

HOT IRON #126: August, 2024

THE JOURNAL OF THE CONSTRUCTOR'S CLUB

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Our wonderful hobby includes participants with a great deal of electronic knowledge as well as those just beginning their journey. Our quarterly newsletter tries to publish a little something for each!

* **Simple Safety (G6NGR)**

Lock out or Lose Out!

I often had to work well away from the electrical supply distribution boxes or power cabinets feeding machinery - the load being inside a 'Clean' room, the feed circuit breakers thus out of sight. One of the first things you learned as an apprentice was to 'lock out' the breaker(s) feeding the circuits you were working on. This is standard practice, accepted and understood in any electrical servicing job in any country.

There are, though circumstances that defeat this safety tactic: 'borrowed' neutrals and 'crossed feeds' being two that can give nasty (or fatal) shocks no amount of 'lock out' will prevent.

Borrowed Neutrals

These are found when, to save expensive cable, a live wire is run via single pole switches to several loads, then *any* (unswitched) Neutral adopted for the return leg. This can result in what is assumed to be a 'Neutral' wire (i.e. close to earth potential) having nigh on full line volts on it, if lifted from the Neutral bar or bolt.

Crossed Feeds

Similarly, to save running a 'live' wire back to the distribution box, a 'temporary' live is 'borrowed' from a nearby load. In a single phase circuit, this just means the circuit breaker for one load actually covers two; confusing - and who remembers to mention this at shift change in 9 hours time? More dangerous by far is the 3 phase situation: a load can end up being fed from $\phi 1$, the rest of the machine running on $\phi 2$ or 3, so you've line to line volts (415 VAC) floating around in a machine designed for 230VAC. It's a recipe for disaster!

Remedies...

As well as a padlock locking out a circuit, protect yourself locally by grounding out all local 'lives' in the kit you're working on. A pair of hefty croc clip leads clipped Live to Earth, Neutral to Earth will protect; some sparks I worked with carried a plug wired short circuit, L-E, L-N, N-E which they put into an adjacent socket. Thus any attempt to render the circuit 'live' instantly took out the fuse(s) or tripped the breaker.

If you're running valve (tube) gear with B+ above 50 volts DC then use a safety ground hook (mentioned in Hot Iron previously) on B+ to ground or an earthing cable with hefty tags on either end. A short length of 40 Amp silicone rubber sheathed TIG welding cable with tags crimped on is good, it's flexible and can shunt all the energy an amateur is likely to come across to ground should the B+ be inadvertently energised. Be sure to bolt the **ground end down first!**

Finally, watch those HV electrolytics. A few μF 's at 2kV will see you into a pair of wings in a jiffy if you treat them with contempt! A pair of well insulated croc clips, with a 100k Ω / 10W resistor wired between them, will discharge those μF 's safely - given time to really drain the charge.

Finally... don't forget to remove all your safety kit before handing the kit back, or doing a test run. Yes, yes, obvious I know, but (ahemm!) I have known it happen!

- * [The ARRL has released a report on the recent breach of its IT systems. Read it here.](#)
- * Musk's Neurolink chip has been implanted in a second patient, with a reported great increase in its efficiency (connections). Apparently, the first patient can control his computer mouse and play video games using only his mind, having only about a 15% efficiency (connections). It will be very interesting to see how this goes. The second patient is said to be playing Counter Strike 2.
- * **Solar Cycle 25** exhibits the highest amount of activity since 2003 if I understand correctly, so get on the air! There have been quite a few 6 meter openings and 10 is alive and well. QRP rigs should work wonders now so look at the ideas in this issue! We should also have a few more years of good activity after 2024. Then back to the low bands!
- * [Information about Space Weather, cosmic radiation, solar cycles and much more is here.](#)
- * [QRPpppp and WSPR allows you to check your antenna's](#) multi-band transmitting and receiving performance. This article by N2YCH discusses this using available software and common techniques.
- * [Need to prepare for an AllStarLink build?](#) Read this KJ7T "*The Random Wire*" newsletter issue to get started.
- * [Many countries have shut down their short wave broadcasting systems](#) in favor of the internet but Radio New Zealand Pacific is installing two new 100 KW transmitters aimed at the South Pacific

islands. This is most refreshing! Read the linked article about RNZ's effort from *Radio Report Smartbrief*. Another recent announcement states that [VOA is closing its Marianas Island transmitter site](#).

* [This Zero Retries link discusses the 902 – 933 \(33cm\) band](#) and what's happening there, including some distance records for 802.11ah modem transmissions.

* [And this Random Wire issue](#) compares the cheap N100 mini-computer to the Raspberry Pi 5 unit...interesting reading.

* Just had a cardiac pacemaker implanted? Frank, W4NPN, did. Worried about RF exposure affecting it? Frank was. Time for QRP only? Frank wondered. [Go to this link for some information](#).

* There have recently been articles about WB3GCK's "Loudspeaker Wire Antenna," which claim good multi-band success. [John, VK3KOT analyzes it and comes to some conclusions](#) which can be read at this link.

* **Remembering that this newsletter** is the "Journal of the Constructor's Club," we are searching for simple but fun projects to build. Kits are fun and useful but building "from scratch" is even more fun, especially if most or all the parts can be found in your junk box or in something waiting to be scrapped. Below, we have a quick look at some high-efficiency Class-E designs and then we go on to simple CW and AM classics.

* **Class E transmitters** can achieve amazing efficiencies and are not necessarily complex. The modern take on Class E in the articles cited below show it's getting better realised as time goes on. Woe betide though, anyone who wants a transmitter for multiple frequencies! You'd certainly struggle to cover the 80m band with a Class E P.A. as you'd need to make a lot of hefty RF bits adjustable, but for fixed frequency (xtal controlled) transmitters Class E will save some tonnage usually expected in an A.M. Tx, especially using Drain / Supply modulation schemes.

This article from KA7OEI discusses the design of a simple Class-E switching-type LowFER Beacon transmitter. Close to 100% efficiency is achieved with a minimum of parts and a good analysis of the circuit is provided.

This link describes a 200 watt Class-E transmitter and provides much amplifying information about the mosfets used, possible alternatives and other thoughts.

Here's an explanation and schematic for the "TEXAS" Class-E LOFER beacon. Lots of reference material is provided, along with excellent analysis of the circuit.

For a little more versatility, here's an article about a 30 meter WSPR *transceiver*!

For a more technical education about Class-E, read this paper by Sokal.

Internet research will find many, many design and explanatory articles about Class-E, and the weather's too hot to do much outside so have a look! -----

With the Solar Cycle so active, a QRP rig can work wonders – build a simple circuit and have some fun! A few simple CW and AM home-brew transmitter circuits found by a web search are below, but before we go too far, have a look at [Hot Iron #114 on the website](#) for more information and thoughts about low power transmitters.

* Many transmitter projects have been published in *Hot Iron* over the years. Here is a list of issues which contain “transmitter” information:

9, 64, 65, 75, 82, 84, 85, 86, 87, 89, 96, 97 101, 103, 112, 116, 117, 118, 119

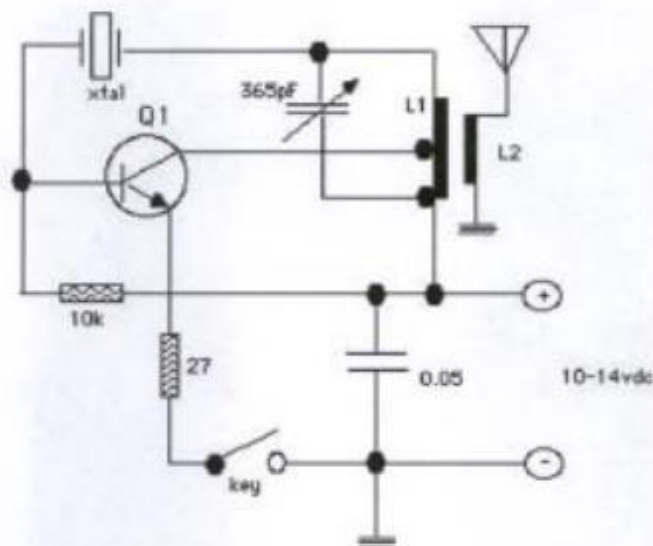
[Here's a link to the Hot Iron library where you can open these issues!](#)

Some QRP and transmitter ideas continue below...

Should you build a QRP xmtr, it will be helpful to know the QRP frequencies used on the various bands. [You can find these at this link.](#)

Some designs:

1) [This one has been around for a while](#) and can be found in various web addresses. It is a roaring 500 milliwatt 2N2222 unit that can be configured for any band (*watch out for undesired harmonics!*) I believe this is extracted from the original “Michigan Mighty Mite (MMM) design” Go to the hyperlink for information. Frank wonders if Q1 could be replaced by a 2n3553 to get perhaps two watts input or if his LM-8 or BC-221 could replace the crystal in this circuit.



2) [Here is a copy of the original MMM](#), with its low pass filter design and a LED transmit indicator.

3) [This website provides more information about the MMM](#) and how to use it on 20 meters.

4) [This website adds AM modulation to the MMM using an LM386 chip.](#) 4) Looks simple enough. Change the crystal for one in the AM portion of the 40 meter band or the band of your choice. Notice that it also includes a low-pass filter on the output to keep the radiation where it belongs. But should we have an RF choke between the LM386 output (pin 5) and the transistor's emitter? And also back to pin 3 of the LM?

YO6DXE has also added AM to this simple transmitter but a copy of his schematic was not found. [VK3YE has many thoughts about ORP...worth a read!](#)

5) Of course, we can't forget the "Pine Board Project," a popular 5 watt AM tube xmtr designed by Bob Heil (SK). The [Pine Board Project is found at this hyperlink.](#)

6) [Here is the old "Chickadee" xmtr \(about 50mw for very QRP\), and the "Ugly Weekender"](#)

7) [ARRL has a list of QRP projects at this link.](#)

8) There are hundreds of other designs but let's end with the [famous W1EB \(SK\) QRP Cookbook](#) which is found under the "Resources" menu tab of the link's website.

* **How to tell if your mini-xmtr is actually transmitting?** Of course you can listen for it using your receiver with little to no antenna, but that's awkward. If you have a sensitive field strength meter, just let that be your indicator. Some of the QRP designs include a LED to indicate output. Or if you can transmit on one antenna and receive on another, you have instant break-in capability. If putting out only very low wattage, the receiver probably won't mind having a receiving antenna close to the transmitting antenna. When I build a QRP xmtr, I will try my 400 foot ground loop antenna for receiving and a vertical delta loop for transmitting. We'll see how that works.

* [Here is a list of QRP clubs!](#)

* Using HC-49 crystals in tube oscillator circuits can be very stressful for the HC-49 style crystal. [Here are some oscillator circuits that claim to lessen the current load affecting the crystal.](#)

* [Hot Iron issue #3 has a neat QRP Dummy Load/Power Meter](#) you can easily build. See page 4. It indicates up to 5 watts and can be used as a 50 ohm dummy load that shows how much power the xmtr outputs. I believe this is a G3PCJ design – thanks!

* **Frank's BC-221 Heterodyne Frequency Meter** is very accurate and stable. Just for fun, maybe I'll add a small solid-state RF amplifier to the BC's milliwatt output to make a QRP xmtr of a watt or two...or three. Some filtering will be required to squash the harmonics, of course. And I have parts to make a mini-antenna matching unit.

Should be fun...I think it will work all the way up to 10 meters. I'm also thinking of inserting a telephone carbon microphone into the final npn transistor's emitter (or the mosfet source) to make it speak AM.

All this has probably been done before but it's time to play with my toys, since I just had a cardiac pacemaker implanted and the doctors don't want me to do any heavy labor for about two months. Also, it's Summer and too hot to do much outside here in North Carolina. Ideas and circuits are most welcome, especially regarding the carbon mike and AM.

* [Here's a super-simple WSPR beacon transmitter](#)...milliwatt power but transcontinental success!

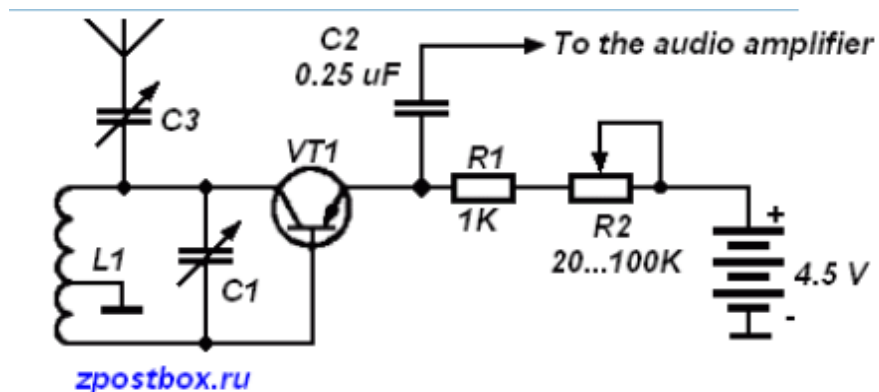
----- There is an almost endless collection of QRP projects on the internet – do a search! -----

* **ARRL has released a new Arduino project book**, which might be of interest for those hobbyists who like Arduino projects.

* **Is this the simplest possible regenerative receiver?** It was first printed in Hot Iron #110 which was a very large issue covering many subjects:

From Viktor Polyakov: "This regenerative circuit can increase the quality factor Q in any frequency range, from Long Waves (LW) to Very High Waves (VHF). It is not necessary for the coil L1 to be a resonant tank - it can be used as a coupling coil [or try an old fashioned valve 'coupling link' or even close proximity to the antenna lead? Or a perhaps a toroid with the antenna wire running through it? Ed.], it will provide coupling with any other resonant tank (in this case remove the capacitor C1 from the circuit). This coil can be wound on a ferrite rod of a magnetic loop antenna of any LW or MW radio, the number of turns needs to be only 10...20% of number of turns of the magnetic loop antenna. So we get a Q-multiplier for any LW or MW radio, this Q-multiplier circuit, based on a bipolar transistor is much simpler than any other Q-multiplier ... based on a FET transistor."

Viktor shows how the circuit adapts to become a regenerative receiver: "A regenerative receiver suitable for short wave reception, it takes an antenna, connected to the resonant tank L1C1 through a coupling coil or through a capacitor with small value (less than 1 pF) [or toroid link coupling / antenna lead in close proximity? Ed.] . An audio signal can be taken from the emitter of the transistor VT1 and applied to an audio amplifier using a capacitor of 0.1...0.5 μ F. Sensitivity of this regenerative receiver is high enough - for AM radio stations it is 10...30 μ V (adjust the feedback just below the point of oscillation), for SSB, CW radio stations some μ V (adjust the feedback above the point of oscillation)." This is surely the dinkiest regenerative receiver! A 2N3906 with careful construction and supply decoupling this would make a neat "/ P" or "/ M" receiver?



* Need an

RF probe? ZS6GM provides one in the [March 2024 AWA Newsletter \(#212\)](#). There have been many designs in the past and this is one of the easy ones. You can use this one with any scope. It rectifies RF and provides a DC voltage proportional to the RMS AC voltage. Using the scope's DC input results in an RF voltmeter. Using the scope's AC input will demodulate an AM signal. Neat!

* [The Hackaday website wants to know](#) if Hackers are the future of Amateur Radio – what's your take on this?

* [Another article from Hackaday shows how to use LEDs as sensors](#) – who knew? It's quite interesting. LED's are not optimum photo-sensors (other devices are better) but if you want a minimum parts count and cost, they might do the job. Read all the comments!

* [The death of Medium Wave AM in Europe is discussed in this REDTECH article](#). Sad to see it go and be replaced by short-range FM and internet signals. What will happen to us after an EMP burst takes out our internet?

* [Can your Wi-Fi reach out 1.8 miles?](#) Using the 802.11ah standard, this company's did!

* [Need Packet Software?](#) Try this website link for lots of free software – it is based in Amsterdam and contains probably more than you'll need!

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Electronic “Trivia” Section

From Hot Iron #103:

Humbuckers... Valve audio (guitar) amplifiers often featured a circuit called a “humbucker”. This effectively reduced power line “hum” heard in the output by balancing the heater feeds about earth, so cancelling any induced or coupled “hum” signals.

This was a low value pot, the track connected across the heater supply lines, the wiper to earth / common, then adjusted for minimal hum.

I recently noticed an article which discussed a very similar - but not quite the same - technique, in which a bench power supply was being used to power a receiver whilst the original power supply was being checked to see if it was faulty. “I was using the supply to power my valve receiver to figure out where an awful hum that (had) just developed was coming from.

The good news is that I found the culprit was a broken wire to a connector that was carrying the regulated 150 volts power to the HF oscillator and half the tubes had no filament voltage. I had split the filament transformer duties between the 5 amp supply in the main power supply transformer and an auxiliary 6.3 volt filament transformer.

Following the advice on one of the audiophile web pages I put a 100 ohm resistor in series with the centre tap to ground on the Triad [heater] transformer and increased the winding twist on the [heater] wiring snaking through the chassis. It was unbelievable how improved the sound was.”

Many years ago the routing of filament (or any other AC power lines) was an important detail when

building new Test Gear or finishing off repairs to equipment; especially sensitive items like valve voltmeters, electrometers, mass spectrometer heads and the like.

The lack of such power lines amongst modern signal chassis (or on PCB's) is a forgotten art - and it's only when the design steadfastly refuses to co-operate does the "hum" issue raise it's ugly head once again. The best advice is to wire such AC power circuits in "twisted pair", and avoid enclosing loops of wire.

The Section below is a more-or-less "standard" section of the newsletter which we hope to repeat repeat in each issue:

- * [AM Broadcast Coverage Night Patterns for U.S. and Canadian MW stations](#) (created by NF8M). Pick any MW frequency and see the typical coverage areas. A unique service!
- * **Antenna Headings:** VU2NSB provides a handy tool to show compass bearings to "everywhere" once your Maidenhead grid square is entered. [Here is the link to that handy tool.](#)
- * [Amateur Radio Weekly](#) has many topics of interest; here's a sample:
- * Similarly, [Zero Retries has many articles of interest](#)
- * Christian, G5DOC writes about [Meshtastic-enabled LoRa devices](#)...this is new to Frank and quite interesting! [Hackaday also has an article](#) about LoRa networks – give it a read. Oh, wait – there's more: [Go here to read about mesh-compatible LoRa.](#)
- * Tom Salzar's [February 23rd Random Wire Review](#) has a lot of articles of interest such as:
 - Why we need Shortwave, and, a text file for the internet
 - He also has a [long article about his journey through Ham Radio](#), which many of us can relate to.
 - More, and look at the archived issues – there is a lot there!
Issue 98 (July 12) is AllStarLink heavy! ASL 3 Beta gets installed on a virtual machine and connected to an SIP phone. This doesn't work like ASL 1 and ASL 2.
- * [HamRadioWorkbench.com](#) has a lot of nifty podcasts, projects and articles to peruse.
- * [The Random Wire newsletter](#) has a lot of computer articles in it and it informs us that the *Analog Engineer's Pocket Reference* (a handbook) is available from Texas Instruments as a free download.

[Go here to get or read a copy](#) (it's a .pdf download). Look under the “Miscellaneous” column of the website page that appears when you click the “Go here...” link.

YouTube Channels we have found (please let us know of others that you know about):

[HB9BLA Wireless](#) by Andreas Spiess HB9BLA

[KM6LYW Radio](#) by Craig Lamparter KM6LYW (home of the [DigiPi project](#))

[Modern Ham](#) by Billy Penley KN4MKB

[Tech Minds](#) by Matthew Miller M0DQW

Other Ham-related Newsletters (please let Frank know of others not listed here):

- * [73 from G5DOC](#) covers many subjects. From this link, scroll to the end to find many subjects to investigate
- * [The Communicator](#) has been recommended by VE7SAR – give it a look!
- * [Here's a link to the ARRL newsletter](#), which has many pages of news of interest to us hams.
- * [DxZone publishes a substantial list](#) of amateur radio newsletters. Have a look!
- * [The QRZ Forum](#) contains news, technical information, discussions and equipment evaluations; there is much to read here!
- * [This DX Engineering website](#) has 31 pages of news and general information about ham radio. Many antenna and feedline articles are included.
- * [QRP Guys](#) advertises kits and circuits
- * [QRPARCI](#) is a club for low power enthusiasts worldwide.
- * [The American QRP Club](#) is for builders, experimenters, and low power enthusiasts.
- * [VK3YE's QRP website](#) is not a club but it provides a lot of information about QRP operations.
- * [The DXZONE](#) provides a list of QRP websites

* Check out the various sections of www.w4nnp.net, the website where the *Hot Iron* newsletters are hosted. There is much more there! Another rabbit hole.

Future Quarterly Newsletter Content – make a suggestion! Some subjects we are considering:

Crystals and Crystal Oscillators, a VFO issue, Regenerative Receiver designs, Classic Xmtr designs, Power Supplies. What interests you? Let us know!

Disclaimer: We have no ties with any commercial company mentioned in *Hot Iron* editions or on the w4nnp.net website.

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