Llais Y Ddraig
The Dragon's Voice

Cylchlythyr Clwb Radio Amatur Y Ddraig
Newsletter of the Dragon Amateur Radio Club

Awst / August 2017. Rhif/No. 115.

Rhaglen Clwb / Club Programme

August 7th **A Radio Related Talk**

(The popular Dr Chris Barnes)

19th—20th International Lighthouses and Lightships Weekend

(From Penmon Coastguard Station.)

21st **2 Metre DF Hunt**

(Come and try your hand at direction finding)

September 4th **QRP In the Bay**

(Portable operating at Red Wharf Bay, followed by a pint!)

18th **Annual Construction Competition**

(Bring along your latest project)

October **2nd** **Chairman's Dinner**

(Open to member's and their partners. Further details to follow)

16th **The WSPR Propagation Mode**

(An introduction to this fascinating mode by John MW0JWP)

November **6th** **Junk Sale**

(Time to see what pre loved items would be useful to you!)

20th **Annual General Meeting**

(Your chance to exercise your democratic rights)

Please note that the main event of each club night is listed in **bold** and will begin at 20:00. However the club will be open each evening listed from 19:00, when there will be an operational HF Station and on occasion other pre advertised workshops.
Weekend activities are listed in Green.

In this Issue....

From the Editor....

Dear friends,

Welcome to the Awst / August edition of Llais Y Ddraig. This is an extended edition thanks in no small part to the many contributions made by members and friends of Dragon Amateur Radio Club. The newsletter covers various recent activities that the club or members have organised, and also highlights future events including special event stations and our Annual Construction Competition. I urge you all, no matter what your skill level to take part in this, as it is aimed at all levels of constructor. I am sure longer established members will be willing to assist or advise you in your construction.

Talking of construction, we have several articles on this very subject, from complicated reports on building AM transmitters and tailoring your audio, to a simple to build Slim Jim antenna which is achievable as a beginner and will really improve the performance of your handheld VHF / UHF transceiver.

In conclusion I hope you enjoy, all comments, thoughts and new material always welcome.

‘73

Simon
MW0NWM
Editor of Llais Y Ddraig

Future Club Events

The club has the following events which are open to all members and friends:

Saturday 19th– Sunday 20th August.
International Lighthouse and Lightship Weekend.

The club will be taking part in this event on behalf of Penmon Lighthouse. We shall be operating from the Penmon Coastguard Station, setting up around 08:30 on the Saturday and operating until the Sunday afternoon. Come along and have a go at operating the station, it will be an enjoyable weekend!

A Weekend in September: Date to be Confirmed
GB2VK at Waunfawr (The old Marconi Station).

We are running a special event station to commemorate the first message sent by radio from the UK to Australia. This message was sent in 22nd September 1918 by the Australian Prime Minister W.M Hughes, reporting his view of Australian troops serving on the Western Front. Further details about this special event will be advertised on our Facebook group and on the club website.

Saturday 4th November
BITX-40 Transceiver and 40 metre antenna Buildathon Event (venue TBC)

Your chance to come together as a group and build your own HF transceiver, the BITX-40, plus 40 metre dipole. This will be a great group adventure, if we have adequate people interested. Further information about the BITX-40 can be found page 38 of this newsletter. Take a look!

Monday 16th November
Club AGM

Your chance to influence the direction of the club. Please do attend this important event!

The New Club Website

The new club website is now available for use and can be found by simply Googling 'Dragon Amateur Radio Club', or better still going direct to the site at the following address:

dragonarc.org.uk

The new look website has kept Bryn MW6DZO busy for a while, who along with the advice and support of Kevin MW0IBT and John MW0JWP have created an effective site. Do take a look and let Bryn know what you think. Helpful suggestions are most welcome!

I was hoping to add a screenshot of the new web pages, alas my aging laptop does not want to assist me in this task!

Thank you....

A huge thank you to the following members and friends for their contributions to this newsletter:

Stewart GW0ETF, Dave Porter G4OYX, John MW0JWP, Paul GW1PCD, Steve GW0GEI and Les MW0SEC.

Museums on the Air 2017

Dragon ARC took part in this years Museums on the Air event from Holyhead Maritime Museum on the 17th June. A great time was had by all, even though band conditions were poor and therefore every contact was hard to come by. A big thank you to all members who came along, operated, helped set up and also tear down at the end of the day. I think I can speak for all when I say that a good time was had by all!

Danny examining the new voice parrot for the club HF rig. Perhaps not quite what we need?

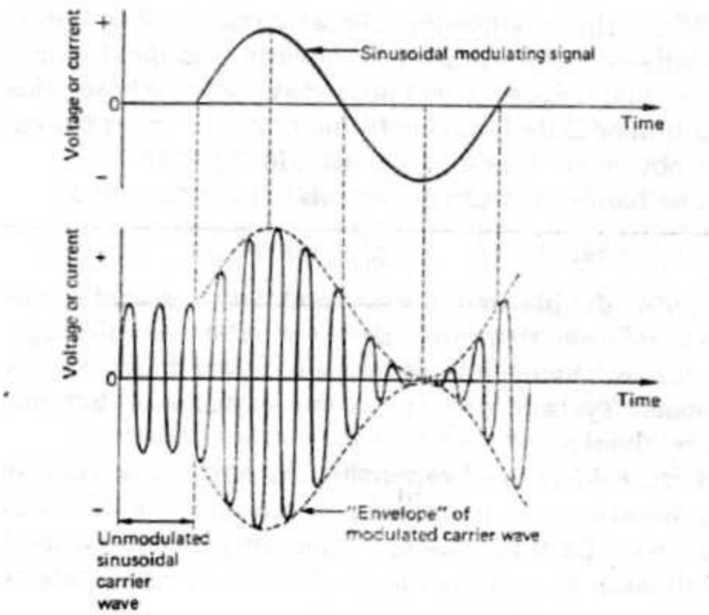
Watts in an AM Signal?

Stewart GW0ETF

Simon's recent talk and demo on Amplitude Modulation reminded me that I wasn't sure how the power limits for AM are specified these days in the licence. When I got home I googled Ofcom and saw that all limits are specified as Peak Envelope Power (PEP) which thinking about it is the obvious way to describe powers for any mode.

PEP is a measure of the power supplied by the transmitter at the amplitude peaks of the rf waveform. For a simple carrier the amplitude is constant which means the power never varies and can be measured by a standard averaging power meter. But as Simon explained in his talk the envelope of an AM signal varies with the modulating audio signal and a normal power meter will only show a time averaged reading and won't be fast enough to show the power level at audio peaks. So how do we equate what we can measure to PEP and thus stay within the law when using AM?

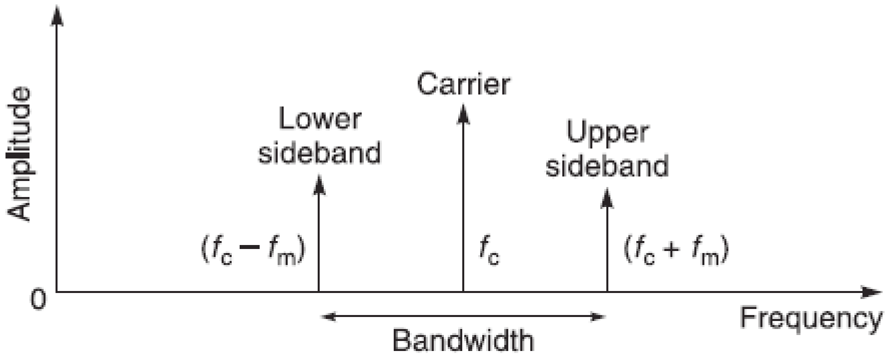
When trying to understand modulation we keep things simple by looking at a carrier and a single audio sinusoidal tone; using a real voice would add so much variation as to make it impossible to see what is going on.



In this diagram you can see the time domain representation of an AM signal such as you'd see on an oscilloscope. The lower trace is a carrier which then becomes modulated by an audio tone; this tone is of sufficient amplitude to 'fully' modulate the carrier. This is called 100% modulation and results in the carrier amplitude varying between zero in the troughs to double at the peaks – and it's the power at these peaks that we need to know. It turns out to be quite straightforward. We can measure the unmodulated carrier power easily enough with a power meter – let's say it's 100w. When we fully modulate this carrier the amplitude peaks at the twice the unmodulated level. Remember we are looking at voltage levels here (such as on an oscilloscope) and Ohms Law tells us that power varies with the square of the voltage in a constant impedance system W=Vsquared/R, so double the amplitude means 4 times the power or 400w at the peaks. So 100% modulate a 100w carrier will result in a 400w PEP AM signal – easy! This also explains why a standard 100w radio will be rated at a maximum of 25 watts for AM because this will result 100w PEP at 100% modulation depth which is the limit of it's power handling capability.

Watts in an AM Signal? Ctd:

But while we're at it there's more we can usefully learn from an AM signal. If instead of looking at the signal with respect to time as you do on an oscilloscope we examine it's spectrum on a spectrum analyser we will see a trace showing amplitude versus frequency. In the case of a carrier modulated by a single audio tone of constant amplitude sufficient to produce 100% modulation we will see 3 signals – the carrier and 2 sidebands. An upper sideband will have a frequency of carrier plus audio and a lower sideband will have a frequency of carrier minus audio. Furthermore the amplitudes of these sidebands will be half that of the carrier. If we represent the signals by simple lines it will look like this...:-



Notice the sideband amplitudes are half that of the carrier. Think about this – these 3 constant amplitude signals are different frequencies and so their phases are continually changing with respect to each other. At certain points in time they will all be in phase and their amplitudes will therefore add to produce a peak of 0.5+0.5+1.0 or twice the original carrier to give the envelope peak. At other times they will all be in antiphase and cancel giving the zero troughs. So it's clear the sidebands can never be more than half the amplitude of the carrier if distortion is to be avoided. And because power varies with the square of the amplitude (voltage) this means the power in each sideband will be 0.25 of the carrier power. If the carrier is 100 watts this means each sideband will be 25w if it's 100% modulated. Remember these are all constant amplitude signals so these are average powers; the average power of a 100% modulated 100 watt carrier is therefore 100+25+25=150 watts, while the PEP is however 400 watts.

We all know that nobody these days other than 'enthusiasts' like Simon use AM because compared to SSB it's inefficient. One clue is in the name Single SideBand which tells us that every bit of information we wish to transmit in an AM signal is contained in just one sideband; for some extra circuitry we can get rid of the other sideband and the carrier and avoid lots of wasted power. Instead of transmitting a 150w AM signal we can use 25 watts of ssb to get the same result. In addition we can't have more than 25 watts of audio information in an AM signal because it would exceed the 400w PEP limit, while there's nothing stopping us from amplifying one sideband in a linear amplifier right up to the legal PEP limit of 400 watts.

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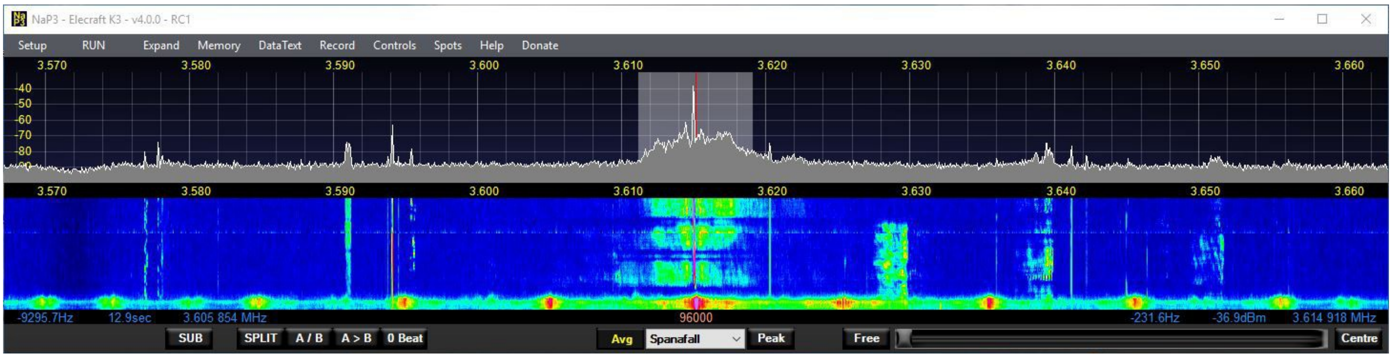
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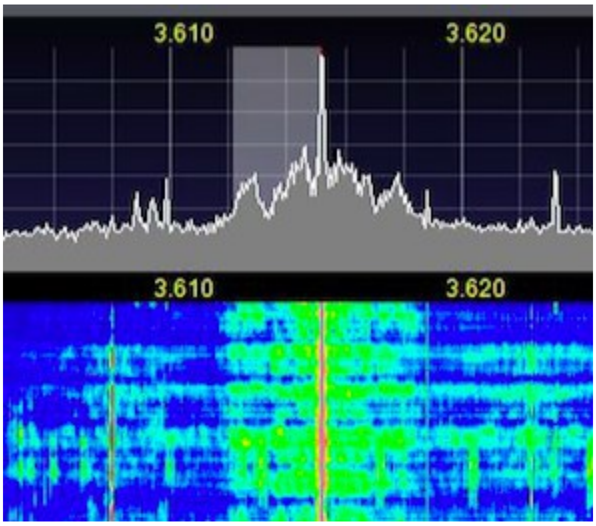
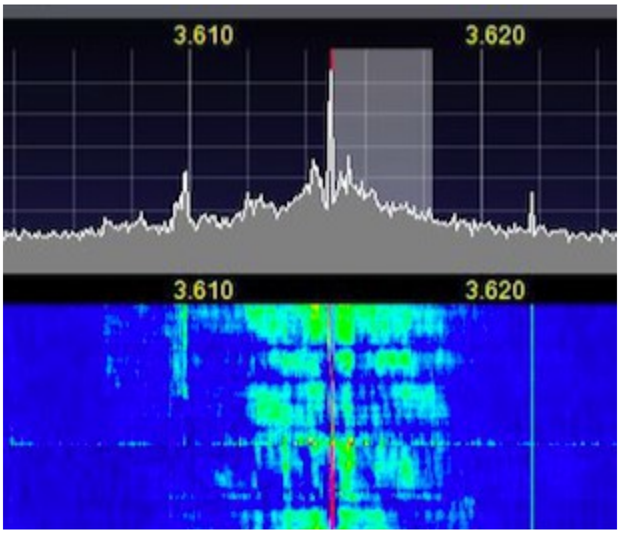
Watts in an AM Signal? Ctd:

At the bottom of the previous page is a screen shot of my panadapter showing the spectrum of a real AM signal at 3.615 Mhz. Note the carrier in the centre with the audio sidebands extending out either side, the whole signal occupying just over 6 Khz (plus a bit of excessive 'spread'); I can copy it with the radio set to AM. But as you can see from the 2 shots below I can receive this signal also by setting the mode to either USB or LSB and filtering out the unwanted carrier and the unnecessary other sideband containing the same audio information. The quality is actually better because it avoids phase interference between the 2 sidebands which can cause fading and other distortions. This is shown in the 2 shots below. The dial frequency refers to the carrier which is however filtered out allowing only the sideband information through; note the filter is set slightly wider in USB.



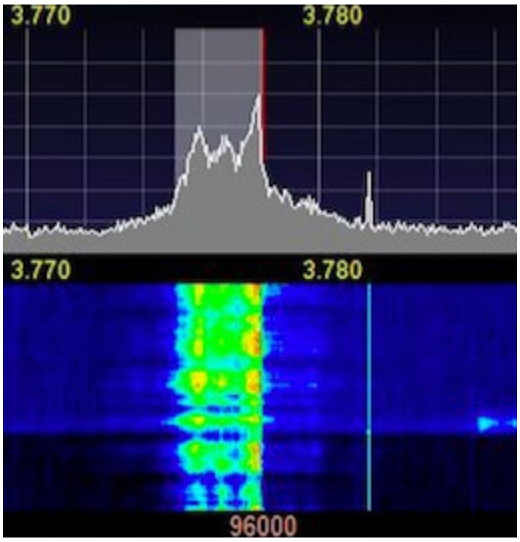
AM Received in LSB



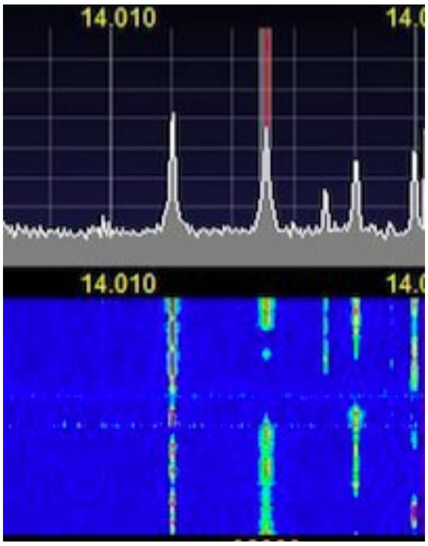
AM Received in USB

The important thing to note is that you hear the same speech in each case. Both sidebands contain the same information so it matters not whether you select upper or lower sideband.

For completeness I'm including below shots of a SSB signal and CW for comparison.....



LSB signal on 80m – with splatter!

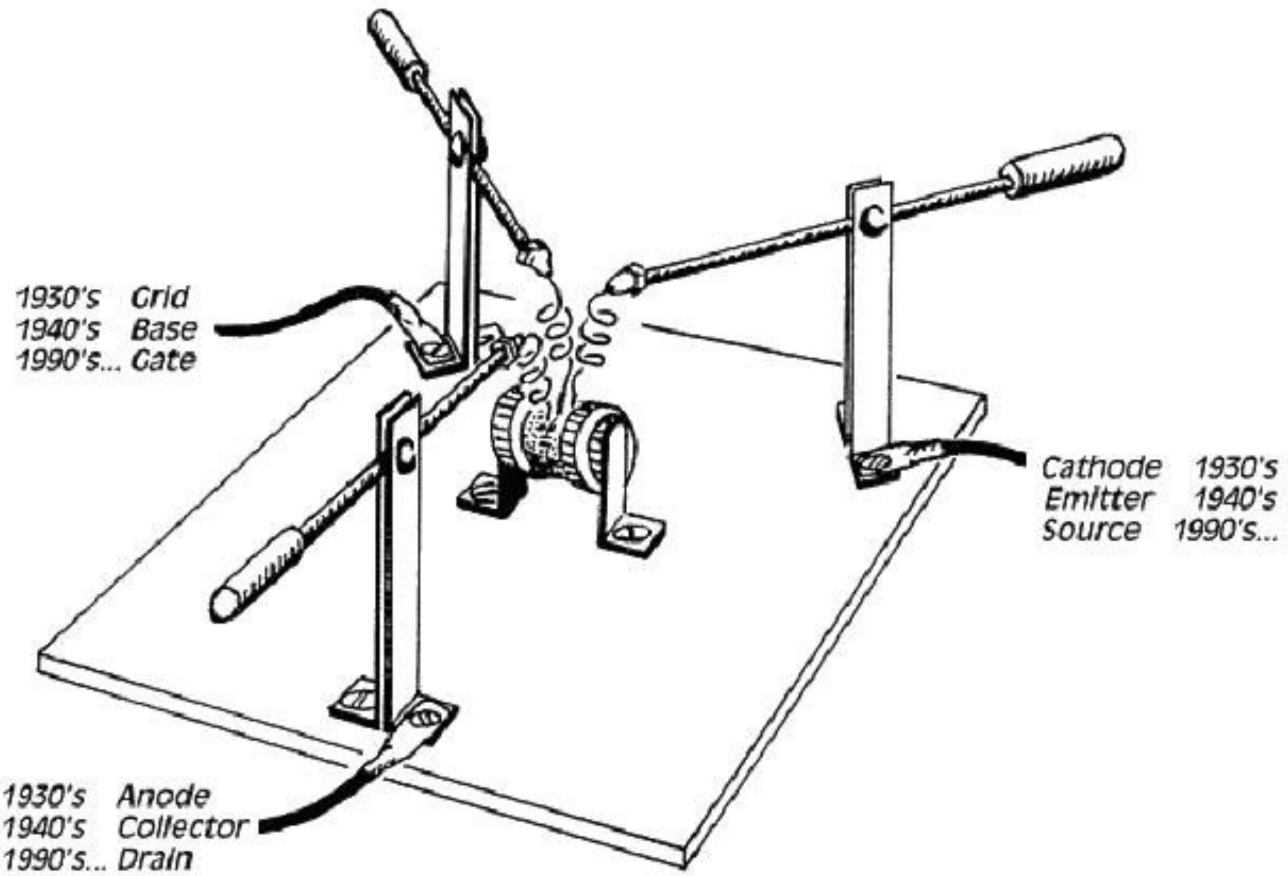


6 cw signals on 20m

Watts in an AM Signal? Concluded:

All these shots have the same frequency scale so you can see immediately the bandwidth advantages of SSB over AM, and CW over SSB. Notice there is no carrier or upper sideband in the LSB transmission so all the power is in the ~3KHz voice signal, although this particular signal is actually being overdriven resulting in spreading skirts and splatter. Similarly all the power in CW is in ~150Hz of spectrum making it by far the best in terms of power density. Also if you watch a SSB signal on a panadapter you'll see the amplitude hardly ever reaches peak power but spends most of the time around 30-40% depending on voice characteristics; a CW signal on the other hand reaches full power and stays there within 5 milliseconds or so of key down. This is another reason why it, and equivalent data modes, is such an effective and efficient mode for low power and difficult conditions.

GWØETF (with apologies for the pun in the title...)

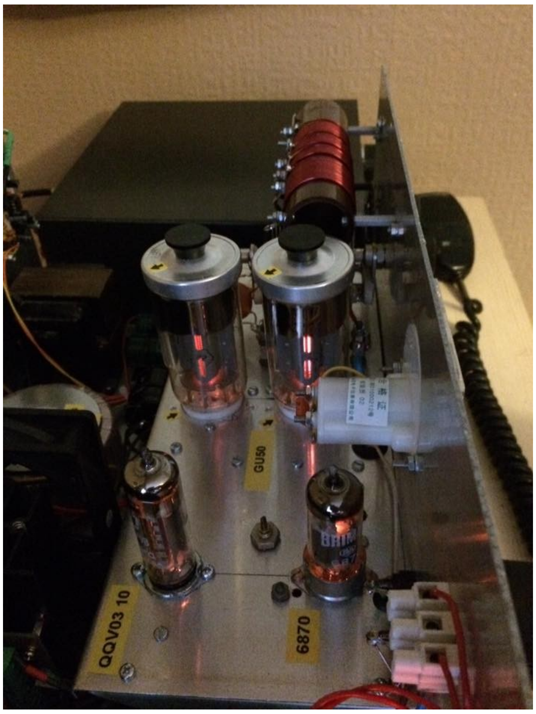


Adams Crystal Amplifier
1933

My AM Transmitter

Simon MW0NWM

I am sure many of you are well aware that I have been fortunate to have a fabulous AM Transmitter built for me by my good friend David Porter G4OYX. The transmitter is crystal controlled and operates on the 160, 80, 60 and 40 metre bands, and has a valve final stage using two of the ex Soviet GU50 valves. I have included a couple of gratuitous pictures of my transmitter below.



Dave Porter G4OYX had a long career working at the Wooferton shortwave transmitter site, near Ludlow and is a member of the Vintage Military Amateur Radio Society (VMARS). Dave has built a practically identical transmitter to the one he produced for me, which was only for the 60 metre (5 Mhz) band. Dave wrote an article about this transmitter for the VMARS journal, Signal and this is reproduced over the next few pages. I would like to personally thank Dave for allowing me to publish this fascinating article.

The following was emailed to me recently from Dave Porter G4OYX:

'The following article, 60 metres from the M54, was first published in "Signal" Issue 27, May 2013, the quarterly publication of The Vintage and Military Amateur Radio Society. It is reproduced here with kind permission from VMARS which exists to help and support Radio Amateurs and Short-wave Listeners who wish to restore and operate vintage military or commercial radio equipment on the amateur bands. See "About VMARS" on their web site for more information'.

VMARS web address is:
http://www.vmars.org.uk/

60 metres from the M54

Dave Porter G4OYX

It is often the situation that a purchase on impulse at a radio rally can be the trigger for a major project; that is exactly the case here, literally. With the M54 motorway and a major trunk road, the A5, running through Telford, access to the Telford Hamfest in Shropshire is easy and it is frequented by many visitors. The author's attention was drawn to a 'lonely' second-hand case languishing under a stall. It was somewhat battle-scarred, having a number of holes in the top, including one of two inches in diameter through which a lead-out insulator was mounted. The rest of the case – the sides, bottom and detachable front and rear panels – were in a near-virgin state.

The case

The case was 13 inches wide by 10 inches high and 6 inches deep with the one-piece steel top, bottom and sides in a dark grey powder finish paint and a light grey smooth paint finish for the steel front and back panels. Both panels were secured using four 4BA round-head screws and, together with the exact Imperial dimensions of the case, suggested the case to be a 1970s pre-metrication product. The base was slotted with 16 ventilation holes, a very useful feature.

The project

There are two frequency allocations (5301 and 5317 kHz) suited for AM operation within the very-recently expanded 60 m band in the UK. The NoV states that the maximum permitted effective isotropic radiated power (EIRP) is 200 W PEP and, effectively, that places a limit of 100 W PEP into a dipole antenna. That means a maximum carrier power of 25 W (producing 100 W PEP) when transmitting AM. Another stipulation of the NoV for this band is that the maximum RF bandwidth permitted for AM is 6 kHz and serious consideration must be given, not only to the frequency response of the modulator, but also to the linearity of the modulation including provision to prevent over-modulation. Hence, to transmit AM on the 60 m band, one requires a transmitter which will produce 25 W output comfortably, with defined, controllable, modulation.

Initial design considerations

In 2007, fellow VMARS Member and work colleague R Glyn Jones G4AIJ returned from holiday in France with the September copy of *Megahertz*, a French amateur radio publication, within which was a design by Alain Guenneguez F1ATO for an 80 m AM transmitter. This used a pair of wartime RCA 815 valves, one in the PA stage and the other in the push-pull modulator. The 815 is, essentially, a pair of 6L6s in one glass envelope with an International Octal base and two anode top-caps. It was the precursor of the RCA 829B which subsequently led to the introduction of Dutch/UK types QQV06-40A and QQV07-50A.

F1ATO appeared to have burrowed deep into his junk box as the choice of the rest of the valves was, to say the least, 'interesting'. The Hartley VFO on 3.5 MHz was a 12BY7A running straight into the PA without a buffer. He did regulate the screen grid of the 12BY7A with two 75 V zener diodes in series, so some attempt was made to stabilise the VFO.

The modulator was, again, unconventional from a UK perspective. The triode section of an ECL80 was used as an electret microphone preamplifier, with the pentode section as a driver into an inter-stage push-pull transformer supplying the grids of the 815. The anodes of the 815 were connected to a conventional modulation transformer.

60 metres from the M54 Ctd:

In the author's opinion, the ECL80 has always been a 'clumsy' valve because the triode and the pentode share a common cathode and, as such, biasing of the two sections is more difficult than it would have been with separate cathodes. F1ATO employed a bias supply of –100 V for the RF PA stage grids, and used potential dividers to provide –18 V bias for 815 modulator output valve to run in class AB1, –6 V for the grid of the penultimate audio amplifier pentode and –3 V for the grid of the triode microphone amplifier, thus avoiding difficulties with self-biasing of the ECL80.

The 'Mark 1' design

A crystal-controlled transmitter appeared to be the best design option because tight frequency control is demanded on two 'spot' frequencies, which can be achieved using switched or plug-in HC-6/U crystals. The best choice of valve for the crystal oscillator is a high gain, high slope, pentode and the 12BY7A fulfils this requirement very well. It has a 6.3 or 12.6 V heater option and an anode current capacity of up to 30 mA. The QRO TT21 80 m AM transmitter (which has given the author and Bronek Wedzicha M0DAF excellent service) also uses this valve in the crystal oscillator **[1, 2, 3]**. The UK-manufactured 12BY7A is available cheaply on the surplus market and in 'Special Quality' CV4151 or Brimar 6870 numbering.

The author's first thoughts were to use an 815 both in the RF PA and modulator with a Pye 277747 modulation transformer. This transformer had been obtained from a Pye F27AM unit and, on the audio side, was designed for a pair of 6V6s operating in Class AB1, to anode and screen modulate a QQV06-40A. The 6V6s are expected to produce approximately 12 W of audio, but experience over the years has shown that this Pye-made transformer is generously rated and will handle at least twice that output reliably. The drive to the 815 in the modulator could come from a cathode-coupled phase splitter using an ECC81 and possibly a small triode (EC90 or EC91) as a pre-amplifier.

Due regard has to be taken of the audio bandwidth requirements. The task of providing tailored audio response is made all the easier as a result of the proven design of the 'FAT-MAX' audio processor by fellow VMARS Member Dave Evans GW4GTE. The design was originally published in *Signal* **[4]** and is available as a kit through Eric Edwards GW8LJJ **[5]**. This processor incorporates a user-selectable dynamic (600 Ω) or electret microphone amplifier stage, limiter/compressor and very accurate user-defined bandwidth limiting circuitry based on a switched-capacitor principle. The audio filter consists of a single 8-pin IC which incorporates the oscillator to drive the switched capacitor cascade. The oscillator is programmed by a single capacitor. Thus, there is one capacitor to specify the cut-off point for the HF end of the audio and, for 2800 Hz, the value is 122 pF. Thus, anyone wishing to use the 'FAT-MAX' in a transmitter where there is a critical requirement to restrict audio frequencies above 2800 Hz, should replace the 68 pF timing capacitor in the original design with 120 pF. Bass cut is also employed to help with received intelligibility. A 12 VDC supply is required.

F1ATO employed a main HT supply of 350 V from a mains transformer with a 320 V secondary to achieve a quoted 30 W RF output which, to the author, seemed optimistic but this HT voltage could provide the desired 25 W. Readers will be aware of the author's article: *600 V at 250 mA* **[6]** which explained how readily available control panel transformers (CPT) can be arranged to give suitable HT supplies after rectification and smoothing. With up to 175 mA being needed for the RF section, and possibly 150 mA for the modulator output stage, there is a requirement for a CPT rated at 160 VA. The physical size of the mains transformer was becoming a consideration, given that the aim was to fit the transmitter, modulator and power supply into the case referred to above. In addition, a filament transformer, smoothing choke, modulation transformer as well as bulky electrolytic smoothing capacitors were putting pressure on the available space. Due consideration must also be given to ventilation for the 815s as well as the other valves.

60 metres from the M54 Ctd:

Final transmitter design

Given that the transmitter design was to be based on an all-valve RF section, a 12BY7A is the best option for a crystal oscillator with a single front panel-mounted HC-6/U socket into which a crystal can be plugged. An RF PA valve, new to the UK market, is available and was described by the author in the article *Back in the USSR courtesy of the Wehrmacht!* **[7]**; this is the Russian GU-50. It is a single-ended pentode having an anode dissipation of 40 W and is available, at low cost, from suppliers in the Ukraine *via* e-Bay. The valve base is specific but supplies are still available, again *via* e-Bay. The heater supply is 12.6 V at 0.765 A and, as such, this valve is preferred to the 815. With the GU-50 and the 12BY7A having 12.6 V heaters, a clamp valve with a 12.6 V heater would be ideal so that the transmitter can be run from a single heater supply. A QQV03-10 fulfils this requirement for loss-of-drive protection, as was the case with the QRO TT21 transmitter design **[1]**. The total heater current is just under 1.5 A with this valve complement, so a 12 VAC, 20 VA heater transformer would be satisfactory for the RF stages. An alternative clamp valve could be the PCL83 using just the pentode section; it has a 12.6 V, 0.3 A heater **[8]**.

Considering the modulator, the Pye 277747 modulation transformer has an 8 kΩ anode-to-anode impedance for push-pull audio, a high impedance secondary rated at 125 mA DC and an unused low impedance winding. It has been shown that high power audio from a solid-state amplifier could be coupled into this low impedance winding and so modulate a valve PA stage successfully *via* the usual secondary winding. For this purpose, it was decided to use a Maplin 'clone' MOSFET 100 W amplifier. The DC power supply rails for this amplifier are specified as ±42 V from a 0–32 V 0–32 V, 160 VA toroidal transformer. However, for a more modest output, a 0–25 V 0–25 V, 100 VA transformer is adequate. This provides ±36 VDC and smaller smoothing capacitors can be used (4700 µF, 50 VW). The heatsink for the MOSFETS and the amplifier printed circuit board can be mounted on the outside of the rear panel to save space inside. Similarly, the entire modulator can be on the rear panel with a die-cast box to contain the 'FAT-MAX' speech processor, the modulation level control and microphone connector. This arrangement also helps to keep RF out of the low-level audio paths.

The transmitter circuit

RF stages

The circuit diagram of the RF stages of the transmitter is shown in **Figure 1**. The crystal oscillator is the usual Colpitts design and the 5:1 capacitive divider consists of 27 pF in series with 120 pF. Bronek Wedzicha M0DAF **[9]**, and Gerald Stancey G3MCK **[10, 11]** prompted by Peter Chadwick G3RZP, experimented with different ratios of capacitance in this string and identified the lowest value of the upper capacitor to maintain oscillation. It is preferable to keep the current flowing through the crystal to a minimum to avoid heating (and drift) but, more importantly, to avoid damage to modern crystals which are made of relatively thin and small diameter quartz wafers. The author recalls seeing 8.2 pF and 150 pF as possible compromise values for the two components, and there is even a suggestion that the high slope of the 12BY7A is sufficient to maintain oscillation when the upper capacitor is omitted altogether and feedback is provided by the grid to cathode capacitance of the valve **[9]**.

The 10 µH inductor in the anode circuit of the 12BY7A is wound on a 0.5 inch ceramic former having an adjustable ferrite slug with 27 turns of 26 SWG ECW close-wound. A Hammarlund 100 pF trimmer is used to resonate this inductance to 5.3 MHz with a mica 33 pF capacitor in parallel so that, when in tune, the trimmer capacitor is approximately half-open. Once this trimmer is set for resonance and best modulation, no further adjustment is required: hence there is no front panel 'drive tune' control.

60 metres from the M54 Ctd:

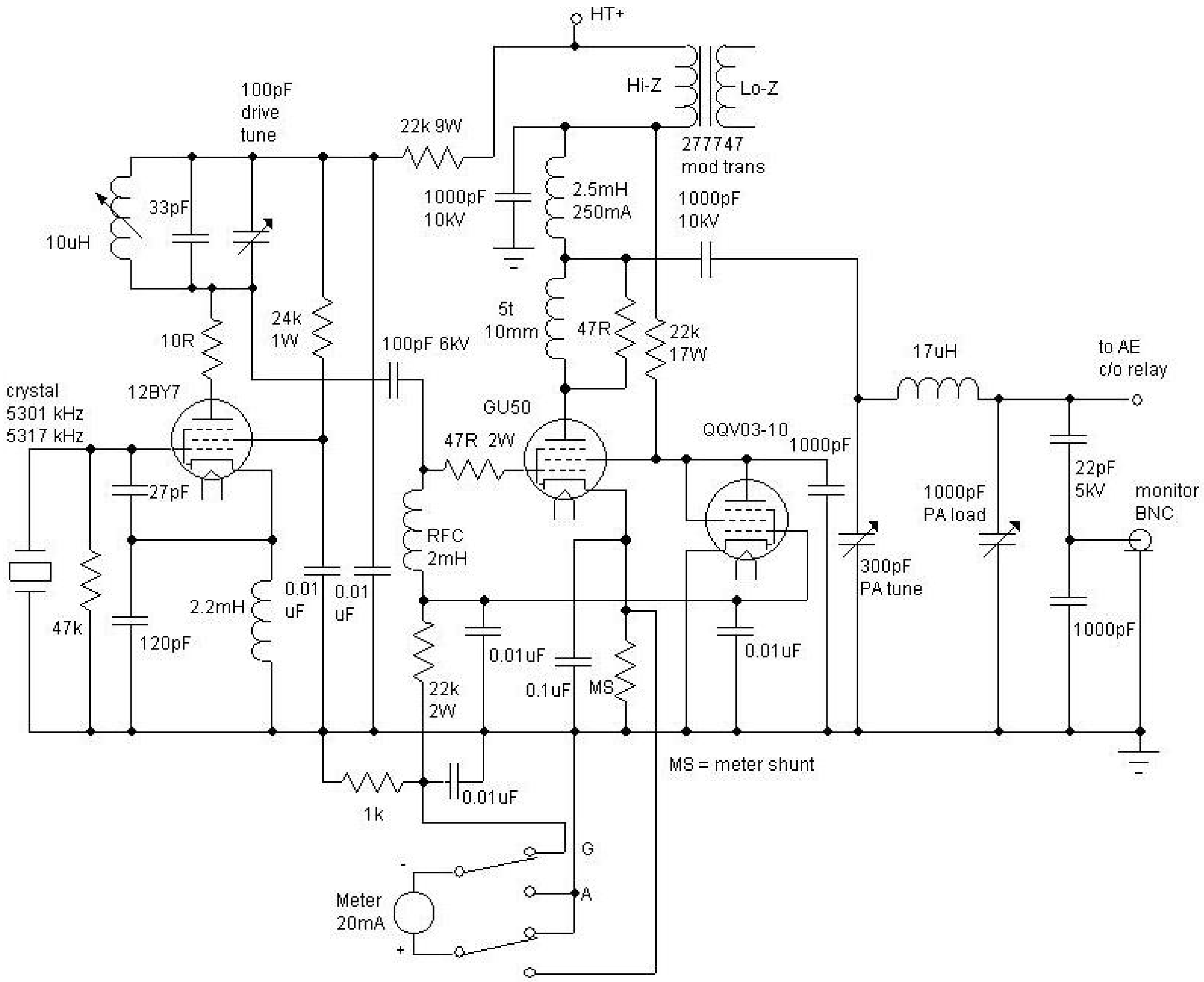


Figure 1. Circuit diagram of the RF section of the transmitter

The RF choke in the GU-50 anode circuit is a Denco 2.5 mH, 250 mA component but values as low as 1.5 mH are satisfactory. The coupling capacitor to the π-network is a 1000 pF, 10 kV red-bodied, wire-ended, component from J Birkett as is the main HT decoupling capacitor on the RF choke.

With space at a premium, the PA tune capacitor is a mid-60s compact Japanese 300 pF component which was to hand, but a 150 pF component would suffice. Similarly, the PA load capacitor is a 500+500 pF variable, with fairly closed-spaced vanes, as commonly used in 1950s valve portable receivers. The π-network coil consists of 22 turns of 18 SWG ECW close-wound on a 1.25 inch paxolin former. The π-network is designed to work into 50 Ω or 75 Ω loads only. An RF monitor point, for a 'scope, or quality demodulator, is provided *via* a BNC socket **[1]**.

Metering is provided by a single 20 mA FSD panel meter calibrated as such for grid current (typically 5 mA) and connected across a shunt (MS) in the cathode of the GU-50 to permit an FSD of 200 or 250 mA. Typical cathode current meter readings are 120–135 mA. A double pole changeover toggle switch allows selection of metering between grid current and cathode current.

60 metres from the M54 Ctd:

Mains distribution

The circuit diagram of the mains switching and distribution arrangement is shown in **Figure 2**.

Mains passes *via* a fuse and an illuminated on/off switch to the heater transformer. The author's transformer actually is rated at 50 VA with two separate 12 VAC windings; the first supplies the heaters (one side earthed) and the second, a bridge rectifier, smoothing capacitor and a 7812 series regulator producing a 12 V bus rail. A 'Uni-Timer' module **[12]** detects the presence of 12 VDC and times up to 40 seconds to allow the valve cathodes to heat up before closing a relay to permit other supplies to be switched. A neon lamp indicates when the delay is cleared. The delay relay is a Japanese IDEC type RHIB-U 12 VDC and is currently available as a box of ten from J Birkett, Lincoln for £3 a box.

Control supplies and relay switching

The circuit diagram of the control supplies and relay switching is shown in **Figure 3**.

Four 12 V relays are used for transmitter control; two are mounted next to the output of the π-network and the SO-239 antenna socket adjacent to the receiver BNC socket. In the de-energised, NC condition, the antenna feed is passed straight through to the receiver. In the transmit, energised, condition, the output of the π-network is connected to the antenna and the receiver input is earthed. Both these relays are controlled by a front panel-mounted 'function switch' which is a three way, four pole break-before-make unit. Only three of the four poles are used; F1 and F2 control the relays and F3 provides switching to indicate 'standby', 'tune' and 'PTT' by LEDs on the front panel. When in 'standby' mode, the transmitter is powered to heaters awaiting HT, with the antenna connected straight through to the receiver. When set to 'tune', F1 closes to energise the transmit and receive antenna change over relays and also closes the 'RF HT on' relay, which permits tune-up of the transmitter while radiating plain carrier with no modulation, as the BY133 diode prevents the modulator mains supply relay from operating. Switching from 'tune' through 'standby' to 'PTT' allows the microphone PTT switch to be executive and operation closes all the relays resulting in full transmit condition with modulation.

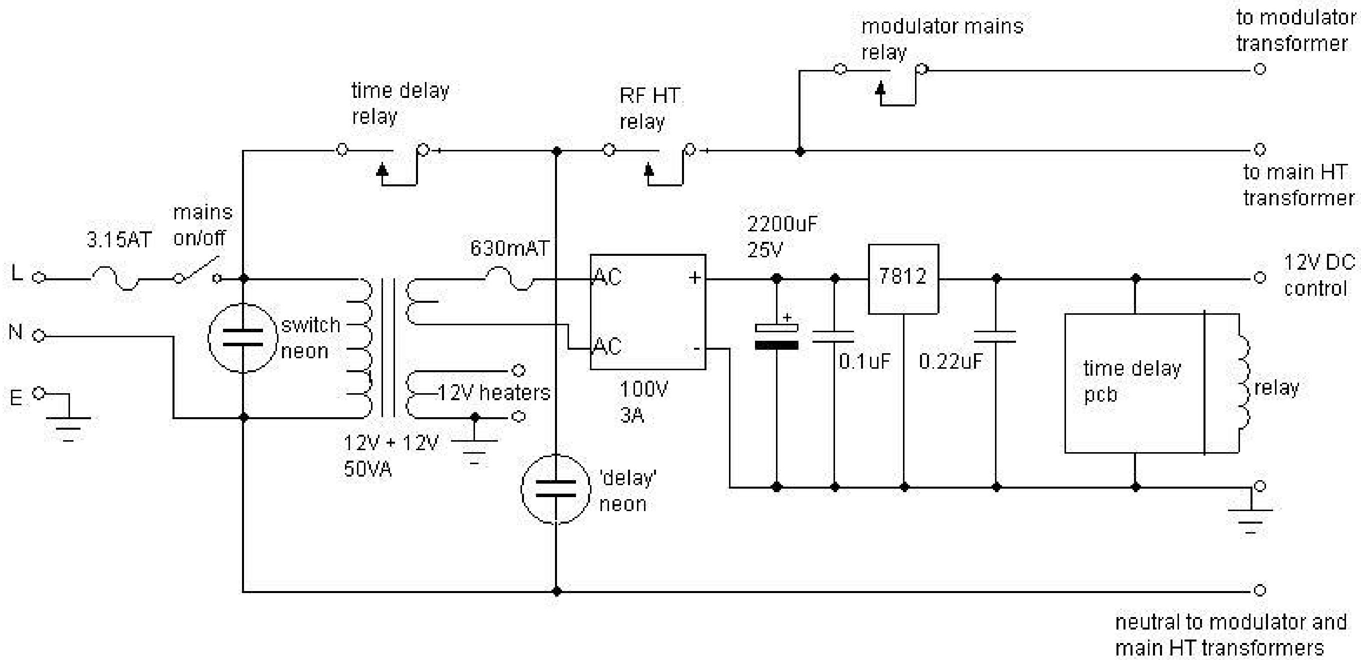


Figure 2. Circuit diagram of mains switching and distribution

60 metres from the M54 Ctd:

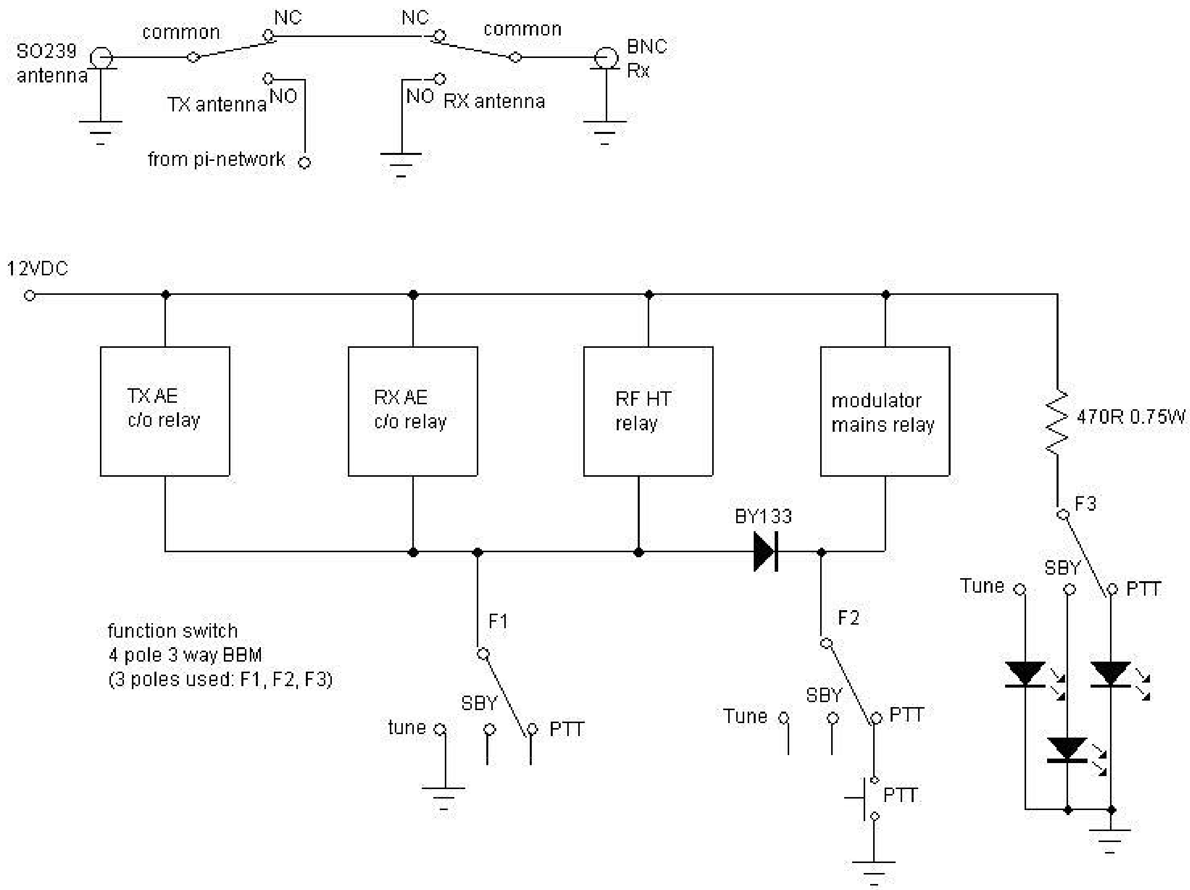


Figure 3. Circuit diagram of the control supplies and relay switching

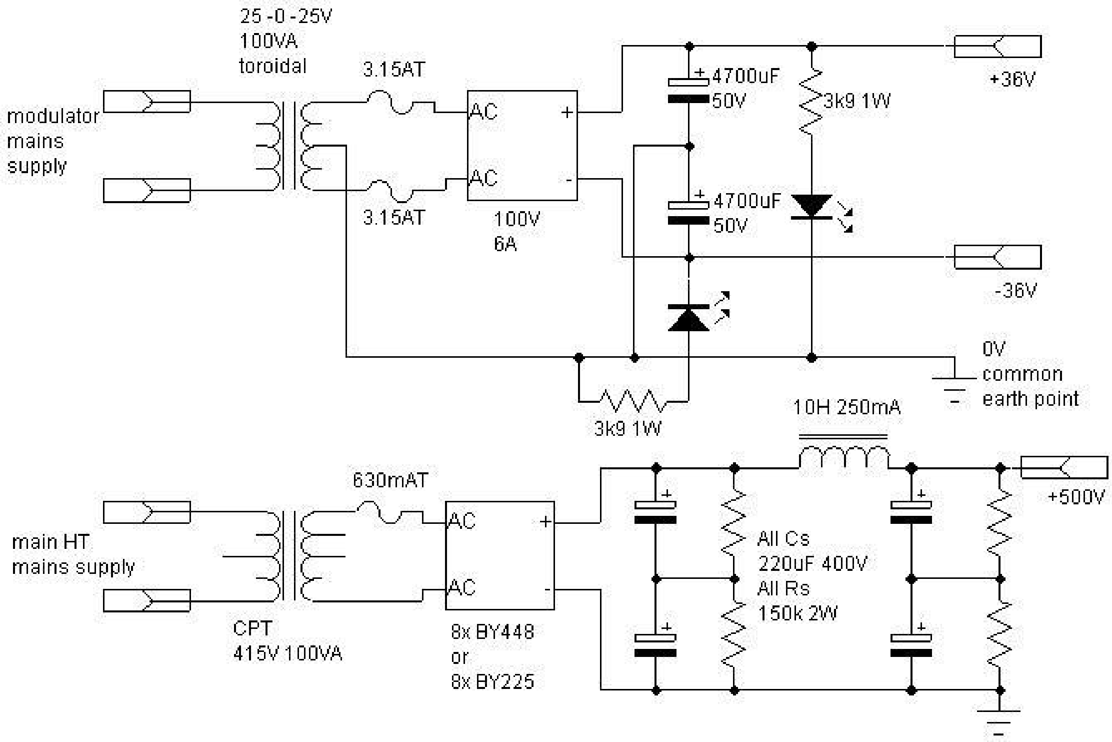


Figure 4. Circuit diagram of the power supply for the RF stages and modulator

60 metres from the M54 Ctd:

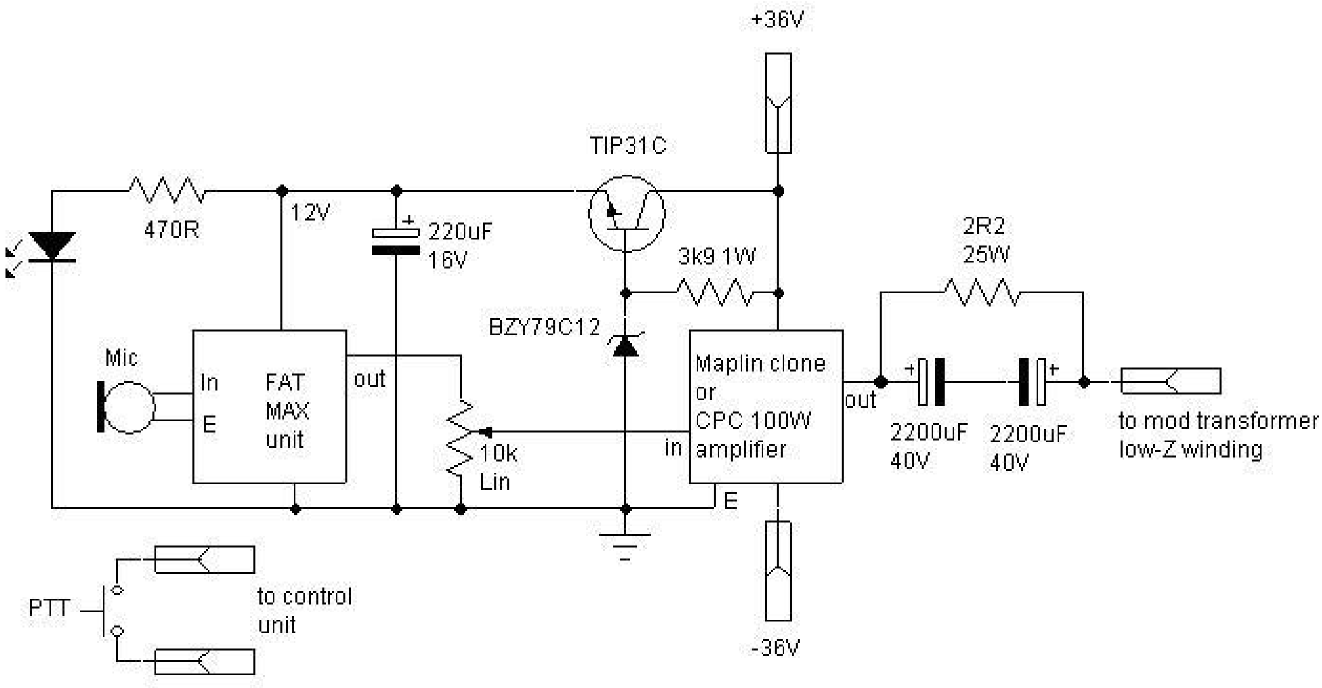


Figure 5. Circuit diagram of the modulator

RF HT power supply and modulator power supply

The circuit diagram of the power supply for the RF stages and the modulator is shown in **Figure 4**.

A CPT rated at 100 VA supplies 415 VAC *via* a 20 mm 630 mA anti-surge fuse to a bridge rectifier consisting of eight BY448 diodes. Smoothing by a π-filter consisting of 110 µF, 10 H and 110 µF ensures a ripple-free supply of 500 VDC.

For the modulator, a 100 VA toroidal transformer delivers 25+25 VAC to a 100 V, 6 A bridge rectifier, the outputs of which are connected to a pair of 4700 µF 50 VW electrolytics. An earthing centre point is provided between the two capacitors and all the 0 V connections on the modulator are made to that point. Thus, two rails of ±36 V are generated and monitored by LEDs with series-connected 3.9 kΩ, 1 W resistors.

Modulator unit

The circuit diagram of the modulator is shown in **Figure 5**.

A series pass NPN transistor, TIP31C, is zener-regulated to 12 V on the base and 11.3 V is available for the ‘FAT-MAX’. An LED is provided to show that the supply is present.

Processor output is *via* a 10 kΩ linear-taper potentiometer ‘mod gain’ and the signal passes into the Maplin ‘clone’ MOSFET power amplifier. CPC in Preston supply a similar, ready-made, bipolar amplifier by the Spanish manufacturer Cebek, type E-8 under CPC part number HK00535, currently priced at £37-50.

Transformers fed with high-power audio at low impedance do not behave in the same way as ‘mainly resistive’ loudspeakers and, for this reason, a buffer network to protect the amplifier against unpredictable inductive loads is essential. This network comprises two back-to-back 2200 µF, 40 VW electrolytics and a 25 W panel-mounted 2.2 Ω resistor.

60 metres from the M54 Ctd:

Construction of the transmitter

Safety first

Anyone intending to build this transmitter must be competent in working with, and the servicing of, high-voltage equipment and this project is not, therefore, for the novice. All circuits must be fused properly so that the HT supply is disconnected rapidly in the event of failure, and protection (typically a 2.5 mH, 500 mA RF choke from antenna connection to earth) must be incorporated to ensure that the HT voltage does not appear at the antenna output should the PA output coupling capacitor fail. It is vital that all modules within this transmitter are inter-connected with earthing straps, in addition to the normal 0 V returns.

Components must be rated for the job to be undertaken. Thus, it is important that capacitors are used well within their voltage ratings, and that constructors are aware that resistors also are rated for maximum working voltage. For this reason, resistors which are to be used in HT lines should be chosen with care. Similarly, the insulation on inter-connecting wiring must be able to withstand the voltage in the worst-case scenario, *e.g.* when the wire trails across the chassis or across other conductors. The transmitter described in this article gets hot, and the insulation must also be capable of withstanding the maximum temperature to which the wiring is likely to be exposed.

Above all, the constructor is warned about the risk to personal safety when working on equipment which is powered at 500 V, and on the AC supply circuits. Relays which switch power circuits can stick and so may not be fail-safe in disconnecting the supply when apparently de-energised, so it is important to check that circuits are ‘cold’ before working on equipment. These voltages are lethal and mains should only be applied to equipment when safety covers are fitted, or appropriate precautions have been taken to avoid contact with high potentials. A risk assessment should form part of the discipline of working with any equipment which uses high voltages.

Detailed construction

A series of photographs (**Figures 6-13**) illustrate the method of assembly. While it is not expected that prospective constructors would attempt exactly this realisation of the transmitter, the author’s design may help in deciding the individual’s approach.

It was decided to replace the steel front and rear panels by aluminium sheet for ease of working. Rather than attempt to drill and file a hole to fit an IEC panel plug, it is easier to use a flying lead terminated in an IEC plug and secure the lead with a panel clamp/grommet. With the relatively slim-line but tall case, it was appropriate to install the power supply section in the base for mechanical stability (**Figure 6**) and to use the detachable front and rear as runners on which to mount the RF stages and modulator. Broadly, the construction can be regarded as four areas of build: the rear panel (with Eddystone die-cast box and MOSFET heat sink as shown in **Figures 7 and 8**), a sub-chassis runner in the base, the front panel and the horizontal sub-chassis on the inner of the front panel (**Figures 9 and 10**).

60 metres from the M54 Ctd:

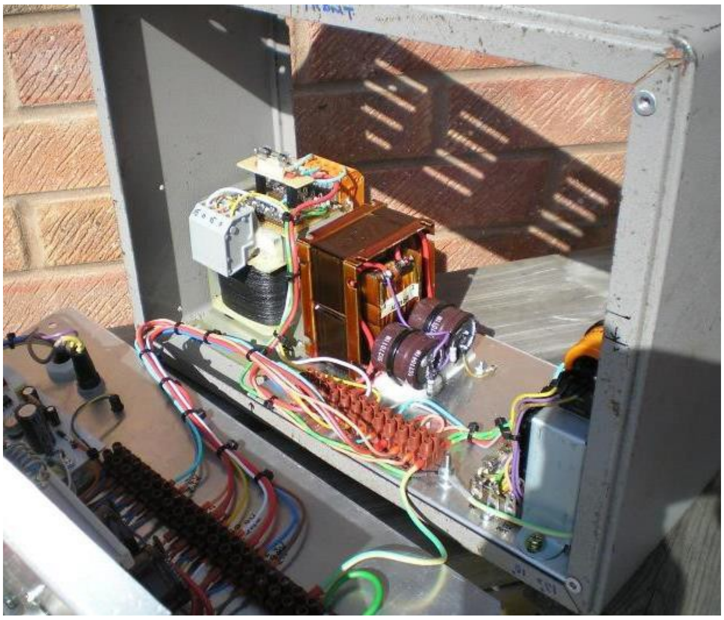


Figure 6. Power supply components in the base of the case. A shadow of the ventilation slots in the top is seen on the wall behind the case

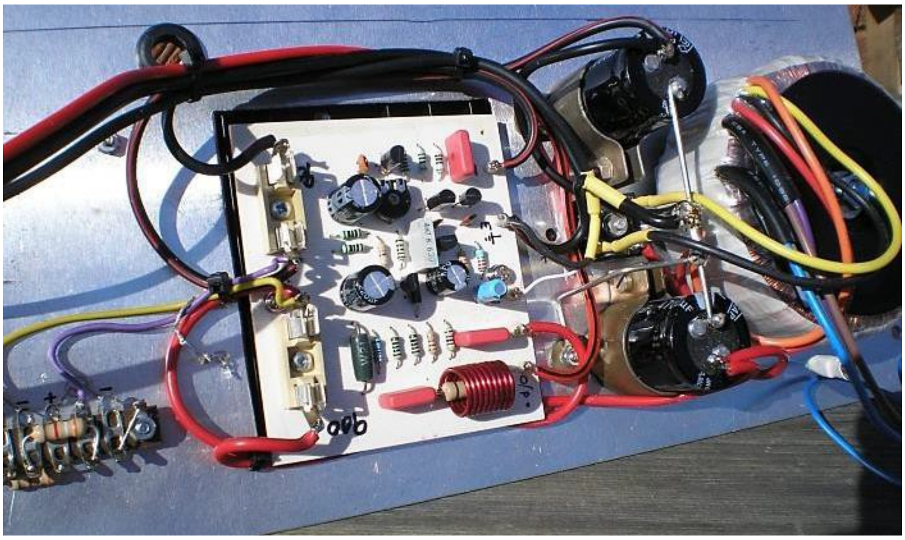


Figure 7. The MOSFET audio amplifier with associated power supply are mounted inside the rear panel

Figure 8. The heatsinks for the MOSFETS are mounted on the outside of the rear panel, together with the speech processor in a die-cast box

60 metres from the M54 Ctd:

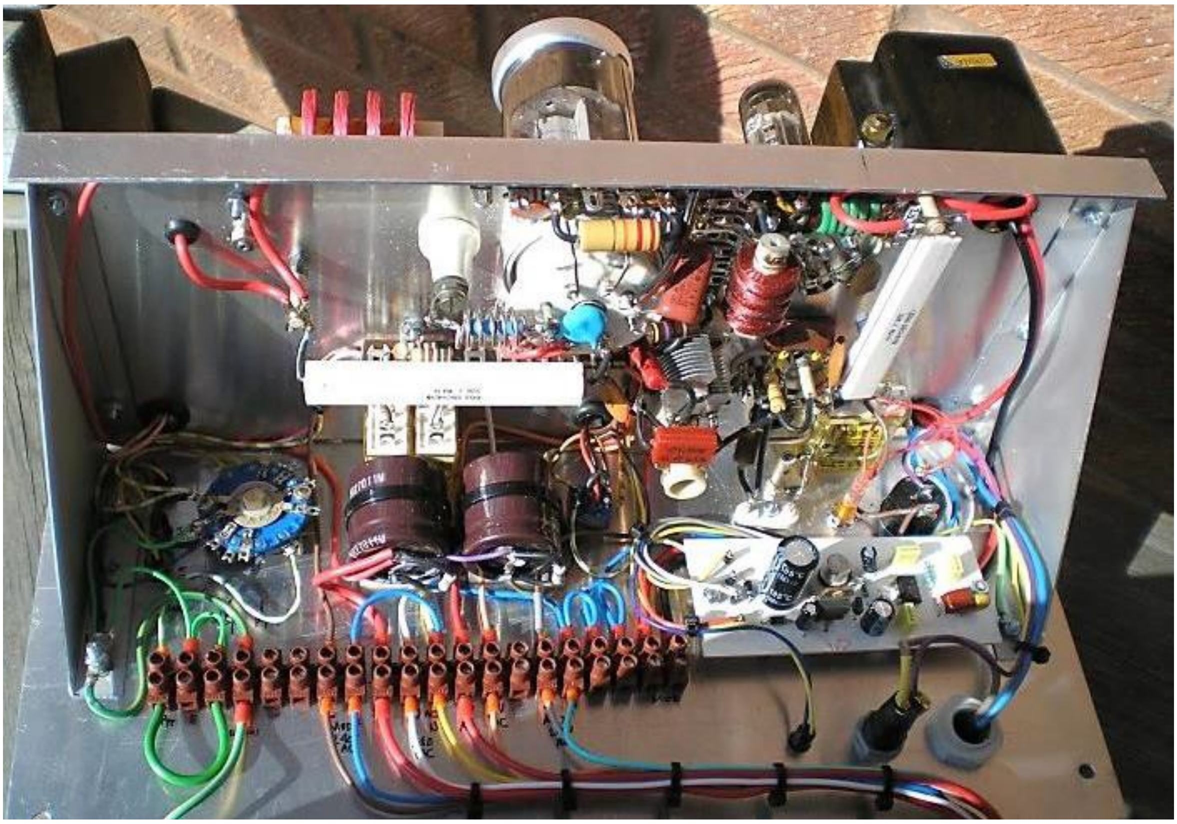


Figure 9. Underside of the RF deck

Figure 10. Top-side of the RF deck with the modulation transformer on the right hand side

60 metres from the M54 Ctd:

The microphone input is *via* a 5-pin DIN 240° panel socket to suit the ex-equipment Philips PMR dynamic microphone. The PTT wiring is completely isolated from the microphone wiring but, otherwise, the socket is connected to the 'FAT-MAX' speech processor board (**Figure 11**) which also requires a nominal 12 VDC supply which is provided by a feed from the +36 V modulator rail. The rear panel became the modulator assembly, requiring only a minimum of connections to the rest of the unit (**Figures 7, 8 and 11**). Being self-contained, it was possible to build and test this unit into a high power 3.3 Ω resistor mounted on a heat sink prior to installation by simply applying 240 VAC to the toroidal transformer.

Figure 11. The 'FAT-MAX'speech processor in its box

The base sub-chassis slotted into the wrap-round case and was secured to bare metal by two M3.5 countersunk screws into suitably countersunk holes that were kept un-painted. This arrangement ensured an additional mechanical earth connection while providing safety earth tails. It is important to ensure that, when using modular construction with separate chassis, **all safety earths are in place to prevent an electric shock risk.** There must be no situation where, for example, the outer screen of the microphone coaxial cable becomes the 500 V HT DC return to chassis, under fault condition. Also, with regard to inter-unit wiring in modular construction, **all insulation on all wires must withstand at least 500 VDC** as, in the final assembly, wires carrying low voltages can pass over connections having exposed high voltage.

The smoothing choke and reservoir capacitor, the 12 VAC, 50 VA filament transformer and the control unit 12 VDC power supply were all mounted on the base sub-chassis, the aluminium plate being a suitable heat sink for the 7812 regulator (**Figure 6**). A 16-way insulated screw terminal block was installed to make inter-unit connections. Consideration was given to mounting the CPT on the sub-chassis but, in the event, it was fixed directly on the base of the case. Here it neatly covered the two-inch diameter hole and gave another few spare millimetres of height; this extra space was useful as it allowed the main HT rectifier tagblock assembly and a 20 mm fuse holder to be accommodated on the transformer. What had been the original top of the case was now the bottom and the 16 slots became a useful cooling aperture above the valves.

The horizontal sub-chassis for the inner of the front panel was made with two right angle supports and a flat 18 SWG aluminium plate (**Figure 9**). A small lip was bent at 90° to strengthen the chassis. This assembly was as wide and as deep as possible because on it were mounted the three valves and bases, driver stage anode components, modulation transformer, PA stage RF choke and coupling/decoupling capacitors, the second series pair of 220 µF, 400 VW smoothing capacitors and the two changeover relays for antenna and receiver switching. Double-sided sticky pads were used to secure all the 12 V relays to the chassis.

60 metres from the M54 Ctd:

Figure 12. The front panel

The front panel (**Figures 9, 10 and 12**) accommodated the SO-239 socket, two BNC sockets, PA tune and PA load variable capacitors, the π-coil, meter and meter switch, the function switch and LED indicators, a second 18-way terminal block, mains input, fusing and switching for the Uni-Timer printed circuit board, modulator load stabiliser and the remaining relays.

Shoe-horning

As one might expect, there was a great deal of 'trial and error' during the 'dry-build' to accommodate all the components. There were times when the back of the unit was in place so that the layout could be viewed from the front with the base sub-chassis in place, or with the front of the unit in place so as to determine the position of the horizontal sub-chassis. Eventually, all the large components were placed and the smaller ones could then be fitted in. After drilling the case for the CPT *etc.*, all was removed and the case was cleaned ready for repainting. There were a few inherited 'rogue' holes in what had become the slotted top, so a 'repair' advocated by the Rev George Dobbs G3RJV was carried out. He recommends using gaffer tape or strong plastic insulating tape on the 'outside' and then applying Plastic Padding™ or Leak-Fix™ epoxy compound from the 'inside' with a spatula. The tape can be removed after the epoxy has cured (about 30 minutes) and the result is a flat, smooth, outside surface that can be painted easily. This technique is particularly good on die-cast boxes but works also on thinner metal. A complete application, inside and out, of Ambersil™ Spray Acrylic paint in Light 'Battleship Grey' (RAL 7032, CPC £6.37) restored the case to new appearance in under an hour. Four self-adhesive rubber feet were fixed to the bottom to allow for ventilation.

A rear view of the completed transmitter (**Figure 13**), without the rear panel connected, illustrates well the utilisation of space within the case.

60 metres from the M54 Ctd:

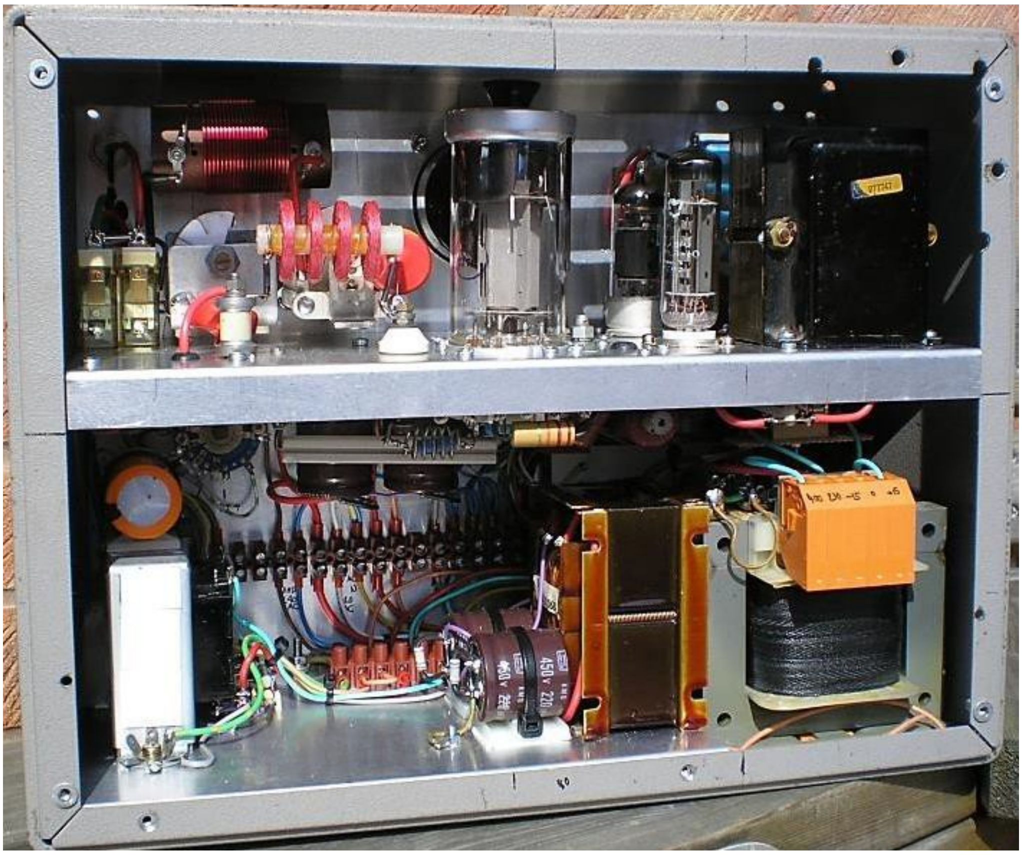


Figure 13. Rear view of the internal construction of the transmitter

Cable forms

After completion of all the chassis assembly, two 'over-long' cable forms with connections to and from the terminal strips were made, allowing the front and rear plates to be positioned horizontally. Safety earthing straps, additional to the cable forms, were added. Testing in stages could then be commenced.

Testing the transmitter

The power supply was tested first to establish the 12 VDC control supply and operation of the function switch, its relays and its indicators, then the Uni-Timer relay operation and mains switching to the CPT, and finally the modulator toroidal transformer.

Having confirmed that the AC secondaries were delivering the correct voltages, the RF stage HT was confirmed as 500 VDC. It is prudent at this point to check the values of DC voltage across the series-connected 220 µF electrolytics in the smoothing circuits to ensure they are balanced. The crystal oscillator appeared to be working and grid current into the GU-50 was peaked after temporarily removing its 22 kΩ, 17 W screen grid supply resistor. Contrary to normal expectation, just under 3 mA of grid current was available, whereas about up to 5 mA would be normal from such an oscillator. Also the rise and fall of grid current was erratic when going through the resonance point with a very rapid fall off in output on one side of 'tune'. The crystals (5301 and 5317 kHz) from Vincent Jakomin of IQ Electronic Design were new so it was unlikely that they lacked activity, therefore, attention was given to the construction of the driver anode circuitry.

60 metres from the M54 Ctd:

Closer inspection revealed that the Hammarlund trimmer had vanes ‘just’ touching at some points on its traverse; this fault was rectified by judicious, almost surgical, re-bending, after which mechanical and electrical operation were smooth, but the oscillator still delivered only 3 mA drive into the GU-50. The 10 Ω anode stopper on the 12BY7A was a vintage and somewhat long ceramic-bodied component that had been connected to the ‘hot’ side of the 10 µH inductor (which forms part of the tuned circuit) using a tag on the inductor furthest away from the chassis. Good practice is to keep such wiring close to the chassis. With a modern, smaller, 10 Ω resistor to the lower tag on the inductor, and a rework of the rest of the circuit, 5.2 mA drive was now available and with symmetrical tuning on either side of resonance. The 12BY7A anode voltage was 200 V with 130 V on the screen grid.

After reconnecting the 22 kΩ PA screen grid resistor, and with a dummy load on the output, it was possible to check PA tuning and output power. With 500 VDC on the anode, an output of just over 40 W was possible. The output could easily, and with no ill effects, be reduced to the required 25 W by reducing the antenna coupling *via* the PA load capacitor. The quartz crystals obtained for this project had been etched to oscillate at the stated frequency with a capacitance of 30 pF in series. Usually one adds a trimmer in series with a crystal to provide in-circuit adjustment of the operating frequency while compensating for capacitance inherent in the layout and circuit components. The output frequency was checked with a counter but adjustment to give the exact AM channel frequencies was not possible when a parallel combination of 7 pF trimmer + 27 pF mica capacitor was connected in series with the crystal to chassis. At best, the frequency was some 100 Hz high. A short circuit across the two capacitors revealed that both crystals were within 30 Hz of the channel frequency without the need for any series capacitance so the short circuit link was left in place. For this reason, no series capacitor is shown on the circuit diagram in **Figure 1**.

By temporarily placing a jumper across the ‘PTT’ link on one of the tag blocks, it was possible to power the entire rig to modulation without having to hold in the microphone ‘PTT’ switch. This arrangement permitted the testing of the MOSFET amplifier and modulation transformer alone *i.e.* without ‘FAT-MAX’ and the microphone. With a tone signal injected directly into the MOSFET amplifier, sinusoidal modulation could be observed on the ‘scope. The envelope was good to >100% modulation and just under 5 mA of grid drive provided the most symmetrical shape for positive and negative excursions.

‘FAT-MAX’

Use of this speech processor was a new departure for the author so it had been sensible to have proved the operation of rest of the modulator first. The original article in which the ‘FAT-MAX’ was described **[4]** is comprehensive and it is pleasing to report that the unit worked first time and the transmitted audio sounded good. An audio signal generator was connected to the microphone input to confirm the cut-off frequency at the HF end. Indeed, as predicted with 120 pF in circuit, 2800 Hz was the HF ‘cliff-edge’. Changing this capacitor to 110 pF increased the frequency response to 3000 Hz. The ‘FAT-MAX’ printed circuit board includes a user-selectable ‘hand-bag’ link to disable the limiting and compression for testing and set-up and it is important to remember to run the processor in service mode with the link out of circuit; it is easy to overlook this final ‘adjustment’.

‘Boxing Day’

After testing had been completed, the transmitter was ready to be ‘boxed-up’. The cable forms were tidied, laced and shortened, and their ends terminated in crimped cable ferrules. Persuading the sections all to fit into the case was not easy but, eventually, with the modulator going in last, it was complete. Power-on revealed a transmitter that was still working with no ‘frying’ noises or short circuits. Particular care was taken to ensure that the mounting bolt for the modulator toroidal mains transformer did not touch the frame of the 12 VAC transformer or else a ‘shorted turn’ would have resulted. It is a shame that no new chromium-plated ‘mushroom-head’ 4BA 0.5 inch screws were available to replace the somewhat unstylish

60 metres from the M54 Ctd:

cheese head screws on the front and rear panels.

Your 60 metre rig

It is appropriate to consider what could have been done differently. The author was constrained by the size of the available case though he wanted to make a compact transmitter but, with a larger enclosure or, maybe, just a chassis, other possibilities become apparent.

The most obvious refinement is to add more bands. It would be easy to add a front panel tuning control for the driver stage, for example, a 150 pF Jackson C804 style component, and tune up with the 10 µH coil for 7143 kHz. A simple coil tap at 15 turns on the PA coil would move the PA output frequency to 40 m. There may even be room for a switch to accommodate a multi-tapped PA coil. Eighty metres could be a possibility using, for example, relay-switching of the tuned circuit in the anode of the driver with a tapped PA coil of *c*. 34 turns on a 1.25 inch former.

An all-valve modulator line-up is possible, but the reader should bear in mind the need for a tight HF audio response when transmitting on 60 m. A Brimar 6BR7 or a Mullard EF86 microphone amplifier into an ECC81 phase splitter and, maybe, an 815 in the modulator output stage would be tempting.

VFO control could be advantageous for 80 m and 40 m with a choice of either a conventional EF91-type Colpitts/Gouriet design into the 12BY7A, now serving as a buffer amplifier, or a 'boatanchor driver' printed circuit board from James D Hagerty WA1FFL, Hagerty Radio Company **[13, 14]**, to raise the low level output from a direct digital frequency synthesiser (DDS) sufficient to drive the 12BY7A. A valve VFO is not recommended for 60 m in view of the tight specification of transmit frequency stipulated in the NoV.

Conclusion

There should be enough detail in this article to enable many VMARS Members to contemplate constructing a valve transmitter, at least for 60 m, in its simplest manifestation.

The author and the Committee will surely welcome Members on the air with their latest AM creation. Please contact the author for advice on component procurement as Maplin clone MOSFET amplifiers, Uni-Timers and 1.25 inch paxolin tubes are available on request.

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Acknowledgement

The author gratefully acknowledges Colin Guy G4DDI for his work in painstakingly redrawing Figures 1–5.

Training Update

Whilst our Training Co-Ordinator John MW0JWP is away in London, he still managed to find time to text me the latest training news. John writes:

'On Monday 7th August, Phil Rea is taking the Foundation examination. On Monday 21st August, Steve Goodwin and James Doyle will also be taking the Foundation examination. Also on the 21st, Malcolm Hanks MW6IML will be taking the Intermediate examination. All of these students have already passed the practical elements of their assessment.

I am sure that the committee and all club members will join me in wishing them the very best of luck with their respective examinations'.

As a club we are also hoping to arrange a formal Intermediate Licence course for October—November this year. Further details will appear on the club website and Facebook group in September.

Finally to remind you that John 'JWP tutors people on a one to one or group basis for the Foundation Licence, thank you John!

John can be contacted on:

mw0jwp@yahoo.co.uk

Sioe Gogledd Cymru, GB0SGC

Paul GW1PCD

Dragon ARC took a stand at the Sioe Gogledd Cymru / North Wales Show in Caernarfon on an unexpectedly hot and sunny 1st July. The main objective was to be a shop window to introduce people to the Dragon ARC. We had a good turnout of members to help Simon 'NWM and I set up.

We were accommodated in a gazebo and had some display material, a banner and a flag for the club. We had a 2m and an HF rig in operation, although band conditions were awful. A few people passed greetings on 2m to club members round the showground and we had a few conversations with visitors.

Although quieter than we might have liked, we learned some useful lessons:

- Ham radio is not visually appealing except to fellow hams, so we need to be more exciting visually.
- We need activities for children – morse oscillators, small tasks to win a prize, a simple construction project etc. And, of course, a dish of sweets!
- Radio operation to be secondary to things like SSTV, computer related applications in operation and other visual attractions. (DARC members in fancy dress? Perhaps not!)

The new club generator (courtesy of John 'JWP) worked a treat and was remarkably quiet in operation. The HF antenna might have caused a Health and Safety inspector some anxiety but it stayed up!

I'd be keen for us to go to other larger local events to spread the good news of amateur radio in general and Dragon ARC in particular.

Sioe Gogledd Cymru, GB0SGC Ctd:

PS: The final lesson I learned was to use sunblock!

Contesting – Strategy wins?

some reflection by Steve GW0GEI / GW9J

It's the weekend after the IOTA 2017 contest, with the Dragon ARC entry as GW6W looking very strong in top place of the 24 hr multi operator single tx section according to the claimed scores on the 3830 web-site. Its tempting to write a short article on how the team achieved that success, but suspicion requires me not to count chickens until the final official results are out. Also, as Stewart gw0etf did a lot of the ground prep work for the station, he may wish to write the article on that one.

Instead, and especially for the benefit of those newer members who are considering trying contesting and thinking that they need a big station to be competitive, I thought I would pen a few lines about strategy. Strategy to help win contests or place higher than previously or whatever goal you are setting yourself.

I used to think that successful contesting was about being in the best location, with the biggest and loudest station, combined with an experienced operator. That is undeniably true to a large extent. But even if you haven't got the perfect location, or the biggest station, its still possible to do very well.

When I used to live on Ynys Mon, I had a reasonably good location for hf/lf. 300 or so feet asl on a 6 acre small holding at Rhostrehwfa – bought with radio in mind! I built up a reasonable size contest station, starting with a 2 ele quad on a 35ft tenamast, a TH7 large tribander on a P60 fixed tower; and ending up with an 8 ele tennadyne log periodic antenna on the tenamast, a 4 ele mono band yagi for 20m and a 5 ele 10m monoband yagi on the P60, butternut hf2v 40/80m vertical, 80m inverted V, and a 160m inverted V at 100ft on top of a second HD P80 mobile tower over wet marshy ground. Between 1997 and the birth of my son in 1999 I contested hard in nearly every major hf contest, and built up my experience. That helped me plan my band strategy before each multi band contest – which band to operate on at which times of the day, to maximise my points total and multiplyer total (countries or zones or both). After a three year period of doing less major contesting, I entered the annual RSGB hf contest championship more seriously in 2002 by entering more domestic rsgb contests and got myself into the top ten by the end of the year. In 2003 I set myself the target of improving on that position, and by competing in all bar one of the eight hf contests in that year, I managed to secure the top place and win the cup, against stations with bigger stations and more experience (and better cw operators too). My winning strategy? – I entered more of the eight hf contests run by the rsgb than my competitors! I was beaten in every single one of those contests by someone with a bigger station or more experience or both. The winning strategy was to enter almost all of the qualifying contests and to also consistently score in the top five or so in each one – meaning I ended the year with the highest overall total number of pointsJ. A look at the rsgb archive results for the subsequent years for this championship will show no sign of my callsign, as I was concentrating on fewer bigger international contests, but you will see Stewart GW0ETF's callsign creeping slowly but surely up the hf championship results table each year – a self confessed anti contester originally, and with a very small station in comparison to the one I had. Excellent cw skills, built up over years of qrp (low power) operation, and a good knowledge of the bands and propogation, saw Stewart climb up the results table each year but with relatively small and non gain antennas.

Contesting – Strategy wins? Ctd:

In 2009 I had to move jobs, relocate to west Wales, and ended up having to dismantle and sell most of my medium (by uk context) contest station. In a way it was a relief not to have to spend so much time maintaining a big antenna farm in between contests. I ended up in a house in the bottom of a deep river valley (Lampeter) with close neighbours and no chance of putting a tower up. Simple low dipoles on 80m and higher bands with just 100w saw me re enter the annual hf championship in 2012 in 23rd place, with Stewart ETF in the top ten at 8th place at the end of that year. 2013 saw me up to 17th place having entered only three of the ten rsgb hf contests that year. At the end of 2014 I was placed second overall, having entered six of the ten contests that year, with Stewart ETF in third certificate place. I had added a 40m wire ¼ vertical hanging in a big tree with two elevated radials which helped my score in the BERU Commonwealth cw contest 100w section. In 2015 I dropped back to 4th place, with strong competition from stations with large hf beams, and only having entered six of the ten contests again. In 2016 I entered nine of the ten contests, against similar strong competition, and ended up in top place again. A combination of consistent results and entering more of the contest series, plus choosing which categories to enter in each contest to maximise my chance of gaining a higher average place (strategy).

If GW6W ends up winning the IOTA 2017 24 hr multi one island section this year, it will be down to a combination of location (Holyhead breakwater EU124 Holy Island), better antennas (a Spiderbeam with multi wire elements on 10,15 and 20m on a 30ft fibreglass boom) and, yes you guessed it, STRATEGY. Lots of pre planning re equipment, antennas, how they would work together, software use (N1MM contesting software, cluster spots, RBN spots, networking two laptops), some experienced hf operators, and concentrating on CW. The previous years log was studied and lessons learnt (which greyline propogation paths were missed and how active was the mult station); and a 24 hr band hopping strategy was drafted out prior to the contest.

If there is enough interest to merit it, some more detailed contesting related advice could be given to any members wishing to give contesting a go. Single band low power contesting is a great place to start, and the rsgb annual hf championship table lets you see your progress over a number of years as you gain more experience and/or improve your station within what constraints you have (location/space/money etc). There are enough experienced contesters and hf operators within the club to offer practical advice and help to anyone needing it; and there are plenty of great contests where the club contest call GW6W could be used as part of a "learn by doing" strategy to build up people's experience. We need more operators and helpers for IOTA 2018!

Feel free to email questions to me : gw0gei@btinternet.com

73 es gl Steve GW0GEI / GW9J

Annual Construction Competition 2017

Simon MW0NWM

On Monday 18th September 2017, we are holding our annual Construction Competition. This is designed to put beginners and experienced constructors on an equal playing field, so I urge you to have a go no matter how simple your build is. Last year I entered two very simple items, a Slim Jim Antenna for 70Mhz and a HF Dummy Load, design courtesy of Ken K4EAA. Ken's design instructions can be found at:

http://k4eaa.com/dummy.html

The rules for this event are quite straight forward.

1) You can build whatever you like, no matter how complicated or simple.
2) The project can cost as much or as little as you like, but must be of an electronics, or radio related nature. Therefore you could even build an antenna!
3) The project must be constructed by yourself, but help and advice from more experienced constructors is to be encouraged!
4) You can build a kit, copy an existing circuit or dream up your own!
5) Using computers like the Raspberry Pie is acceptable.
6) Most important of all you must have FUN!

On the 18th September, each entrant will show members their project. After this all members can inspect projects before voting for their favourites. There are no marking criteria, simply vote for the project you feel has most use or simply has stretched the abilities of the builder.

Each member will have three votes. We will then count the first choice votes, and if there is no winner we then add the second choice votes and so on. There is a TROPHY for the winner!

Please do not be shy to enter the competition, every entrant is appreciated and encouraged. Plus it makes for a more enjoyable evening for all! I also encourage the more experienced amateurs to support, encourage and mentor our newly licenced friends!

If all else fails, why not try building the VHF Slim Jim antenna described on page 31.

GOOD LUCK

Slim Jim Antenna for VHF / UHF

Simon MW0NWM

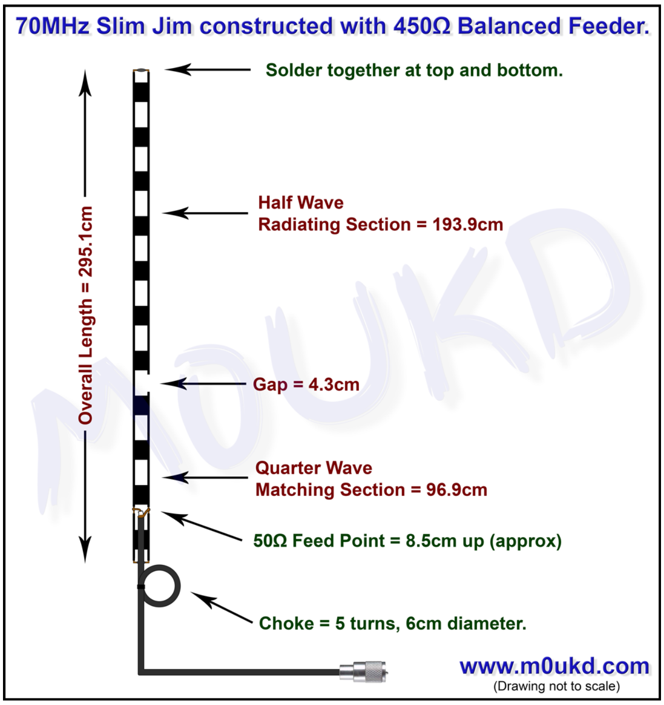
If you are a newly licenced amateur, perhaps at Foundation level, you may not own a HF radio and perhaps only own a simple handheld VHF / UHF FM transceiver. Fed up with hearing little on the supplied antenna? Then why not try a 'Slim Jim' antenna. These fabulous little antennas are made simply with a piece of ladder line (450 or 300 Ohm), coax feeder and connector.

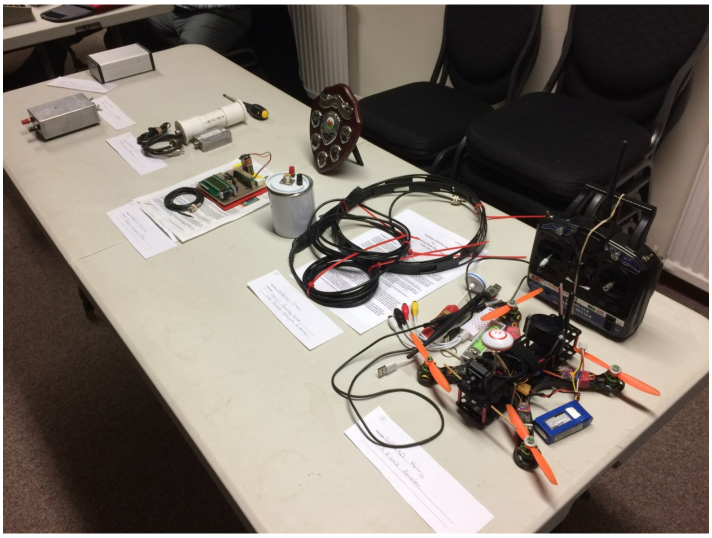
Full construction details can be found online for a two metre (145Mhz) version at:

http://www.essexham.co.uk/slim-jim

If you wish to make a Slim Jim antenna for another band, then the Slim Jim and j pole antenna calculator courtesy of M0UKD is really useful. I know this to be true as I used it to build a 70Mhz version which I have used successfully and also entered in the 2016 construction competition. This can be found at:

https://m0ukd.com/calculators/slim-jim-and-j-pole-calculator/





My rough effort of a 70Mhz Slim Jim can be seen coiled up, just to the right of my paint can dummy load on one of three tables of projects at last years Construction Competition.

These fantastic simple antennas can be hung from trees, in attics, or taped to the side of a telescopic fibreglass pole, which make them great performers from hill tops!

If you only have your little VHF / UHF handheld, I challenge you to build one of these over the coming weeks and give them a try, you shall be really surprised how well they work compared to the standard rubber duck antenna your handheld was supplied with. From a hilltop locally you will easily be able to access VHF repeaters in Ireland and even have simplex contacts!

So why not dust off that soldering iron, make one for 2 metres, possibly even 70cm and get out portable whilst the warmer weather is here. Finally and importantly, bring them to our Construction Competition!

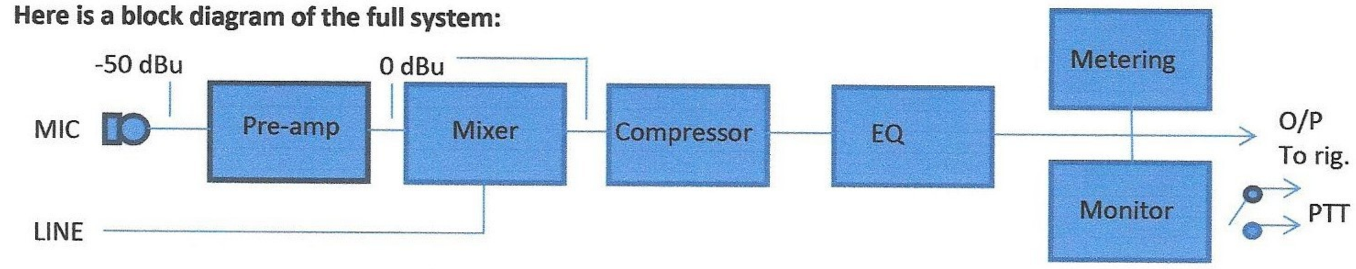
Audio Considerations

Les MW0SEC

There are a number of reasons why operators may prefer using an alternative to the hand-held microphone commonly supplied with transceivers. Some people find difficulty squeezing the switch for long periods; others (myself included) prefer to have a spare hand for writing up the log whilst talking. Some like to achieve the best possible audio quality. There is a solution to all of this – one could buy specialist desk microphones from a certain American supplier, but these tend to be very expensive and equally good results may be achieved with the use of a few components and almost any studio or public address dynamic type microphone.

This article is intended to illustrate a possible approach. It is not necessarily intended as a full constructional piece, but I have described the equipment which I use, and elements of this might be of help to others. Clearly, the minimum requirement will be a small pre-amplifier and possibly a mixer to add audio from a computer or tape player, but I go on to describe a full system which also includes an audio compressor, some equalisation and metering. This results in too much material for one article so it is my intention with the editor's agreement, to confine this piece to the pre-amp & mixer and leave the rest for subsequent publication.

Here is a block diagram of the full system:



And here is a picture of the complete unit in my rack:

So, to start with the pre-amplifier design: If we were designing this for a studio mixer, we would need to take account of such things as noise floor, harmonic distortion and slew-rate. In our case these may be disregarded, since we can assume that the transmission system will certainly be worse than our engineering! We do however need to calculate the required gain, headroom and audio bandwidth.
You will note that I include transformers in this design. These are not essential, but do provide excellent isolation from hum and RF loops which can occur when a number of independently earthed units are linked together. They should be of mu-metal screened types and mounted away from mains transformers.

What gain do we need (how long is a piece of string!) – The mic output will be dependent upon its sensitivity, distance from the speaker and voice volume. There is an industry *nominal* figure for a dynamic mic which is around -50dBu (where 0dBu = 0.775V). We will use 0dBu as our nominal working level in this design.

Audio Considerations Ctd:

Dynamic microphones typically have an impedance of around 150-200 Ohms and are not designed to be ‘matched’ into a particular load, but work instead into a nominal bridging impedance of around 1K Ohms. For design purposes, they should be regarded as a *voltage*, not power source.

-50 dBu equates to around 3mV, so to raise this to 0.775V requires a gain of X 258. The gain of the preamplifier is determined by the resistors R3 & R2 and is given by the formula 1+ R3/R2. Note however that there is a voltage increase due to the ratio of the mic transformer of 15 times, so the amplifier feedback is chosen to reflect this.

The line level from say, a computer is likely to be already around the 0dBu level, so both signals now have a similar level for presentation to the mixer. Note that the mixer also has some gain as determined by R6/R5-4) this is to allow for the assumption of a comfortable adjustment level of the faders i.e. not fully at maximum (-10dB).

We now have a composite signal ready for further processing, however if the preamp/mixer is used in isolation, its output will need to be reduced and adjusted to a level to suit the transceiver. This is accomplished by VR3.

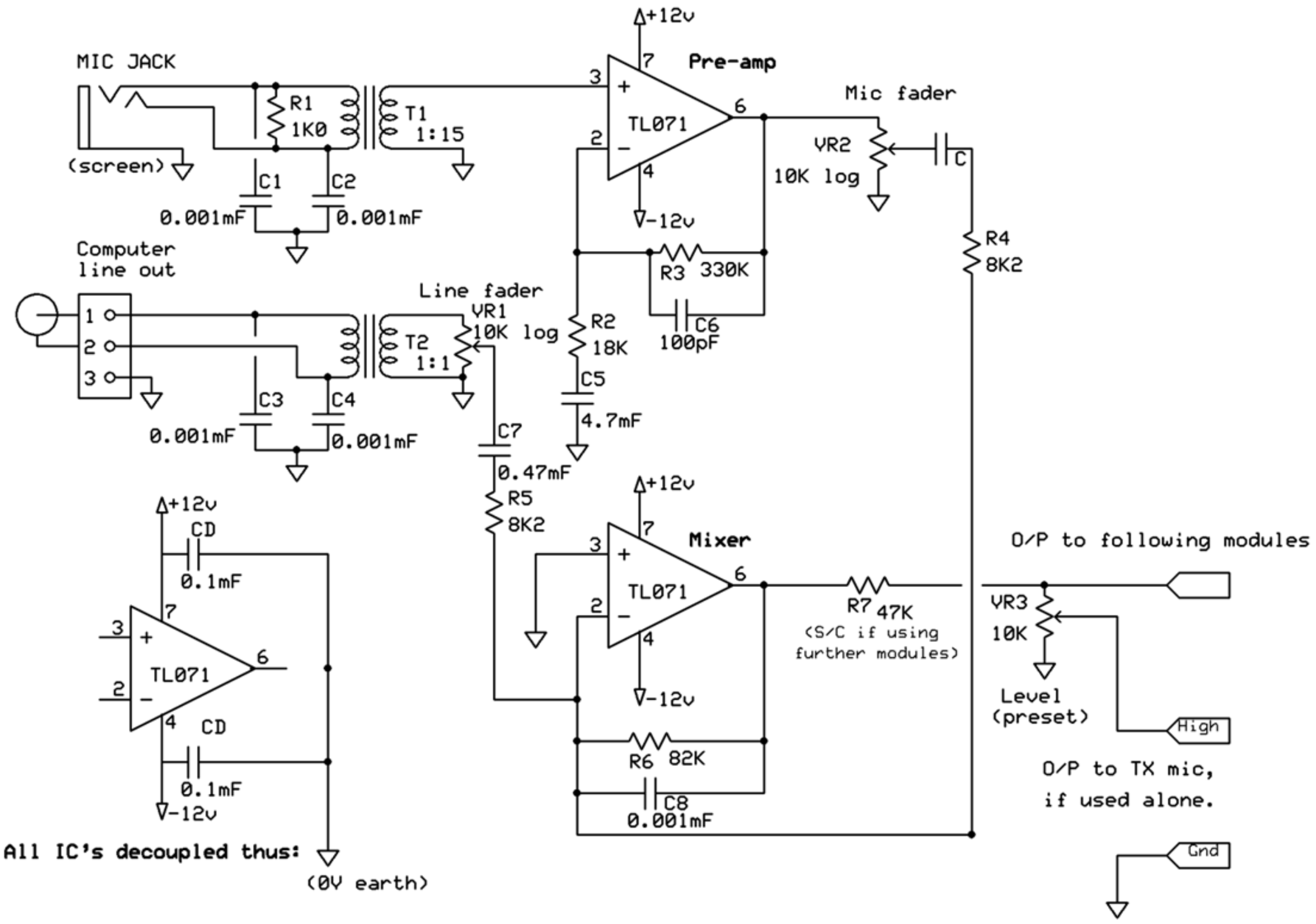
Regarding the audio bandwidth: We do not need to be too fussy about the bandwidth, provided that it is sufficiently wide, as the final TX bandwidth will be set by the rig. It is good practice though, to set a limit on the upper & lower frequency range to preserve HF stability and DC offsets. The HF roll-off is set by R3/C6 and the LF by R2/C5. The -3dB reduction point is determined in either case by the formula $f=1/(2\pi RC)$.

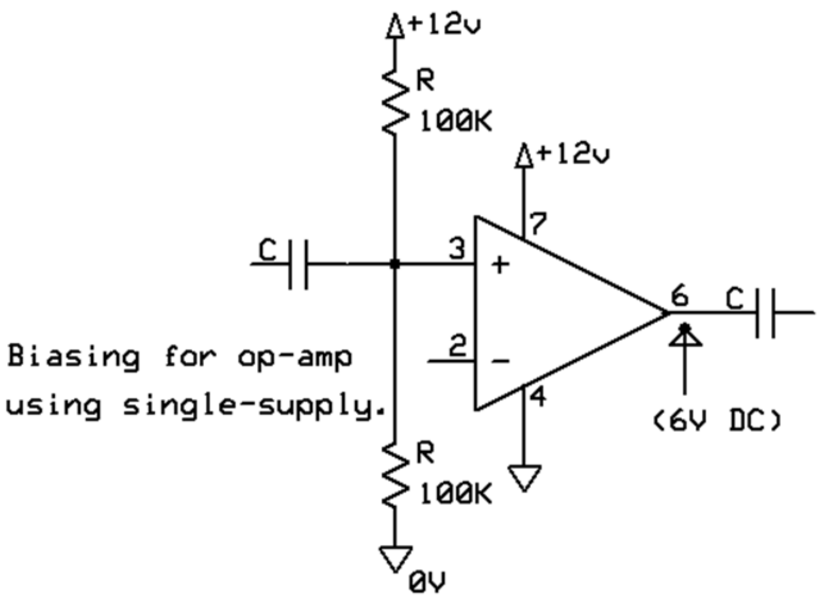
Note also that I have used an internal mains derived power supply for the box, having dual 12V supplies. The voltage is not critical and does not necessarily have to be stabilised – but it does need to be filtered both from RF and hum. I include below a method of biasing the operational amplifiers from a single supply if required.

On a final note, beware of the dangers of RF feedback which can give rise to appalling distortion when transmitting. For this reason the unit must be enclosed within a metal box and all leads in and out considered as potential aerials and bypassed with capacitors close to the point of entry. Note C1-C4 in the circuit. The same must apply to any power leads.

Instead of squashing the attached circuit details of Les’s article here, I have published them overleaf on Page 34.

Audio Considerations Concluded:





GW6W - IOTA Contest 2017

Stewart GW0ETF

The annual Islands On The Air contest took place on the final weekend of July from 1200utc Saturday to the same time Sunday. As in previous years we asked Stena permission to use the breakwater approach in Holyhead for our site; it's good access and Holy Island is classed as part of the Welsh Island group with the EU-124 identifier which makes us far more attractive and desirable than being on the UK mainland.

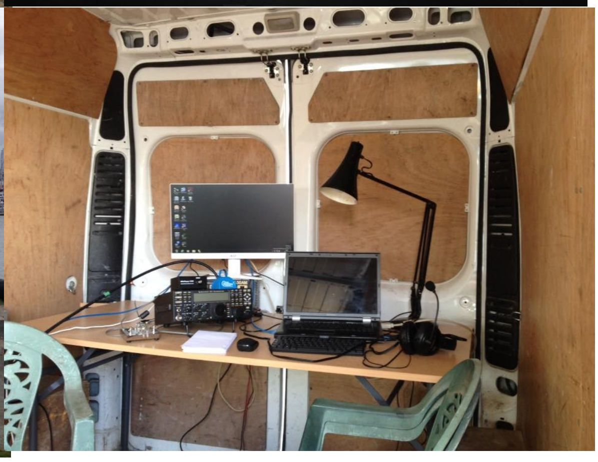
In this contest you can work anyone on CW and SSB on 10m, 15m, 20m, 40m and 80m but the emphasis is on other island stations which will have their own island identifier eg UK mainland EU-005, Madeira AF-014, Tasmania OC-006. These stations earn 15 points compared to 5 for non-island stations. In addition they form the basis of 'multipliers' by which the total points score is multiplied to give the final score; each time you work a new IOTA on each band and each mode it adds one to the multiplier total. The club has entered this over several years with mixed success and this year we decided to put more effort into it and be more serious in our approach.

As usual we entered the so called Multi Single category. The description is a little confusing but it allows any number of people to operate with a single 'Run' radio. On this you can operate by calling CQ and working stations replying ('running'), as well as tuning around looking for stations to work ('Search and Pouncing' or S&P). However you're allowed to have a second radio which is restricted both to S&Ping and only working new multipliers ie stations that have an IOTA number which you haven't worked before on that band and mode. This means there will be 2 stations operating all the time but one will only be working new multipliers and won't ever be CQing. This means you need enough antennas for the 2 stations which also have to be networked in order that the computer logging is synchronised. The contest exchange for an island station like GW6W is an incrementing serial number plus our IOTA reference and the serial numbers naturally have to be co-ordinated between the 2 stations.

GW6W - IOTA Contest 2017 Ctd:

This year Steve GW0GEI was available and he persuaded a friend of ours Martin MW0BRO from South Wales to guest with us. Myself and Danny GW7BZR completed the team. We set up from early Friday and with no club caravan hired a Stermat large van to use as a shack; this worked very well. The station was based on two K3 transceivers, which are proven to be very resistant to co-station interference, and 2 laptops with large monitors running networked N1MM+ logging software, and everything powered by 2 Honda 1KVA inverter generators. The network was set up with ethernet through a Gigabit switch with a second port on one laptop connected to my phone/4G giving us internet and cluster/rbn access. With cluster/rbn we could see where new IOTA mults were operating and the mult station in particular could quickly tune to them using hot keys in the logging program. You have to have this facility ('assisted') to be competitive as Multi Single doesn't have a non-assisted sub category. Steve brought up a Spiderbeam 10/15/20 beam antenna which we installed on the harbour edge. This gave us 3 elements on 20 and 15m and four elements on 10m. We also installed a ¼ wave vertical and a dipole for 40m, a dipole for 80m fed with open wire feeder (to allow us to tune to either ssb or cw using the auto ATUs in the radios), a 20m vertical dipole and a Moxon beam for 10m. This gave us enough choice to keep both radios occupied. The Spiderbeam is a bit of a beast and took a while to put together and mount. We managed also to get the 80m dipole up on my 15m Moonraker fibre glass mast by the time rain arrived in the afternoon when we retired a little damp into the van where we began setting up the station. The rest of the antenna work was completed in the sun on Saturday morning, myself and Martin having slept on site overnight.



GW6W - IOTA Contest 2017 Concluded:

Conditions for the contest seemed quite good although not a lot of dx was worked. We manned the 2 stations throughout except for a couple of hours in the dead of night when things went really quiet with the only action being on 80m. Usually in these types of contest you find it tails off as the end approaches but last year 15m suddenly got very busy in the last hour or two. It was the same this year with Martin working big pile-ups on 15m cw before we realised 10m was opening and I took over on 10m cw with manic pile-ups on that band. I worked 84 in 45 minutes before handing over to Steve to mop up the last half hour on ssb when he added 77 QSOs to the total while I continued working a few multipliers on 15m cw. It was a fabulous sporadic E opening on 10m to end the contest! The final tally looks like this:-

Band	Mode	QSOs	Pts	IOT	Pt/Q
3.5	CW	207	1975	43	9.5
3.5	LSB	94	1100	31	11.7
7	CW	246	1960	57	8.0
7	LSB	43	545	32	12.7
14	CW	522	3325	50	6.4
14	USB	22	330	22	15.0
21	CW	145	1115	30	7.7
21	USB	8	120	8	15.0
28	CW	148	1020	22	6.9
28	USB	78	660	17	8.5
Total	Both	1513	12150	312	8.0

Score : 3,790,800

Pulling down went better than I feared with the likes of the 80m dipole being taken down by spare hands before the end as it became redundant. The extra effort was worth it as this is by far the best IOTA result we've had so far, and shows the benefit of strategy planning and operators familiar with contest techniques and the N1MM logging program. Thanks to Stena for allowing us access once again, and also to the club for use of kit.

GW0ETF

The BITX40, 7 watt SSB Transceiver Kit
A Possible Club Construction Project
Simon (MW0NWM)

This article describes the BITX40 transceiver project, where you can build your own 40 metre transceiver. This is a simple to build kit where the hard work of populating circuit boards has already been completed, leaving you with the simple task of connecting the two boards and ancillaries together.

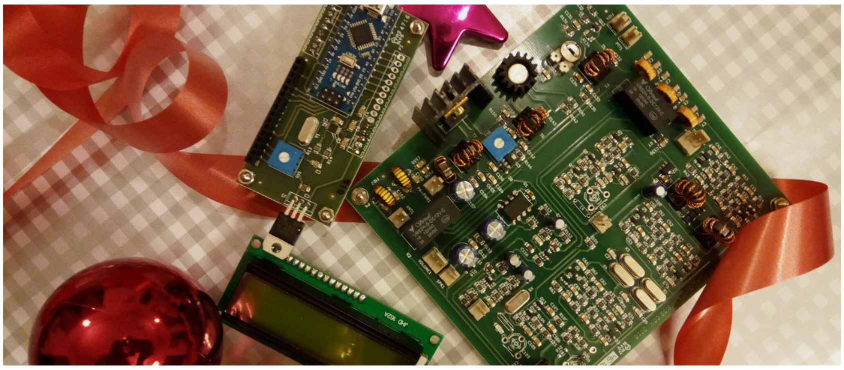
The BITX40 is a 40 metre (7 Mhz), 7 watt Single Sideband (SSB) transceiver kit that was the brainchild of Ashhar Farhan, VU2ESE. The original design used a basic 'Hartley' style Variable Frequency Oscillator' VFO in order to be able to change frequency, however this can be difficult to keep stable and had a tendency to drift. This problem has now been overcome by using a little more updated technology, namely an Arduino Nano which is a small hackable board based on the si5351 synthesiser, which can be programmed to act as a Direct Digital Synthesiser (DDS) VFO; allowing rock steady operation with no drift.

So why am I telling you this? It so happens that Ashar Farhan has started up a company in India employing many of the poorest local women, who compared to others in the area earn a fair living wage by working at home soldering components onto BITX40 circuit boards.

You can order the analogue transceiver board, DDS VFO and the hardware listed below, delivered to your door for the princely sum of $59 USD, yes that is a 40 metre 7 watt HF transceiver for just **£45.25** at the exchange rate on 06/08/17!

The kit consists of the following and comes well packed:

1. 1 x BITX40 board
2. 1 x Raduino board
3. 7 x 2-pin connectors (for DDS, Mic, Ear/Speaker, Antenna, Power, PA power, PTT)
4. 2 x 3-pin connectors (for tuning, volume)
5. 1 x 5-pin connector (for attaching the Raduino to the BITX and power supply)
6. 1 x 8-pin connector (for attaching the Raduino to the front)
7. 1 x DC connector (for power)
8. 1 x DC Jack (for power)
9. 2 x EP connectors (Mic and Earphones)
10. 1 x chassis mounting, female BNC Connector (for the antenna)
11. 8 x Half-inch brass stand-offs
12. 8 x M3 mounting bolts screws
13. 4 x M3 mounting nuts
14. 1 x 10k linear pot (Tuning)
15. 1 x 10K log pot with on/off switch (Volume and On/Off)
16. 1 x Pushbutton for PTT
17. 1 x Electret Mic (transmit)



The BITX40, 7 watt SSB Transceiver Kit Ctd:

To complete the kit, either an 8 Ohm speaker or headphones need to be sourced, along with a suitable box and knobs for the two potentiometers which act as the volume / on and off swith, plus the VFO control.

However the circuit does not have an Automatic Gain Control (AGC) which prevents stronger signals overloading the speaker, or more importantly headphones, which could do potential damage to your ears! I am currently researching a couple of very simple circuits which could be used for this.

I am currently costing up a kit and all the parts you need to build a fully boxed BITX40, with microphone, AGC circuit and a half wave dipole antenna. All you would then need to add is a power supply (battery or PSU), coax feeder, a mast (fishing pole, chimney, convenient tree?) and the desire to operate your new transceiver from home or portable.

I anticipate that if we order items in bulk the whole project could cost no more than £60 - £70 each, a bargain for a complete single band HF station.
We are then planning to run a group Buildathon of the BITX40 and antenna on Saturday 4th November. This is when we construct as a group with the support of more experienced members. Do you wish to take part? Please let me know if you are interested, I will chase people at club! It should be a fascinating project suitable to newly licenced amateurs.

There is lots of information on the internet about the BITX40 including many hacks (alterations) which can be made to the transceiver. The website of HF Sigs, Ashar Farhan's BITX40 kits can be found at:

http://www.hfsigs.com/

The YouTube channel of Peter Parker VK3YE has several videos about BITX40 including the old analogue VFO version, DDS version and several alterations he made. Of course many other sites, reviews, hacks and videos about the BITX40 can be found online... Take a look.

So will you take up the challenge and build your own BITX40 SSB transceiver?

Further details will be revealed about this project later this month.

Gwybodaeth am y Clwb / Club Information

- Cynhelir cyfarfodydd y clwb yn Neuadd Ebeneser Lon Foel y Graig, Llanfairpwll ar Nos Lun y cyntaf a'r trydydd yn y mis am 7.00 ar gyfer 8.00 o'r gloch. Croeso I ymwelwyr ac aelodau newydd.

- Club meetings held at Ebeneser Hall, Lon Foel y Graig, Llanfairpwll on the evening of the first and third Monday in each month at 7.00 for 8.00. Visitors and new members always welcome.

- Pob gohebiaeth at yr ysgrifennydd. All communications to the Secretary, John Pritchard MW0JWP
  QTHR. Tel: 07515 031025. email: mw0jwp@yahoo.com

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We are on the web…

http://www.dragonarc.org.uk

Issue number 116, will be issued in Tachwedd / November 2017. Any material for inclusion to be sent to the editor.