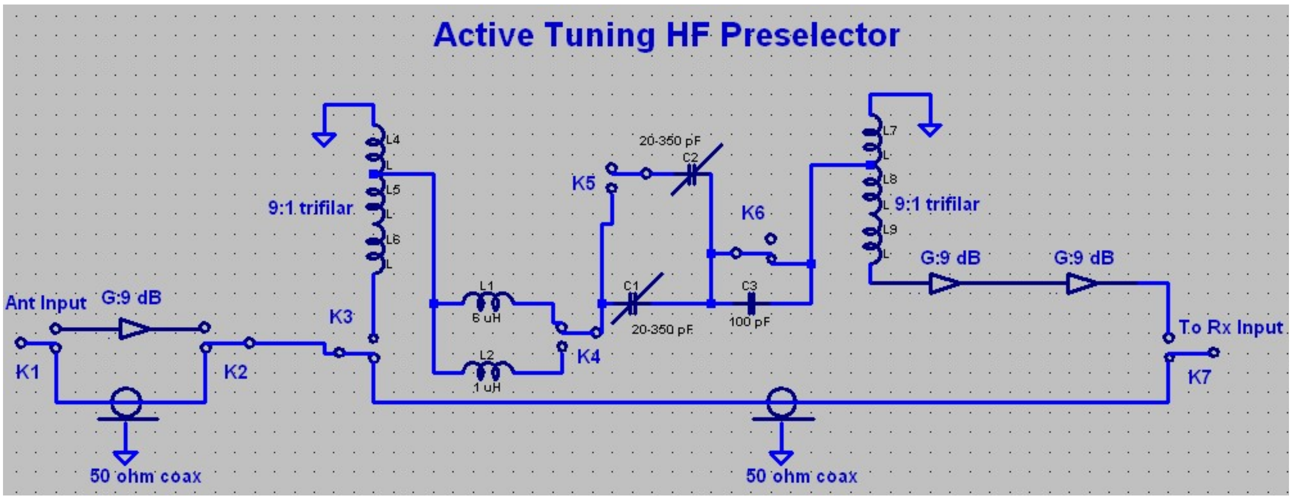
A series tuned circuit is used. Unlike a parallel tuned circuit, the resonant frequency is independent of the resistance used. A portion of the R values are set by the antenna Z on one side of the selector and the receiver input resistance on the other. The simplified diagram of selector is shown below.



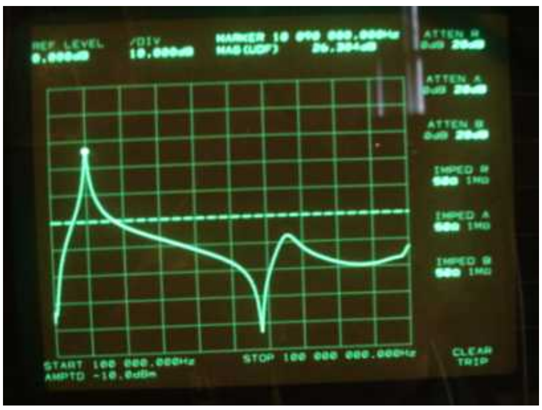
The bandwidth of the selector is controlled by the total series R and this is reduced to a value that can control the bandwidth of the selector. Wideband transformers like a 4:1, 9:1 to 16:1 are easy to build and are placed at the input and output of the selector. At the antenna port, the Z value is reduced and at the output port, the same transformer is used to step the Z back up to match the receiver input. The selector bandwidth (BW) is controlled by the selector Q and this Q is given by

$$Q\_s=2*\pi*fo*L\_fixed/(Rz\_ant+Rz\_rx)$$

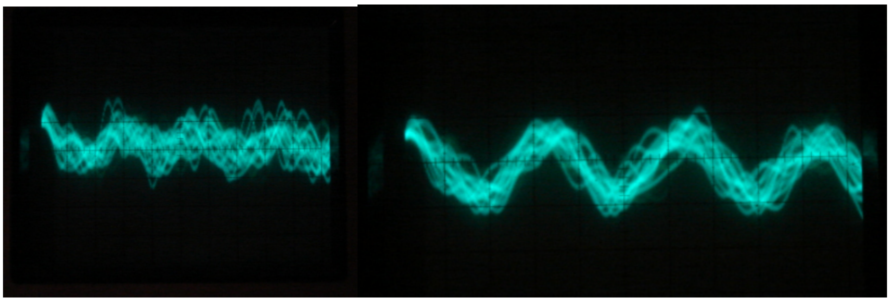
Where fo is the desired center frequency and Rz_ant and Rz_rx are the transformed Z values of the antenna and the receiver. For example, assuming the antenna and receiver are both 50 ohms and a 9:1 transformer pair are used, then these values are each 12.5 ohms. The value of C_tune controls the center frequency. Using a selection of L_fixed and C_tune, it is quite easy to cover the entire HF frequency range. A schematic of such an arrangement is shown below:



The selector loss is quite small if a high Q inductor is used and the addition of low noise amplifiers will further improve its utility. The amplifiers may be placed before or after the selector depending on your operating conditions and local strong signal environments. The improvement in selectivity and sensitivity is clearly visible in the figures shown below. The sensitivity on a boat anchor receiver with 0.25 uV input with selector OFF and then ON. The selector passband response centred near 10 MHz.



The selector frequency response



The selector signal to noise at 0.25uV RF input… OFF to ON"

Many thanks Alan: much appreciated!

In days gone by...

...it used to be *de rigour* that an aspiring radio amateur, before even considering the RAE (the UK radio amateur's examination) would build a simple HF band(s) receiver - to listen to the fascinating world of short wave broadcasts as well as amateurs in his locality and - hopefully - further afield, even inter-continental. A soldering iron was soon fabricated from scrap brass rod offcut filed down to a point from the local machine shop mounted on a ¼" welding rod plus wooden file handle, to be heated over a gas cooker's small burner on low simmer. Tinner's solder (60/40 tin - lead) scrounged from a local sheet metal shop - after learning the hard way that plumber's solder was NOT suitable! - made for easy soldering. Simple chassis made from ply and covered with earthed (flattened) tin cans, and a a couple of brass screws and washers for antenna connection, a scrap ¼" jack socket from an old "radiogram" made the 'phones connection. To power the receiver, batteries initially, common and cheaply available in those days, but soon gave way to a simple mains transformer / rectifier PSU in a plywood box, which gave better regulation - fed power via "choc" (terminal) block, as a "polarised" connector (blank hole with a bit of wooden skewer as a key).

To hear an amateur signal from "across the pond" USA was a true accolade; an signal from the antipodes was a real gem, to be discussed for days over lunch in the works canteen and QSL card eagerly awaited. The construction of this "window on the World" entailed checking various DC voltages and currents; a 1mA moving coil meter plus a bundle of resistors - series multipliers for voltage measurement, shunt resistors for current, easily calculated values by simple maths, made the construction and testing possible. Some rotary switches made a multimeter , some used sockets for each range.

The receiver opened the door to much, much, more: a switched crystal controlled multivibrator gushed harmonics - a frequency marker was soon built, with 100kHz / 1MHz crystals from a scrapped machine - made for accurate calibration of the receiver tuning dial. A home made "grid dipper" was now feasible, as the receiver could pick up the dipper, allowing dipper calibration. The dipper made resonating antennas and tuned circuits easy: what's more the dipper, turned down to just below oscillation, made an effective wave meter.

The aspiring amateur could now consider building a transmitter: the dipper ensured harmonics and spurious outputs were detected then eliminated, and was tuned to the right spot. The RF coils - home made from scrap “Twin & Earth” mains cables, carefully stripped, wound onto whatever cardboard tubes were available - resonated with shunt capacitor and dipper.

Designs studied, parts scrounged, borrowed, begged, and construction underway, each stage tested with a simple diode RF probe feeding the now well used DC voltmeter, currents and voltages noted for future reference in fault finding.

All this cost literally pennies, from scrap materials, imagination and determination, and was the finest teacher an aspiring radio amateur could wish for. Thorough grounding in all the aspects of electronics by practice, the actual construction of a working amateur station from ground up (literally! So that’s where that 6’ length of ½” copper water pipe went...!) gave far more satisfaction than any bought toy, a lifetime of discovery and development, experimenting and new ideas.

To me, that’s what amateur radio is all about: try it and see for yourself. You don’t need industrial electronics tools, equipment or mountains of cash: it’s all out there waiting to be adopted, adapted, and improved. Use what you can to the best of your ability and give it a try! It can be done, within the regulations, without causing interference or straying out of the bands, without budget planning or constant reference to a specification. Amateur Radio is a HOBBY, not a profession: it is a PASTIME, not an occupation.

Building and running an amateur radio station from ground up is a lifelong affair; if you want to sample this approach, try a building a receiver kit. Once the kit is finished and tested, put it into a case and fit, to the best of your ability, a tuning dial and control pots with scales. Make the case (10 - 12mm ply is good) and line it with aluminium foil (earthed) to prevent “hand effects” and paint the outside of the (empty!) case a decent black crackle finish. It will become a thing of value far beyond anything you could buy, believe me.

Modular!

Well, bless my soul! Somebody has grasped the mettle and put together a “modular receiver”, see:

https://oz1bxm.blogspot.com/2021/05/dc-receiver-01-100-mhz.html

Purists will note the lack of audio filtering and the use of an LM386 isn’t perhaps the best choice for low noise and audio quality but plenty of other options are available, have a hunt around in our favourite online auction house(s) for a plethora of choices: but avoid class D amplifiers - life’s difficult enough in the amateur constructor’s world, don’t compound the difficulties with a switch mode audio amplifier! (Note... look up the LM3886, it’s on my list for a superb bench amplifier and looks like it will make a cracking good amplitude modulator too.)

Pseudo Stereo and the frustrated CW man

Years ago, it was a neat trick to “stereofy” a mono audio signal be using filters of various sorts to create false left and right channels. It was rumoured at the time a certain Sergeant Pepper had this technique impressed upon him to widen and intensify the stereo effect: be that as it may, it is a very useful technique for the CW man, in his constant battle to dig out those tiny signals from the fading, drift and other ionospheric nasties that abound around very weak signals. Step into the breach, pseudo stereo, where the signal can be split into two "channels" - so listening in the headphones, as one side's signal fades, the other side picks up: and the human brain is very alert to spacial sounds.

The ideas for pseudo stereo were manifold, but the two techniques that will probably be useful for the CW man are high / low pass filtering and time delay channel splitting.

Here's a circuit or two from makingcircuits.com, which illustrates the filter method and signal inversion technique to create pseudo stereo -

https://makingcircuits.com/blog/simple-stereo-simulator-circuits/

As the signal drifts slightly, the apparent "position" of the sound from stereo headphones inside the listener's head appears to shift to one side; adjusting the receiver's RIT incremental tuning can be tweaked to centre the sound again, enhancing readability, or biased to the listener's preferred ear which might be more sensitive. Here's another option:

http://zpostbox.ru/how_to_create_stereo_from_mono_signal.html

And finally a simple option using one chip:

https://www.aaroncake.net/circuits/stereosynth.asp

Another technique is to apply a frequency sensitive delay to one pseudo "channel" - a technique originally developed by R.A. Penfold in 1994 - which can be seen at:

https://theramsgatehovercraft.com/2013/05/11/mono-to-stereo-effect/

These techniques can be usefully used as bit slicers too, for the basic frequency shift keying detection so beloved by our RTTY colleagues from days gone by; are there still some RTTY enthusiasts out there in this digital world?

Oscillator Topics

DDS / PLL thoughts...

Well, it's finally happened: I'm falling to bits. Yes, bits and bytes - after all these years of doing battle with recalcitrant machine code, EPROM's, and gawd knows how many LS-TTL and C-MOS chips that have been dispatched to their sandy silicon sepulchres in a sniff of smoke, I've decided to go digital. I'm gathering the bits to build my first Si5351 VFO, covering 10kHz to 225MHz, controlled by an Arduino Nano control board, as advised by Pete Juliano, as noted below.

This doesn't mean that I have eschewed "analogue" VFO; no, it's horses for courses: if I need a signal source that I can rely on being bang on frequency, nowadays, it's got to be digital: if I want a BFO running somewhere around 470kHz then it's an analogue job every time.

The fact I've chosen, for this experiment, an Arduino Nano controller doesn't mean I've discarded alternative controllers: for instance, VK5TM, Terry Mowles - a no-nonsense, zero "B-S" man if ever there was one - has some superb PIC chip designs, see:

https://www.vk5tm.com/homebrew/xtal_sub/xtal_sub.php and ZL2PD, Andrew Woodfield, whilst embracing the Arduino Nano in his design at: https://www.zl2pd.com/9bandModularVFO.html

his “Sugacube” oscillator is a triumph in miniaturisation, see:

https://www.zl2pd.com/sugarcube_VFO.html Now isn’t that the most cute bit of kit?

Below is a concise and accurate synopsis of the digital revolution in RF VFO’s by Pete Juliano, N6QW:

Hi Peter,

Just some info for your article.

1. *I started with the PIC and long ago abandoned same. EI9GQ was instrumental in my getting my feet wet with the PIC but alas working in assembly language is not my cup of tea. I want to build hardware not become a software engineer.*
2. *The Arduino is far more intuitive and has a larger support base with tutorials etc. One of the best introductions to the Arduino is from the genius behind the that device. Massimo Banzi has written a small book that steps you through simple projects that can be built upon into more complex circuits.*
3. *Now a huge factor with the Arduino – portability of the code. Once you have code set for an oscillator it can literally be like a set of woman’s panty hose – one size fits all. I simply reuse the same basic code set for any project –what may change is the display type or maybe a few more switch inputs. There are literally thousands of pieces of downloadable code for the Arduino*
4. *Another factor is transposition between various Arduinos. I can write a program that can be used on an Uno, R3 a Nano or Pro-Mini and the only difference is when you load the code you must tell the programmer – which one are you loading.*

For a general one size fits all article– I would place a pox on anything other than the Arduino.”

Installing Arduino programming suite on an Ubuntu Linux machine (I don’t like Windoze and can’t afford anything Mac) gave me some issues: after thrutching about with infuriating error messages that bore no relevance to the real problem, I found https://www.chippiko.com/2021/05/install-arduino-linux.html that did the trick.

Test Equipment, Servicing & Maintenance

Analogue Signature Analysis - finding faults with no circuit diagram

You use what is basically a curve tracer: it plots the V/I characteristic of each voltage node in a circuit. If the “good” V/I characteristics of every voltage node are logged, it’s very simple to go through the nodes of a “faulty” circuit to find where the trouble lies. You don’t have to be too specific; a slight deviation from the logged result is perfectly acceptable. A real fault - often showing as short or open - will be readily detected. Of course, the old hands at the fault finding game will tell of using a multimeter on ohms to do a similar job: ohms test every pin on every IC and log the "forward" and "reverse" resistances registered on the multimeter. The power rails too can yield to resistance checks: the supply rails should never be dead short or open circuit.

Any short or open pin is readily found - but, from experience, it's a tedious procedure. The big plus is, of course, you can find a dud component without a circuit diagram.

The tracker is capable of showing both forward and reverse characteristics of every node in one test: thus cutting the search by half. If a short is indicated, a quick check on the pcb can show a deliberate connection to common, 0v.

A neat circuit for an amateur curve tracer / signature analyser using commonly available parts is:

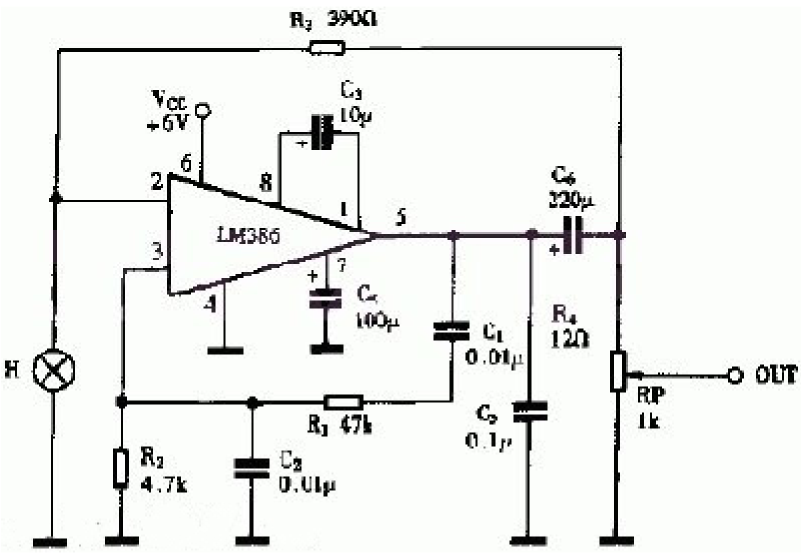
https://www.qsl.net/kd7rem/octopus.html

and I can thoroughly recommend it. It has been mentioned previously in Hot Iron; I'd like to present here (not presented in the previous text if I remember right...?) some rather different approaches to Octopus testing I saw promoted recently. You can use ANY two voltage nodes as test points. You don't have to put one test probe on the common or 0v. rail: it's possible to use other voltage nodes for signature analysis, as are individual components like capacitors and transformer windings. You don't have to use 50Hz from the mains, either: build a power oscillator for 1, 10, 30 kHz or whatever that gives good results. A 100pF capacitor on 50 Hz won't give a signature that's too readable, but try 20 - 50kHz and you'll see the signature ellipse clear as a bell.

For a useful power oscillator to drive the Octopus for HF measurements, see:

https://www.apogeeweb.net/circuitry/lm386-oscillator-circuit.html

...and look down the page for the sine wave oscillator (copy below):



The arbitrary filament lamp ("H") is usually a show stopper, but from experience an old Xmas tree bulb - or in fact any other filament lamp you can lay your hands on - or even a pair of back-to-back equal value zeners (3v3 or 4v7) plus a 1k series resistor. A bit of cut and try will get the job done.

This is not a common application for the LM 386! I wonder if somebody will put together a QRP VLF transmitter with one?

ESR of electrolytics - AGAIN
http://www.conradhoffman.com/capchecktut.htm makes the very valid point often ignored by those amateurs looking to repair a switch mode power supply: the original designer specified a particular electrolytic because it had ESR, temperature, ripple current and value / tolerance that suited his requirements. In making a repair, you need to meet - or better - his specifications for the power supply to continue giving good and reliable service. One value very rarely quoted, but very important to the SMPS designer is the inductance of an electrolytic: remember these beasties are put together by winding aluminium foil electrodes very tightly, the perfect recipe for creating inductance. Not a problem on 50 / 60 Hz; but the 30kHz - 200kHz often found in miniature SMPS's might find that tiny and cheap replacement 'lytic too inductive to be suitable.

The best bet: replace with an exact duplicate of the original; and thoroughly clean out and test the cooling "fins-n-fans" to assure proper cooling - 'lytics don't like hot, Mum!

Measuring RF voltages
Chas. Wenzel's biased diode RF volt meter circuit at: http://techlib.com/electronics/detect.htm will do the job with simple circuitry and yields far more accurate results on low level signals - the differential circuit is especially useful for fault finding: for single point tests, ground one probe. This is a much better solution than the usual shunt diode type for low RF voltages.

Or, if you want to push the boat out, Roy Lewallen's (W7EL) circuit can be seen at:

https://www.robkalmeijer.nl/techniek/electronica/radiotechniek/hambladen/qst/1990/02/page19/index.html (thank you, Rob), will keep you on the straight and narrow.

Heathkit diagrams, circuits, service information
For those who are repairing one of these marvellous bits of kit, useful information and servicing notes can be found at:

Can be found at: https://www.vintage-radio.info/heathkit/

On the topic just discussed, for those of you who have faith in a 1, 10 or 20k-ohm per volt analogue test meter (AVO rules, OK?) Heathkit produced an RF probe kit specifically designed for lower impedance readouts or oscilloscopes: see below -
https://archive.org/details/Heathkit337CDemodulatorProbemanual/page/n1/mode/2up

If you study the circuit diagram, identify the 27k shunt resistor and remove it for useful readings on a 10 or 20 k-ohm per volt analogue multimeter.

One point I will make, however, is that whilst the probe and analogue multimeter might not be as sensitive or capable of very low RF voltage indication, it *will* suffice for most tuning up or peaking in amateur construction. The current manic desire for accuracy and more digits in a digital multimeter is utterly pointless, as absolute measurements are rarely required in amateur construction. What you DO need are comparative readings: whether or not the circuit is peaked up or tuned for best output - where a digital multimeter presents no advantage. The few µA's drawn by a 10 or 20k-ohm per volt multimeter can be useful as it shows the stage can deliver some RF current, and what's more, the peak is far more readily seen on an analogue meter.

The table below illustrates some typical measurements:

Meter Ohms per Volt	Meter range (FSD*)	Loading Resistance	Current drawn at FSD*
1k	100 volts DC	100k-ohm	1mA
10k	500 volts DC	5M-ohm	0.1mA
20k	10 volts DC	200k-ohm	0.05mA
10M digital	1000 volts DC	10M-ohm	0.1mA

*FSD = Full Scale Deflection on the meter

From Ohm's Law: I = V/R thus "20k-ohm per volt" represents 50µA, 10k per volt represents 100µA, 1k-ohm per volt represents 1mA, and so on, *quo rata*.

The 20 k-ohm per volt will read closer to a 10M-ohm digital multimeter the higher the voltage scale selected; the loading resistance increases as the range setting is increased but the pointer is deflected proportionally less. Loading resistance = (Ohms per volt) x (meter scale selected)

The digital meter is usually 10M-ohm input resistance. On HV circuits an analogue meter on high volts ranges offers very similar light loading to a 10M digital multimeter! Note too that a voltage node can read as expected on a digital meter even fed via a high resistance joint as the input resistance is so high. Don't be fooled: once current is being drawn, the output sags - always test a power supply on load.

For example, let's consider a dry joint in a power supply output. The dry joint has a resistance of 10k-ohms; the nominal PSU output voltage is 500 volts. A digital multimeter, of input resistance 10M-ohms, will read (500v) x 10M/(10M + 10k) = 499.5v. You'd be happy to say your power supply was running fine? Near enough to 500 volts? Now let's try our home brewed 1k-ohm per volt multimeter and see the result. The meter will have a resistance of 500 x 1k = 500k-ohms. Applied to our "dry jointed" PSU, the meter will read 500v x 500k / 500k +10k = 490.2v. It's 10 volts light!

That would certainly be enough to prompt a further check at GW6NGR; so out comes my "universal" load bank: a string of 40 watt 230v light bulbs in series, 3 of which on 500 volts are about 1k-ohm each (filaments, when not run on full volts, will be lower resistance) across the PSU.

Let's calculate the output voltage: our load resistance is 3k-ohm in parallel with the 500k-ohm of the analogue meter = 2.9821 k-ohms. The resistance of the dry joint is 10k-ohms so the total circuit resistance = 10k-ohm + 2.9821k-ohm = 12.9821k-ohms; the current flowing is 500v / 12.9832k-ohm = 38.51mA. Thus the terminal voltage is 38.51mA x 2.9821k-ohms = 114.85v.

The table below summarises the results, spot the "uh-oh" line!

Nominal output = 500 volts DC

Meter	Output Volts	Load resistance	Comments
Home made 1k / volt	490v	500k-ohms	This PSU is probably faulty!
Digital 10M	499.5v	10M	This PSU is probably OK! <<<!!!
1k / volt or digital	114.8v	3K lamp load	This PSU is definitely faulty!

The moral is that whatever meter you use to check a power supply, check unloaded volts first, then compare with loaded: the difference should be well within the regulation specification of the PSU.

If you take meter loading into account, and use comparative readings, an analogue meter can be just as useful as a digital multimeter as it can indicate trends far better and is invaluable for "peaking up" a circuit.

Filament lamps, now obsolete and thus somewhat rare: are a very useful and adaptable bit of RF shack test gear. Go and buy some now and keep them for future shack use!

If used as a bridge detector, an analogue multimeter becomes an **infinite impedance** device. Read up on bridge measurements, it will be useful in the long run, believe me!

Kit suppliers

This is from the Long Island CW Club, Radio Kit Guide Updated from Neil W2NDG list at: http://radiokitguide.com...and my very grateful thanks to Neil for the effort in compiling and updating this list for all us kit watchers.

Reverse Polarity protection

Whilst semiconductors are generally low power, efficient devices, the machinery to manufacture them is decidedly not! It takes many hundreds of kWh's to make the most basic devices; and a breakdown represents a catastrophic loss of money as the machines following the breakdown stand idle waiting for silicon to work on. Thus reliability is paramount - machines frequently use many layers of protection, such as phase rotation detectors, automatic re-connect fusing, reverse polarity protection and the like.

The last item might seem somewhat trivial; but think instead of what happens if another machine in the plant, it's transformers consuming hundreds of kW's, blows a fuse. The inductive transients are BIG, and walk straight past most VDR's and the like as they are fast, big energy transients, not the 2µS & 10µS classic simulations of lightning strikes. Thus the reverse polarity protection has to cope with some really heavy currents, fast (nS) rise times and long decay times of many kJ's energy.

It's wise to see what automotive electronics designers are up to: they seek reliability and economy at every turn and semiconductor manufacturers are definitely switched on to this, as that's exactly what they want users of their products to enjoy. I found this in my notes:

https://www.infineon.com/dgdl/Reverse-Batery-Protection-Rev2.pdf?fileId=db3a304412b407950112b41887722615

from Infineon Semi, where this topic of reverse protection is discussed.

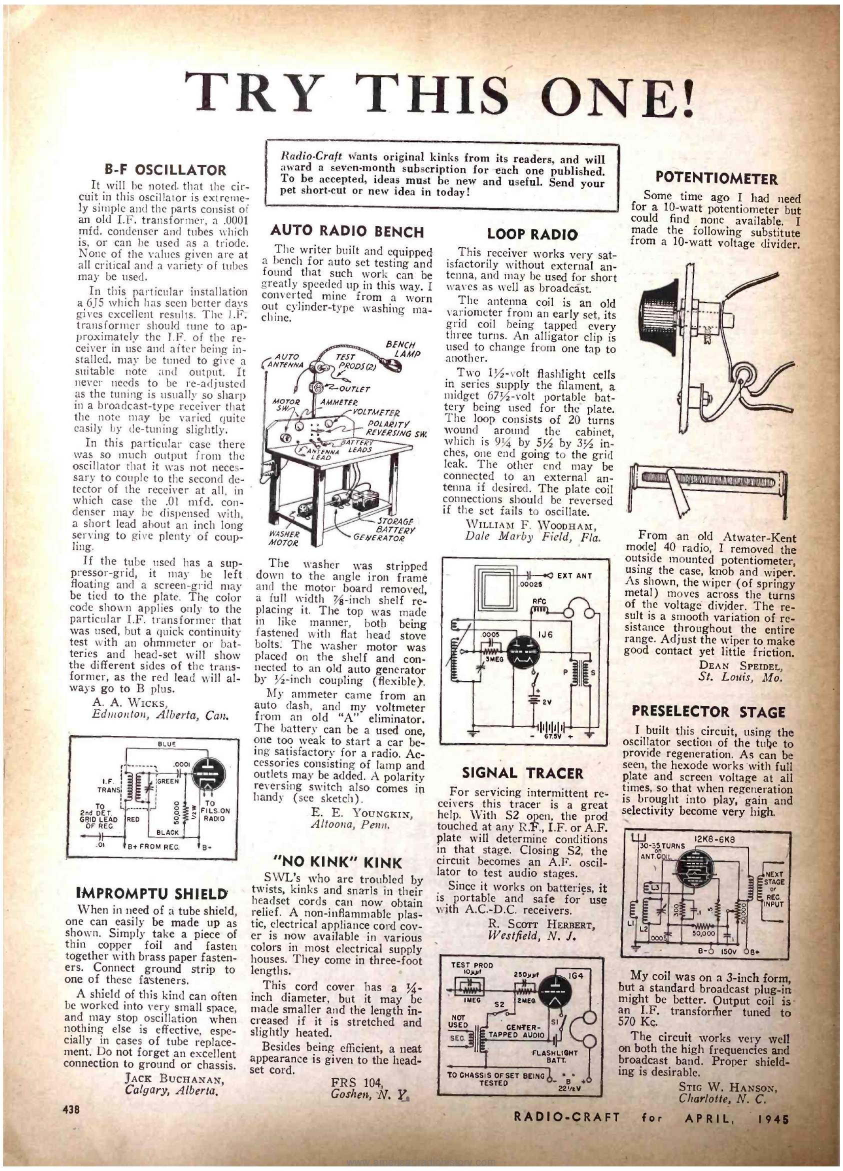
I will add only one additional comment: the most reliable, regularly used HV power supply in the Wafer Fabrication plant I last worked in has several layers of reverse polarity protection, and the one that never failed was a high current mercury vapour switch, that could switch in less than 10nS a current of 100 amps. P-Channel mosfets abounded in the electronics and the 3 phase line conditioner was the size of a small car and considerably heavier; but the mercury vapour switch did it's job and we only ever needed routine cleaning and interlock tests for maintenance.

Well designed protection pays every time!

Old ideas...

Here's a page that caught my eye from 1945, the signal tracer / injector with just ONE active component - if you don't want to use a hearing aid "pencil" tube, a jfet (with added 3k9 bypassed with a 0.1 µF in the source lead for DC biasing) would likely substitute nicely, with a 500 + 500 ohm centre tapped transistor interstage transformer for the feedback. It's a complement to those old boys back them how they squeezed every drop of performance out of one tube!

Take a look at the bench set-up too: those old boys knew how to make the most with the least, that's for sure. Something we all could learn from, rather than discarding or throwing more and more silicon into a design. (Hint, use a bit of "zoom in" for a clearer view. Ed.)



TRY THIS ONE!

Radio-Craft wants original kinks from its readers, and will award a seven-month subscription for each one published. To be accepted, ideas must be new and useful. Send your pet short-cut or new idea in today!

B-F OSCILLATOR

It will be noted that the circuit in this oscillator is extremely simple and the parts consist of an old I.F. transformer, a .0001 mfd. condenser and tubes which is, or can be used as a triode. None of the values given are at all critical and a variety of tubes may be used.

In this particular installation a 6J5 which has seen better days gives excellent results. The I.F. transformer should tune to approximately the I.F. of the receiver in use and after being installed, may be tuned to give a suitable note and output. It never needs to be re-adjusted as the tuning is usually so sharp in a broadcast-type receiver that the note may be varied quite easily by de-tuning slightly.

In this particular case there was so much output from the oscillator that it was not necessary to couple to the second detector of the receiver at all, in which case the .01 mfd. condenser may be dispensed with, a short lead about an inch long serving to give plenty of coupling.

If the tube used has a suppressor-grid, it may be left floating and a screen-grid may be tied to the plate. The color code shown applies only to the particular I.F. transformer that was used, but a quick continuity test with an ohmmeter or batteries and head-set will show the different sides of the transformer, as the red lead will always go to B plus.

A. A. WICKS,
Edmonton, Alberta, Can.

IMPROMPTU SHIELD

When in need of a tube shield, one can easily be made up as shown. Simply take a piece of thin copper foil and fasten together with brass paper fasteners. Connect ground strip to one of these fasteners.

A shield of this kind can often be worked into very small space, and may stop oscillation when nothing else is effective, especially in cases of tube replacement. Do not forget an excellent connection to ground or chassis.

JACK BUCHANAN,
Calgary, Alberta.

AUTO RADIO BENCH

The writer built and equipped a bench for auto set testing and found that such work can be greatly speeded up in this way. I converted mine from a worn out cylinder-type washing machine.

The washer was stripped down to the angle iron frame and the motor board removed, a full width 7/8-inch shelf replacing it. The top was made in like manner, both being fastened with flat head stove bolts. The washer motor was placed on the shelf and connected to an old auto generator by 1/2-inch coupling (flexible).

My ammeter came from an auto dash, and my voltmeter from an old "A" eliminator. The battery can be a used one, one too weak to start a car being satisfactory for a radio. Accessories consisting of lamp and outlets may be added. A polarity reversing switch also comes in handy (see sketch).

E. E. YOUNGKIN,
Altoona, Penn.

"NO KINK" KINK

SWL's who are troubled by twists, kinks and snarls in their headset cords can now obtain relief. A non-inflammable plastic, electrical appliance cord cover is now available in various colors in most electrical supply houses. They come in three-foot lengths.

This cord cover has a 1/4-inch diameter, but it may be made smaller and the length increased if it is stretched and slightly heated.

Besides being efficient, a neat appearance is given to the headset cord.

FRS 104,
Goshen, N. Y.

LOOP RADIO

This receiver works very satisfactorily without external antenna, and may be used for short waves as well as broadcast.

The antenna coil is an old variometer from an early set, its grid coil being tapped every three turns. An alligator clip is used to change from one tap to another.

Two 1½-volt flashlight cells in series supply the filament, a midget 67½-volt portable battery being used for the plate. The loop consists of 20 turns wound around the cabinet, which is 9¼ by 5½ by 3½ inches, one end going to the grid leak. The other end may be connected to an external antenna if desired. The plate coil connections should be reversed if the set fails to oscillate.

WILLIAM F. WOODHAM,
Dale Marby Field, Fla.

SIGNAL TRACER

For servicing intermittent receivers this tracer is a great help. With S2 open, the prod touched at any R.F., I.F. or A.F. plate will determine conditions in that stage. Closing S2, the circuit becomes an A.F. oscillator to test audio stages.

Since it works on batteries, it is portable and safe for use with A.C.-D.C. receivers.

R. SCOTT HERBERT,
Westfield, N. J.

POTENTIOMETER

Some time ago I had need for a 10-watt potentiometer but could find none available. I made the following substitute from a 10-watt voltage divider.

From an old Atwater-Kent model 40 radio, I removed the outside mounted potentiometer, using the case, knob and wiper. As shown, the wiper (of springy metal) moves across the turns of the voltage divider. The result is a smooth variation of resistance throughout the entire range. Adjust the wiper to make good contact yet little friction.

DEAN SPEIDEL,
St. Louis, Mo.

PRESELECTOR STAGE

I built this circuit, using the oscillator section of the tube to provide regeneration. As can be seen, the hexode works with full plate and screen voltage at all times, so that when regeneration is brought into play, gain and selectivity become very high.

My coil was on a 3-inch form, but a standard broadcast plug-in might be better. Output coil is an I.F. transformer tuned to 570 Kc.

The circuit works very well on both the high frequencies and broadcast band. Proper shielding is desirable.

STIG W. HANSON,
Charlotte, N. C.

438 RADIO-CRAFT for APRIL, 1945

Construction notes

Wire Nuts

There is considerable misunderstanding about electrical safety in the UK, especially among the "non-technical" radio amateur cohort, that it is somehow "illegal" to use Wire Nut connectors according to UK "IEE Regs".

We all carry a duty of care; if someone is hurt because of your negligence, be it from loose slates falling, a wobbly fence or exploding power supply electrolytics, it is this injury that forms the basis of claim the injured party can bring in the Civil Court. Broadly speaking - and I'm no lawyer - it's not a Criminal but a Civil matter. There are NO "electrical police", NO list of "illegal" components that must not be used: whatever you do, beyond the socket of any domestic electrical installation, it's down to you to make the area safe for anybody who could be hurt by what you've built.

This "illegal" misunderstanding dates back to the 1930's, when ceramic wire nuts ("Screwits") were used in the UK. They had a nasty habit of cracking, break in half and were the cause of a few 'shocking' incidents.

Now let's move on: in the USA, the ceramic Wire Nuts were replaced by the steel spring insert in a plastic cap type - these were the forerunners of wire wrap technology so common and reliably used in all aspects of electronics and electrical power interconnections nowadays. They are used literally everywhere in the USA and Australia for house and other general wiring: they are cheap, reliable, safe, secure, far easier to use and smaller than the screw type "choc-bloc" so common in the UK. I have several boxes of Wire Nuts, and to be fully "IEE Regs" compliant they should be installed under a secure cover, just as a choc-bloc should.

Wire Nuts contain a tapered spiral hardened steel spring, they are used by stripping the wire ends to expose the copper conductors which are twisted lightly together in a clockwise manner. The Wire Nut is placed over the exposed copper ends and screwed (clockwise, right hand thread) up until the outer insulation has one or two full twists visible. Because of the internal tapered shape of the steel spring, the copper of the conductors being joined is forced together intimately; the spring material is square section so the corners dig into the copper making a metal-to-metal cold weld. The copper conductors, being in close intimate connection for their entire stripped length, make the best possible copper-to-copper joint locked into place by the tapered spring then insulated and supported by the wire nut cap. They form the finest wire connection possible: copper to copper, no intermediate joints.

The outer insulation twists provide a visible "tight enough" indication, and a small degree of strain relief. Moreover, you can common many wires in a Wire Nut, by choosing the appropriate size. You can't over-tighten Wire Nuts: hand tight is perfect - try fitting or undoing choc-bloc connectors up a swaying ladder with a heavy antenna wire to contend with and you'll soon see the advantages of Wire Nuts! One hand holding the ladder; one hand holding the choc-bloc; one hand holding (each) antenna wire; one hand holding the screwdriver.... you see the problem!

For fixing antenna wires and similar outdoor electrical joints, mount the Wire Nuts closed end upwards and they will withstand weather as they naturally shed water and even with wind blown water ingress, mounting the Wire Nuts open end down naturally drains water away, preventing shorts. You can find more information here:

https://www.heamar.co.uk/ideal-wire-nuts/41572-ideal-30-074-wing-nut-box-of-100-783250300747.html

Antennas

An updated Mini-Whip

https://www.pa3fwm.nl/projects/miniwhip/ has designed a nice derivative of the original PA0RDT idea. I'll refer you to the original (Copyright reasons) rather than going into detail here.

I'd be tempted to try a BS170 mosfet as the Hi-Z input element but the gate / source capacitance might be bit on the high side. Another approach - for those who like building things to see what happens, rather than spending hours and hours with data sheets and theory - is to bung in a 2N3819 j-fet driving a BD136 (high Ft medium power video amplifier) PNP transistor (or equivalent, see: BD132, BD136G, BD138, BD138G, BD140, BD140G, BD166, BD168, BD170, BD176, BD178, BD180, BD180G, BD188, BD190, BD227, BD229, BD231, BD234, BD234G, BD236, BD236G, BD238, BD238G, BD376, BD380, BD786, BD788, BD788G, BD790, MJE235, MJE252, MJE711, MJE712) (my grateful thanks to https://www.el-component.com for the equivalents list). If you build one of these, or an "alternative device" version, please let me know how it performs, and I'll publish your circuit in Hot Iron (sorry, no money, just everlasting fame and fortune..!).

From Harry Lythall, SM0VPO...

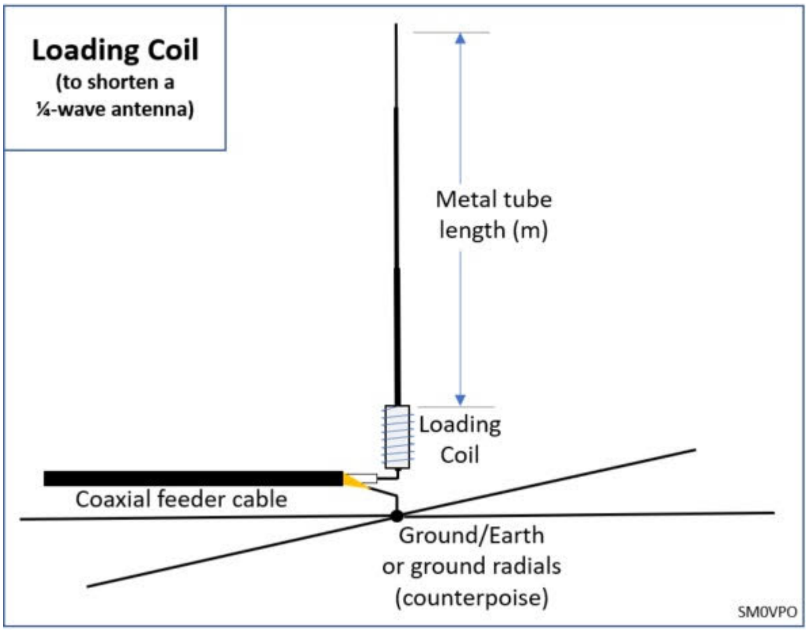
A welcome note from that magnificent RF guru, Harry Lythall, SM0VPO:

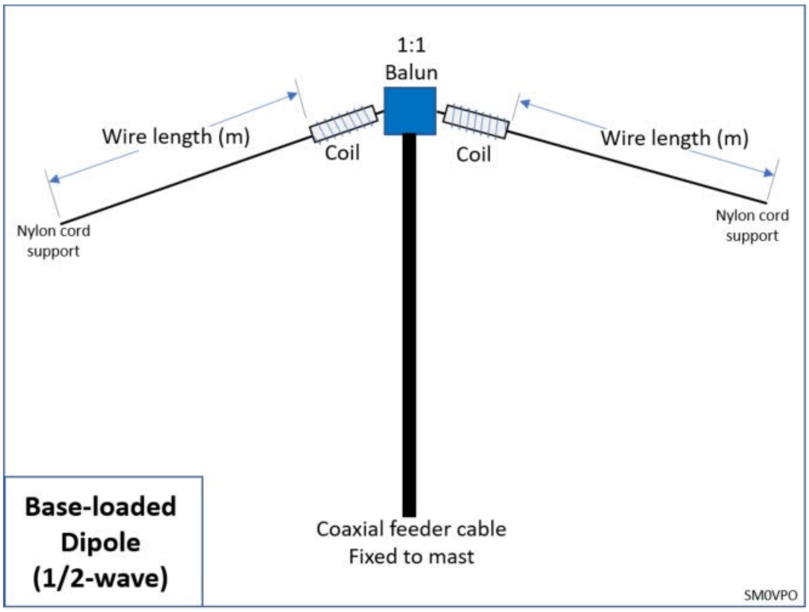
"Hello Peter,

I found this month's Hot Iron 112 really interesting, but my eyes zoomed into the paragraph on page 3:

"Correspondents write...
The third topic is winding inductors: quote: "I need 22µH, and I have a cardboard tube 2 inches diameter, how many turns of wire - and of what gauge - will I need, at what spacing?" is a typical (unanswerable!) request."

No it is NOT at all unanswerable. I recently moved into a house with a miniscule garden in a community where any visible structure is frowned upon. I was told that I may be able to get away with some installation, providing it had a low visual profile.
Short vertical antennas require some form of correction, ie. a base loading coil. Shortening a dipole is exactly the same problem as the ground-plane, but using two coils that are located out of reach. The ends of the dipole may be accessible for trimming.





There is a formula published in QST September 1974 for calculating coils, but it is a bit big and cumbersome (http://85.226.187.247/). Not only that but the dimensions are in inches and feet.

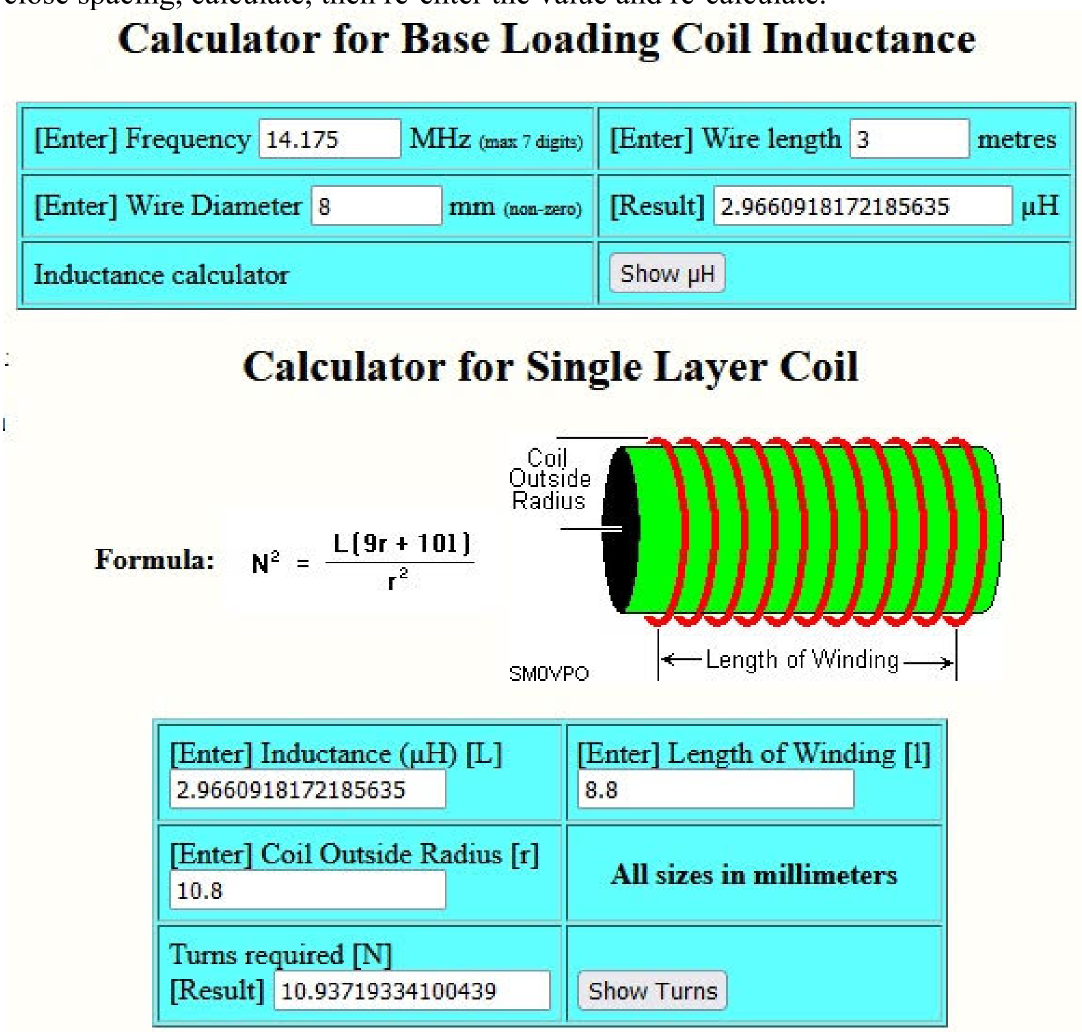
$$L_{\mu H} = \frac{10^6}{68\pi^2 f^2}\left\{\frac{\left[\ln\frac{24\left(\frac{234}{f}-B\right)}{D}-1\right]\left[\left(1-\frac{fB}{234}\right)^2-1\right]}{\frac{234}{f}-B} - \frac{\left[\ln\frac{24\left(\frac{A}{2}-B\right)}{D}-1\right]\left[\left(\frac{\frac{fA}{2}-fB}{234}\right)^2-1\right]}{\frac{A}{2}-B}\right\}$$

So I wrote the article http://85.226.187.247/ and re-wrote the formula in script so that there is an online calculator "Calculator for Base Loading Coil Inductance". I also modified it to remove centre-loading options (to simplify it) and to use metres and millimetres. Using this formula you can calculate the inductance required to make a short antenna resonant at any HF band frequency, without an ATU (I do not believe in them).

Immediately after the inductance calculator is a coil-turns calculator that gives the number of turns of wire for a single-layer coil.

$$N^2 = \frac{L(9r + 10l)}{r^2}$$

That calculator also answers the question given in Hot Iron112, and you do not need to take off your shoes and socks to use your toes to count. The only thing is you need to guess the coil length for close spacing, calculate, then re-enter the value and re-calculate.



Calculator for Base Loading Coil Inductance

[Enter] Frequency 14.175 MHz (max 7 digits)	[Enter] Wire length 3 metres
[Enter] Wire Diameter 8 mm (non-zero)	[Result] 2.9660918172185635 µH
Inductance calculator	Show µH

Calculator for Single Layer Coil

Formula: $N^2 = \frac{L(9r + 10l)}{r^2}$

[Enter] Inductance (µH) [L] 2.9660918172185635	[Enter] Length of Winding [l] 8.8
[Enter] Coil Outside Radius [r] 10.8	**All sizes in millimeters**
Turns required [N] [Result] 10.93719334100439	Show Turns

As an example let us take a vertical ground-plane antenna, but I only have a 3m aluminium pole, painted and decorated to look like a fishing rod in a garden umbrella stand. I want it to resonate on 14.175MHz. Enter the parameters 14.175Mhz, (average) diameter is 8mm, the result is 2.9661µH.

Using a 20mm diameter plastic water pipe and 0.8mm diameter magnet wire, you need 11 turns of wire, close spaced.

If your readers want just the formulas on their desktop then they can copy/paste from the HTML document (below) into a new notepad.exe file and save it as: `EasyNameYouWillNotForget.html` on your desktop. As regards copyright, just be sure to copy it correctly or it will not work :-). Your readers are welcome to copy and use the code in their own homepages.

I used these calculators to build a complete multiband dipole from 7MHz to 29MHz (including 27MHz!!) and no ATU is needed for any band. The only point to remember is that a shortened antenna with a coil has a higher Q-factor, which makes the bandwidth a little narrower.

If you want constructional ideas for a hidden vertical GP antenna then how about a high metal bird-table (2m high because you have cats), with a 1m stainless-steel "birdy-flagpole" for our feathered friends, just to extend it a bit. An interesting legal point is that the UK height restrictions do not apply to bird tables. I used to have a 20m high bird table when I lived in Grunty Fen. The planning officer who came was most upset when I told him it was a bird table and the antennas were anchored below the actual table, on a secondary basis, on an existing structure. He admitted there was nothing he could do.

Ok Peter, I hope that this answers the question about winding coils, and some additional information about calculating coils for shortening antennas, without the use of a lossy ATU. If you want to use this information then you are most welcome to share it.

Very best regards from Harold "Harry" Lythall - SM0VPO
harry.lythall@sm0vpo.com

Harry's routine is listed below: I apologise if my "cutting & pasting" has disrupted the formatting: you may need to adjust appropriately - aaarghh!

```
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<head><title>Extract From Small Space HF Antennas by Harry Lythall
(www.sm0vpo.com)</title></
```

```
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style="font-size:10px">(max 7 digits)</span></td>
    <td>[Enter] Wire length <input name="l" size=6> metres</td>
</tr>
<tr>
    <td>[Enter] Wire Diameter <input name="d" size=7> mm <span
style="font-size:10px">(non-
    <td>[Result] <input name="uH" size=22> µH</td>
</tr>
<tr>
    <td>Inductance calculator</td><td><input type="button"
value="Show µH"
onClick=coil.uH.value=(
</tr></table></form></p></p>

<p><center><h2>Calculator for Coil Turns</h2>
<p><center><p><form name="slayer">
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    <td>[Enter] Length of Winding [l]<br><input name="len"
size=20></td>
</tr>
<tr>
    <td>[Enter] Coil Outside Radius [r]<br><input name="rad"
size=20></td>
    <td><center><strong>All sizes in
millimeters</strong></center><
</tr>

<tr>
<td>Turns required [N]<br>
    [Result] <input name="tur" size=20></td>

<td valign="bottom" halign="right">
    <input type="button" value="Show Turns"
    onClick="slayer.tur.value=
    (slayer.uH.value-0)*
    ((9*(slayer.rad.value-0)/25.
    (10*(slayer.len.value-0)/25.
    /(((slayer.rad.value-0)/25.4)
    *((slayer.rad.value-0)/25.4))
</tr>
```

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</table></form></center></p></
</body></html>
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From Gerald Stancey, G3MCK

FILE GW6NG

Matching an indoor dipole

Gerald Stancey G3MCK

I was interested to read in Hot Iron 112 Tom's (K4ZAD) solution to his friend's problem as I have had this problem but took another route. On any feeder that is operating with a SWR there are points where the resistive component of the impedance is the same as the impedance of the line. A Smith Chart, figure 1, shows that when a 50 ohm line is terminated in a resistive load of 84 ohms at 0.106 wavelengths from the load the impedance is 50 ohms resistive in series with a capacitive reactance of 25 ohms which, at 14 MHz, is equivalent to 0.28 micro Henries. Inserting a coil of that inductance into the line at that point will ensure that the rest of the line operates at unity SWR. The author has successfully done this with both 30m and 20m indoor dipoles. The only equipment needed was a SWR meter, Smith Chart and a tape measure.

Having got the theory out of the way let us look at some practical details; do you need to achieve unity SWR? You will reduce the line loss but for the short lengths of line that you are likely to be using this is trivial so it can be ignored. However your rig may be unhappy and may even self destruct. This is serious so read the manual and see what is the maximum safe SWR. Let us assume that it is 1.5, in other words you don't have to achieve unity SWR. The author always terminates his coax in the roof space with a coaxial plug so that he can play with what antenna takes his fancy. This means that the easiest way to establish the desired point on the feeder is to extend it by 0.106 wavelengths rather than cut into the existing coax. At 14 MHz using normal 50 ohm line this equals (300 x 0.66 x 0.106 x 39.6)/ 14 metres which 59 inches, the velocity factor of the coax being taken as 0.66. To be on the safe side make it a bit longer, say 66", as it is easier to reduce the length rather than extend it.

Now to find the size of the inductance. The author likes to make coils where the diameter is the same as the length and uses the following formula:

Inductance in micro Henries = (diameter x n^2)/58 where n is the number of turns and the diameter is measured in inches.

For a 1½" diameter coil this formula gives 3.23 turns and if the coil is made self supporting then making it three turns and squeezing it a bit will yield the desired value. If you

{Please forgive the image quality; my scanner isn't the best...!}

can't get an acceptable SWR then reduce the length of the coax a little and adjust the coil again. The author first made the coil from 22 swg wire as this is easy to distort and when its final, ugly, shape was found he made a nice copy from 16 swg wire. A variation in inductance of about 2:1 can be achieved by varying the length by +/- 50%. Figure 2 shows the layout that the author used. Unity SWR depends solely on how much time you want to spend.

Another way of dealing with this problem is stub matching and this is adequately dealt with in the standard hand books. If you have access to an antenna analyser this looks to be very easy. I only write about things that I have done, if you do it then please write it up and tell us all if it is as easy as it appears.

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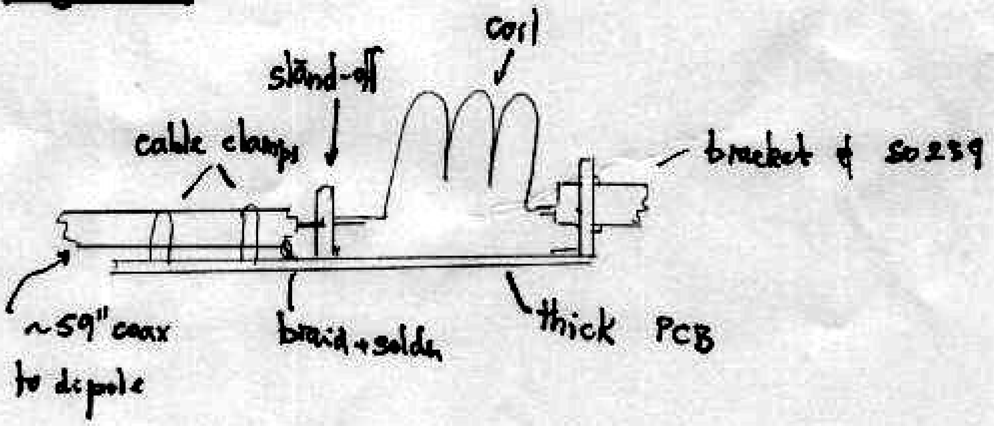
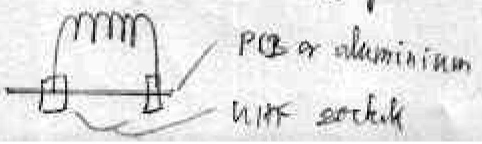
Figure 2



Peter, apologies for a very poor sketch. Another method is:-



please use either.

I particularly like the use of SO239 “UHF” sockets as insulating stand-offs: probably a far better function for them than as a “UHF” connector!

A last word...

My apologies for a somewhat abrupt |edition of Hot Iron; my computer went dool-alley during an upgrade, leaving me with a teletype screen and not much else. It has taken many hours of head scratching to recover my Hot Iron files, when the PC you rely on goes PHUTTT! you don’t have too many options open! Thank goodness I run Ubuntu Linux, the help available - even to working via a TTY-1 screen in stark black and white with rudimentary commands and my lack of in-depth Linux - got me recovered, and you see the result above.

I couldn’t have done this on any other O/S; I can thoroughly recommend Ubuntu Linux to anybody looking for an easy-to-fix O/S with masses of on-line free help.

Thank you Ubuntu!