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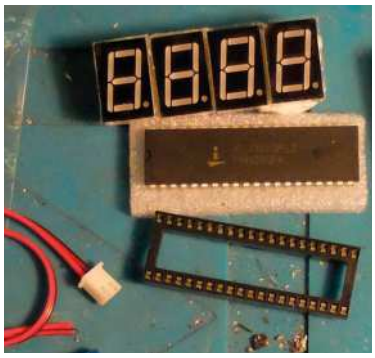

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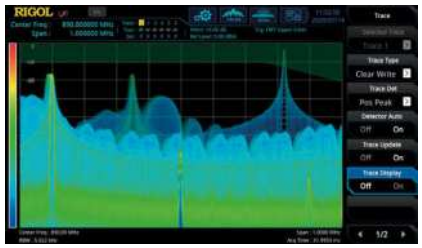

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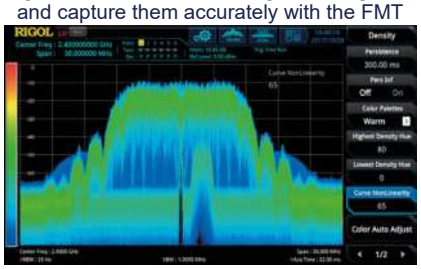

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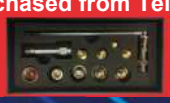

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Keylines

Things are gradually returning to some semblance of normal and portable operations are allowed once again. I hope to be out with friends for the RSGB Field Day in early June and the *PW* 144MHz Contest (rules in this issue) takes place later in June. We will also see, as the weather continues to improve, a restart of the popular Summits on the Air activity. And a number of UK operations are planned for the Islands on the Air Contest in July, with trips further afield still something of a gamble at this stage.

And as you'll read in **Steve Telenius-Lowe PJ4DX's** column, there are plans to hand for international DXpeditions. Indeed, some have already been taking place. Not many, understandably, but I note plenty of special event activity to keep us amused in the meantime – sometimes it seems there are more 'special' prefixes on the bands than regular callsigns!

Ofcom EMF Rulings

This one continues to play out. You'll see some correspondence on the matter in our *Letters* pages and in the *News* pages we have the latest about where to find guidance. I see no reason for panic at this stage but we will all have to make assessments of our stations in due course so it behoves us to at least start to think about it, even if the guidance still lacks some of the clarity we would like.

HRH Duke of Edinburgh

Most readers will be aware that the **Duke of Edinburgh** was, for very many years, Patron of the RSGB. He attended quite a number of RSGB and other amateur-radio related events during that time. My personal memory is of GB50, the special event station run at Windsor Castle for the Queen's Golden Jubilee in May/June 2002. On the occasion of the Duke's visit to the station the RSGB worthies were standing by the front door of the marquee in their finery, only for the Duke to arrive unescorted (it was his home, after all!) via the side door and proceed to chat to all and sundry, showing a keen interest in all that was going on, only to suddenly realise that he would be, as he put it, in trouble with the wife (!) because they were supposed to be going into Slough to

open something or other.

Also, while there, he watched with interest a CW QSO by my good friend **John G3WGV**. Some years later, at the Lowther Country Show in Cumbria, the Duke was carriage driving. Afterwards, he went into the bar, saw John, walked straight up to him, saying *"I remember you, you're that crazy Morse guy!"* Remarkable memory.

He will be fondly remembered by all who were at GB50 and, of course, by the amateur radio community as a whole.

This Month and Next

I have some excellent material in the pipeline for *PW* and this month will, I hope, yet again tick the boxes for many readers. From **Richard Constantine G3UGF's** review of some accessories for the IC-705 (already proving to be a very popular lightweight transceiver) to **Doug Fenna M0DSF's** explanation of complex numbers. Quite a range.

Meanwhile, I am enjoying playing the new FTdx10 transceiver from Yaesu and will have a review for next time. I have to say that the performance of most modern transceivers is excellent and they are distinguishable more by their ergonomics, interfaces, etc. Not so in years gone by - some of the early solid-state rigs had very poor RF performance compared with valve rigs and as for the early synthesisers, replacing more conventional VFOs, the less said the better!

Don Field
Editor, *Practical Wireless Magazine*

Newsdesk

Have you got something to tell our readers about? If so, then email **practicalwireless@warnersgroup.co.uk**

New from Nevada

Nevada are pleased to announce Spiderbeam have introduced two new Mini Spiderpole telescopic antenna poles. These smaller sizes, 10m and 7m, plus an optional carrying case, make them ideal for outdoor or portable operations.

Although they are light and small enough to fit in any suitcase, they are developed to be rugged and durable. These Mini poles use a fixed screw bottom cap which is flat and padded inside. This gives the pole a stable stand and prevents the mast from unwanted extraction while hiking. Spiderbeam fibreglass poles are extremely strong, with a much greater wall thickness than the usual 'fishing rod' types.

A special reinforcing winding technique uses several layers of fiberglass wound in alternating directions to provide greatly increased lateral and linear strength.

Stronger joints are achieved by a much larger overlap between the individual tube segments than usual.

Prices start at £59.95 with the optional carrying case priced at £14.95

www.nevadaradio.co.uk

New from ML&S

Martin Lynch & Sons have just recently introduced another accessory for the Yaesu FT-817/FT-818ND portable QRP transceivers.

The MyDEL brand Leg-Pegs is a neat retractable pair of folding feet that allow the transceivers to be tilted up when placed on a flat surface. Unlike wire bale-type versions seen before, this design allows the user to fold away the stand when not in use. Better still they are so beautifully made that it looks like Yaesu put them there in the first place and you can still use the Yaesu CSC-83 carry case without removing them. In stock at £19.95 plus P&P. More information see:

HamRadio.co.uk/LegPeg

YOTA Contest

Team YOTA (Youngsters On The Air) has just announced the new YOTA Contest. Sessions will take place on 17 July and 30 December. More information about the event can be found on the website:

www.ham-yota.com/contest

New Draft UK Amateur Radio licence

The draft of the new Amateur Radio licence expected to take effect on 18 May is available on the Ofcom site.

The new licence contains the EMF clause that Ofcom have added at 7(1)(c) along with an extra three pages for Schedule 3 specifying conditions relating to Electromagnetic Fields (EMF) compliance. Ofcom have also taken the opportunity to delete the reference to the old Full (Reciprocal) licence that was abolished in 2016.

Download the new draft licence from:

https://tinyurl.com/4dfcfmne

www.ofcom.org.uk/manage-your-licence/emf

Read more radio news and reviews at www.radioenthusiast.co.uk/news

Moonraker Warehouse Expansion

Moonraker has opened a third warehouse in order to increase its stock levels and range to support the next day solutions it offers to its many customers.
Justin Godefroy 2EOJSG Sales Director said, "With the lockdown continuing to fuel online sales we are just running out of space and with our continual investment in the future with more IT infrastructure, including a new website, we don't see things slowing for the medium to long term".

FRIENDSHIP ON THE AIR AWARD: The RSGB has launched a new award that is designed to celebrate the friendship of amateur radio over the airwaves.
Radio amateurs are encouraged to exchange the four-letter identifier of their club and accumulate points for each qualifying QSO. Through this you can gain the award. However, the main purpose of the award is to contact other people in a friendly and non-competitive way, connecting with them rather than simply making a quick QSO and moving on. If you're not a club member but are a member of the RSGB, you can use the RSGB identifier 'RSGB'.
There will be monthly and annual awards for individuals, clubs and the highest-scoring club in each region. The points system is simply an encouragement to get on the air, represent your club and have a chat with radio amateurs across the airwaves.
The award is part of the RSGB-NHS 'Get on the air to care' campaign, which was created at the start of the pandemic. Its aim has been to support radio amateurs living in social isolation, promote mental wellbeing and raise the profile of amateur radio in the mainstream media to help people looking for something to do during lockdown.
The Society hopes that the Friendship on the Air award will continue to support the radio amateur community as restrictions lift over the coming months.
To find out how to take part in the Friendship on the Air Award, visit the RSGB website:
www.rsgb.org/friendship-award

SPECIAL EVENT STATIONS: Durham and District Amateur Radio Society (DADARS) is privileged to be participating as one of the bonus stations in the hugely popular 13 Colonies Special Event. The callsign GB13COL will run from 1 to 8 July. The primary focus will be the HF bands, including VHF and UHF, using SSB, CW, FM and various Digital Modes.
www.13colonies.us
GB5UTA will be active celebrating U3A day on 2 June. The station will be active 1 to 28 June, on SSB and data modes on 160m through 70cm. The organisers are looking for licensed u3a operators to support this event. Please contact Mike G4GUG (U3A Subject Advisor for Amateur Radio): g4gug161@gmail.com
https://tinyurl.com/ay8ywrxm

DITS AND DAHS: This small but solid guide is the perfect read for those interested in learning or improving CW operating techniques.
Topics covered include: The secret of becoming a proficient CW Operator; Where and how to practice, practice, practice; Straight Key or Paddle? Adjusting your Straight Key or Paddle; Keyers, Iambic Keying and Bugs; Contests, Events, DXing; Operating QSK; CW Filters; Signs, Signals and Procedures; Tips on Taking CW On the Road.
The book costs $15.95 plus $10 handling for UK orders, from the CQ Magazine bookstore:
https://store.cq-amateur-radio.com

RESUMING EXAMINATIONS IN CLUBS: The RSGB remote invigilation exams have been a great success during the Covid-19 pandemic. Over 3,100 candidates have made the first step into the hobby by obtaining a Foundation pass, nearly 950 have progressed to the Intermediate exam and over 330 to the Full licence.
However, the UK Government's roadmap to exiting the Covid-19 restrictions means the Society can now plan to resume exams for candidates who prefer to sit them in a club setting with in-person invigilation.
The RSGB will start accepting bookings from club Examination Secretaries from the date when the Government lifts all Covid-19 restrictions in their part of the UK. There will be some changes to make the booking process more streamlined and details will be released in a later communication.
The online remote invigilation exams will continue in parallel as they clearly satisfy a demand from many candidates who do not have easy access to a club setting.
Mandatory practical assessments at Foundation level will remain suspended pending an ESC/ESRG-led review and consultation on their long-term future. The review and consultation will consider whether the mandatory practical assessments should continue and, if so, in what form. The suspension will allow clubs time to get back on their feet after the long closure and will also avoid them having to get practical assessments back up and running only to find there may be changes made to those assessments after only a short time.

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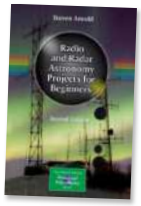

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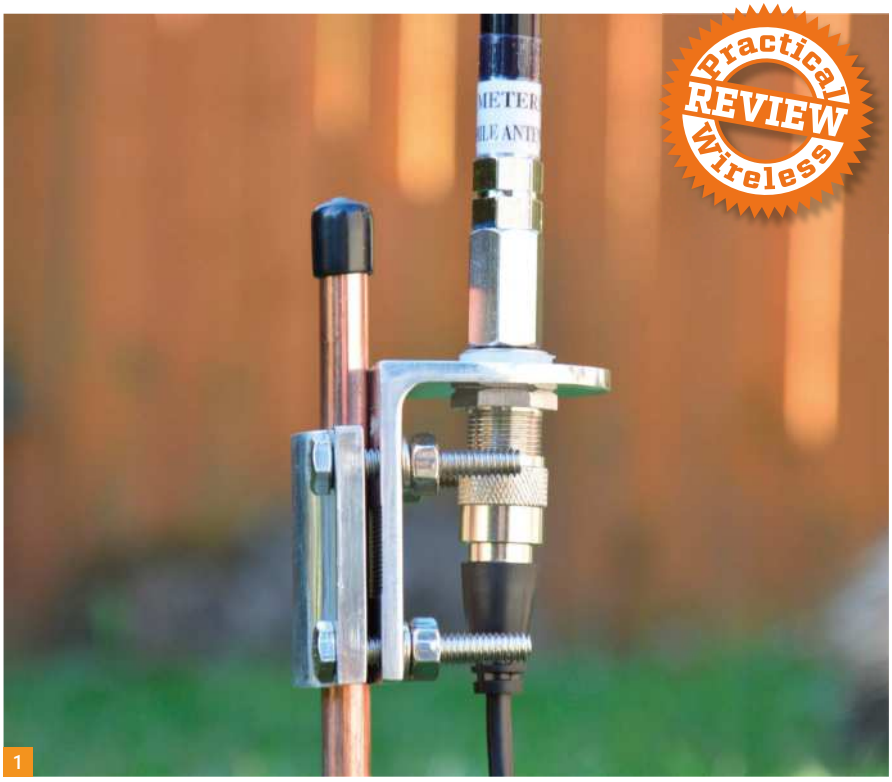

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Out and About with the Ampro Field Kit

Richard Constantine G3UGF takes to the hills with a handy multiband portable antenna kit.

Mobile and Portable antennas have always been something of a passion of mine, both professionally and as a hobbyist. As an avid hoarder of all things radio, I have quite a collection. Among my favourite single banders are G-Whip and Hustler. While there's nothing better than the full size, real thing, it never ceases to amaze me what can be done with less than ideal antenna systems. Of course, propagation and location play a big part. The starting point is, as always, the design, construction and matching of the antenna to the transmitter.

Regular readers may recall my 2018 article on converting a camera tripod for use with mobile antennas. This time, I'm looking at ground mounting with the Ampro Field Kit, courtesy of Moonraker UK.

Opening the box revealed a 60cm solid copper earth spike, a universal 3/8in UNC stud, alloy mirror mount and 10m of PL259 terminated, RG58U coaxial cable, total weight 660 grams.

The package contains eight single-band, 250W PEP rated, mobile antennas covering all bands from 80 through 6m. The high quality, fibreglass section radiators have chromed steel fittings and are 1.25m in length. The design is similar to some others I've encountered in the past.

Each has a 50cm long tapered, ground stainless steel whip for easy VSWR adjustment. To avoid confusion, every antenna is individually band marked and packed in its own reusable plastic sleeve.

The tapered whip section screws on to the radiator and slides inside the hollow lower section for adjustment or transport. It can be locked in any position by tightening two, 2.5mm countersunk, Allen screws.

Adjusting the antenna for best VSWR is straightforward. If at first the resonant frequency appears higher than wanted, you simply extend the top whip section in small amounts, until the desired and lower resonant frequency is achieved. If the resonant frequency appears lower than wanted, you simply loosen the set screws and adjust the whip further into the bottom section, shortening the overall length. This raises the resonant frequency to that desired.

Some Words of Caution

For personal safety and power amplifier protection reasons, always use low power when adjusting.

After adjustment, if it's found that the lower end of the upper whip section is long enough to slide inside the coil windings area when in use, the maker recommends that it's shortened appropriately to prevent overheating losses and damage. You will need to leave a little extra clear of the coil, as matching changes with location.

TIP: Ground Stainless whips are notoriously hard to cut with a hacksaw. Cutting a V shaped groove on opposite sides, with the corner of a flat file, is much easier. You then simply snap off the unwanted section and de-burr the wanted part with the file – it's quick and easy.

In the full kit there are eight 2.5mm set-screw keys to lose. I would highly recommend anyone buying just a single antenna to have more than one key to hand because they are small, fiddly and easily lost (some dayglow tape is also a good idea!).

Setting Up

Gauging how easy the antennas are to set up, I aimed to use three different methods, a NanoVNA, my trusty but aging MFJ-269 analyser and finally the traditional VSWR meter method.

All proved very straightforward. I was pleasantly surprised how easy it was to do with only the VSWR meter in the radio. I simply set the antenna for best signal on receive, checked the transmitter on three spots across the band for a starting point and adjusted the whip length to where I wanted it to be. As expected, on lower bands, usable bandwidth of around 1.2:1 or less was much reduced, requiring whip adjustment when moving across the band.

80m was typically only 30kHz while 10m was as much as 500kHz, with a decent earth connection.

Photo 1: Copper earth rod, bracket and coax. Photo 2: Hill topping with the IC-705. Photo 3: QRP operation good earth and clear take off. Photo 4: The Field Kit complete.

Speaking of earths, I found it important to mount the bracket as near to the top of the earth rod as possible. Doing so reduced unwanted, extra capacitance to earth, caused by proximity of the copper rod running parallel to the radiator. The earth rod and the bracket are different metals and something to be aware of longer term is the junction of the two. The junction of dissimilar metals must be kept clean to avoid increased resistance and possible noise effects.

Driving the rod into damp, softer ground with a rubber camping mallet gave the best physical and electrical results, as expected. Earth losses, although a complex mathematical calculation, can in practical terms be thought of as resistance and a low resistive connection is a vital part of the system. (matching a very low earth resistance to 50Ω coax at RF – I'll leave for another time!)

Something I intend to try is placing an insulated sleeve over the ground mount and attaching raised radials to the bracket bolts. This could prove a handy alternative in some locations. Higher, stony or dry ground locations made finding a good earth more difficult but frequently gave a clear, obstruction free and beneficial take-off angle for such a small antenna, in wavelength terms.

The Technical Bit

This leads me to the technical bit. Viewing at a distance I had always thought of this type of antenna as being helically wound – not quite so. With two exceptions, they are a hybrid design using slim inductor loading coils approximately one-third to halfway up the complete antenna, in order to maximise available current distribution. The position varies slightly according to the coil length and the band, etc.

Every fibreglass section is the same length for practical reasons, giving the designer a problem trying to maximise performance over a wide range of frequencies. The lower the frequency the harder this is bound to become and as the need for greater inductance increases.

Mobile antennas like all verticals, face a number of complex issues such as ground resistance at the feedpoint, base capacitance, radiation impedance of the loading coil and series loss resistance, shunt capacitance to ground, and the top area radiation resistance above the coil.

Add to this compensation for the protective covering, choice of wire diameter, winding spacing and power handling and what at first seems simple gets very complex, if you think too hard about it. That said, in this application the most critical parts are blindingly obvious – the ground connection and the coil design.

For this type of antenna, it's generally accepted that current flowing into the antenna must ideally equal that flowing out of the ground. That's because the ground is the imaginary/implied other half of what you might consider to be a dipole. Realistically, performance on hard stony ground is always going to be different from damp, softer ground and results found were as predicted. All the more reason to carry some radials for /P operation.

Loading coils are fascinating so, bear with me on this technical bit. Many years ago, as a student, my instructor told me that the *Q* factor of a coil is its 'goodness' for the purpose in hand but that if I had a lifetime to waste, I could study it in more detail. Here my education ended. It's actually all about the loss factor, that is the ratio between the resistive components and the frequency dependent inductance (R/2πfl) The inverse number is known as the *Q* factor (*Q*=2πfl/R).

What this means for mobile antenna designers is trying to achieve the best *Q* factor to minimise loss and maximise radiation. Coil diameter/form factor and choice of materials among a host of things determine the outcome. That's why mobile antennas come

in all shapes and sizes and different designers have their favourite ideas. Anecdotally, our US friends prefer bigger, fatter loading coils, especially for best power handling. 1kW when operating mobile is not uncommon.

Many consider a coil of around 5-6.6cm (2-2.5in) diameter best, with a one turn spacing between coil windings, others say close wound is better. If the coil gets much fatter than quoted above, performance begins to suffer and losses potentially increase, but I have no personal proof of that.

Much design also revolves around other things such as desired bandwidth, ease of tuning and repeatability.

As indicated, the Ampro designer is using a standard length and diameter of mast section for every band, for repeatability of manufacture. This means that on 80m the inductor is around 85% of the length of the lower section, making it the heaviest and effectively base loaded. The 10m mast has no added inductor as such. With its top section whip fitted it becomes a resonant quarter wave on 10m. Using just half the antenna makes it compatible for use on 6m.

The end result is a compact, well-constructed, extremely cost-effective multiband mobile antenna system, with a quality finish.

Testing

With all of this in the back of my mind, I set up comparison tests using the larger, higher power coil versions of the Hustler antennas as reference for the much slimmer, longer coils of the Ampro whips. Both antennas are similar in overall length at around 2.5m/8ft.

The QRO Hustler coils are on average some 15% higher above ground than the Ampro inductors.

They are a tried and tested standard for judging others by but offer greater wind resistance when travelling and are perhaps ideal for mounting on a US pickup truck.

Results from ground mounting the same band antenna on the Field Kit mount demonstrated on receive that both local noise and wanted signal levels were typically, 1 to 1.5 S-points (6-9dB) lower using the Ampro whips with similar results on transmit and in line with expectations. The largest differences being understandably on the 80 and 40m bands. The higher frequencies proved more difficult to distinguish the difference, as differences appeared smaller and subject to varying conditions.

The Ampro system impresses, for its size. A nearby, remote mounted Bird field strength meter indicated the higher coil position of the Hustler was in general giving it some increased radiation and a small edge.

3

Here a word about the Ampro's use of hybrid design on some, but not all, bands. i.e. the helical winding below the coils on bands from 40-12m.

Helically winding a conventional coil introduces losses, as the magnetic field isn't self-contained within the inductor. In this application the windings aren't parallel or evenly spaced for a reason. I suspect that they are contributing to raising the overall maximum current radiation along the full length of the radiator and why the Ampro certainly held its own in comparative terms in ground-mount configuration.

It performs better than some other base loading coil designs I have and also a couple of other mid-coil types in my arsenal, that don't have windings below the band coil. In such designs the feedpoint proper begins at the base of the coil.

The Ampro system achieved good results for such a simple and discreet installation. I would think it ideal for temporary locations such as a campsite, or for casual portable. It's certainly quick and easy to deploy.

Looking at it objectively, you could simply buy in to the system with just the ground mount and one or two band whips. However, were you to buy the Field-Kit complete at £199.00 at time of press, you save around £50.00. That's like getting your two favourite bands for free!

In Conclusion

When it comes to rating the package, I feel that I have to consider the construction versus cost independently of the performance versus price. There's little doubt in my mind that for a single band antenna at this price-point, it has to be 5 stars.

4

Performance versus price is a different matter. I'm more cautious and would love to do more experiments before a final judgement, as results are a movable feast. I'm happy to give it 4.6 stars for now. Remembering that one QRO Hustler type coil and mast section is around four or more times the price of the equivalent Ampro, I have to say that either a single band Ampro or the complete Field Kit is undisputedly good value. How well they perform is largely up to the user, as I've indicated.

Attractively priced antennas, great fun, many possibilities for mobile or portable and other temporary uses, as my experience indicates. You can't argue with that.

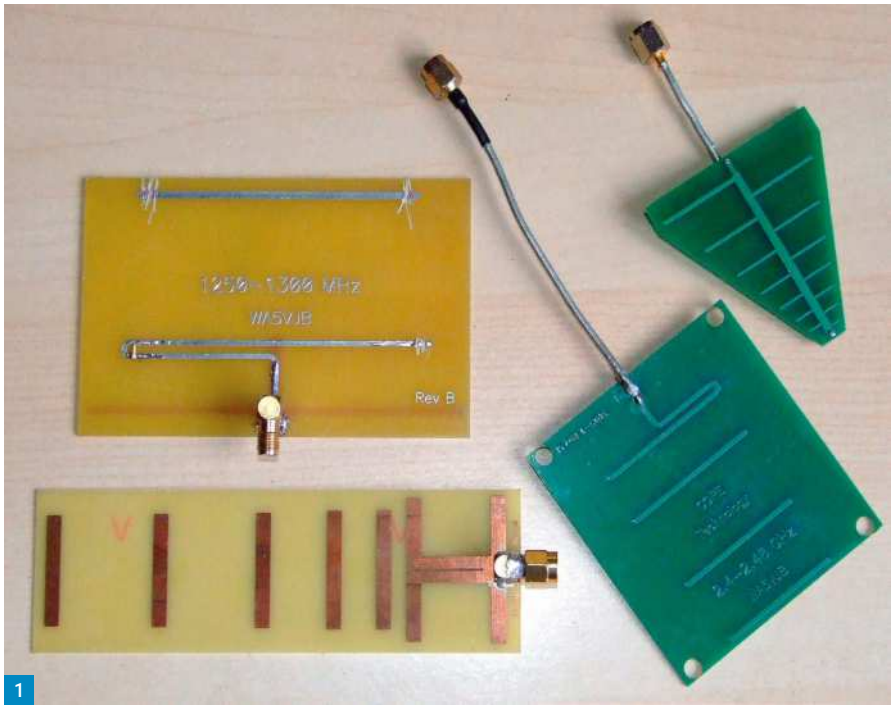
My grateful thanks to Moonraker UK for the opportunity to test their Field Kit over an extended period.

https://tinyurl.com/pnxm4wd8

Simple Microwave Antennas

Bernard Nock G4BXD
military1944@aol.com

Bernard Nock G4BXD explains how to build simple but effective antennas for the microwave bands.



1

Having recently been enticed into the wonderful world of Microwaves, the radio kind not the cooking kind, a whole host of new equipment had to be acquired, receivers, oscillators, converters, transverters, test equipment, plugs, sockets, better coax and, of course, antennas.

Surprisingly though, while the electronics at these frequencies starts getting more like rocket science, it's amazing just how well some simple antennas work at the frequencies involved.

Obviously, for outside mounted antennas that have to survive wind, rain and snow, high quality materials are needed and to get the utmost gain a high precision of dimension cutting is required. For all this you will need expensive equipment or have to pay a lot these days.

For testing out a radio, making local contacts and even some light portable work it is surprising just what can be achieved with no more than a printed circuit board Yagi or a few bits of bent wire. Regarding PCB antennas, **Fig. 1**, you do need to get the right kind of board material on which to make these types as the actual PCB material has significant effects at gigahertz frequencies, the main effect being of the loss type.

There is a good supplier of PCB antennas from Kent Electronics in the USA but handy for us there is a UK stockist of these antennas in the form of **Sam Jewell G4DDK**: **www.g4ddk.com/Products.html**

Radio waves travel at the speed of light, which is about 300 Mega metres (Mm) per second (the exact speed is 299,792,458 meters/sec). Therefore: Wavelength (mm) = Velocity of wave (Mm/sec) / Frequency (GHz) or w = v / f

23cm

Starting on the lowest of microwave bands, 23cm, I looked around to see what designs were available and the one that looked the easiest to build is the Bow Tie or Bi-Quad antenna. This is basically a backplate with a bent bit of wire in front of it. Even given my limited toolbox, junior hacksaw, hammer, pliers, a Dremil with assorted bits and a few screwdrivers I felt this was well within my constructional ability.

The Bi-quad antenna is widely used because of its compact size and thus can be portable, easy to make, cheap, only one radiating element and reflector, 11dBi gain, SWR as low as 1.05 if made ideally, 50Ω impedance, equal radiation pattern in horizontal and vertical planes and good bandwidth, better than a Yagi.

The antenna is a wire double-quad-like structure above a reflector or backplate. The connector can either be a socket mounted on the backplate or direct coax from the wire, through the backplate to a length of coax and plug. The wavelength for 1296MHz is 231.5mm.

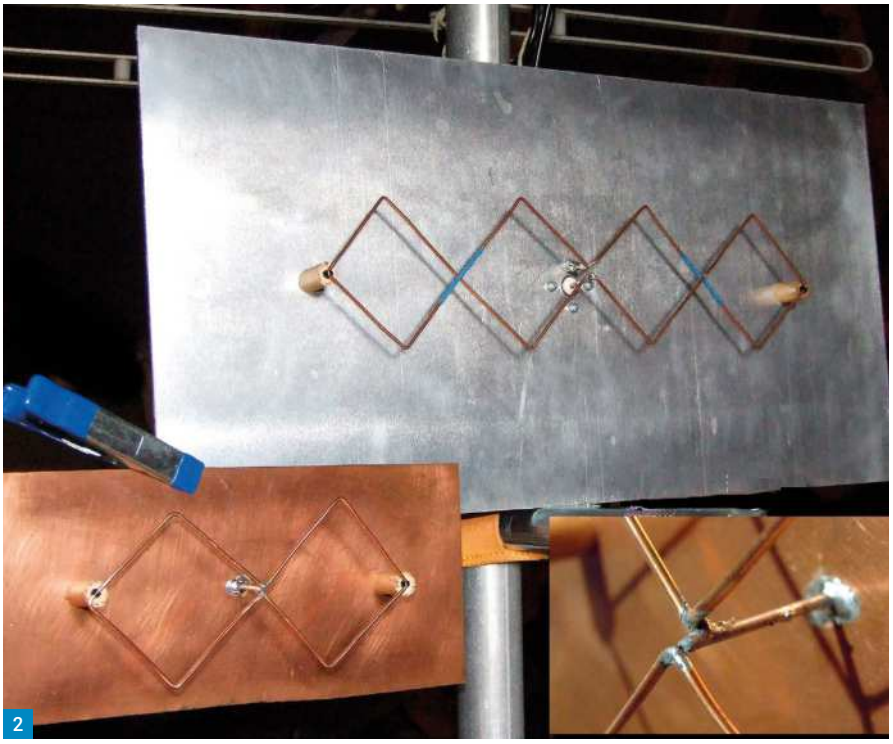
Dimensions of the reflector (see URL below) are not crucial. It should be 0.9 × 0.9 of the wavelength, but it was discovered that 1.2 x 1.6 wavelengths gives the largest gain. For 1296MHz the sides of the square are a quarter wavelength, 58mm, so 58 by 58mm forms the square.

https://tinyurl.com/ygg6hxl8

The backplate is about 200 by 240mm and the antenna wire, 2mm diameter, sits 17mm above the backplate but you can adjust this distance to get the best SWR. When building, try and get the corners of the squares as sharp as possible and the connection between the wires to the coax as close as possible. I used small pieces of bamboo cane as the end supports.

The standard Bi-Quad has a gain approaching double figures, depending on your build quality, 8 to 10dBd. The double Bi-Quad could extend the gain to 12dBd. The backplate for the double Bi-Quad is 250 by 500mm and the square sides are still 58mm. Spacing at 20mm is a good starting point. The picture of both Bi-Quads appears as **Fig. 2**, with the cable connection on the smaller shown in the insert.

On the single unit I used PCB sheet as backplate and a length of semi-rigid coax with SMA plug fitted but on the double unit I fitted an N-type socket because



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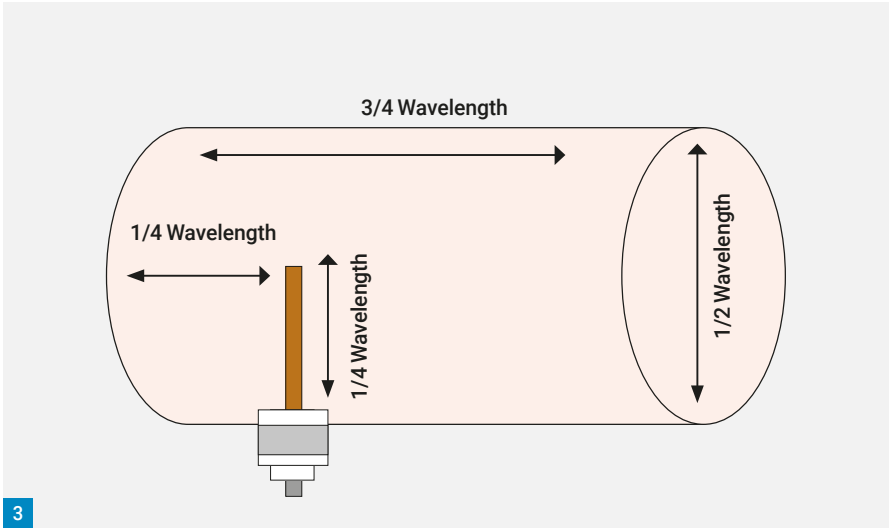


3

4a

4b

5

the aluminium backplate was more rigid. Slightly counter-intuitively, mounting the antenna with squares side by side horizontally gives you vertical polarisation, while one above the other gives you horizontal polarisation.

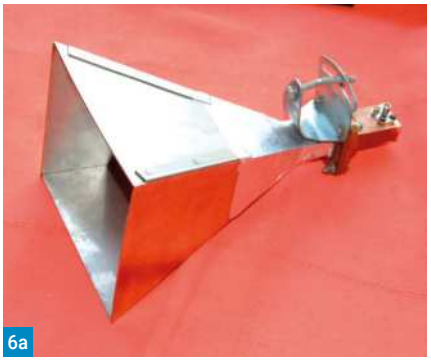
13cm

Let's use 2.3202GHz as the basis for these antennas. Using the formula would result in a wavelength of 129.299mm. The Bi-Quad mentioned previously is also suitable for the 2.3GHz band, easy to build and provides a very handy gain for little outlay. The backplate will be about 130 x 130mm while the wire square sides will be 32mm with spacing 11mm. A double Bi-Quad would have a backplate of 142 by 284mm, a square of 32mm sides with a spacing of 11mm.

Another popular easy-to-make antenna for 13cm is one widely used on the 2.4GHz Wi-Fi band to increase range and coverage. It's commonly called a Cantenna, **Fig. 3**, as it can be made using a common tin can found in the larder.

The length of the can should be longer than 3/4 of the wavelength, the diameter of the can should be longer than 1/2 of the wavelength, the probe element should be approximately 1/4 of the wavelength, the probe element should be 49.56 millimetres away from the back of the can, this is based off the overall diameter of the can.

Fig. 1: PCB antennas, top left clockwise: Kent 23cm 2 ele Yagi, Kent 2-11GHz LPA, Kent 2.4GHz 5 element, 3.4GHz 7 ele from SG Labs. Fig. 2: The Bi-Quad and Double Bi-Quad with connection inset. Fig. 3: The basic antenna arrangement. Fig. 4: The 67mm tube with probe fitted. Fig. 5: The finished 3.4GHz antenna with flare on SG Labs transverter. Fig. 6: My 10GHz horn and feed arrangement. Fig. 7: The 60cm dish and feed arrangement.


6a


7a

7b


6b


7c


7d

The two variables, frequency of operation and can size determine all the other dimensions. I wrote a small spreadsheet to calculate these for me and the results are in **Table 1**.

9cm

Again, I calculated the dimensions for a Cantenna-type antenna, with the results shown in Table 1.

I first tried the usual baked bean tin but was not happy with the results. I chose to buy a new length of copper tube, **Fig. 4**. The online stockist had 67mm diameter tube in 100mm lengths, which seemed close enough to the 104mm calculated. The design I chose has a flared hood on the end of the tube which I cut out of 1mm copper sheet. The hood, **Fig. 5**, is claimed to improve gain and side lobe attenuation.

Needless to say, a soldering iron is unsuitable for this job so I used my cooking blowtorch, which was ideal at delivering enough heat to melt the solder. The end plate was again a 1mm copper sheet. The tube ends need cleaning really well and I used liquid flux, solder paste and resin cored solder moving the heat to and fro until it all started to melt together.

3cm

I haven't mentioned 6cm, 5.7GHz, as I have not played on that band yet. My next extension was into the 3cm or 10GHz band. Things start getting a little harder up here mainly because small things like bolts, heads or nuts start being significant wavelength sizes with the basic wavelength of 10368MHz being 29mm, so a quarter wave is just 7.2mm. If you leave a screw or bolt sticking up in the wrong place it could really upset the circuit.

At 10GHz the normal feed for an antenna is waveguide. This is the rectangular metal tube with mating flanges on the end you usually see poking out of military radar sets and the like. You could use coax, but, either very short coax or very, very expensive coax.

It is common practice at 10GHz to actually mount the transmitter, receiver or transverter on the back of the dish antenna with the shortest feed length possible. Fairly easy if you're running a portable station but for home tower use the rig housing needs careful attention against weather.

The simplest type of antenna for 3cm must be the Pyramidal Horn antenna, a simple metal structure, aluminium, copper clad PCB even, connected to a short length of waveguide with a transition fitted, a device that enables coax to be used. The horn can be used on its own or as a feed for a parabolic dish.

A typical horn (see URL below) will have double figure gain properties, 10 to maybe even 15dBd. Luckily, I had just such a horn already, **Fig. 6**, and after fabricating a transition for it I tried it out on top on my pole with a 250mW transverter. I worked a station 176km away, which I was very pleased with considering the simplicity of the antenna.

www.w1ghz.org/10g/horn18.gif

The W1GHZ.org website has many projects for microwavers to drool over; many though expect the reader to have access to some sophisticated machinery. Given the rather meagre offerings in my toolbox I like the simple life.

Another relatively easy 10GHz setup is a parabolic dish and a horn feed. I picked up a nice 60cm one, **Fig. 7**, for £1 at a recent rally. A short length of waveguide, WG16, is the norm for 10GHz use. Cut a slot in one end and mount a penny (see link below), in my case an Irish penny just for luck, and a transition on the other end. As the waveguide is very solid you can mount the dish on the waveguide and attach it to the pole or such. The transverter sits on the pole behind the dish with a very short length of suitable coax connecting it.

https://tinyurl.com/yfwfoxhd

A 60cm dish at 10GHz has over 30dB gain. The penny feed is not very efficient though but considering how easy it is to construct it's a well worthwhile start into your operations while you wait to get your computer-controlled lathes and miller so that you can construct a really efficient feed for 10GHz and the bands above it.

I hope the above shows that even without CNC equipment you can make something that will radiate and allow you to play on these interesting frequencies.

Frequency (GHz)	2.32	3.4
Tube dia (mm)	100.00	67.00
Wavelength (mm)	129.31	88.24
Tube length (mm)	148.68	104.1
Probe dist (mm)	49.56	34.7
Probe height (mm)	32.33	22.06
Hood od (mm)	193.97	132.35

Calculated dimensions of 13cm & 9cm Cantenna

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DXpeditions Return

Steve has news of some recent and welcome DX activity as well as looking at what the future might hold for some of the rarer ones.

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

Welcome to the June *HF Highlights*. Although we can be fairly sure that we are now a little way into Sunspot Cycle 25, there is little evidence yet of any great increase in solar activity. Indeed, the solar flux (SFI) and sunspot number (SN) on 11 April were at the same levels as in January and February and even somewhat lower than last month's measurements, as can be seen in **Table 1**. The unexpected but very welcome peak in these figures that took place last autumn and which led to some great propagation on the higher HF bands – even 28MHz – is becoming a fast-fading memory.

If you can get to see the ARRL member's magazine *QST* I recommend the article by well-known HF contester **Frank Donovan W3LPL**, *What to Expect During the Rising Years of Solar Cycle 25*, which starts on page 57 of the May 2021 issue. Frank gives us the benefit of his activity over more than 60 years and six solar cycles to provide some predictions of how the next few years of Solar Cycle 25 will affect HF propagation as it rises to its peak, expected to be in 2025.

DXpeditions Present...

No DXpeditions for months then, rather like the 99 bus, two come along at the same time! In March, DXers' patience was rewarded by A25RU, a Russian team operating from Botswana, and by VK9CE, a group of no fewer than ten amateurs from the Perth area who took the flight up to the Cocos (Keeling) Islands for an eight-day operation, **Fig. 1**.

Both teams favoured digimodes, but also made some QSOs on SSB and CW. From here in Bonaire, Cocos (Keeling) is the opposite side of the world and VK9CE was not always very strong, though they were still worked on 7MHz SSB and FT8 and on 14MHz CW. **Eva PJ4EVA** also worked them on 14MHz FT4.

I worked A25RU easily enough on 7 to 24MHz inclusive on FT8 using the 'Fox and Hounds' (F/H) mode, as well as on 14 to 28MHz CW, although I missed their occasional forays on to SSB. A25RU closed down on 1 April after more than 48,500 QSOs but to everyone's surprise (well mine, anyway) the group then drove 1500km across southern Africa to the Indian Ocean coast of Mozambique, from where they started operations as C92RU on 3 April. C92RU was rather more difficult to work from here on Bonaire and as of 11 April I had only managed two QSOs, on 10MHz and 14MHz FT8. However, they were reported with good signals in Europe on 1.8 and 3.5MHz CW and as of 11 April had made nearly 35,000 QSOs, with at least two days yet to go.

	Apr '21	Mar '21	Feb '21	Jan '21	Dec '20	Nov '20	Difference
SFI:	73	75	72	73	81	86	(–2)
SN:	0	11	0	0	11	27	(–11)

Table 1: Rolling six-month Solar Flux Index and Sunspot Numbers as of 11th of each month. The final column shows the difference between the April and March figures.

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Finally, on 23 March an operation by **Janusz Wegrzyn SP9FIH** from French St Martin also took many people by surprise, bearing in mind the restrictions to travel due to Covid. Janusz used the special callsign TO1K (St Martin's normal prefix being FS) and he was still active on 11 April as this column was being put to bed.

...And Future

Looking ahead, there are now ongoing plans for two DXpeditions to the world's second-rarest DXCC entity, Bouvet Island, **Fig. 2**. This is a notoriously difficult place to activate, and the last two tries in 2018 and 2019, while they both got tantalisingly close, failed because neither group was successful in actually landing on the island. The Rebel DX Group, which made the 2019 attempt, has announced that it will have a second shot at the end of December this year. If all goes to plan, 3Y0I should be on the air around Christmas for up to 30 days. Updates are posted on the group's Facebook page: facebook.com/rebeldxgroup

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Fig. 1: VK9CE made just over 10,000 QSOs from Cocos (Keeling) (picture: qrz.com/db/vk9ce)
Fig. 2: Bouvet Island, in the southern Atlantic (credit: Eric Gaba, Wikimedia Commons Sting / Norwegian Polar Institute, CC BY-SA 4.0).
Fig. 3: Let's hope 3Y0J can beat all the odds and activate Bouvet Island.

Meanwhile, the Intrepid DX Group has announced that they plan to operate from Bouvet as 3Y0J in January 2023, **Fig. 3**. A team of 14 experienced DXpedition operators led by **Ken Opskar LA7GIA** and **Paul Ewing N6PSE** will travel on the *RV Braveheart* for the ten-day voyage to Bouvet and spend 20 days at the island, weather permitting. Much more information on the website: 3y0j.com

The Future of DXpeditioning?

Imagine an entire amateur radio station including transceiver, 1kW linear amplifier, power supplies, and control and networking equipment, all pre-assembled in a weatherproof case. All you would need to do is connect a generator at one end of the box and an antenna at the other to operate a DXpedition on a remote island from the relative comfort of the ship moored offshore.

Sounds like a fanciful futuristic fantasy? Think again: at least one DXpedition has already taken place with exactly this setup, using a high-speed 900MHz IP radio link connecting the boxes on land with operators on a boat moored just offshore.

The Radio In a Box ('RIB', **Fig. 4**) is the brainchild of **George R Wallner AA7JV** who, with three other amateurs, used four RIBs on an uninhabited island in the Bahamas in November last year. Operating from their boat as C6AGU they made 9000 QSOs over a two-week period. Such operations count for DXCC because all the pieces of equipment, including crucially the antennas, are on dry land. (C6AGU was also active in the CQ WPX SSB contest at the end of March, but it's not clear if this was using the RIBs or a more conventional setup.)

The idea of the RIB came to George when he was on the 2018 KH1/KH7Z DXpedition to Baker Island. It had taken many years to secure permission to operate from this environmentally-sensitive wildlife reserve. George discovered that the reticence of the authorities to grant operating permission was not so much due to the danger of birds striking the antennas, as had previously been supposed, but rather the prospect of the group *"building a miniature city"*, as he described it, on the island – that is camping with toilets, showers, sleeping and operating tents, rubbish *"and all the back-and-forth activity"* that this entails.

The Northern California DX Foundation (NCDXF, **Fig. 5**) sponsored the development and production of the prototype RIBs and George has written about the project in a fascinating article published in the Spring 2021 *NCDXF Newsletter*. It (and other *Newsletters* dating back to 1981) can be downloaded from:

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Fig. 4: The NCDXF-sponsored 'Radio In a Box' (from Spring 2021 *NCDXF Newsletter*).
Fig. 5: Logo of the Northern California DX Foundation. Fig. 6: Data from Club Log shows the remarkable uptake in the number of QSOs made using FT8 (G7VJR Blog). Fig. 7: QSL from VR2BLEE, the Bruce Lee Memorial Station.
Fig. 8: Paul Beard G1OVK will be operating GB0SOS until 31 May.

ncdxf.org/pages/newsletter.html

It will be interesting to see if the development of the RIB will lead to permission being more readily granted for operations from difficult to activate places such as Kure Island in the Pacific, Desecheo Island in the Caribbean, or some of the French islands in the Indian and Southern Oceans.

The Dominance of FT8

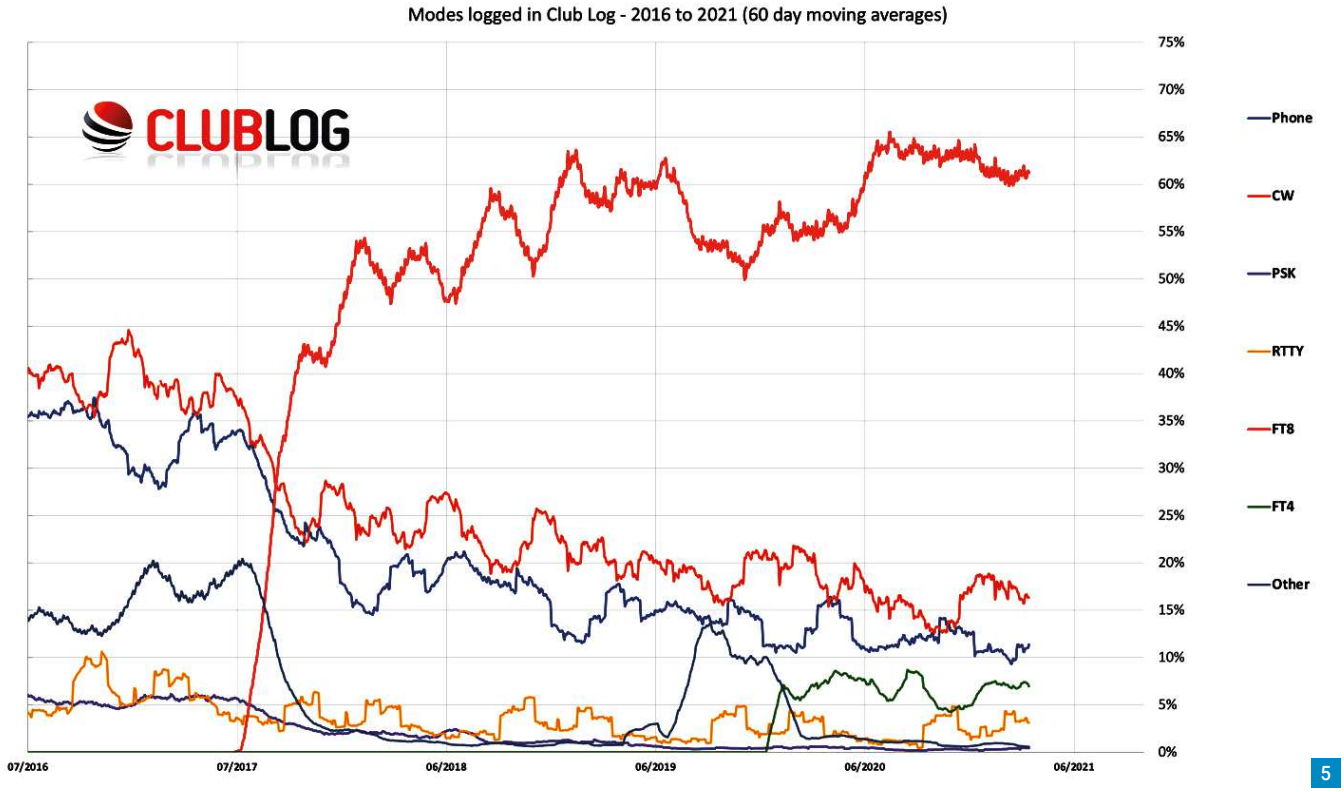
Love it or loathe it, the emergence of FT8 as an operating mode in the summer of 2017 has had a marked effect on amateurs' operating habits. **Michael Wells G7VJR**, the man behind Club Log, has written an interesting article on his blog, which shows just what an impact FT8 has had since its introduction. The graph, **Fig. 6**, shows the remarkable uptake in FT8 QSOs, along with the concomitant decrease in the use of what might perhaps be called the 'legacy' modes, i.e. mainly CW and SSB. The data are based on logs uploaded to Club Log by users and as of March 2021 it contained some 731 million QSOs, so the data can be regarded as being statistically significant. There is much more detailed analysis about operating trends in G7VJR's blog which is well worth a read: tinyurl.com/h6dcjbcm

If you are at all active on HF, I would encourage you to upload your logs to Club Log. The amount of data it provides for users is unique and genuinely fascinating. To register (and it is completely free!) go to: clublog.org

Readers' News

Owen Williams G0PHY wrote *"The DX activity this month was split between the Russian DX contest and the CQ WPX phone contest with a surprise operation from French St Martin by SP9FIH at the end of March / beginning of April. The rules for foreign travel from Poland must be different from the UK as at present it's illegal for us to take holidays abroad. During the Russian contest I had contacts with 9K, VA and UA9 and also R7QR in Ingushetia, the smallest region in the Russian Federation, all on 14MHz. I found that conditions were a bit better during the CQ WPX contest and I had a few contacts on 21MHz as well as 14 and 7MHz. 14MHz was open to Asia and North and South America and 21MHz was open to Asia and Africa. There were very strong signals on 14MHz on the Sunday evening of the CQ WPX contest from the Caribbean, in particular 3E3E in Panama (I had to look 3E up as I did not recognise it). The signal was S9+ for about five minutes and then there was a change of operator and the signal went right down and the audio was much less punchy. TO1K from French St Martin produced two new band slots on 18 and 14MHz."* All Owen's contacts are made on SSB with 200W to a quarter-wave inverted-L and dipoles.

Kevin Hewitt ZB2GI wrote *"My March log included 900 FT8 contacts operating on eight bands and 200 SSB QSOs operating on three bands. I only operated portable once as I have*



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been busy painting the upper Rock shack and carrying out maintenance on the 10m, 6m and 4m Yagis ready for when conditions improve and the bands open." Kevin also operated as EA7/M0GTD from across the border in Cadiz on 10m FT8, working mainly South American stations.

Tony Usher G4HZW reckons that *"if there were any good openings on 28MHz, then I missed them! Pretty depressing with just one contact outside Europe* [see 'Around the Bands' below – *Ed*]*... Still the band always holds promise and the Sporadic E season is imminent, perhaps we'll work JAs and KL7 again during the summer. 7MHz is what it is: too much noise here, reports received are better than I can give, showing my noise level is much higher than stations I'm in contact with."*

On 1 March, Asiatic Russia's R9LY opened the log of **Victor Brand G3JNB** on 20m CW. Next morning, he tried PJ7AA St Maarten on 40m but says that Tom suddenly faded out. *"Same thing with E29TGW Thailand who, over half an hour, was fading in and out and seemed unable to hear many of his callers, including me. This occurred again with both TZ4AM and CX5FK, as though we had one-way propagation. However, closer to home, the DARC's special event DL21EURO, promoting the UEFA Cup, did come straight back and, celebrating the 200th anniversary of Greece's independence, SZ200ERS on 20m with SX1A and SX2A on 40m and 17m also worked. A particular highlight was just listening to FK8IK New Caledonia holding court on 20m CW with EU 'big guns', way above my power grade! So, I just enjoyed QSOs with CN8KD Morocco and 7X3WPL Algeria on 20m. The intriguing call C7A, worked on 20m, was operated by the 4U1A team for the World Meteorological Organisation. Then, I got a real 'kick' working on 17m with 12W as I slipped past the pile-up for Hong Kong's VR2BLEE, the Bruce Lee Memorial Station,* **Fig. 7***!*

"It was the night before the BERU [Commonwealth] Contest that I heard XL3A in Islington, Ontario, on 40m working a substantial pile-up on split. Ron was doing an excellent trade so I crawled beneath the howling mob to where I hoped he just might 'see' me on SRD, called and back he came to my 16W. During the contest, I worked a couple of VKs and four VEs but my most rewarding effort was finally getting a response from ZF2CA Cayman Islands just minutes before QRT time. Funny thing was that, next morning, ***Colin G4CWH*** *mailed from Bishops Stortford just a few miles from me, to reveal that it had actually been he who worked me via remote to his shack in ZF. My final and cryptic DX QSO in March was on 17m with CX2DK Uruguay. I just received 'JNB', replied and back came '599 QRZ'. Short but not so sweet!"*

Paul Beard G1OVK wrote to say that he will be using the callsign GB0SOS, **Fig. 8**, on HF SSB and digital modes throughout the whole of May. The station is supporting SOS Radio Week (which is actually a month! – *Ed*) and highlights the work of the RNLI and the National Coastwatch Institution. QSL is OK via the bureau and more information on the SOS Radio Week is at:
sosradioweek.org.uk

Finally, it was a pleasure to work regular contributor **Etienne Vrebos OS8D** on 21MHz in the CQ WPX SSB contest at the end of March. Etienne was one of several who commented on the extraordinary weather in April, with his local temperature plummeting from a high of +24°C to –4°C within 24 hours, followed by snow lying on the ground for several days. As well as being a *PW* subscriber, Etienne is a member of both the RSGB and ARRL and also reads the German *FunkAmateur* magazine. He comments that he really appreciates the advertisers in the British magazines as, unusually, they show

the prices and availability of their products. Etienne uses the callsigns OS8D on HF and ON8DN on VHF but comments that from 18 April and until December Belgian amateurs are allowed to use the OS prefix in place of ON, so he will also have OS8DN available for use. This *"makes my mind a bit difficult!"* he says.

Around the Bands

Owen G0PHY: 7MHz SSB: A61QQ, TM9A, UP2L. **14MHz SSB:** 3V8SS, 4X7R, 9K9A, PR4T, RA9V, RA9Y, T6A, TO1K (=FS, St Martin), UP0L, VA2E, VC2W, VE9CB, W7WA. **18MHz SSB:** TO1K. **21MHz SSB:** 4L0G, C44C, FR4NT, TA2NC.

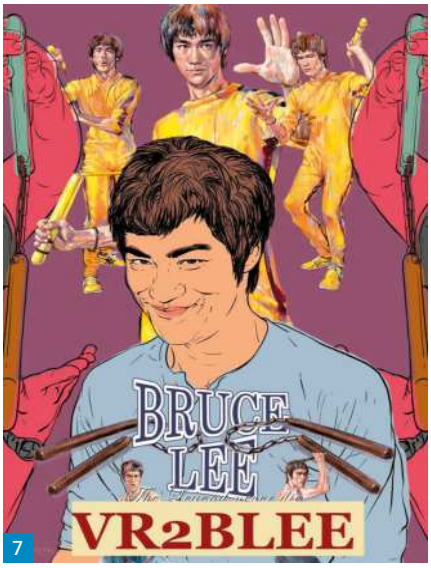
Kevin ZB2GI: 3.5MHz FT8: HF1J, LX2SM. **5MHz FT8:** KJ3N, TF2MSN, TA4Q. **7MHz FT8:** 5P2A. **14MHz SSB:** 6Y5HM, AA3TT, HH2AA, KA9KLR, N0JR, N1RPH, N4WFU, N8DE, OE6END/P (OE-OT233), VA3EB, VE1PVH/P, W2GI, W6SFG. **14MHz FT8:** AC4BV, K0HD, K3EA, K5CKS, NA7L, VA3SF, W1IE. **18MHz FT8:** K1OF, N0ODK. **21MHz SSB:** 5B4XF, FY5KE, LU5FC, LW1D, N2OC, P45A, XQ1KZ. **21MHz FT8:** AC4CA, NF4A, PY2IQ, R9FE, TK5IH, YB8HI. **24MHz FT8:** 9K2BM, A92AA, PY2UG, YB1MIG, ZS2EZ. **28MHz SSB:** PY5FJR. **28MHz FT8:** CE3KRM, CP6CL, CX1AO, FG5FI, HK3X, LU1CFU, PT2DF, YB8HI, YV4GLF. And as **EA7/M0GTD: 28MHz FT8:** CA4COQ, LU1EFX, PP5AM, PU2HEN, PY2DPM.

Tony G4HZW: 7MHz FT8: HI3EAL, KP3G. **7MHz FT4:** CU5AAS, EA9BO, HI8RD, K2MRK, K9ATX, KA6LMS/1, KB8ARL, VE3WNO, VE9HF, W0JAY, W4MRJ, W6L. **28MHz FT8:** ZS6NL.

Etienne OS8D: 7MHz SSB: GD1JNB, GS8VL. **14MHz SSB:** 3V8SS, 4U1GSC, 9M2MDX, EX0M, FP5AC/P, JH4UYB, KL7RA, SU0ERA, UN7QF, UP0L, UP9L, VU2DSI, YB0IBM, YB1RKT, YB1TJ, YI1WWA, Z62FB, ZF2PG. **18MHz SSB:** 4J10SFR, JH3NGD, TO1K, TR8CA. **21MHz SSB:** 4L0G, CB6I, CV7S, E20NGF, EK1KT, FR4NT, LO5D, LU5FC, LU5VV, LU6UO, PJ2T, PJ4DX, PR4T, PQ2M, PY1VOY, PZ5RA, T6A, VU2XO, YC1JGE, ZV2C.

Signing Off

Thanks to all contributors. Please send all input for this column to teleniuslowe@gmail.com by the 11th of each month. Photographs of your shack, antennas, or other activity would be particularly welcome. For the August issue the deadline is 11 June. 73, Steve PJ4DX.



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An Audio Special

Mike Richards G4WNC focuses this month on PulseAudio as found on the Raspberry Pi.

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk

This month is a bit of an audio special. With so many using Raspberry Pi's for data modes, I've provided a run through of the often misunderstood PulseAudio system used to power the Pi's operating system.

Raspberry Pi Transmit Audio and WSJT-X 2.3 Problem

I'm covering the Linux sound system in some detail elsewhere in this column, but I should mention a problem I encountered recently. Now that the Raspberry Pi operating system has moved over to PulseAudio as its default sound system, we should use the included server to route all the Pi's audio. We do this by setting the Audio in and out to Pulse, instead of a specific sound card for data modes programs. By doing this, we can use the default Pi level controls to adjust the audio levels. While this works fine for FLDIGI, QSSTV and a few others, there is a problem with WSJT-X. On initial use, everything seems fine, but as soon as you generate any transmit audio, part of WSJT-X will hang! The interface will appear to be responsive, but you won't be able to generate transmit audio. If you then restart the program, you will see a lock-file error that you can't clear.

This occurs because, when you close WSJT-X, the graphic interface closes, but a stray wsjtx process is left running. When you try to restart the program, WSJT-X sees the running process and thinks you're trying to run two instances with the same name, which is not allowed. The only way to restart WSJT-X is to either reboot the Pi or use the Pi Task Manager to kill the errant wsjtx process, **Fig. 1**. Although I've investigated the problem and reported it to the WSJT-X development team, I'm not sure whether it's a WSJT-X or Raspberry Pi related PulseAudio problem. In the meantime, the simplest solution is to revert to selecting the soundcard directly. You can do this using the WSJT-X Audio in and out drop-downs, as shown in **Fig. 2**. As most people use a USB soundcard with the Pi, the drop-down menu entry you need will begin with: **alsa_output.usb** and **alsa_input.usb**, respectively. You are likely to find these entries near the bottom of the sound devices list.

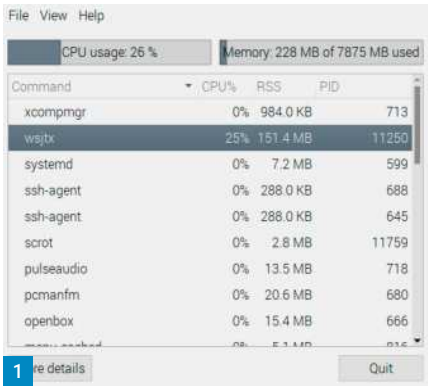
Raspberry Pi and Linux Audio

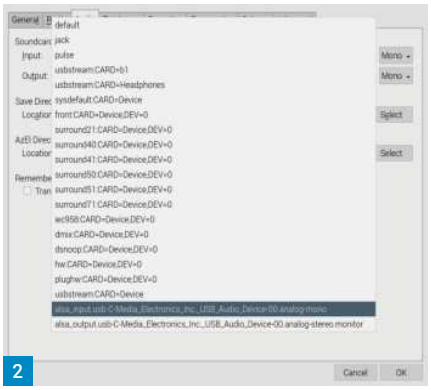
Those of you that have dabbled in Linux sound will be aware that it's not necessarily straightforward. One of the problems has been the lack of consistency between different Linux distributions and even within versions of the same distribution. Let's start by explaining a little about the Linux sound architecture. As I'm sure you can imagine, there is a vast range of sound cards on the market and these use many different audio codecs to digitise audio signals. In this case, a codec is the chip that converts the audio between analogue and digital formats. It is clearly impractical to expect programmers to write separate audio interface code to cope with all the different codecs. The solution employed by most operating systems is to use some driver code that converts the specialist codec commands into a standard format. Linux, manages this using the ALSA (Advanced Linux Sound Architecture).

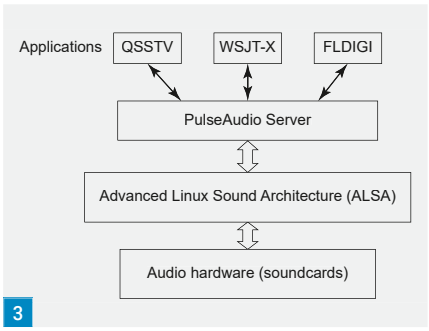
ALSA has two sides to its functionality. The first is to interface to the codec manufacturer's driver code, while the second is to provide a standardised set of controls for application software. For example, to increase the speaker volume, all programs send the same commands to ALSA where they are transformed into bespoke commands to alter the volume of the selected codec or soundcard. ALSA's interface is known as an API (Application Programming Interface) and APIs are used extensively in all modern computing systems for all manner of hardware and software interfacing, **Fig. 3**.

While ALSA does a great job of providing low latency access to a wide range of audio hardware, it's not the friendliest system for managing audio at a user level. The solution is to add a software layer on top of ALSA that provides simpler access to standard audio requirements. There are three contenders for this role, namely PulseAudio, JACK and PipeWire. All three applications operate as audio servers, so user programs connect to the audio server for their input and output sources. Once connected, the server handles all common actions, such as level adjustment, input/output selection, audio routing, etc.

The next question is which server to use.







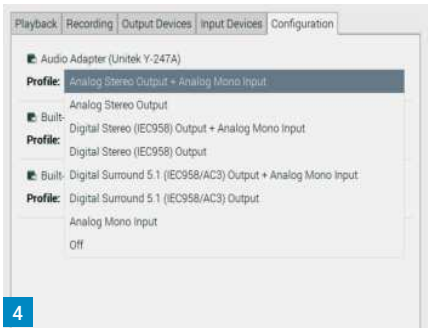


Fig. 1: The errant wsjtx process as seen in Task Manager. Fig. 2: Setting the soundcard in WSJT-X. Fig. 3: Block diagram showing the ALSA architecture. Fig. 4: PulseAudio Volume Control Configuration tab.

Fig. 5: PulseAudio Volume Control Input Devices tab. Fig. 6: Illustration of the PulseAudio' Monitor of' facility. Fig. 7: The WSJT-X audio stream in PulseAudio.

PipeWire is still very new and has yet to be incorporated into any of the popular distributions. Of the two remaining, JACK is best suited to professional, multi-channel, low latency audio and MIDI applications, whereas PulseAudio is better for everyday and consumer audio needs. As a result, PulseAudio is rapidly becoming the default audio server for most of the larger Linux distributions, including the current Raspberry Pi Operating System. From the December 2020 release, all the Pi built-in level controls operate via PulseAudio. For amateur radio use it's also worth installing the dedicated PulseAudio Volume Control application. This App is easy to install, as follows:

Open a terminal session (Ctl-Alt-T)

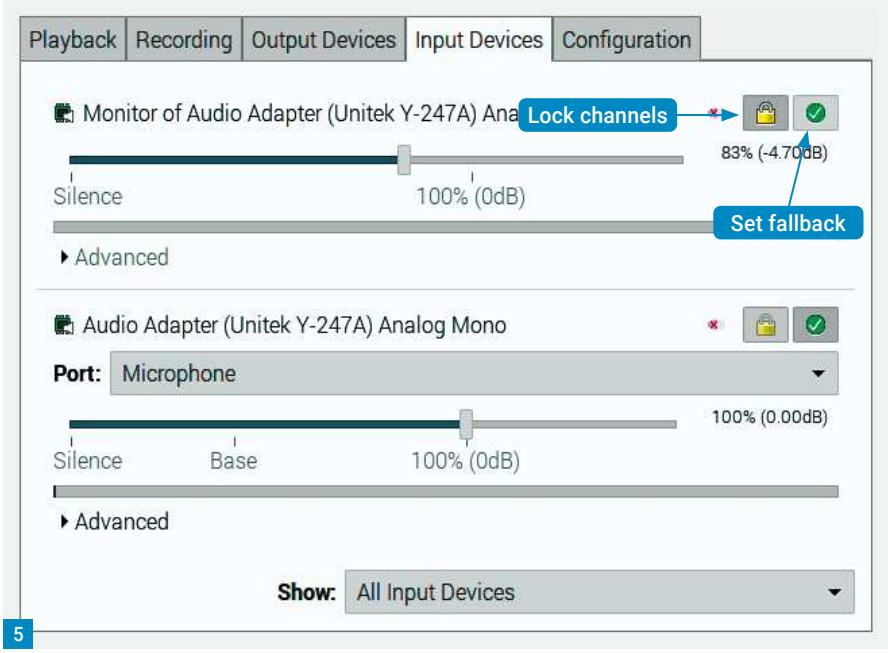
Enter: sudo apt install -y pavucontrol

Once installation completes, you can access the control panel via the Pi menu – Sound & Video

PulseAudio Volume Control is a versatile application with many useful features that may not be obvious to new users. I'll begin with a run-down on the tabs at the top of the panel, starting with Configuration. This tab configures the available hardware sound devices. For example, in **Fig. 4** I've shown the Configuration panel with the drop-down menu for my USB soundcard. As you can see, there are lots of options available, but I'll be using the default, which is analogue stereo output and analogue mono input. You can also use this section to disable unwanted sound devices, such as the Pi's built-in audio device. This configuration panel is particularly helpful if you're using a more sophisticated USB sound device with several inputs/outputs.

The Input Devices tab gives access to the input level controls for all the active inputs. The top line shows a lock and a tick icon, **Fig. 5**. The lock icon binds the channels (typically left and right) together so a single level slider controls both. The tick icon, when activated, sets that device as the fallback. If, for example, a sound device were to fail, the sound would automatically fall back to the device selected here.

Port selection is helpful if your input device has multiple ports, i.e. analogue and digital inputs. Below the Port selection are the two most important controls; the input level slider and the signal level bargraph. The input level slider provides fine control of the input level to your decoding software.



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You can use this in conjunction with the associated level display to make sure you avoid input overload. You will see that the input level control goes up to 153%, providing a useful 11dB boost to the incoming signal. This can be useful if you have a particularly weak audio input level. At the bottom of this panel is a drop-down menu where you can select which input devices are displayed. In the drop-down list you will probably notice a 'Monitor of' input that's linked to your soundcard. This often confuses users because it has the same name as the audio input device. However, this is a handy feature that provides a new input that monitors your sound card's output. This can be used to monitor the transmit audio level being sent to your rig. I've shown a block diagram of what's happening in **Fig. 6**. If you like to have individual level meters for the inputs and outputs, the free PulseAudio Volume Meter is a good choice. This is easy to install as follows:

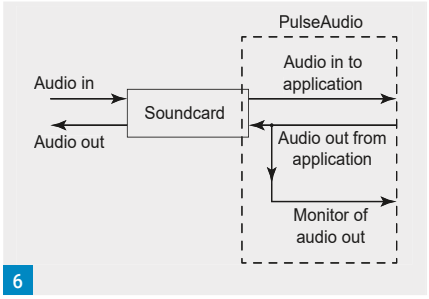
Open a terminal session (Ctl-Alt-T)

Enter: sudo apt install -y pavumeter

Once installed, it will be available via the Pi menu - Sound & Video

You will note that you have two volume meter entries, one for capture and the other for playback. By running both meters, you can actively monitor your soundcard's input and output levels.

Moving on to the Output Devices tab, you will see a similar layout to the Input tab, but this time it's displaying the output devices. If you have multiple output ports, they can be selected via this panel. You can also see the output level and adjust that level with the slider. The next two tabs, Recording and



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Playback, are used to show the active audio streams dynamically, so they will change as programs start and stop. For example, when running WSJT-X in receive mode you will see a stream with a name similar to: **QTPulseAudio:** in the Recording tab, **Fig. 7**. This is the audio coming from your rig and heading to WSJT-X. You can use the slider to adjust the level. When you exit WSJT-X, that stream will disappear. Similarly, the Playback tab will show a stream name similar to: **QtPulseAudio:** when in Tune or transmit mode.

I hope that's served as a useful insight to the workings of PulseAudio and Linux sound in general. I'm currently experimenting with the new PipeWire framework that promises a new system that will handle both audio and video streams. I'll report back here when I've made some progress.

Two Millivoltmeters

Geoff Theasby G8BMI offers two millivoltmeters, one for DC, one for RF.

Geoff Theasby G8BMI
geofftheasby@gmail.com

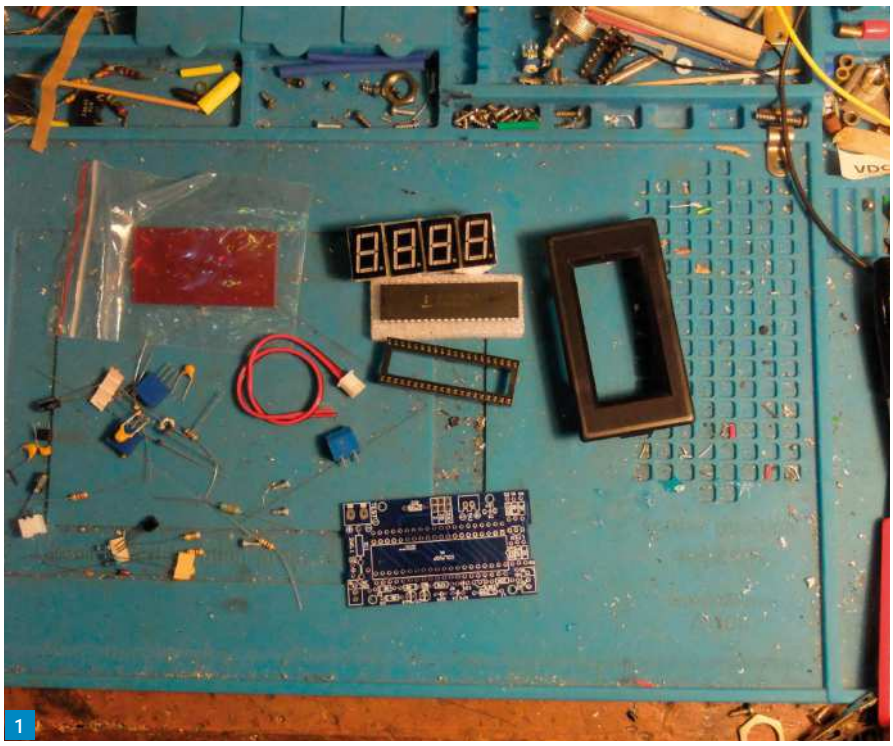
Building an electric locomotive to be run at my local model engineers track, I became concerned at the apparent loss of power at the motor, although the wiring should have been adequate. The problem was in fact the connectors, each of which had a significant voltage drop across them. This was in the order of tens of millivolts per connector. As my equipment is not at its best at these low levels, I searched online and found a suitable kit, presented here. Ex-laboratory or industrial millvoltmeters are quite common on eBay, indeed one has just sold for about £40. I also built a simpler version from *Electronic Test Equipment Projects*, by **Alan C Ainslie**, which is quite good in view of its simplicity.

Despite the use of a 42 pin 'Adams' IC, it is not a microcontroller and does not need programming.

The kit (£4) *[£15 when checked on eBay recently – **Ed.**]* for LCD readout (7106) or LED (7107) is constructed on a well-made PCB with parts on both sides, using through hole components, **Fig. 1**. The components, though few, are tightly packed, increasing the chances of a missed joint. Continuity tests will show up this problem. Mine didn't work first time, but after rectifying a couple of bad joints and a misplaced resistor, it did. The meter in **Fig. 2** is not yet fully calibrated. The analogue meter in **Fig. 3** is an ICE Supertester 680G, movement only, bought at Newark for £1. When complete, the module should be calibrated. Almost none of the various guides to assembly found online are clear on how to do this, but the 'Instructables' (URL below) guide is the only one (of five checked) that I would recommend. Switch to the 5V position and apply a known voltage to the input terminals as measured by your best multimeter, preferably simultaneously, and adjust both VR1 and 2 until the module display reads the same as the multimeter.

https://tinyurl.com/n873wk6k

In a multiplicity of modules, I have included an AD954 precision voltage source (£8) providing 2.5/5/7.5 and 10V, for a 4.5 to 30V supply, and I also acquired an 8-decade 1% resistance substitution module (£6) for the intermediate measurements. I used a USB Cable for 5V supply. Both modules should work at this voltage.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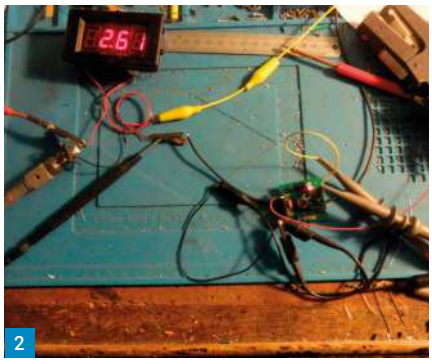
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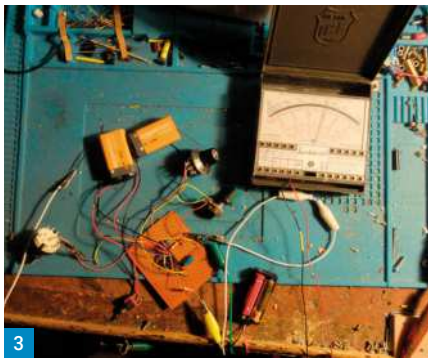
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Fig. 1: The components as unpacked.
Fig. 2: The digital meter, ICL 7107.
Fig. 3: Analogue circuit, indicating 3.2V.
Fig. 4: The circuit made up.
Fig. 5: 3½ digit meters, both agree quite closely, kit-built meter at left.

RF Millivoltmeter

If you are building a signal source, such as a signal generator, oscillator or other RF device, it is often necessary to measure the output level in millivolts or less. At G8BMI, I was lacking the capacity for this and consulting the usual internet sites informed me that used equipment could cost from £200+ in working order, to £50 with no sensing head (without which they are essentially useless). I therefore decided to build one, having found several circuits in my surfing of the internet. A simple design by VE3ZAZ (basically an untuned crystal set) is built onto the back of a coaxial socket.

Continued on page 28

Tim Kirby GW4VXE
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Summits on the Air (SOTA) – a VHF Perspective

Tim Kirby GW4VXE has another great selection of VHF/UHF/Microwave news.

The Summits on the Air programme has been going for many years and seems to go from strength to strength. I confess, though, when I was in Oxfordshire, SOTA on VHF wasn't really a huge thing, with only a relatively few summits within 'easy' VHF reach. Here in Wales, of course, things are very different and I know the same is true in other parts of the country, where hilly/mountainous districts are within VHF/UHF range.

A few weeks ago, I was driving into Fishguard to get some shopping and the 4m FM rig in the car burst into life, somewhat to my surprise. It was **Allan Jones GW4VPX** operating portable from the highest point in the Preseli range, Foel Cwmcerwyn, a SOTA summit, **Fig. 1**. I worked Allan and went on to hear him work a number of stations on 4m FM, including over the water into Southern Ireland. After working through his pileup on 4m, he went onto 2m FM where I think he was at least equally popular. I thought I would drop Allan an email to find out about his SOTA activity and he very kindly replied with lots of interesting information.

"I've been addicted to SOTA since 2012, both chasing and activating. In 2016 I managed to achieve SOTA Mountain Goat status and by now I'm well on the way to my second Mountain Goat, hopefully before I get too old. I use a variety of HF bands and modes but I've always included 2m with a variety of antennas, modes and handhelds. For VHF the Yaesu FT-270 with its solid front-end has been my main rig but the FT2 now gets used more and more. I also carry the SOTAbeams filter as a back-up on those summits with communication towers. I run a blog, Radio Tales from West Wales, which was started by my good friend ***Steve MW0BBU*** *many years ago:*
https://gw4vpx.blogspot.com

"For my 'homebrew' 4m 'flowerpot' I've wound seven turns of RG58 on to a 50mm former (discarded Bathroom Silicone tube) then the usual calculations for a Flowerpot taking into consideration the velocity factor of the cable with coax and the element without the braid. The antenna is one continuous piece of coax terminating in a BNC plug. All my connectors are BNC, HF and VHF. I've been using a 4m fibreglass pole from Life's a Breeze. They have a good range of telescopic flagpoles, which are slightly stronger than fishing poles but just as light:
https://lifebreeze.co.uk

"My rig for 4m is the Wouxon KG-UV8G 2m/4m handie bought as a package from Martin Lynch, which includes spare battery, etc. Portable 4m is new to me and something that I wanted to try on my SOTA activations. One of the most important criteria for a successful 4m activation is to let others know you will be on a summit. As with all my activations I post an alert on the SOTA website (URL below), the Facebook group 70MHz/4m Ham Radio group, word of mouth and emails to friends, including the newly formed Facebook group GW SOTA (Summits on the Air). There are loads of IC-7300 rigs out there, which are unused on 4m".
https://sotawatch.sota.org.uk/en


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If you are in one of the 'SOTA-rich' areas, then listening on the 2m FM calling channel, 145.500MHz, may well yield contacts with SOTA activators from local and not-so-local summits. Since the majority of 2m activity is vertically polarised FM, your 'white-stick' vertical can be pressed into service here and perhaps you may be moved to work towards the 'Shack Sloth' award, presented by SOTA for summit chasers operating from home. Of course, if you are tempted to

Read more radio news and reviews at www.radioenthusiast.co.uk/news

Fig. 1: GW4VPX uses this Slim-G (related to the Slim Jim) 2m antenna for SOTA activations.
Fig. 2: The neat antennas of Colin G8YIG at Stalybridge.
Fig. 3: A screenshot of the 23cm Q65 aircraft scatter contact between EI8KN and G4HSK.
Fig. 4: A nice shot of the moon over Patrick WD9EWK's portable operating spot in DM22/DM23.

join the summit activators, you can work towards the 'Mountain Goat' award.

It's nice to see people such as Allan including 4m FM in their activations and I think that some intrepid summiteers have been active on 23cm FM. Reports are always very welcome for the column.

If this combination of the outdoors and amateur radio, appeals to you, then you can read more on the SOTA website (below). Many thanks to Allan for the interesting information and the pictures. Keep up with Allan's activities on his blog.

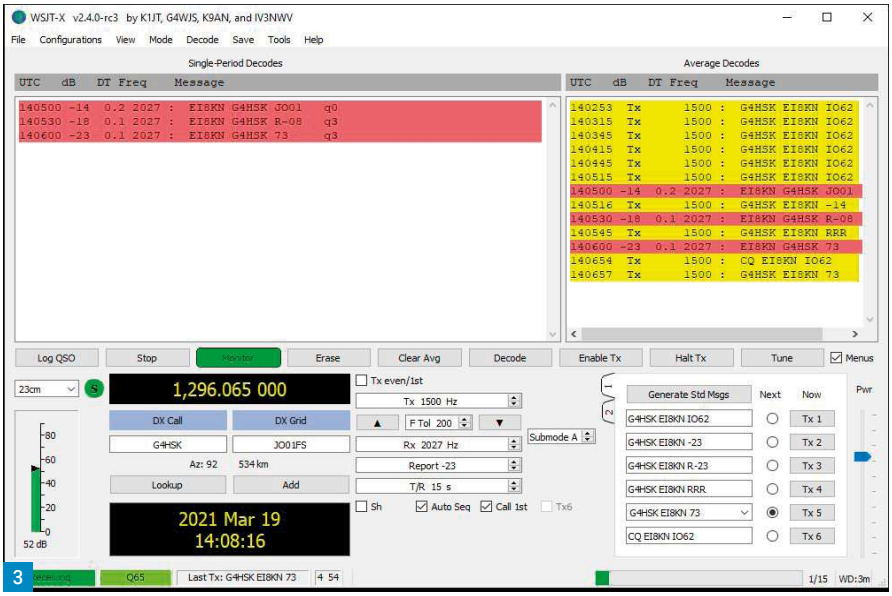
www.sota.org.uk

The 6m Band

Tony Collett G4NBS (Cambridge) says that the 6m band is becoming a real challenge for him with new sources of interference appearing and he's hoping that the Es will be strong enough to overcome the unwanted signals. During the 11 March UKAC Tony's interference sources were so bad that even the big gun signals were inaudible. Fortunately, on 8 April, that noise source was absent for the first hour and signals seemed good, so GI4SNA was worked easily for the first time since September. F4HRD was worked too but unfortunately the QRN increased towards the end of the contest making a CW QSO with GW0GEI a struggle – although signals came up again later. During the contest on 11 April QRN was absent, but signals seemed fairly weak although Tony used aircraft scatter to complete some QSOs (like Tony, I was surprised, some years ago, to discover that aircraft scatter works on 6m).

The 4m Band

Gordon Smith GW6TEO (Castlemartin) kindly sent details of the last two months' activity. At the end of February, Gordon worked DL6BF (JO32) and S52OR (JN76) via meteor scatter using MSK144. Gordon has also been looking at the new Q65 mode and heard G3SHK and G0LFF using it. During March, Gordon completed a number of MSK144 meteor scatter QSOs with the 4m 'stalwarts' but is looking forward to a bit more activity during the Es season. MS QSOs included DG1ROD (JO62), DL6BF



(JO32), LA4YGA (JO48), OZ1DLD (JO45), OZ8ZS (JO55), DM2BHG (JO51), DJ2QV (JN58) and SP9HWY (JO90).

Simon Evans G6AHX (Twyning) continues to enjoy 4m FM activity and says that on 30 March he worked M7EMH in North Nibley, who was new to the band and Simon was his first contact. Simon also took part in the Cheltenham club 'on the air' event on 15 April, working G8NSZ, G4BSC and G3LVP. During the RSGB UKAC Simon used his IC-7300 and vertical antenna, working five stations with the most distant being GW1YBB/P (IO81) at a distance of 70km.

Here at **GW4VXE**, I've been enjoying some 4m FM activity. During a recent visit to Gloucestershire (as **G4VXE**), I operated both mobile and portable. My portable activity was from Cleeve Hill near Cheltenham from where I worked a number of stations, including G3YNT (Newent), G3NKS (Cheltenham), G3LVP (Cheltenham), M0OJG (Alcester), G4BSC (Cheltenham) and G6AHX (Twyning). G4PWD/P on Clee Hill in Shropshire was heard, but sadly, we didn't work, or that would have been a nice distance. Other stations further north, around Birmingham, were heard but not worked. The portable setup was a Wouxun KG-UV8G using a Spectrum Communications 'Flexwhip' antenna. Stations worked mobile included M6AIX (Nr Weston Super Mare), GW4MBS (Carmarthenshire) and GW1JFV (Haverfordwest). Perhaps the longest distance was a scratchy contact between myself near Carmarthen and GW1JFV,

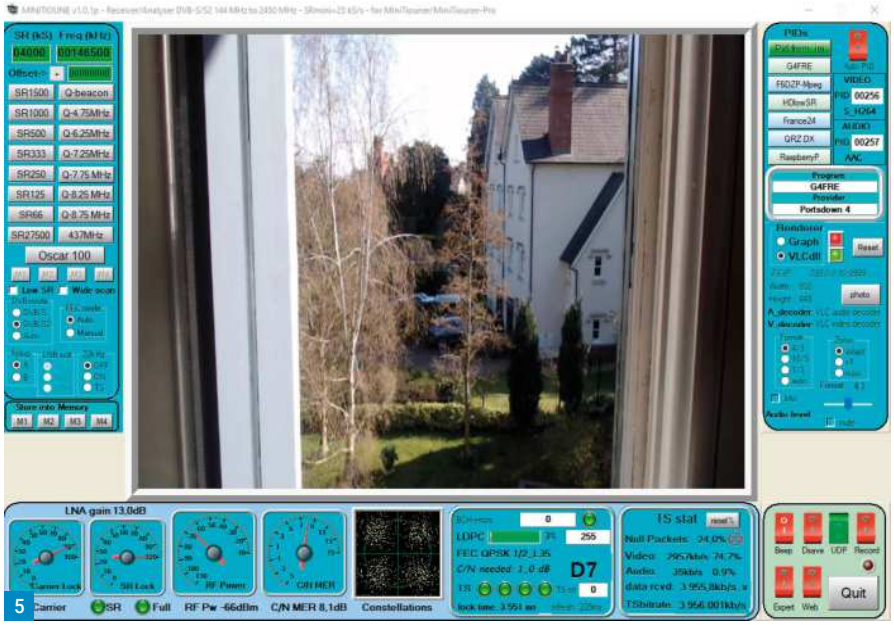


Fig. 5: The DATV console at G4FRE for his 13cm QSO with Graham G3VKV.

a distance of just over 50km. My mobile setup was an Anytone AT-588 mobile with about 15W to a quarter-wave magmount on the car. It is good to hear that there is a fair amount of activity on 4m FM.

Colin Fawcett G8YIG (Stalybridge, **Fig. 2**) worked a good number of stations during the UK Activity Contest, including G8DMU/P (IO94), G0CER (IO82), G4FZN/P (IO94), G3TDH (IO83), G4HGT/P (IO93), G4JLG (IO83), GW4ZAR (IO83), G4NTY (IO83) and G8REQ (IO83).

Dave Thorpe G4FKI (Ampthill) writes to say that he now has an NoV for an Echolink Gateway/Simplex repeater with the callsign MB7ADT located at IO92SA on 70.3625MHz with a 77Hz CTCSS tone. The gateway is often linked to the 2m gateway at the same location. Dave would welcome any reports.

The 2m Band

Gordon GW6TEO found it hard to leave the tower up during February and March, owing to what seemed like a continual barrage of Atlantic storms! However, at the end of February, Gordon worked IK0BZY (JN61) using JTMS and IV3GTH (JN65) on FSK441. On 3 March, Gordon participated in the FT8 Activity contest although had some problems with his PC, so only used Search and Pounce mode. His best DX was MM0OKG (IO86). At the start of March Gordon caught some tropo, with the best DX being ON1WFF (JO11). On 9 March, Gordon tried some meteor scatter again, working S51AT (JN75), IK3VZO (JN55) and OK1DSZ (JN99). Later in the month around 21/22 March Gordon caught some tropo to the south, with the best DX being F5DYD/P (JN03) and three EA stations in IN83 and IN93.

It was nice to hear from **Ian Bontoft G4ELW** (Bridgwater) following a QSO we had on 29 March on FT8. Ian had made a QSO into the Calais area using 15W into a V-2000 from his QTH, which is 600mm (note the units!) ASL on the Somerset levels. Ian says he's hoping to retire in 12 months' time and perhaps spend a bit more time on the radio.

Jef Van Raepenbusch ON8NT (Aalter) listed stations worked over 400km during March. All were on FT8: G0LTG (IO81), M0WYB (IO81), EA2XR (IN83), F1NCZ (JN15), GB3RS (IO91), GW8ASD (IO83), G6WRW (IO82), G8EEM (IO93) and M0BKV (IO70).

Simon G6AHX took part in the April UK Activity Contest and says it was great to have the portable stations back on the band. Simon's best DX was GM3SEK (IO74) at a distance of 338km.

Highlights of Tony G4NBS's FT8 log include 46 QSOs in 22 locators during the RSGB/EU activity on 2 March, with GM3POI (IO88) being a very nice contact. On 4 March, Tony worked several French stations in JN09 with DLs in JO30/31/32. On 5 March, Tony worked GM3POI again as well as GM4FVM (IO85).

During the UK Activity contest on 2 March, Tony worked 15 stations on FM, mostly in IO83/IO93 but also G4RRA (IO80). During the SSB event, the notable contacts were GD1MIP, GD8EXI, GD0AMD/P, GI4SNA, GM3SEK, GM4JTJ, F1CBC (JN09), F1MKG (JN08), PE1EWR and PA5Y. Tony says that the event on 6 April was one to forget, despite the return of portable stations, although he managed aircraft scatter with GM4BYF (IO85), GM3SEK (IO74), GI4SNA (IO64) and GI6ATZ (IO74). PA5Y and PE1EWR were both worked, but were weaker than usual.

Highlights of the 2m FT8 log at GW4VXE include EI8FHB (IO52), GI4SJQ (IO64), GD3YEO (IO74), EI9JA (IO53), GM4FVM (IO85) – new square, thanks Jim, MM3DDQ (IO75), F6EGD (IN88), F6APE (IN97), F6HRO (IN88), F6CIS (IN94), EA2XR (IN83), EA1SA (IN71), EB1FNS (IN73), F5APQ (JO00), F1OIL (JO00), F4FWT (JO00), F4EMG (JO00), PA8KM (JO32), PD7RF (JO22), DJ9ON (JO32), DF0MU (JO32), EA1UR (IN53), EA1M (IN53), F6DBI (IN88) and F4HRD (JO00). There were also some nice FM QSOs with EI6GVB, EI2HI and EI2IAB during the tropo on 2 April. It's always good to be the first QSO in a newly licensed station's log and it was a real pleasure to be the first QSO for **Imogen Wright MW7IMO** and also **Will Brooks 2W0NFT** – congratulations to you both on your new licences!

The 70cm Band

Jef ON8NT took part in the 70cm contest on 7 March, working F5FL (JN19) and G4ODA (IO92) both on SSB.

Tony G4NBS enjoys the 70cm FT8 EU activity and says the events need publicising. Take a look at: **www.ft8activity.eu/index.php/en**

The March event saw poorer activity, Tony thought, but April better, when he worked 50 QSOs in 22 locators. Best DX were DL5EBS (JO31) DL1KDA (JO30), ON5AEN (JO10) and ON4BCV (JO21). During the UK Activity Contest in March, Tony felt conditions were above average with 12 stations worked on FM. Tony was pleased to work GJ8CEY, only the second time that Tony has worked Jersey on the band since a QSO with GJ4ICD back in 1985! GM4BYF was a struggle on CW, but the QSO was completed – also GD8EXI and GI6ATZ with 'usual' signals. From the continent, F1BHL/P (IN99), F1CBC (JN09), F1MKG (JN08), F4HRD (JO00), PA5Y and PE1EWR were worked. For the 13 April event, Tony felt that conditions were poorer than average with aircraft scatter needed to complete contacts that would normally be 'straightforward tropo'. A highlight was working DL2GWZ/P (JN49) on CW, which started out as an aircraft scatter sked. They missed the plane but completed a very weak tropo QSO at a distance of 672km.

The 23cm Band

Roger Greengrass EI8KN (Co Waterford) wrote to say that he had his first aircraft scatter QSO using the new Q65 mode on the 23cm band on 19 March, **Fig. 3**. Roger worked **Steve G4HSK** (JO01) using sub-mode A and 15 second periods over a distance of 534km. Steve was running 12.5W to a 67-element WIMO antenna and Roger was running 10W to a 44-element WIMO antenna.

Both stations were running the AirScout software and the QSO was achieved fairly easily with the benefit of a large aircraft on the path. A second QSO was made a few minutes later, using a different aircraft.

Satellites

Jef ON8NT heard the ARISS contact on 22 March at 1827UTC with good signals from the ISS. Jef also notes an article in the AMSAT-EA newsletter from **Carlos EA3HAH** about using digital modes such as FT4 on linear transponders. The satellites used were XW-2A/F, CAS-4A/CAS-4B and RS-44. Jef says you can read more in the AMSAT-EA newsletters (below) – scroll down the page to see the English versions.

https://tinyurl.com/7kn8f9bw

Kevin Hewitt ZB2GI also monitored the same ARISS contact as Jef. Kev has also been taking advantage of the reappearance of the AO-91 satellite. Although the satellite is not in great shape, with the transponder switching off and on during a pass, it is usable in daylight hours only. Please do not try to use it when your station is in darkness because this will deplete the already damaged batteries and hasten the satellite's demise. Kevin listed some nice QSOs through AO-91, including EB3SA (JN11), G0ABI (IO80), 2E1EBX (JO02), OH5LK (KP30), F5RRO (JN18), CT2HUU (IN51), DL4EA (JN48) and M0NPT (IO92). Kevin says that he has also heard 6W1TA calling CQ shortly after AOS on a westerly pass, but unfortunately has not managed a QSO so far.

Patrick Stoddard WD9EWK (Phoenix) writes his update on the satellite scene in North America, "*As springtime has started, more are getting out to work satellites all over North America. **Tyler WL7T** made a trip to the southeastern US, including the rare grid EL58 near Louisiana, and made many satellite operators happy. **Jim ND9M** is now operating from a US Navy cargo ship, sailing from Florida to Guam via the Panama Canal. Jim is experienced at working satellites from ships, having done this in the 2000s and 2010s, and serves as the communications officer on these voyages. In international waters, Jim will operate as ND9M/MM. With an International Amateur Radio Permit (IARP) in hand, he will operate as HP/ND9M/MM while sailing through the Panama Canal on 18 April. Now, as in the past, ND9M/MM operates from the helicopter deck behind the bridge, a nice open area for satellite work. When near population centers, ND9M/MM has also been heard making terrestrial contacts on 6m, 2m, and 70cm from the rare grids he was in.*

*"At the end of March, I made a day-trip out to the Glamis sand dunes in southeastern California. This section of desert is a recreational area used by off-road vehicles of all sorts, and has been used in movies like Return of the Jedi. The US Marine Corps also does training of its ground and air forces in the area. Marine helicopters were flying around while I was out there. The town of Glamis is at the DM22/DM23 grid boundary, **Fig. 4**, which was my destination for a day of satellite operating. Working FM, SSB, and packet (ISS, FalconSat-3), I spent a Saturday afternoon on bunches of satellite passes. I had never been in this part of California, and the weather was cooperative with temperatures around 25°C/77°F in the afternoon. In the middle of summertime, the temperatures in this part of the desert are usually around 50°C/122°F. I used an Icom ID-5100 mobile radio for the FM satellite passes, the combination of a Yaesu FT-817ND and an Icom IC-R30 receiver for the SSB passes, and two Kenwood handheld radios for the packet activity (TH-D72 for FalconSat-3, and TH-D74 for the ISS digipeater)."*

Here at GW4VXE, I've enjoyed working AO-91 again with some highlights in the log being VE1VOX, VE1CWJ, N1AIA, KB1HY and RA3LDP.

DATV

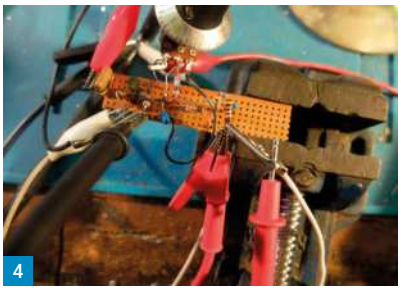
Graham Jones G3VKV (Cheltenham) writes, "*After having received **Dave G4FRE**'s digital TV on eight bands last year (146.5MHz to 24GHz) over the 30km path from Cheltenham to Malvern from our home QTHs we thought it was about time we did it both ways.*

*"In the last few months we managed to complete seven bands even though there are trees in the way. The best was 13cm at a quality of 4MS/s, but the hardest was 6cm as we were beaming through windows and I only had 1.8W, **Fig. 5**.*

"We still have got 24GHz to achieve as I have not finished building the PA, which should produce a watt or so of video to a 36dB Flann lens horn antenna."

That's it for this month! Thanks to everyone who has contributed to the column. Hopefully next month, there will be the first of the Es contacts to report.

Continued from page 24



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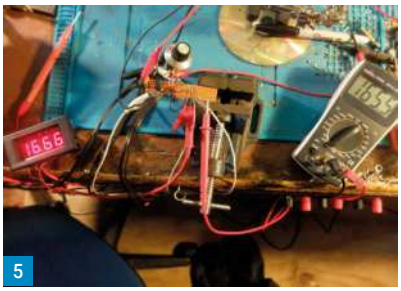

5

Plotting the response from measurements with my oscilloscope, I found a large peak at 4MHz fading away to a very low response by 10MHz. I built one, which worked quite well, but was perhaps too unsophisticated. The output is sent to a digital testmeter, which can resolve down to three decimal places, ie 1 millivolt, without loading the circuit and giving erroneous results.

Mr Byrne's RF Millivolt meter from the website below is only slightly more complex, using a 2N3819 FET, for the high impedance input, which works like a charm. My Thandar TG102 is specified (when new) at 60mV output at maximum. I got 64mV at the first attempt on 1MHz, verified by two digital meters and my Advance VM78.

The level was checked with Mini-Circuits coaxial attenuators and the Thandar's internal provision. The specified multiturn potentiometer is not frivolous, the adjustment is very tricky if a normal preset potentiometer is used. The response was level-ish up to 10MHz, beyond which I did not proceed, and both RMS and Peak values are obtained, from different parts of the circuit. NB: These figures are from the manual, and are the case when new. Older equipment may be out of calibration, or otherwise not conforming to published specifications.

www.zen.22142.zen.co.uk

When testing, I used my bench DMM, a Sparkfun DC830L and the millivolt DMM described above and which I built from a kit featured on Amazon and eBay, ILS – ICL7107 Voltmeter.

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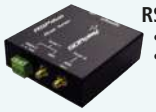

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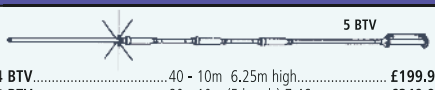

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• Gain: averages 11.24 dBi
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Getting Started (Part XI)

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

Colin Redwood G6MXL introduces readers to Club Log and QRZ.COM. Club Log is a useful tool for those chasing DX and for requesting QSL cards, while QRZ.COM can provide information about stations you contact.

Club Log is an internet-based system that can be used to track countries, bands and modes worked and confirmed. It also enables you to request QSL cards without the need to send one. It is used by over 52,000 amateurs with over 84,000 callsigns worldwide.

Registration

The registration process for Club Log is very straightforward, **Fig. 1**. You only need to register once, no matter how many callsigns you have – just follow the instructions. Visit: www.Clublog.org

Callsigns

Once you have registered, you can then set up your main and other callsigns you use (I initially set up G6MXL and G6MXL/P). You can link callsigns for the same DXCC. This could be very useful if you have upgraded your licence from Foundation to Intermediate or operate portable for example, **Fig. 2**.

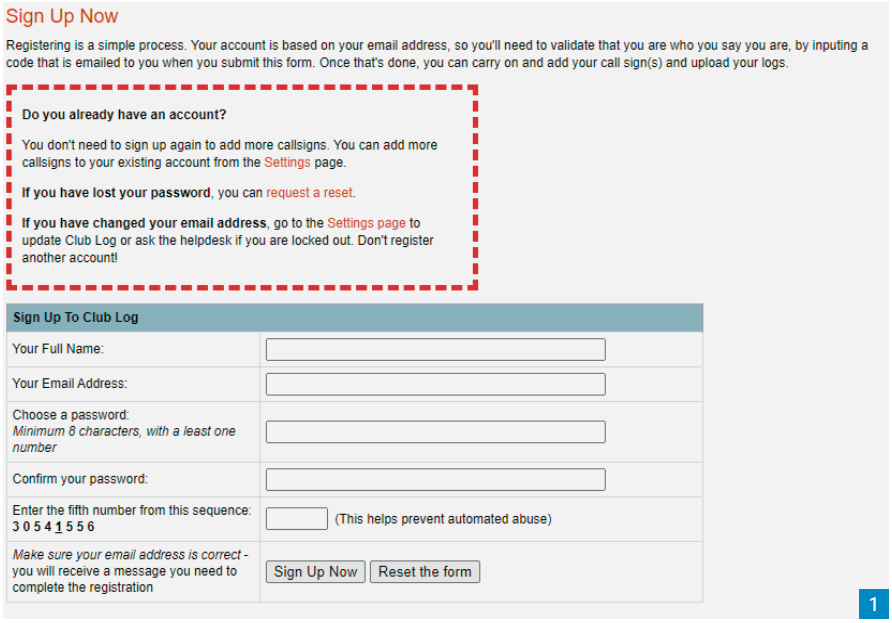
If you have operated from another DXCC (such as other countries or other parts of the British Isles), you can add these callsigns to your email address but note that these are rightly not linked for DXCC scoring purposes.

Uploading Logs

Once you have registered you can upload your logs in ADIF (.adi) format, **Fig. 3**. This is a very straightforward process. At busy times, it may take a while before an uploaded log is visible. Club Log is aware of the DXCC of many special event callsigns in the GB series. It is also aware of the DXCC of other callsigns that might otherwise be ambiguous such as VP8 callsigns, which can be from one of several DXCC countries (**Alan 5B4AHJ**, ex-G3PMR, puts a huge amount of work into maintaining this valuable database). This is particularly helpful if you weren't sure of the DXCC of a particular station when you worked them.

Limitations

There are some limitations to Club Log. The bands available exclude microwave bands above 13cm. Club Log only supports one locator per callsign. Although this is a bit of a drawback, if you operate from multiple locations in the same DXCC entity, I don't see this as a major drawback for most operators because Club Log is really about recording progress towards DXCC and beyond.



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League Tables

You can choose to indicate which clubs you are a member of (e.g. RSGB, UKSMG, G-QRP) so that you can see how you are doing in a DX league for the club. You'll need to find ten members of your club already using Club Log in order to get your club registered.

Club league tables are only updated once a day, so that it can take a few hours before uploaded logs will be reflected in the league tables. You'll also need to visit the settings area if you want your callsign to be included in the league tables.

Online QSL Request Service

The cost of obtaining paper QSL cards for awards purposes is increasing year on year. An online QSL request service (OQRS) enables amateurs to request a QSL card from a DX station without incurring the cost of sending your QSL card in the first place. Potentially this can also halve the time it takes to get a QSL card, **Fig. 4**.

If you want to offer OQRS through Club Log, then you'll need to visit the OQRS tab. Here you can enable OQRS requests from others (Incoming) and see OQRS requests that you made to other stations. If you decide to accept OQRS requests, you can choose whether to offer to send cards via the bureau or direct. You are permitted to make a small charge for direct.

Other OQRS

Although it is certainly one of the best known and most widely used, it should be noted that Club Log is by no means unique in offering OQRS. Quite often the QSL Manager of large DXpeditions will offer their own OQRS. However, DXpeditions are increasingly using the Club Log OQRS facility. If you work such a DXpedition, you don't even need to be registered on Club Log to take advantage and request a QSL card.

DXCC Charts

Club Log has many embedded tools and facilities. Perhaps the most useful for begin-

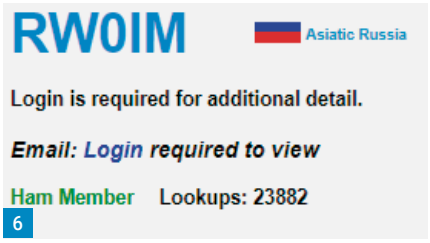

Fig. 1: Registering with Club Log.
Fig. 2: Club Log handles multiple callsigns.
Fig. 3: Uploading a log file to Club Log.
Fig. 4: OQRS enabling a QSL card to be obtained via the bureau. Fig. 5: A Club Log DX chart, showing contacts made with Belgian stations from visits to Wales (GW6MXL/P).
Fig. 6: QRZ.COM Basic information visible of station.

ners are the DXCC charts. You can get an accurate picture of your countries worked and/or confirmed by band, for a particular period such as the current year or 'all-time'. Clicking on a particular band/country combination on the chart will then show all your QSOs with that country on that band, **Fig. 5**.

Data Mining

Other useful features of Club Log come from data mining its database of over 737 million QSOs. Suppose, for example, you are trying to set up a schedule with a friend in Peru. The propagation tool allows you to select England and Peru (in this example), a solar flux number and a month, and it will show actual QSOs in the database by time and band for that path and those parameters. This can be handy in scheduling a QSO or picking the best time and band to catch up with a DXpedition.

DXCluster

Club Log now includes access to the DX Cluster. I'll look at DX Clusters in general in a future *What Next* column.

Downloading Your Log

You can download your log from Club Log at any time, which means that if, for example, you suffer a computer crash and lose your computer log, Club Log is there as your back up (excluding the higher microwave bands) as long as you have uploaded your logs to it. Hopefully, you'll not need this facility too often!

Integration

Many of the more sophisticated logging programs such as Log4OM now include a facility to upload each QSO to Club Log as you log it. I'll look at Log4OM in a future *What Next*? You can also upload adi files of confirmed contacts from Logbook of the World (LoTW) into Club Log. I looked at LoTW in the November 2020 issue of *PW*.

Other Tools

Club Log offers several other useful facilities, such as downloading from LoTW your confirmed contacts, printing QSL labels for sending physical QSL cards, and much more. There is lots of online help available as well as volunteers who can deal with one-off queries not covered in the help files. You can also embed your log from Club Log into your callsign page on QRZ.COM (below).

QRZ.COM

Many readers will have heard QRZ.COM (not to be confused with QRZCQ.COM) mentioned on air or during a discussion with other amateurs. QRZ.COM is arguably the most comprehensive international callbook on the internet. Without doing anything more than just typing in a callsign, you can see some very basic information about the station in question, **Fig. 6**. To see more information, you'll need to register with QRZ.COM.

www.qrz.com

Registering with QRZ.COM

The way you register with QRZ.COM has changed over the years. The important thing to note is that if you have more than one callsign, perhaps a Foundation and Intermediate, or you intend to operate in another part of the UK or elsewhere, you need only register once, and then add additional callsigns as needed.

To register your first callsign, you'll need to enter your callsign and email address. The administrators will then contact you to request some further information (your first and last name, town and country). The administrators then create a basic record, which you will need to activate. More information can be found at:

https://tinyurl.com/kxjr25hb

Additional Information

Most amateurs add information regarding their preferred arrangements for QSLing such as whether they QSL by post, eQSL or LoTW. If you use a QSL manager, then it is a good idea to provide the relevant callsign. If you don't wish to send and receive QSL cards, it is helpful to clearly state so. I would also suggest checking and updating other information such as your IARU locator, Islands on the Air (IOTA) reference (it is EU-005 for mainland Great Britain) and perhaps adding your WAB (Worked All Britain) square, etc.

More Information

Once you have registered with QRZ.COM, you can enter a callsign of another station, **Fig. 7**, and see much more information about the station than you could see before

registering. In most cases you'll see the station's full address, other information such as their email address, and in some cases pictures about the station that they have chosen to add.

The accuracy of geographical information about other stations depends on whether they have provided the information and kept it up-to-date. If they haven't entered anything, then locators, bearings, distances and so on are likely to be generic for the country. As a 'basic' user, there are no charges for using QRZ.COM, however there is cap on looking up more than 50 callsigns per day.

QRZ.COM Logbook

Besides being a callbook (for which it is rightly well known), QRZ.COM also has a logbook. You can enter details of contacts you have made, individually or by uploading an ADIF file (the same .adi file format that is required for LoTW, eQSL and Club Log). I know of some stations that use the QRZ.COM logbook as their main logbook, **Fig. 8**. Provided you have access to the internet, then you can view and update records to your log. One particular drawback with the new, 3.0 (Beta) version of the logbook facility is that it no longer shows the band unless you pay for one of the QRZ.COM subscriptions – a significant retrograde step in my view. Incidentally, the route to uploading your log is not the most obvious: Your Logbook > Settings.

Matched contacts are shown with a yellow star. You can click on the DX station's callsign in the log to see full details of the contact. You can also edit or delete details of the contact.

Other Callsigns

If you operate or have operated using another callsign, perhaps using a previous Intermediate or Foundation callsign, or from another part of the British Isles, portable or from another country (DXCC), then you'll need to register these callsigns with QRZ.COM. When you upload contacts by .adi file, you'll need to be careful to select the appropriate callsign's logbook that logged contacts are to be added to.

Subscription

There are no fees to join and use the basic functionality of QRZ.COM (including the logbook). A number of subscriptions are available, which enable such things as unlimited daily look ups, exporting your QRZ.COM log, lookups without the adverts, and XML integration with a number of popular logging programs. Subscriptions range in price from US$29.95 per annum up to US$995 for a lifetime subscription, which can be paid in US$250 annual instalments.

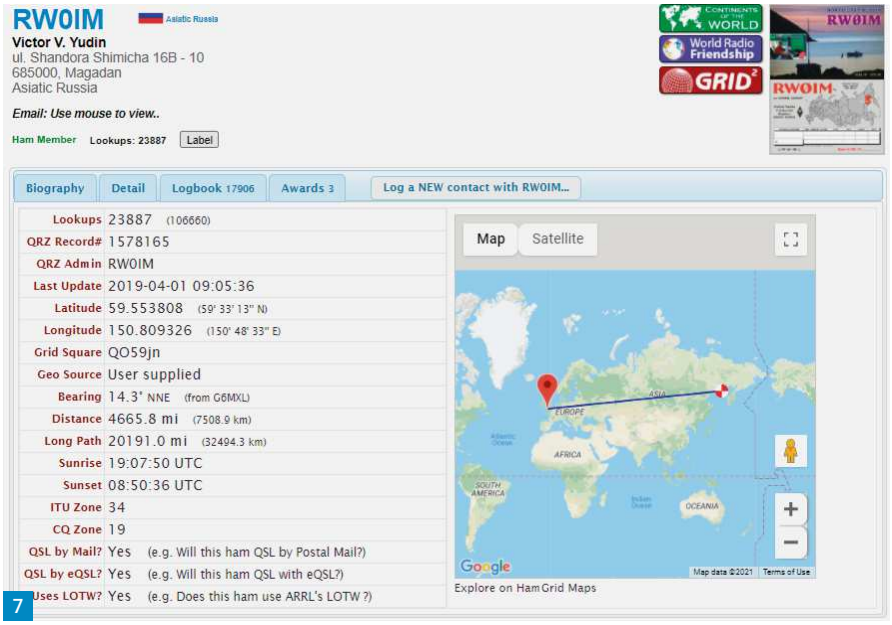

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Fig. 7: QRZ.COM Detailed information visible once registered and logged on.
Fig. 8: The logbook in QRZ.COM.

QRZ.COM Awards

QRZ.COM has a range of awards. These are automatically awarded based on cross-referenced logs. Your awards are shown on your QRZ.COM page at no charge. You have the option to purchase certificates at US$24.94 each. Discounts are available for those who subscribe.

Other Features

QRZ.COM has a number of other features, including an international swap meet to sell surplus equipment (but beware of possible scams), international amateur radio news and propagation predictions. The latter two bring together information that is readily available elsewhere.

Conclusions

Logbook of the World, eQSL, Club Log and QRZ.COM, all have something to offer. None of them is all encompassing. If you have log files available in .adi format, I think it makes sense to load your contacts to each of them.

By doing so, you are not only helping yourself towards a range of awards, but also doing the same for your fellow radio amateurs worldwide.

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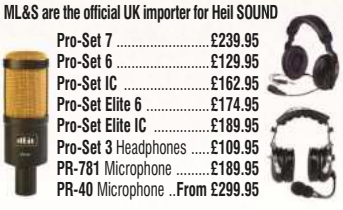

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The Transportable Small Station

Joe Chester M1MWD plans a contest operation to try out his QRP mobile setup.

Joe Chester M1MWD
m1mwd@gmx.com

Of course, you are right. It may be a long time before it actually reaches our shores. But I can be patient. At least for a while, anyway. What am I talking about? The latest and greatest in transceivers, that's what I'm on about. Last month I explained my reasoning, so if you want the details read last month's piece. You may disagree with my conclusions, but each to their own, as they say. So, the wait continues. (Yes, I'm talking about the Elecraft K4, which holds great promise but is taking its time to be produced in quantity. And, to put you out of your misery, the three back panels shown last month were the FTdx101D, the FTdx10 and the Elecraft K4).

ARRL Contest

Meantime, there is a contest this weekend – the annual ARRL SSB contest, which some would probably agree is one of the biggest. Yeah, I told you before, many times in fact, that I am not a contester. But I am interested in this one for several reasons. One of these is my annual '59 73' with my friend Tom (you know of whom I speak), and the chance to work stateside when there are lots of US stations on the air.

For the past few years, I have been making this contest more and more difficult for myself. Just for fun. I started off a few years ago with 100W, then moved into QRP range with 10W, and then tried 5W although, to be fair, this latter didn't work very well. This year, I've decided to set the bar even higher – or maybe not! Read on.

You will be aware that I favour portable operations. This gets me away from the man-made noise sources all around me, and it also gets me out of the 'house', so to speak. A fine Spring day, jump in the car, pull into a nice spot, maybe by a river, set up my small station and see what happens. I have not done /M operations for maybe 30 years, most of my life as an amateur radio operator. I did look at this quite recently, but apart from the need to drill holes in the new car, I'm less than certain that driving on UK roads while operating an amateur radio station is a very good idea. Others may have a different view. There isn't a mobile transceiver (yet) that can be operated by means of a digital voice assistant (such as Siri). But this does not mean that it is impossible to operate from a car. And this is what I am planning to do for the ARRL SSB contest.

Of course, I have to deal with the Covid restrictions, which right now basically say 'stay home', unless there is one of the permitted reasons to leave home, and amateur radio operating isn't one of these. But my home is by a riverbank, and there is a large car park here, with few cars in it due to the restrictions. What's more it's surrounded on three sides by the river. Think about the take-off! So, my plan is to set up my small station in the car, using my KX3, running off its Zippy battery, and using my AX1 antenna fixed to the car's roof rail. The counterpoise can just drop down to the ground beside the car. I decided I didn't just want the KX3 thrown on the passenger seat, so I invested in several RAM Mount components. The Ram-a-Can base means no modifications are needed to the car; it just squeezes into the elbow rest cup holder, **Fig. 1**. There is a floor mount too, which slides under the passenger seat bolt, but I decided against this basically because I was worried about vibration through the stalk to the transceiver. And because I'm effectively at home, right beside my barge/houseboat, I won't even be breaking the RSGB rules about portable operations. Here's a picture of the setup, **Fig. 2**; you can just see the pontoon poles in the background.

1

Fig. 1: The RAM mount for the KX3.
Fig. 2: The AX1 gutter mount.

ICNIRP

And, finally, there is ICNIRP. Yeah, I know the new OFCOM regulation has not been implemented yet, but I thought I'd see what

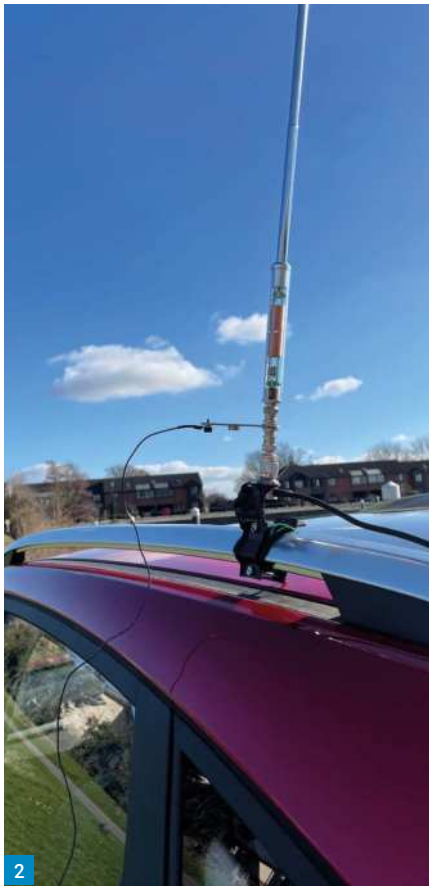
if any difference this requirement would make for this particular adventure. I have enquired widely and seen the barrage of emails circulating. I'm obliged to one particular net denizen who advised that it was too early to understand what exactly the impact of the new regulation might have on our operations. This does seem to me to be sensible advice. And I'm also aware of what seems to be the general understanding that QRP operations are very unlikely to breach the new rules. This is from the OFCOM website:

"6.5 This assessment can be very simple. For example, spectrum users can comply with the EMF condition if: a) Their radio equipment never transmits above 10W EIRP (6.1W ERP). For example, radio equipment may not be capable of transmitting above 10W EIRP (6.1W ERP) or it may be set-up or installed in a way which means it cannot transmit above 10W EIRP (6.1W ERP)."

I'm grateful to **Dave G3YMC** for mentioning this on the G-QRP mailing list. So, for now, I will take this as my default position – this expedition, all the way to the car park (!), will be using QRP power levels, and the car park is empty. If anyone comes close, then it will probably be someone I know, just curious about what I have up on the roof of the car. Which means I won't actually be transmitting while I speak with whoever this might be. So, tick that box, and move on. For now.

I tried this setup out last Sunday. It worked surprisingly well. I heard lots of Europeans and even a few US stations. However, there was a contest on, and the strongest on-air were only interested in French stations, although I heard several *"only France station"* comments! So, I know I was getting out!

Now you might ask why not just operate from home? After nearly a year and a half of shielding and self-isolation, I need to get out. Everyone does. And I recently had my jab, so I have some sort of resistance. I still plan to stay safe, so I'm not inviting the neighbours, or anyone else to visit to see this. And there is a good solid radio reason for this as well. Lockdown won't last forever, even if some sort of restrictions do (like wearing a mask in the shops). So, it's time to start planning. And part of every plan is bringing my radio station along. And now is a good time to see how to set this up, so that I can, for instance, roll into a motorway service station, grab a coffee and a sticky bun, and, while enjoying those, mount my little AX1 on the roof rail and see who's on the air. And knowing me as you do, this is only a glimpse of what I'm going to do next!



2

Antennas

The AX1 fits nicely on the roof rail mounting, but I wouldn't dream of driving down the M5 with it up. It is also limited to 20m, 17m, and 15m. There is another base-loaded coil for 40m (which I also have). But what do I do about 80m? Those fibreglass rod-type antennas would work, but I prefer a whip type. Anyone any ideas? And while I'm at it, what about 2m? There is a 2m board that fits inside the KX3 (with difficulty I'm told by those with more experience of this modification). Also, it's very low power, a few watts. But here's the thing; once installed it produces one of the things I have been on about for many a year now – a 2m multimode transceiver small enough to take out portable. So, I've now ordered this add-on board. As none of the UK suppliers had one available, it has to come from abroad, so it's anyone's guess when it will arrive.

It will need a 2m antenna, but steady on – this is not about mobile operation. So, I think that part of my transportable small station might to involve a small 2m beam, with associated mounting pole and probably an under-wheel mounting plate, or even a tripod mount. And while I'm at it, what about 6m? A vertical would be easy, and something like a 6m two-element beam? I should also mention that one of the lumps of kit lying idle here at present is a full Buddipole kit of coils, arms and other associated parts. With this, I can build beams for 2m, 6m, and even for 10m and 12m! Imagine, sitting in the car operating QRP with a 10m beam!

So as usual with this hobby (I wanted to write affliction but wasn't sure **Don** would let me get away with it!), I set out to have a small bit of fun next weekend, and a major project has now unfolded. To give this project a name, I've decided on the Transportable Small Station. And, of course, there are many, many further add-ons in the potential pipeline. My friend **Kim M0KNV**, the RTTY King, suggested I might need an amplifier to go with that 2m add-on modification. Indeed. I once owned a beautiful Microwave Module's 100W linear, which seems to have gotten lost somewhere along the way (if you find it, please let me know!). Yeah maybe, Kim. But there is also the problem of the well known limitations of 10W on 80m to be solved, if I can source a suitable antenna. Anyone any ideas? Go on Kim, surely you can do better than that, hihi.

So, to round off, how did I do in the contest? Pretty well, in my opinion. I was set up by about 10:00hrs, and could hear a few Europeans calling CQ. Just to check the equipment, I quickly called IR4K, 9A9A, a big contest station, and **Lui YU5R**. I asked him if he was hearing anything from stateside. He suggested that they weren't out of bed over there yet! I gave it a break for an hour (I do have other things I need to do!), and then worked K1TTT, WX3B, who said 'congratulations' when he heard my 10W report, K3WW and W2MKM in quick succession. Then guess who popped up – that's right, **Tom N1MM**. It was a bit difficult due to the QSB, but we made the contest exchange. After that I worked another 14 stations, including three from Canada. I was hoping to work stations from the US west coast, so I watched the DX cluster waiting for stations from there to appear. But the propagation from over there never reached me. The DX cluster also showed lots of activity on 15m between North and South America, but those signals didn't reach me either. I could have gone on longer, but I felt that I had proved the point I wanted to make. And it was getting dark. The car setup worked well enough to work stations in the US, even with just 10W. My tally of states reads CT, MA, PA, NJ, MD, VT, FL, GA, ON – and WW4LL, GA was a new state for me. Not a bad afternoon's work on-air!

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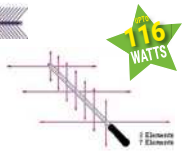

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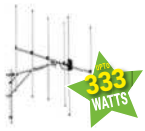

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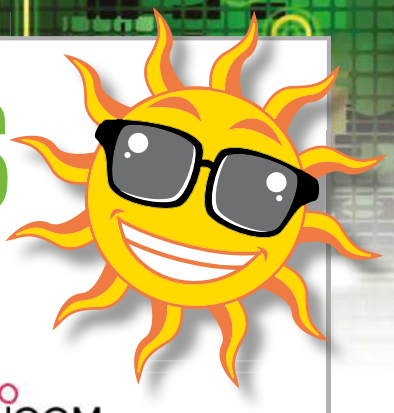

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Steve Telenius-Lowe PJ4DX
Eva Telenius-Lowe PJ4EVA
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An Absolute Beginner's Guide to FT8 (Part II)

Steve and **Eva Telenius-Lowe, PJ4DX** and **PJ4EVA** describe ways of speeding up your digimode QSOs.

In Part 1 last month we looked at the set up and making a basic QSO using FT8. This time we look at some FT8 operating tips and at ways of speeding up your digimode contacts.

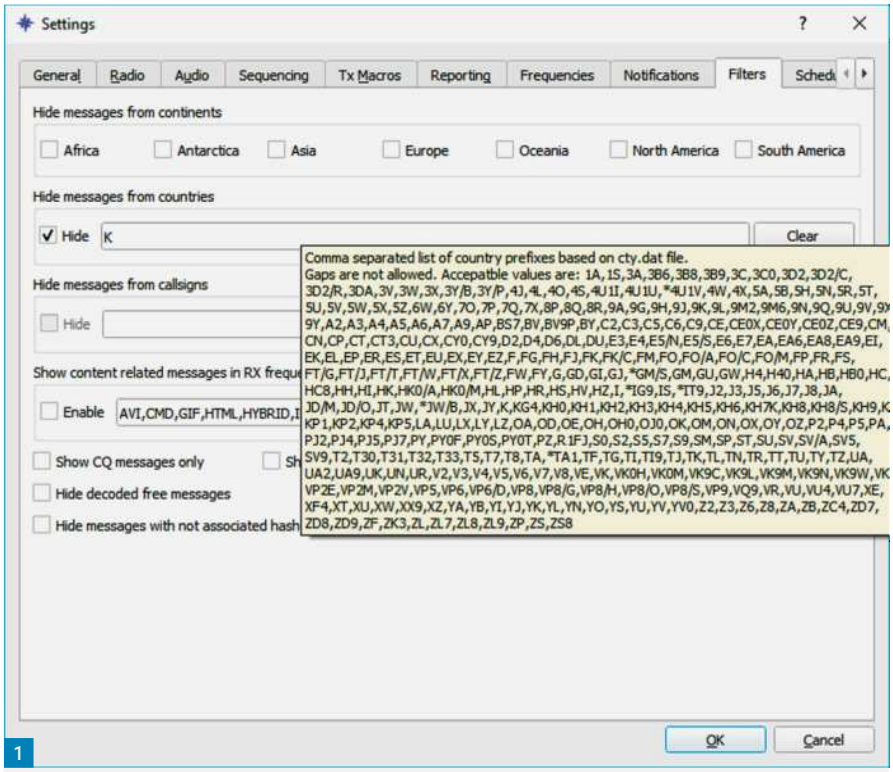
With its capability of decoding signals down to –21dB or better, FT8 was designed with DXing in mind. Although some users are happy to exchange callsigns and signal-to-noise ratio reports with local stations or those in nearby countries, most will be keen to exploit its weak-signal capabilities and try some DXing. Even if you only run 5 or 10W to a simple antenna, it should be perfectly possible to make contacts with stations on other continents on a regular basis.

Filtering the DX

On a busy band, such as 20m during the day or 40m in the evening, the number of stations being decoded in each 15-second reception period can seem to be overwhelming. The stations decoded and displayed on the left-hand side of the screen sometimes scroll by so quickly that it's almost impossible to read them, let alone double-click on one in order to call them.

The answer is to filter out the display of many of the stations calling. If for example you are in the UK and looking to work North America you could filter out all European stations by going to File →Settings → Filters and clicking on 'Europe'. You will still see stations in South America, Asia etc, which presumably you would still want to work, but if you really wanted only stations in, say, Oceania displayed you would need to click on Africa, Antarctica, Asia, Europe, North America and South America and then only those stations being decoded from Oceania (if any) would appear on the screen (note that all signals are still being decoded; they are simply not being displayed).

If you wanted to work Caribbean stations but were overwhelmed by the number of USA stations being displayed, you can't filter out North America as that would also stop the very stations you wanted from being displayed. So instead of filtering out the entire continent you can filter out an individual DXCC entity (or several entities) by going to File → Settings → Filters → 'Hide messages from countries' and entering the prefix of the country or countries you wish to be filtered out, in this case 'K' for USA. Hovering the mouse cursor over the entry bar brings up a list of the accepted prefix for each DXCC entity, as shown in **Fig. 1**.



Speeding Up Contacts

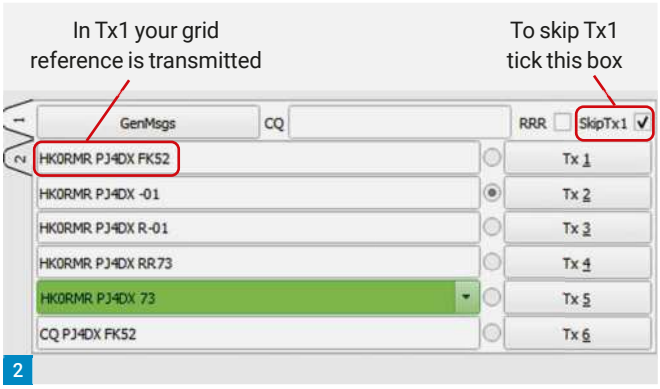
The PJ4DX and PJ4EVA station shares use of an old laptop for FT8 operating. Its processor runs at 1.6GHz and has 4GB of RAM. We have discovered that this is adequate, just, for FT8 but a faster processor and 16 or 32GB of RAM would allow for quicker decodes and decodes down to a lower signal level. But don't let this put you off. If you only have 4GB of RAM and a slow processor, you can still operate FT8 and have a lot of fun.

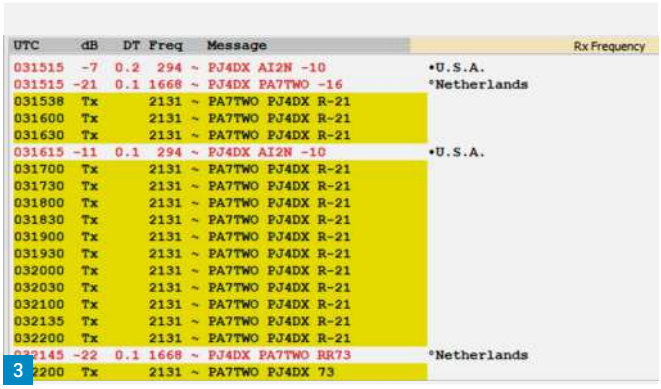
Although FT8 contacts exchange a minimum of information, each contact can seem to take a long time, particularly if fading or interference means that your QSO partner's signal is not decoded for several 15-second reception periods, or if you are not being decoded by him. If you are used to high-speed DXpedition contacts, or contest operating on SSB or CW, FT8 can seem rather like watching paint dry! Short of going out to buy the latest computer with the fastest processor available and loading it with as much RAM as it will take, there are a couple of ways to speed up your data mode contacts. The first is to 'SkipTx1'.

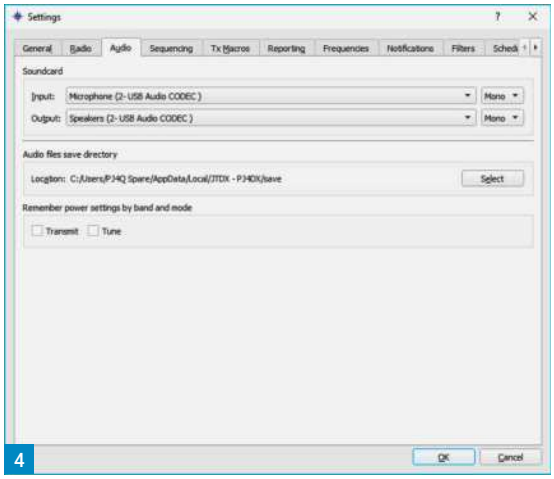
SkipTx1

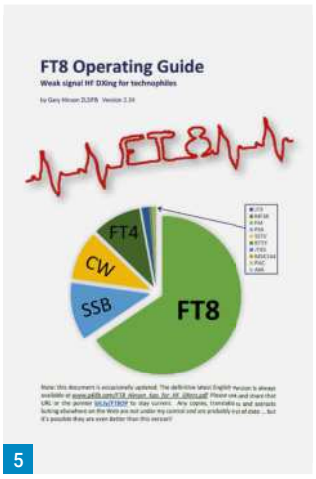
You can see in **Fig. 2** that the first transmission you make when calling a station ('Tx1') consists of his callsign, your callsign and your grid. Most of the time, though, exchanging grid locators is totally unnecessary. After all, you know where your QSO partner is located from their callsign and JTDX displays their DXCC entity.

In JTDX you can forego Tx1 by ticking the 'SkipTx1' box as shown in Fig. 2 and the first transmission you make will then be Tx2, with his call, your call and a report. If both stations have the 'SkipTx1' box









ticked it will speed things up a lot, saving a minimum of 30 seconds from each QSO. If the contact is marginal, with interference or fading making decoding difficult, it could save several minutes from the time taken to complete a contact and in extreme cases it could be the difference between completing the contact and not making it at all (see 'A Difficult QSO' below).

Eva PJ4EVA discovered how useful it is to 'SkipTx1' when one evening she had a 'pipeline' into Japan on 20m and the whole screen filled with JA stations calling her. Each time she worked one station at least two more entered the pile-up. Almost all the Japanese operators called with the report (Tx2) and not the grid, and Eva noticed how much quicker each QSO was. When propagation is good Eva and I often have many stations calling us after a single CQ call. Under those conditions in order to speed things up we now always prioritise answering those stations who call us with our report, rather than with their grid. You're therefore more likely to make a contact with us if you 'SkipTx1' and send our report with your first transmission instead of your grid – and we know that we're not the only people employing this technique.

I suspect the reason grids are included in FT8 is that it is a development of earlier data mode programs originally intended for weak-signal working on VHF, where grid locators are routinely exchanged. On HF, however, they are rarely of interest and their exchange only slows down further what is already a slow mode. (Having said that, there are a few operators who 'collect' grids and I have discovered at least one who goes as far as refusing to respond to those who 'SkipTx1', so *"you pays your money and you takes your choice"*!)

A Difficult QSO

In January I received an email from **Kees PA7TWO** who had decoded me on 160m FT8 and who was requesting a sked. Kees already had 10-band DXCC and had 99 entities confirmed on 160m. Bonaire would be DXCC number 100 on 160m, allowing him to claim 11-band DXCC – quite an achievement – if we were able to make the contact.

I was pleased to help. We tried around my sunset, 2230UTC, but there was no propagation to Europe. Kees agreed to set his alarm for 4:00am local time, 11:00pm my time. Conditions seemed to be good: I worked UA9MA at over 11,600km and ZS1LS at over 10,600km and a new 160m DXCC entity for me. But although Kees later said he was decoding me most of the time, I only received a single decode from him with a report, but no 'R' received: insufficient to claim a two-way QSO. After trying for over 30 minutes we gave up.

Kees set his alarm clock for 4:00am the next night, but conditions were well down on the previous night and I was unable to decode any European stations at all.

For the third night in a row Kees was up in the middle of the night and, once again, I received a single decode from him at 0315:15UTC. I responded with my 'R–21' report, but had to send it multiple times before I eventually received the 'RR73' response from Kees at 0321:45UTC, **Fig. 3**, and I could log the contact.

There's dedication for you! But this shows the advantage of not sending your grid with your first transmission, particularly if contacts are as marginal as this. If I had had to receive three separate transmissions from Kees, the QSO may never have been completed.

Fig. 1: Filtering out displayed signals from a specific country. Fig. 2: To speed up FT8 QSOs tick the 'SkipTx1' box and not send your grid reference with your first transmission. Fig. 3: It took no fewer than 14 15-second long transmissions before PJ4DX received the 'RR73' transmission from PA7TWO and thus complete the QSO. Fig. 4: Checking the Settings ➔ Audio screen. Fig. 5: The *FT8 Operating Guide* compiled by Gary Hinson ZL2IFB.

Speedy FT4

The second way of speeding up your digimode contacts is to use FT4 instead of FT8. FT4 is selected by going to 'Mode' at the top of the screen (JT65, WSPR and other modes are also bundled with JTDX).

FT4 is a development of FT8 and the user interface is identical. FT4 is twice as fast. Each transmission and reception period is 7.5s long compared with the 15s of FT8. This seems almost lightning fast if you move straight from FT8 to FT4! While it's possible to multi-task and do other jobs

Fig. 6: Eva PJ4EVA working her favourite mode, FT8.

around the shack while simultaneously making FT8 contacts (though perhaps not recommended), you do need to have your wits about you when operating FT4!

The disadvantage is that FT4 is 3.5dB less sensitive than FT8 (see **Table 1**), so it will always be somewhat less effective for making DX contacts, or when propagation is marginal, or for those with very limited antenna possibilities. A second disadvantage is that there are far fewer users of FT4 compared with FT8, at least for the moment. We have discovered that most FT4 activity is on 40m, where the usual frequency is 7047.5kHz.

Power Levels

Although FT8 is a weak-signal mode, it's not necessarily a QRP-only mode. While it is great for power-restricted licensees such as those with UK Foundation or Intermediate class licences, if your licence allows it, higher power can be used when necessary (though most of the time it isn't).

As an example of how well low power works on FT8, from here in Bonaire working Japan or Korea via the long path on 40m during the winter months is perfectly possible on SSB, but from the PJ4DX station with a 16.5m high dipole it almost always requires the linear amplifier to be run at around 1kW output in order to be copied in the Far East. Yet on FT8, PJ4EVA was working many JA and HL stations on 40m using just 25W output.

When could higher power be used? I would suggest that if you have been trying unsuccessfully for a while to contact a station that you are decoding at a level of –20dB or less, it might be necessary to increase your power somewhat. Typically for marginal paths on 160m higher power may be necessary in order to make the contact. The same probably applies to 6m, though as a newcomer to FT8 I'm still looking forward to the Sporadic E season to give FT8 a try on 'Six'.

If I find I need to run more than about 45W out in order to make an FT8 contact, instead of increasing the transmit power of the transceiver I decrease the transceiver's power output and turn on the linear amplifier. At a drive level of 30W I put out about 300W from the amplifier and since it's rated at 1500W the signal from both the transceiver and the amplifier should be extremely clean at that level. I found I needed to use about 300W to work E51WL on the North Cook Islands on 160m, for example.

...And Finally

And finally, a couple more operating tips that might not be immediately obvious. If you find you have made a mistake and double clicked on the wrong station, perhaps because the left-hand side of the screen was scrolling too quickly for you to place your cursor in the correct position, clicking off 'Enable Tx' to disable your transmission has no effect because your transmission will only finish at the end of the current 15-second transmission period. (And by this time the unwanted station may well have replied to you.) Instead, simply click on 'Halt TX' and your transmission will cease immediately.

If, mysteriously, you find you're no longer decoding anything, and when you click on 'Tune' there is no tone being transmitted, you should check to see if the Soundcard Input and Output settings are correct. You do this by going to File → Settings → Audio. If you connect your transceiver straight to the computer without an interface, the screen should look like **Fig. 4** but in our case occasionally, and for no apparent reason, these settings are lost and, instead of 'USB Audio CODEC', the settings change to 'Default Input (or Output) Device'. If the wanted settings no longer appear in the drop-down menu, close JTDX and after a few seconds re-open it and they should re-appear.

This article has only skimmed the surface of the JTDX program and the capabilities of FT8/FT4. After two months of using these modes I am still learning new things all the time. If this has whetted your appetite and you need more detailed information and operating tips, I can recommend the comprehensive *FT8 Operating Guide*, **Fig. 5**, compiled by **Gary Hinson ZL2IFB**. It is an 81-page PDF and can be downloaded from:

http://bit.ly/FT8OP

As a primarily SSB operator who had never used RTTY, PSK31 or any other data mode before November last year, I must admit to have been somewhat sceptical about FT8 and FT4. However, with over 300 DXCC entities confirmed on SSB or CW but no DXpeditions to new entities available to contact due to the Covid-19 pandemic, I found myself in need of a new operating challenge. FT8 provided that challenge and I am pleased that Eva (shown in **Fig. 6** operating FT8) persuaded me to give it a go. I won't be abandoning SSB and CW but the new data modes have given me something new to 'chase' on the bands, which are otherwise rather quiet. After using FT8 for a couple of months I am finding it strangely addictive!

SSB:	approx +10dB
CW:	–15dB
FT4:	–17.5dB
FT8:	–21dB
WSPR:	–31dB

Table 1: Extract from 'Lowest copiable signal-to-noise ratios in 2.5kHz bandwidth' (source: ZL2IFB's *FT8 Operating Guide*).

Inductors & Inductance (Part II)

Eric Edwards GW8LJJ continues his look at inductance.

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

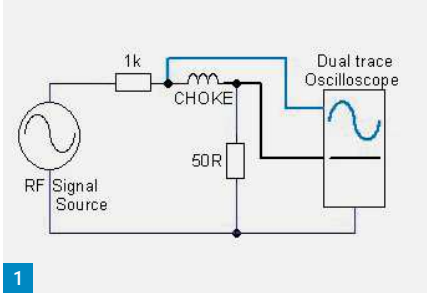
Chokes, Coils and Inductors are all the same components but used in different ways so they are sometimes given the different names. Chokes are so-called because they are used to 'choke' the RF (AC) to stop it passing through the circuit. Coils are wire-wound around a former or self-supporting and are used, for example, in radio transmitter PA 'tank' circuits, and the term Inductor is used when making filters.

Chokes

An inductor placed in series with an AC source blocks or impedes changes in current and functions as a lowpass filter by allowing low frequency and DC to pass through. Because inductors restrict changes in current, they are named 'chokes', and when used as such, the AC (also includes RF) is blocked but to DC it has very low resistance so it passes through an inductor easily.

Let's look at a circuit to show how a choke works, **Fig. 1**. An RF signal generator is connected to a 1kΩ resistor in series with a 4.7µH inductor (choke). At the other end of the inductor is a 50Ω resistor with its far end connected to ground. This is used for terminating the signal. The components used are not critical as it only for showing the effect of the choke. The resistors are ¼ watt types and the inductor is a small low-current type. Some are similar looking and in size to low wattage resistors. Two probes are used on the scope, channel one monitors the input to the choke and channel two is looking at (monitoring) the output of the choke.

The scope timebase for this test is set at 25nS (per division) and both the 'Y' amplifiers are set to 50mV per division. The signal generator output level has been adjusted to provide 150mV peak-to-peak signal seen on channel one. The ground connections of the signal generator and the scope are connected together to provide a common ground. The 50Ω resistor is also connected to this common ground. It can be seen that the signal at channel one on the scope, **Fig. 2**, is much larger than that on channel two. This shows that the AC (RF) is being 'choked' by the inductor and is not able to pass through it.



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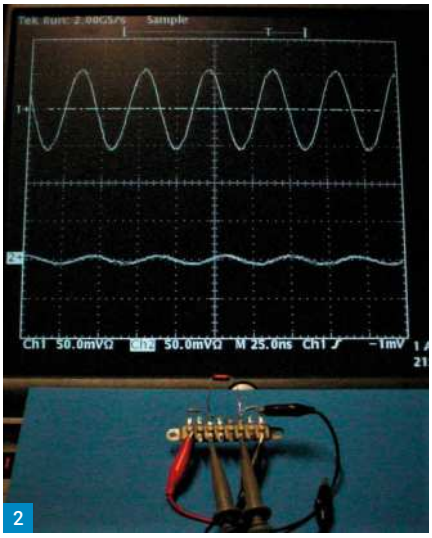
Let's remove the choke, **Fig. 3**. In the photo, it is actually being bypassed with a link so that the signal from the generator is flowing through the 1kΩ resistor and the 50Ω resistor. It can be seen that the signal on channel one on the scope is now at the same level as channel two. The signal is free to travel through the circuit but is reduced in amplitude because of the terminating resistor.

Chokes in Power Supplies

In early high voltage power supplies as used for valve radios and other equipment, a choke was used for removing the AC content at the output of the power supply. In more modern low voltage (linear) power supplies this is no longer the case and a simple resistor/capacitor filter network is used along with voltage regulation. There may very well be exceptions.

To show what happens when a choke is used in a power supply, a test was set up, **Fig. 4**, using a mains transformer with a low voltage secondary rated at 5A output, a bridge rectifier to provide full-wave rectification along with a smaller transformer using the 'mains' primary winding as a choke and the output connected to a reservoir capacitor and a load resistor so that current can be drawn from the power supply. A scope probe is connected to the positive tag of the electrolytic capacitor, which is also connected to the output of the choke. The scope amplitude is set to 0.1V (100mV) and the power supply switched on.

The output is shown on the scope in **Fig. 5** and it can be seen that there is very little AC content. The DC across the electrolytic capacitor is 27V. Placing the scope probe on the input of the choke shows a very large 100Hz AC ripple. The frequency of the AC voltage is 100Hz because it is using a full-wave rectifier (bridge) and is rectifying the positive and negative cycles of the AC wave-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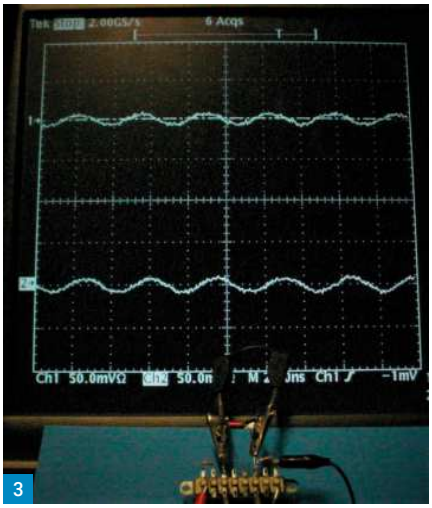
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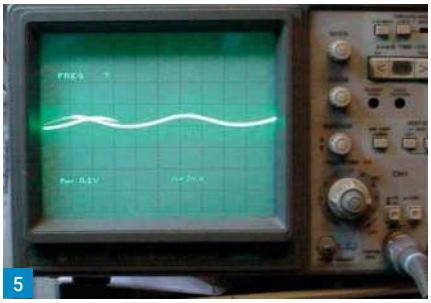
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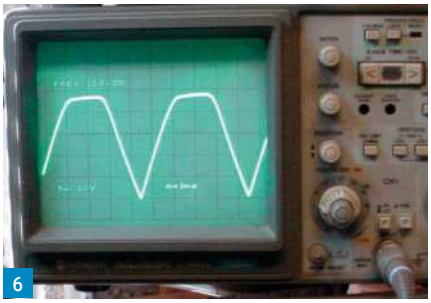
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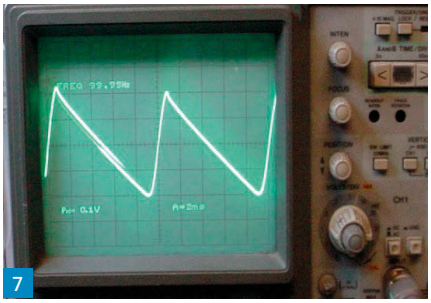
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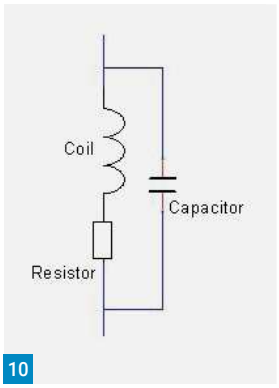

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Fig. 1: Circuit to illustrate the operation of a choke. Fig. 2: Signal on channel 1 much larger than on channel 2 (see text). Fig. 3: As (2) but with the choke removed. Fig. 4: Test to illustrate using a choke in a power supply. Fig. 5: Relatively small AC content superimposed on the DC. Fig. 6: The rectified waveform. Fig. 7: Output with the choke disconnected. Fig. 8: All grey (ferrite) cores. Fig. 9: Coloured (iron) dust cores. Fig. 10: Self resonance is due to the inherent capacitance and resistance in any coil.

form. This is the 'ripple' on the DC voltage after rectification, **Fig. 6**. This 'lumpy' DC, sometimes referred to as 'pulsed' DC, contains a high AC content and needs to be removed for use as a DC power supply. This is achieved with the use of the choke. Normally a high current coil wound on an iron former similar to a transformer but only having one winding suited to the current drawn from the power supply load is used. The AC is blocked from passing through the choke but allows the DC to flow. Disconnecting (bypassing) the choke and with the bridge rectifier now connected directly to the electrolytic capacitor and load resistor with the same settings on the scope, the result is seen in **Fig. 7**. The scope shows an AC waveform at 100Hz and the 'reservoir' electrolytic is charging and discharging but cannot provide a smooth DC output. This has to be done with a lowpass filter (LPF), which in modern linear power supplies normally incorporates a resistor and a 'smoothing' electrolytic capacitor following the reservoir capacitor.

Inductors

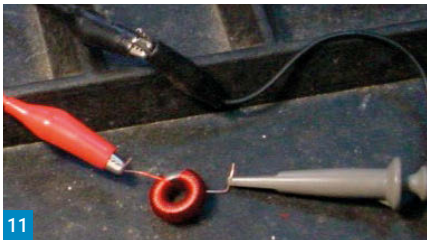
Inductors are coils of wire either self-supporting such as in a transmitter tank (PA) circuit, or wound on insulated tubular formers as once used in the homebrewing of older radios and 'crystal sets'. Inductors are also wound on iron dust or ferrite cores and this increases the inductance far more than when wound on insulated formers. Toroidal ferrite, the all grey, **Fig. 8**, and Iron dust cores, **Fig. 9**, are common in RF circuits. The colours of the iron dust cores indicate the frequency they are to be used with. Some are two-colour types with a main body colour and an underside colour. This under colour is very important, along with the body colour, in determining their use for the required frequency.

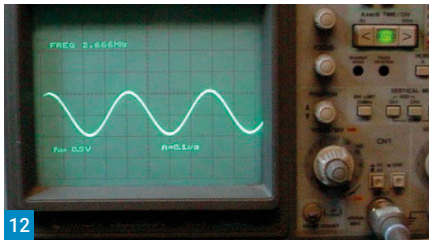
To give an example, a core that is has a red body with a clear (or grey) underside and two inches (200 = 2in) in diameter is a T200-2. 'T' is for Iron Power type whereas 'FT' refers to 'ferrite' types (all grey). The red core with a clear underside has a frequency range of 2MHz to 30MHz. A T200-6, however, has a yellow core with a clear underside and its usable frequency range is 10MHz to 50MHz. Other types are T50-2, which is a core of 0.5in and has the same frequency range as the T200-2 but smaller diameter, which determines the power ratings. A T200, for example, has a power rating of almost 800W whereas a T50 has a 50W (approx) power rating. Other toroids such as T200-6 indicate a 2in diameter core but have a yellow body with a grey or neutral under side. If the underside is white, it will be suitable for audio frequencies and has the dash number 26 so the toroid will be T200-26. RF and audio toroids in the 'T' range are colour coded with the main body colour and an underbody colour. Cores with a blue body and clear underside are type 1. Type 2 is Red with clear underside. A Grey with clear underside is type 3 and the list of types includes 6, 7, 10, 12, 15, 17 and zero. Full information on toroids for use with RF and audio frequencies is available at Amidon on the internet.
www.amidoncorp.com

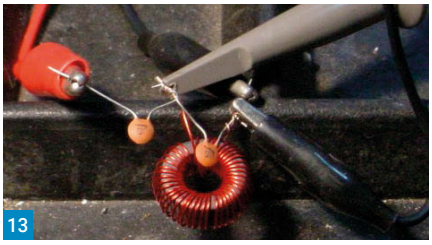
Resonance

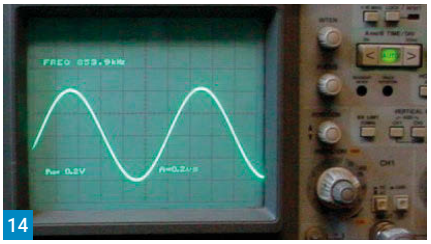
An inductor, as with all things in life, is not perfect and in the early days of radio it was discovered that a coil of wire is not an ideal inductor. At certain frequencies it is at resonance but at higher frequencies, the impedance of the coil is capacitive. Between the windings of the coil it has capacitance, which occurs when two 'plates' are placed close to each other and also when a coil of insulated wire is wound close to each other. It also has resistance (as does any length of wire). This resistance and capacitance are very small but because they are there, self-resonance takes place, **Fig. 10**.

Let's take a coil of insulated copper wire, wind it around a ferrite core and strip the insulation at both ends of the wire. The output of a signal generator set to 100mV and at any frequency in the MHz range is connected at one end of the coil and a scope probe connected at the other. The common (ground) connections of the signal generator and the scope probe are









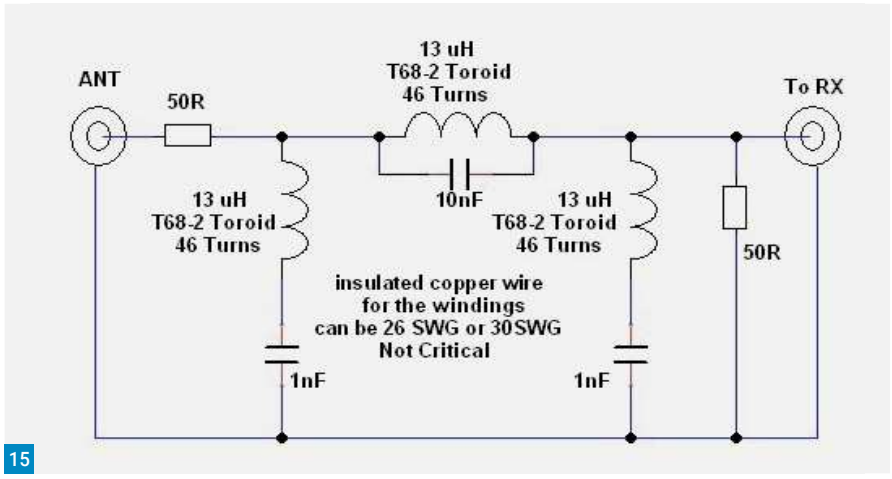


Fig. 11: Ready to measure self-resonance.
Fig. 12: The inductor resonating at 2.66MHz.
Fig. 13: The self-resonant frequency can be changed by adding capacitors.
Fig. 14: The new resonance near 854kHz.
Fig. 15: Circuit of notch filter for MW.
Fig. 16: Characterising the notch filter.

connected together, **Fig. 11**. The frequency of the generator is adjusted until the maximum signal amplitude is shown on the scope. At a frequency of 2.66MHz the signal amplitude is 1V as shown in **Fig. 12**. This is the natural or self-resonance of the inductor and provides an increase from 100mV at the other frequencies, or at 2.66MHz without the coil in circuit, to 1V at its resonant frequency, which is a multiplication factor of 100, or 20dB.

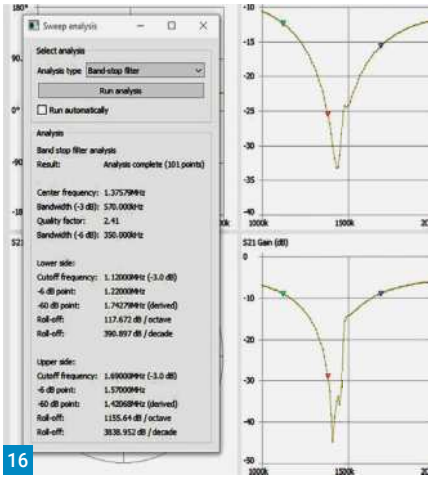
Tuning It

A capacitor can be placed across the inductor used in the last experiment to select a required frequency. A 100pF capacitor is connected in parallel with the inductor but this time the inductor with the capacitor is connected across the signal generator output and with a 100pF capacitor in series with the parallel circuit, so it is now a series/parallel tuned circuit. The other end of the parallel circuit is connected to the common connector (gnd) of the signal generator and the scope probe is connected directly across the parallel tuned circuit, **Fig. 13**. The signal generator dial is rotated until the resonance of the tuned circuit is found. This will be lower in frequency than the previous result. It was at its maximum output on the scope, **Fig. 14**, and is shown to be 800mV (0.8V) at a frequency of very near 854kHz. This is due to the combination of the parallel tuned circuit and the series capacitor. Changing the values of any of the three components will change the resonant frequency. The response is quite sharp and although this is at low frequency the same principle is used at higher (HF) frequencies with a higher value inductor.

Medium Wave Notch Filter

A notch filter is an example of using a combination of series and parallel filters. Making radio receivers with wideband front ends (RF input), such as regenerative and direct conversion receivers, there is a probability of local Medium Wave (MW) stations breaking through onto the HF bands at certain times of the day and night. A filter, **Fig. 15**, to remove, or greatly attenuate, the unwanted stations, was made with insulated copper wire wound onto iron dust cores. This 'Notch Filter' has the desired effect on the MW band with a significant drop of −60dB shown in the table, **Fig. 16**, at 1.4MHz. I connected this filter between the antenna and a Trio TS830 transceiver for test purposes, and could not hear any broadcast stations except one very weak one, which would have been well off scale on the S-meter, while all others were non-existent. Without the filter all broadcast signals were full scale when it suffered the highest MW breakthrough.

It's a simple circuit and I have customised the components to standard values. I used 26SWG wire for the coils but this is not critical. The cores for the 13µH coils are T68-2, which is a 0.68in diameter (68 = 0.68in) red core with grey (or clear) underside. The design is based on a Butterworth filter design and I have kept it as simple possible by using only three poles.



Filters

Filters use various combinations of inductors and capacitors in parallel and series. These are lowpass (LPF), highpass (HPF), bandpass (BPF) and notch (Band Stop) filters. The notch filter has been shown and the others will be described in the final article of 'Inductors and Inductance'.

References

- Elsie: electrical filter design program from Tonne Software.
- NanoVNA: for notch filter measurements.
- Iron and Ferrite Cores: Type Amidon Toroids in a search engine for lots of information.

The Second Stab!

Roger Cooke G3LDI
roger@g3ldi.co.uk

Roger Cooke G3LDI surfaces from his second COVID jab to bring us the latest Morse news.

Call it what you will, I just had my second and it was the dreaded AstraZeneca. I had an adverse effect the first time, aches and pains and the next day felt very sick for a few hours as well. The nurse who 'stabbed' me, when asked if I would suffer the same again, said normally people suffered less the second time. Wow, was she wrong! Aches and pains again evening and morning when I got up around 5am. 7am and I was just about delirious! I was not in control at all, perspiration coming off me like water and I felt awful.

It all lasted about five hours total, so I shall ask for the Pfizer one if I have to be 'processed' again. Hope none of you suffered the same.

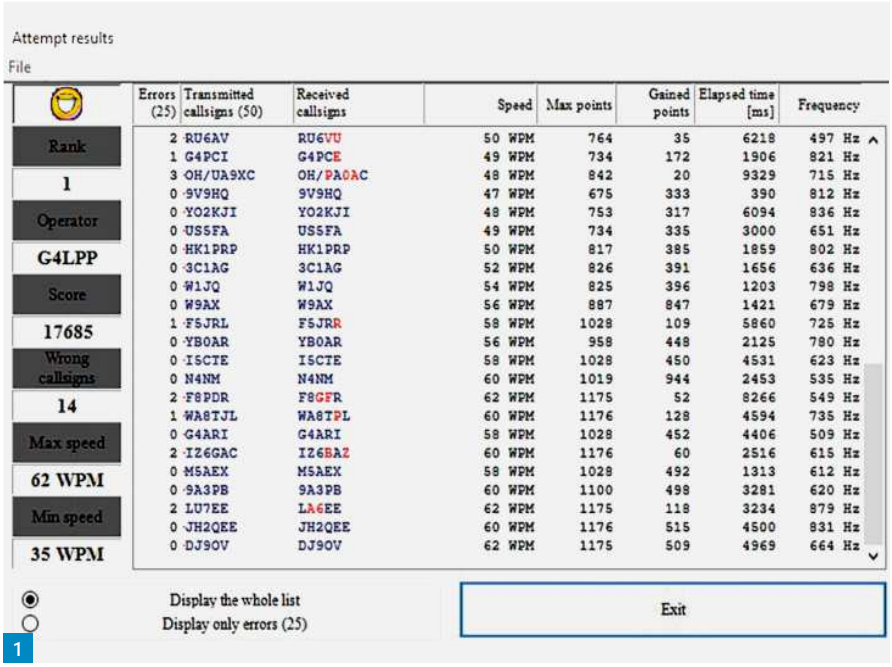
NARC Training

We had a tutor's meeting on Zoom here in Norfolk in which we reorganised our tutorial sessions. People vary with their homework and the practice they do. Some do a lot, some none and there are those in between. To try to cover all cases we are overlapping the classes with the speed ranges and also types of practice. Starting with raw beginners, we then end up with those doing 25 to 30wpm.

We will advise students when they are ready to move into a following class and in doing that we might be able to persuade those left behind to do some more of the Big P word and in that way move themselves on too.

We have also instigated a table of RUFzXP results, and that has produced better results than we had hoped. Ten took part this week and top of the charts was **Phil G4LPP**, **Fig. 1.** Phil must have found the right mojo for RUFzXP because I cannot come anywhere near his score!

Phil moved to Norfolk some three years ago and joined my class then. Since that time he has progressed rapidly, so much so that he has now become a tutor in his own right. Phil takes the Raw Beginners' class on a Friday evening on 145.250MHz and we are trying to encourage our new licensees to join him and start learning CW, **Fig. 2**.



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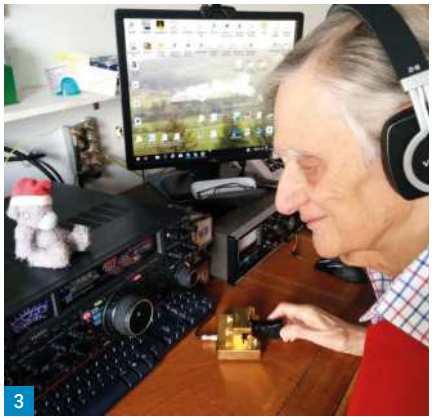
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NARC have a total of six classes in the Norwich area now and are doing quite well with getting new students to join.

NARC Net

The NARC Net takes place on 80m on Monday evenings at 2030 local time on 3.545MHz. We have decided to lower the speed there to 20wpm to encourage more to join in. We also run an SK (Straight Key) night on the last Monday of the month.

You may have heard us on there at some time. The net usually goes on for about an hour or so.

I received no input on Net protocol following my request from last time so I assume nobody uses anything out of the ordinary. We are, however, now taking turns at the role of Net Controller

Fig. 1: G4LPP achieves 62wpm on RUFzXP.
Fig. 2: G4LPP runs a tutor session on 145.250MHz.
Fig. 3: Victor operating with his Begali key.
Fig. 4: Victor G3JNB's straight keys

to enable everybody to take on the responsibility of running a Net.

Victor Brand G3JNB

Victor kindly sent me some pictures for the NARC Morse Key directory and having seen that he has recently gone to QRP only, I thought I would share these keys in the column, **Fig. 4**.

Strangely enough the smaller of the straight keys is the same as one I found in my workshop when I was clearing out some boxes one day. The picture shows Victor operating his Begali Magnetic, **Fig. 3**.

Victor says: *"Mounted on wooden plinths, the larger of the ex-WD keys is my original one, bought for a shilling from the famous Proops Brothers in Kingston 70 years ago to learn Morse. Its baby brother I acquired some 40 years ago for QRP and portable work. Both still do occasional duty.*

"The gold 'Begali Magnetic' (an absolute dream to use) keys the FT-2000 for DXing and the venerable Sampson ETM-8C memory keyer operates the FT-818 or my delightful Heathkit HW8 QRP rig."

73 and May the Morse be with you!

4

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

Amateur Radio on a Budget (Part III)

Daimon Tilley G4USI discusses the options for budget-priced antennas for the VHF/UHF bands.

Until very recently, in terms of VHF/UHF antennas at our QTH, these were all home-made and cost very little. However, a recent bargain was found on the internet and the princely sum of £60 secured me a (barely) used Diamond X-510 dual-band collinear. This antenna is a beast at over 5m tall, but the gain it brings is very noticeable indeed over my previous antennas. At about half of the retail price I couldn't resist it and have to say it was a worthwhile buy. A fairly expensive antenna, but on a budget due to being used.

This article is going to focus on much cheaper homebrew options though, many of which I have built and used at home, and still do.

Vertical Antennas: Using a Cheap Mobile Whip

Four years ago, when I returned to the hobby I brought the old venerable TS700 mentioned in the last article and needed an antenna fairly quickly. A quick scan through the websites of the main dealers revealed a 2m 5/8-wavelength mobile whip antenna from Moonraker for £10. A 5/8th vertical is typically acknowledged as having about 3dB of gain over a quarter-wave whip or dipole. This 3dB gain is the equivalent of doubling your transmitter power, so is useful to have. I considered making the whip, but for a tenner I decided it was easier and cheaper to buy. The antenna arrived a few days later and seemed reasonably well made.

Let's just spend a moment thinking about vertical antennas. They, effectively, can be considered as one half of a dipole, mounted vertically, and to which the centre coax conductor is connected. So where is the other half, the part that the outer braid of the coax connects to? In the case of a vertical antenna (other than a vertical dipole) it is considered to be a ground or earth. In the case of a mobile antenna on a car, for example, the ground part of the antenna is the car body. Sometimes this connection is achieved by a direct connection to the car bodywork and in others, for example in the case of a magnetic mount, by capacitive coupling. How do we achieve this ground connection with a vertical antenna at home? The answer is the use of radials. A radial is a conductor, typically around a quarter of a wavelength long. With a vertical antenna, three to four radials are typically used.

So, I had my 5/8th radiator, I now needed some method of mounting it and connecting, in my case, four radials. Time to visit my collection of bits in the garage. I needed the following:


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- The mobile whip
- A mobile antenna mount with SO239 socket
- A bracket to mount it on
- Four quarter-wavelength radials (about 19in long)
- A pole to raise the antenna above the eaves of the house, my chosen mounting point
- A bracket to fix the pole to the eaves

In the garage I found a mobile mount of the type that you drill through car bodywork. I had bought two of these from the Newark Hamfest to use on my vintage Land Rover, but only used one in the end. I had some pieces of thick aluminium chequer plate, cut this and bent it into an inverted-L shape, drilling the top to accept the mobile mount and the side to accept two U-bolts. For radials I used four lengths of scrap aluminium flat bar, which I had salvaged from supports for an old greenhouse shelf. These were measured to a quarter wavelength long using the formula, drilled and riveted to the aluminium bracket equally spaced around the mobile mount. They were then gently bent downwards to about 45° below the horizontal, which assists with impedance matching.

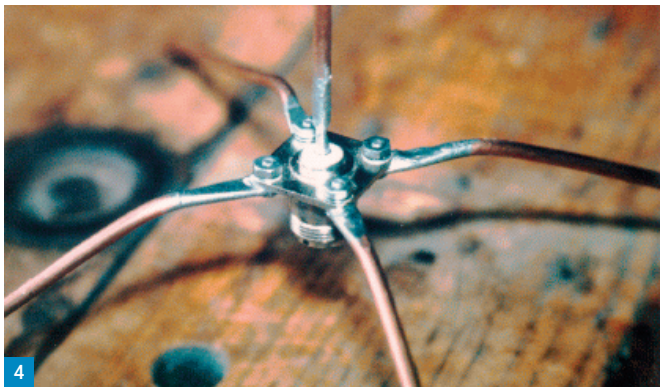
Now for a mast. A number of years ago, my wife and I used to race catamarans on Rutland Water and one day I had bent the long tiller extension on our Dart 18. I replaced it, but kept the old one, which I had managed to straighten reasonably well. It has moved house with us twice and, now, over 15 years later, I actually had a use for it! Finally, I needed some U-bolts and a bracket for the eaves. Again, the garage yielded its treasures. I had a small bracket and U-bolts kept from the flagpole I had put on the children's old play-tower when they were much younger. I had all the bits, put them together and added coax. Raising the antenna into a tree (just to get it off the ground) I tested the SWR as below 1.3:1 at 145.500MHz. On the eaves it went, SWR improved further, and it performed very well for four years until the Diamond arrived. I took some photos of it when I eventually took it down and these are shown in **Figs. 1**, **2** and **3**.

A Quarter-Wave Ground Plane from Wire & a SO-239 Socket

You could make a quarter-wave ground plane out of cheap and stiff wire. Merely cut five quarter-wavelength pieces of stiff copper wire. Take the first and solder it to the centre pin of an SO239 socket. Then connect the four radials to the four holes of the bulkhead connector. Ring crimp terminals are good for this – solder the radials to the terminals and bolt them to the SO239 holes. Bend the radials down at 45°, connect your coax and you are done. **Fig. 4**, courtesy of AMSAT.org, shows how this can be completed.

A Vertical Dipole using Coax Cable

If you want something even simpler and more discrete, then how about a vertical dipole made just out of coax, a scrap of wire, a ferrite core and a PL259 plug? First, decide how long you want the feeder and antenna to be, as they will all be made out of a single piece of coax, with no joins. In this case, slip a round ferrite core, of sufficient diameter to wrap three turns of coax around it, over the coax, but do not wind the turns yet. RG-58 or even RG-174 coax would work well here, particularly for a light and portable antenna. A



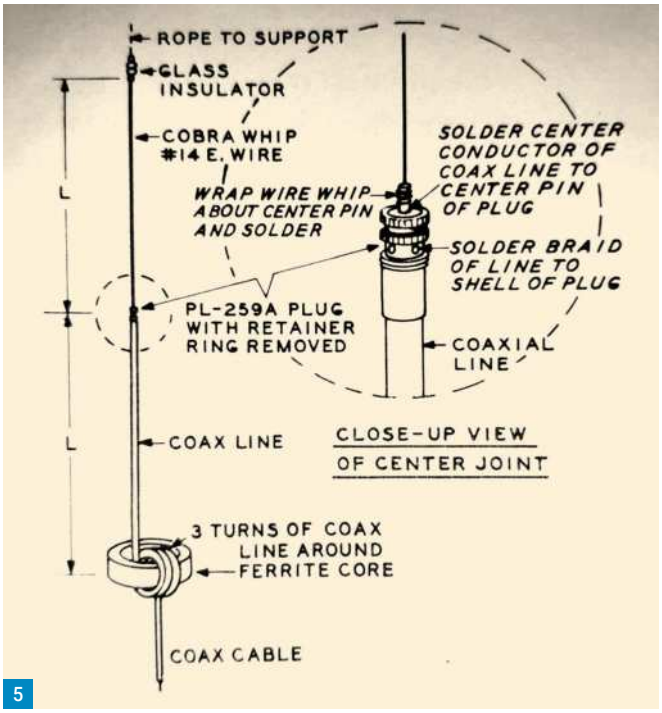


Fig. 1: The 5/8 wave mobile whip installed as a base station antenna.
Fig. 2: The mounting arrangement. Fig. 3: A closer look at the fixing.
Fig. 4: A wire vertical (photo courtesy of AMSAT).
Fig. 5: Using coax to form a vertical dipole.

suitable material for the core would be type 43 ferrite, and this could be a round ferrite core or one of the snap-on types, if you can get three turns through the centre.

Next, terminate one end of the coax in a PL259 (or BNC, N-Type, etc.) in the normal way, but omitting to place the outer screw ring on the coax, using just the inner of the plug. From the plug, working down the coax, identify and mark the point where the coax is electrically a quarter of a wavelength back from the plug. A quarter wavelength can be calculated by using the formula 234/144.5, giving an answer in feet and inches. Now we need to multiply this result by the velocity factor of your coax.

This is available online, but for RG58 is typically 0.66. So, an electrical quarter wavelength of RG58 would be (234/144.5) x 0.66, or 12.83in approx (325.8mm.) Once this point has been marked on the coax, wrap your three turns of coax around your core just below this marked point. The turns on the core are effectively terminating the bottom half of the dipole and allowing the coax braid to form the bottom half of the dipole. Below the core the coax acts normally.

You then need to wrap a length of stripped and tinned wire around the outside of the PL259 pin. Once that has been done, cut this slightly longer than a full quarter wave (234/144.5) or 19.43in (494mm). Notice I have not accounted for velocity factor here. This velocity factor will be different (higher) than your coax. It will vary depending on the insulation covering it, and different again if you are using uninsulated wire. By starting with a full quarter wave (I would actually start at 500mm) you can trim this length a little at a time to get minimum SWR. Finally add the coax connector of your choice to the long end of coax to allow connection to your rig.

If you plan to build this antenna, which is perfect for throwing up in a tree, just bear in mind that lighter weight coax such as RG58 and RG174 is quite lossy at VHF/UHF frequencies, so I would not advise that the feedline length is much longer than, say, 10m. A diagram of this design is shown at **Fig. 5** and is taken from my 1972 copy of *Simple, low-cost wire antennas for radio amateurs* by **Orr** and **Cowan**.

A Dual-Band (2m & 70cm) Slim Jim Antenna

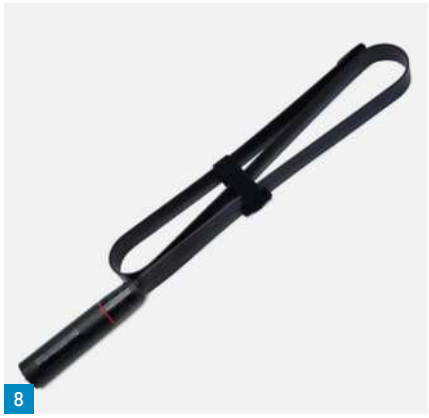
This cheap and easy to build Slim Jim antenna was built by **Josh** and me for his use, and is still in place outside his bedroom shack today. It is very effective and ridiculously simple, using just scraps. Even if you have to buy the parts, it won't cost you more than a few pounds to make.

I remember reading about the Slim Jim in *PW* many years ago. It was designed by **Fred Judd G2BCX** in 1978 and is one of the ways to form an antenna known as a J Pole. If I recall correctly, the original was made from aluminium tubing, but there is a much easier and simpler way to make it, using either 450Ω or 300Ω ladder-line feeder. As what is essentially a folded dipole, performance is similar to a quarter-wave ground plane, but it is arguably easier to make as there is less engineering and no radials involved.

Essentially all that is required is to cut and connect a piece of ladder-line to the appropriate dimensions, add coax, adjust for SWR and away you go. If using this as a portable antenna, at the top of a fishing pole for example, that is all you need to do, but if using it as a fixed antenna at home, then casing it in plastic plumbing pipe for rigidity and weatherproofing is highly advisable.

Rather than try to describe construction dimensions here in detail, I can do no better job than direct you to the excellent online calculator of **John M0UKD**, here: **https://tinyurl.com/4jpvj8xf**

This calculator gives a good explanation of how the antenna works, its construction and design. Make sure that you correct the velocity factor for the ladder-line you are using. I used 0.9 for 450Ω ladder-line. By cutting it for 2m it also works very well on the third harmonic of 70cm – two antennas for the price of one!



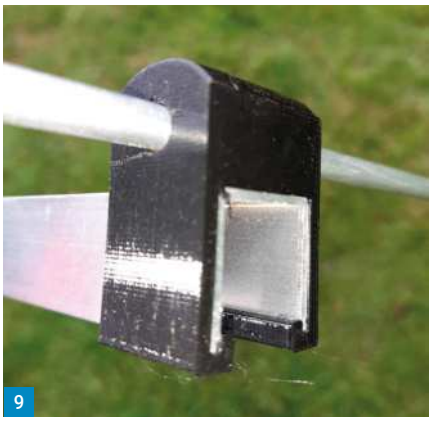


Fig. 6: Dual-band Slim Jim. Fig. 7: Commercial hand-held telescopic antenna. Fig. 8: Military 'fold up' antenna. Fig. 9: 3D-printed element support.

In order to make this a more permanent antenna for Josh, we decided to house it inside a waterproof enclosure. This had the benefit of protecting the coax from moisture entry as well as making the antenna rigid. I had some left-over 43mm diameter plumbing pipe and two end caps from a previous project. We made and tuned the Slim Jim by temporarily raising it in a tree and adjusting the coax feedpoint position.

We did this by just wrapping the coax inner and outer around the ladder-line and securing with tape. Only once we had adjusted this up or down for SWR did we then make it permanent by soldering.

In order to keep the ladder-line centred within the plastic pipe, I used a length of pipe insulation that was a snug fit inside. We opened up the insulation, laid the ladder-line inside and secured it with tape. I added a blanking plate on the top and sealed it from the weather. Before we cut the pipe to length, I was conscious that I wanted to clamp the tube in a TV antenna-type wall clamp from the DIY store. Keen to avoid any adverse interaction between this metal bracket and the antenna I cut the pipe about 2ft (600mm) below the bottom of the antenna and added a bottom blanking plug with a hole for the coax and a small drain hole to allow condensation to escape.

Finally, four or five turns of the RG58 coax cable were made and taped together to prevent RF flowing back down the screen of the cable. Sadly, I did not photograph its construction, but **Fig. 6** shows the completed antenna mounted outside Josh's bedroom.

Improving your Hand-held Antenna for Pennies

Most hand-held radios come with a 'rubber-duck' type antenna and often the wire inside this antenna is wound helically to reduce height (length). Inevitably these antennas are a compromise. They are usually much less than a quarter wave long and the ground plane or 'radial effect' is provided by the PCB of the radio board (the case being plastic). What can you do to improve this?

Well, it is not too expensive to buy a better antenna, and examples are readily available online. I have a telescopic antenna for my FT70D that I bought from the rally at Weston Super Mare for less than £20. It is about a half-wavelength long and has a loading coil, going under the designation 'RH770'. When extended it provides significantly superior receive and transmit performance than the stock antenna, but it is a little heavy and unless you keep it pretty vertical it must place quite a strain on the radio's SMA connector. Also popular seem to be the flexible, so-called 'tactical' antennas. These are similarly much longer but are made of a foldable metal inner covered in an insulating material. They tend to be quite light and can be folded for storage and carriage. Think of a tape measure element in heatshrink wrapping and you will be close to the mark – indeed you could easily make one in this way. (Anecdote: many small satellite antennas are made from tape measure type elements as they can be folded away for launch and will spring open when the satellite is deployed.)

My hand-held telescopic antenna is pictured in **Fig. 7** and a tactical type in **Fig. 8**. Both retail for around £23.

But what about a homebrew approach? One very simple way of improving your standard rubber duck antenna is to improve its ground plane. As mentioned, this consists of little more than the ground tracks of the printed circuit board and improving this is easy and simple. You need to merely cut a length of wire to a quarter wavelength and add a suitable ring terminal, which can fit between your antenna and the radio. Unscrew your

antenna and add the terminal between the two, ensuring that you can make an electrical connection with the outer casing of the coax connector without shorting the inner pin.

For some connectors this will be easy, but with some recessed connectors on radios you might need to use some washers or other arrangement. You should find that this improved ground plane increases both your received and transmitted signals. Such an arrangement is often called a 'rats-tail'. While this is simple to do, you will probably find your 'rats tail' is actually more efficient than the actual antenna, so it pays to think of the whole setup really.

Directional Antennas

If you wish to improve your range at VHF and UHF, then a Yagi antenna is a good way forward, with only a few elements capable of providing 6dB or more of gain – the equivalent of increasing your power by a factor of four. Of course, the additional benefit is that you will 'hear' better in those directions too.

I have to say that I had always shied away from making a Yagi antenna until fairly recently. Mainly because I hadn't really done any proper research to assist. In the June 2020 edition of *PW* I described, in detail, the build of a dual-band 2m and 70cm hand-held beam for satellite or portable use, and having successfully built this following a proven design, I have since gone on to build several more. It really is not complicated if you use a proven existing set of plans or one of the online calculators. Perhaps the job becomes more of a practical engineering job than other, simpler antenna builds, but they should still be within reach of most of us with just basic hand tools.

I have found a few good resources to help with dimensions and a couple of these are listed here:

https://tinyurl.com/8vwdxxfe
https://tinyurl.com/azs244hx

One recent build was a simple design for the 2m band, a six element Yagi for portable use. This also comes from the website of John M0UKD:

https://tinyurl.com/2pak66fk

John calls this the 'pegtenna' as it employs very simple and quick construction using wooden spring clothes pegs to hold the elements in place, allowing quick and easy assembly on a hilltop, etc.

In my case, I used John's design but decided to mount the elements a little differently, using 3D printed parts of my own design. This allowed secured fixing of the elements in such a way that it could easily be used portable, by sliding the elements into the holders, or as a permanent installation at home by riveting or screwing through the 3D printed parts into the elements. See **Fig. 9** for detail.

I found it worked well and I was pleased with the end result. However, I was a bit disappointed with the cost of materials. I bought the 6mm tubes and the 25mm square boom from a DIY store and the cost added up to well over £30. Add the construction time and effort, plus the 3D printing and a feeder box and I think, in all honesty, I could have bought a commercial antenna. In fact, you can buy the Diamond A144S5R 5-element Yagi, on a boom length of just less than 1m, for £41 plus shipping. So, unless you particularly want the fun and satisfaction of building your own Yagi antenna, you might, in some cases, find it as cheap to buy new.

In conclusion, I hope I have managed to give you plenty of ideas for cheap and simple homebrew antennas for the VHF and UHF bands. In the next instalment, in two months' time, we will be looking at budget options to get on the air on HF. In the meantime, get building antennas!

Phoenix Kits FMT Mk3 Morse Tutor

Colyn Baillie-Searle GD4EIP
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I got my licence in 1962, in South Africa with the callsign ZS5VF. In those days a person wanting to obtain an amateur licence had to just pass the Morse test and then was only allowed to operate the first year 50W CW only. I completed the first year but carried on using CW. I could have operated AM or SSB except that my set was only capable of CW. Some amateurs who found learning Morse code not a pleasant experience sat the first year out. I was not like that; I continued using my ex-military 80/40m transmitter, an Eddystone general coverage receiver and a vertical antenna. It was not long before I became friends with an excellent CW operator, **Royce Scott ZS5FC**. We would chat two or three times a week. He soon got my speed up to a reasonable level and I have never stopped using it. I left South Africa in 1975 and arrived on the Isle of Man where my new call GD4EIP was waiting for me.

Over the years, I have taught a number of amateurs on the Isle of Man and once they had obtained the full licence, I supervised them operating my station, so they could build up confidence to eventually operate on their own. A number of years later I was invited to became one of the Morse examiners on the Island until it was no longer required. I have often been asked, even today, where can someone learn Morse code or brush up their ability to operate CW again.

There are a number of good sites to learn Morse code or increase your Morse proficiency, such as the two listed below:
www.g4fon.net
www.ARRL.org/code-practice-files

Datong was the first to produce a Morse tutor and they can still be found on eBay. These units send letters, mixed and numbers only, You do not know what is being sent so it is not the easiest tutor to use. I have known a few amateurs who learnt Morse code and passed the Morse exam just using it. Since then there have been others on the market.

I am a member of FISTS CW Club and in the September issue of their magazine was an article on a Fists Morse tutor kit and recently there has been an update model

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Two Morse Tutors

Wanting to learn Morse Code? We have two short kit reviews, both featuring products from Phoenix Kits.

with extra facilities. I decided that I would buy one and see how it performs with the aim of recommending it to new amateurs who would like to learn Morse code or other amateurs who would just like to brush up their Morse proficiency.

The Kit

I contacted Phoenix kits (URL below) and placed an order for one. It arrived two days later, a nice box, well packed.
phoenixkitsonline.co.uk

Opening the box, **Fig. 1**, were three packets containing the digital display, the main board and a small Nano board, a small loudspeaker, three variable resistors, five small resistors, a transistor, switch, key socket and a blue LED together with detailed eight-page instructions. The display board had a small board already soldered on it.

The Nano board needs to be attached to the main board. This is achieved by soldering the two 15-pin socket strips, and these are soldered onto the main board. I pushed the strips onto the Nano board and then pushed the short pins through the main board and soldered them. You do need a fine tip soldering iron for doing this job. The reason why I did it this was to align the pins correctly in case I need ever to remove the Nano board. If I had soldered the two 15-pin socket strips on their own, when I came to attach the Nano board, the sockets might not be vertical to push the Nano board into them.

Next come the five resistors, one 39Ω and four 2.2kΩ (the instructions

Fig. 1: The Phoenix Kits FMT Mk 3.
Fig. 2: The assembled kit ready to install in the box.Fig. 3: The kit fitted to the box.
Fig. 4: External view of the finished unit.

indicate where they go on the board), then the transistor – the marking on the board prevents you from attaching it incorrectly. Finally, the multi-turn tune control potentiometer and three variable resistors. The volume control has a built-in switch and a couple of 2.54mm headers for jumpers at a later stage and a 2.54mm 4-pin header, which also has to be fitted onto the main board. This is to allow the main board to be connected to the display board. Connecting wires are supplied for this purpose.

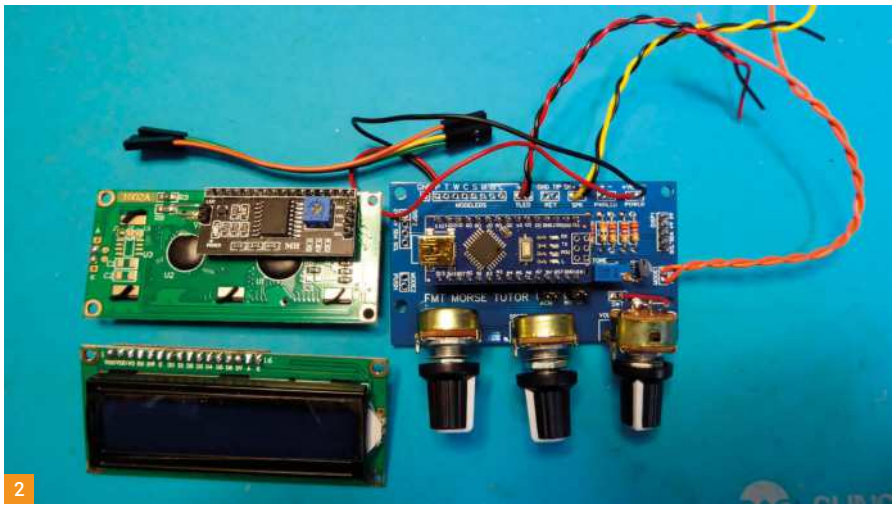
Six wires now have to be soldered onto the main board. The two for the speaker, two for the mode switch, two for the LED and finally the PP3 plug. The kit supplies a short length of multicore wire, which I assumed was for this purpose. I stripped the outer insulation and removed all the multi-stranded wires. I have had trouble in the past with the insulation melting when tinning the stranded wires, so I decided to test the wires before soldering them onto the board. Therefore, I stripped a short length of the insulation and tinned the bare wires only to find that some of the insulation had melted exposing more bare wires. I decided not to use these wires but solid insulated wires, which I had in my wire drawer. Now all wires attached, boards, mode switch and LED fitted and then wires soldered to the speaker and mode switch.

I now needed to purchase a box to fit it all in. On eBay I managed to find a nice sized box, 150 x 100 x 50mm, black plastic. Once the box arrived, it was time to decide which assembly method I would choose.

Final Assembly

There are three ways this can be done. One with no display, when you push the mode button a letter is sent indicating which program will be sent, letters, numbers, callsign etc. The second option is to have a row of eight LEDs, which will cycle through and indicate the different programs. The third is to use the LCD display. I decided to just have the LCD display but you can have LEDs as well. However, I cannot see the point of having them when you have the LCD display showing all the information.

The next was marking out for the LCD display. In the kit, an LCD mounting bevel is supplied and I used this to mark the outline for the LCD display and the four holes to fasten it to the box. Cutting out the rectangle for the LCD display was not difficult. I held the box securely in a vice and using my pillar drill carefully drilled four holes in each corner. If the box is not securely held, it can suddenly quickly jump up once the drill is nearly through, so holding it securely is essential. I then used a small hacksaw blade to carefully cut down the sides until the centre area was free. Using a file , carefully file the sides,



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checking that the display fits nicely.

Now it was planning to fit the three controls for volume, speed and space. I made a template for the three controls and marked their position, then using an 8mm drill, drilled the three holes. I decided to solder the controls onto the board, as this would be easier for mounting. Now there were two holes to be drilled, one for the mode push button and the other for blue LED and then five small holes in the place where the speaker will be mounted, to allow the sound to come out. I fitted the speaker using hot melt glue around its side.

Six wires now have to be soldered onto the main board, two for the speaker, two for the mode switch and two for the LED and finally the PP3 battery connector.

Now all wires attached, boards, mode switch and LED fitted and then wires soldered to the speaker. All assembled and ready to fit into the box. **Fig. 2.**

Into the Box

First it was fitting the LCD display and I decided not to mount the controls on top of the LCD display. Standoffs are supplied for this purpose. I just used the spacing washers and nuts and therefore not requiring the standoffs. I next mounted the control board and finally soldered the wires from this board to the speaker, mode switch and LED.

Make sure that the positive wire from the main board goes to the positive, anode lead of the LED, which is the longer leg. All completed ready for testing **Fig. 3** showing the inside of the box and **Fig. 4** the completed assembly ready to try it out. I attached a PP3 battery and turned the volume control to switch on. The display lit up and immediately starting sending numbers. Pressing the mode switch, changed to mixed, callsigns etc. It all works very well. The tutor will generate code between 11 to 30 wpm, but has the capability of sending up to 60 wpm, when attaching a jumper to two of the pins on the board – the jumpers are supplied.

Conclusion

The kit is supplied with everything needed to complete the tutor except for the box. The eight-page instructions are clearly written and easy to follow. This is a well thought out kit, which I am sure many new to the hobby as well as those wanting to better their Morse code ability will find beneficial. If you encounter any problems, Phoenix kits are on hand to answer any questions.

Universal uCPO Code Practice Oscillator & Multi-Mode Morse Tutor

Duncan Fisken G3WZD
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This handy device came to my attention through a post of the FISTS reflector and I thought it may be of interest both to Morse advisors and their students. Let me say right away that I have absolutely no connection with, or financial interest in, the manufacturer of this device, PhoenixKitsOnline, a UK company specialising in designing and producing amateur radio kits.

Some students need or want a Code Practice Oscillator; either because they don't have a rig with built in keyer/sidetone or want something portable for practice.

PhoenixKitsOnline have one such device; the UCPO (Universal Code Practice Oscillator) This is available either as a complete kit, a module or ready-built unit. **Paul M0BMN**, the owner of Phoenix and designer of the UCPO, kindly made a unit available to me for evaluation. Following some post-evaluation suggestions, Paul made some tweaks to hardware and software to make the unit more relevant to the CWOps CW Academy (*for more on CWOps, see our regular Morse Mode feature, **Ed***).

The compact UCPO device auto-senses the type of key (straight or paddle) when it is plugged in and can be used as a straightforward code practice oscillator or multi-mode morse tutor. Speed and Farnsworth spacing are adjustable. The Tutor mode features user-selectable Letters, Numbers, Mixed (letters and numbers), Prosigns, Callsigns and Pseudo-contest, where callsigns are sent and followed by 5NN and a serial number (occasionally including cut numbers for zero and 9). The callsign mode features varying speeds and tones, which I think adds some realism.

Other enhancements approved by Paul were to fit two 3.5mm jacks, one for stereo earphones and the other, a mono jack, to provide a fixed low-level audio output that can be fed into a USB mixer for use with an application such as Skype or Zoom. The low-level output tone is clean and close to a pure sinewave. These modifications will be included in the next production version of the UCPO. Power is from an internal PP3 9V battery.

Prices range from £18 to £38 depending on whether it is a module, full kit or ready-built unit. I assume there will be a price adjustment to include the two jack sockets as I fitted these to the evaluation unit. PhoenixKitsOnline will ship worldwide.

(***Editorial note**: The FMT Mk3 has now been replaced by the Mk4. The price is £39.99 when supplied with its own enclosure. Phoenix Kits supply two other Morse tutors not reviewed here, the Pocket Tutor PT20 and the 'Old School' Tutor, the T20)*

Japanese Miniatures

Bernard Nock G4BXD introduces some unusual Japanese sets that have found their way to the Museum.

Bernard Nock G4BXD
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A big hello from the Military Wireless Museum here in Worcestershire. It's certainly been a strange time recently, no visitors and very little movement in the acquisitions department. Most of the time has been spent checking over various sets, making the odd repair or restoration and building those little units I never had the time to do before.

Even in lockdown, though, I did manage to secure a few new items. The postman and delivery companies have trodden a steady trail to the museum's door. In addition to reviewing some old timers from the shelves there is a strange but exciting new addition.

Japanese Miniatures

I have been very fortunate over the years to acquire quite a few Japanese WW2 sets. The first I ever got came from the shed of an amateur just a few hundred yards away. Not long after arriving at this location I was talking to local amateur on 80m and I mentioned my interest in old military sets. *"Ah"* he said, *"I have some old bits in my shed"*. Anyway, it tuned out there were a couple of WW2 Japanese sets there, which he kindly gave me, starting an interest in that particular country's equipment.

The Japanese had several wartime miniature, battery powered sets and I'll mention a few in the collection. These sets were used by the standard foot soldier, sometimes carried by individuals or supplied along with bigger sets and used as monitoring devices.

Model 94-6

This amazing little transmitter receiver, although you can call it a transceiver as all the parts are common to both transmit and receive, uses just a single valve, a double-triode type, yet receives and transmits AM or CW.

A very small VHF set, Model 94 Mk6, manpack, single valve rx/tx. This, **Fig. 1**, is my current collection of 94-6 sets, three of the usually seen three-band sets and top right the rarer single-band set, an early production version. The data on my sets: the single-band set, no s/n but 196 stamped in base, meter is dated 1937 and transformer is dated 1937. The three-band sets: s/n 4626, dated 1939, s/n 10081, dated 1941 and s/n 102554, dated 1943.

The double triode acts as, regenerative detector and audio amplifier on receive and on transmit, as a self-oscillator power amplifier (PA) and modulator for AM or, strapped together, as a self-oscillating PA with slightly more RF output. Ingenious.

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Fig. 1: The 94-6 receivers. Fig. 2: The 53C receiver. Fig. 3: The 97 Type receiver. Fig. 4: The Special set in its box. Fig. 5: The special receiver. Fig. 6: Internals of the special. Fig. 7: The built-in loop antenna.

Type 53C

Type 53C receiver, **Fig. 2**, in its transit box, with plug-in coil packs and spare tubes. 0.4 to 5.754MHz using five plug in-coils. CW, MCW and voice reception possible. It uses four miniature tubes, weight given as 11lb, including batteries. Made by the Tokyo Instrument Co, a very compact regenerative receiver. It was issued with the Type 94 No.3 station and used as a monitoring receiver, termed sub-receiver. It is 1-V-2 autodyne method using four valves, a UY14M and three UY11M types.

Type 97

This is a portable radio, **Fig.3**, for the Imperial Japanese Navy Land Force. The basic facts from the Yokohama Military Radio Communication Museum's website (below). It has the same function as the Army Type 94 No.6 radio, but there is some consideration for waterproofing. Communication distance: 1km. Frequency: 23,000-31,000kHz. Radio format: A2 (modulated telegraph), A3 (telephone). Transmission output: 0.5W. Equipment overview Vacuum tube used: 1 31MC. Transmitter: Self-oscillation, anode modulation. Receiver: Super regenerative detection, low frequency one stage. Power supply: Batteries or hand-held generator. Antenna: L-shaped, vertical 140cm, horizontal 65cm.

www.yokohamaradiomuseum.com

Special Receiver

Now we come to a very interesting receiver, one where very little information is available

and one which is thought to have been provided to agents or spies. I was asked via email if I had any information on this unknown set. I made a few enquiries but discovered very little about it. I relayed this to the owner mentioning that if he was interested in selling, I would be interested in buying.

Luckily for me he was and I did. Once again, I consulted my friend **Mr Doi** at the Yokohama Museum to see what info they had. Mr Doi states: *"Mukinanu 610 type receiver, for intelligence personnel? The structure of this receiver is similar to the regenerative receiver called '1568 type receiver' said to be a special piece of equipment made by the Army for intelligence personnel".*

The wooden storage case, **Fig. 4**, for this receiver, and the front of it was labeled 'Mukinanu No. 610'. This unit is a regenerative detection (autodyne) type receiver consisting of three direct-heat type pentodes manufactured by Shinagawa Electric, and the operating frequency is four bands covering 3-16MHz.

I have never seen this one before, so it is not clear about its model number and purpose. However, according to the attached paper, this receiver uses a loop antenna. And made up with three B-03 type small MT tubes. This tube is considered to be similar to 1U5 and 1T4.

From the above, this receiver, **Fig. 5**, can be considered as a regenerative portable direction finder (SW receiver in use as well) that receives 3-16MHz. However, its structure is special and cannot be considered a normal army field radio. A similar set, with number 1568, was detailed on the website of the late American collector **William L Howard**. That one was a regenerative SW receiver (0-V-2) consisting of three B-03 type vacuum tubes.

The configurations of both units are similar, but unlike the 1568 type, the Mukinanu type receiver has a transformer coupling method that takes into consideration the improvement in gain in the low frequency amplification stage. Compared to the 1568 type, the Mukinanu type receiver has a sophisticated structure and a high degree of perfection, so it can be considered as an improved version of the 1568 type receiver.

The Valve Museum (URL below) has data on the 1U5. *"The 1U5 is a diode-pentode designed for detection and first audio voltage amplification in lightweight portable radio equipment and the sensitivity of the pentode allows for a low anode voltage thus saving weight on the HT battery. Above the top mica is the diode anode and the filament tension spring is hidden by the gettering. The filament is a single-coated inverted-V. The diode anode connection passes inside the main anode cylinder. The pentode section with three wire grids. The thin glass tube envelope is 18mm in diameter, and excluding the B7G base pins is 47mm tall. Type 1U5 was first introduced in 1945."*

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http://www.r-type.org/index.htm

The Radio Museum website (below) has info on the maker: *"Shinagawa Denki K.K. Office and Plant: 1-429 Gotanda, Shinagawa-Ku, Tokyo. Tube brand: Kotron/K.O. Tron. Small manufacturer listed on page 2 of* ***Hisashi Ohtsuka's*** 'Dawn of Tube Production in Japan', *section 007L, with a founding date of 1941. The company has existed previously however: there is an article* 'On the New Tubes', *by* ***Hisao Maeda*** *of Shinagawa Denki, published in 1936 in the* Journal of the Institute of Electrical Engineers of Japan. *Founded: 1931. History: Founded as Horikawa Industrial Co in 1931. Company renamed to KO Vacuum Tube Mfg. Co., later to Shinagawa Electric Co. Ltd. In 1942, the tube brand Tou was introduced."*

www.radiomuseum.org

Mr Doi added: *"The developer and application of the Mukinanu type and 1568 type receivers are unknown. However, the 1568 receiver is reportedly manufactured by the Army for intelligence personnel. If this is the case, the developer is Army Technology Headquarters 9th Research Institute (former Army Science Research Institute Todo Branch Office) Department 1 (radio weapons, balloon bombs, radios, bacterial weapons, cattle epidemics virus (Research and development), but unfortunately the museum does not have the materials to support it."*

The receiver, **Fig. 6**, is very well made, the main tuning has a very smooth slow-motion tuning control. It's difficult to trace the wiring as it's all the same brown-covered type of wire, but I assume that we have the first valve as a tuning detector stage followed by two stages of audio amplification, though this has yet to be confirmed.

There is a five-position bandswitch but only four bands on the chart. Again, due to the compact nature of the internals it's hard to figure out if the fifth position is unused. The variable resistor seems to be in the heater line because I noticed when testing the set that the heater current varies with this control's rotation.

On top of the set is a five-pin socket and there is a little sub-unit housing a switch and what I thought at first was a small lamp, which has a five-pin plug and lead, going to the switch and then to flying leads to the batteries. On closer inspection it seems the small bulb is actually in the HT positive supply to the set so must be there to act as a fuse. I could not see where the headset plugged into; there are no other sockets save for the antenna ones on the set.

I then noticed that on top of the five-pin plug coming from the switch box there was a two-pin socket into which the headset's two-pin plug could be inserted. I fitted three 1L34 types, a 1.2V heater pentode, into each socket in turn at first to ensure the valve bases were OK and applied about 60V of HT to the set. At first there was no output in the headset. I measured what should be the anode and screen 2 of the valves. Valves 1 and 2 had HT to both, the third valve had HT only to g2. There was no HT on the output anode.

I was unable to see just where the anode load was. The output capacitor can be seen but

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the load was either an open resistor or it might have been one of the two wound components, chokes or transformers, but hard to see. I fitted a suitable anode load resistor from HT to pin 2 and there was plenty of audio out when g1 was touched. Unfortunately, there was no received signal or a sign of reaction or regeneration so obviously there are other faults.

When in use the receiver plugged into a frame or loop antenna, **Fig. 7**, which is housed around the inside of the carrying box. There is space in the box for the two batteries, 1.2 or 1.5V and probably something like 45V or 67V types. A small blue label in the lid details the rest of the boxes contents, spare valves (6), 3Ω variable resistor (1), 10µf capacitor (1), low frequency transformer (1), blocking coil (1), bulb (2), headset(1), connecting leads.

I shall persevere with this little set in the hope of getting it fully functioning again but it was certainly nice see such a clever design and an example of engineering as compact as this set. Now if we could only find out how it ended up in an attic in New England.

And Finally

Hopefully in the near future the museum can reopen its doors and welcome visitors but in the meantime there's more pictures on the website below, and hope to see you here again soon. Cheerio.

www.militarywirelessmuseum.co.uk

The Practical Wireless 144MHz QRP Contest

Colin Redwood G6MXL, our QRP Contest adjudicator, introduces the 2021 event, which takes place on Sunday 13 June 2021.

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

The popular *Practical Wireless* 144MHz QRP Contest is the ideal way for newcomers to the VHF bands and contesting to get a good feel for many aspects of amateur radio contests. It is an excellent way to experience the thrill of making contacts over many kilometres on the 2m band.

Power

The power limit will again be **5 Watts** at the transmitter so that participants with all types of UK licence can participate equally.

Equipment

The only equipment you'll need is a low-power 2m transceiver and an antenna. While you can expect to make some contacts with a basic 2m FM hand-held transceiver, most of the activity is likely to take place using single sideband (SSB). Most stations use horizontally polarised Yagi antennas when operating on SSB or CW.

Location

As always at 2m, a clear take-off such as a hilltop will certainly help. Every year new entrants are surprised just how far their signals can travel between hilltops.

You'll need to find the 6-character IARU locator (sometimes it is known as 'Maidenhead Locator') for your station's location, for example IO92KL. I think the easiest way is to visit:
https://tinyurl.com/yrz9k4b5

Contest Exchange

For each contact to count towards your score, you'll need to exchange your callsign (**including any /P**), signal report using the standard RS(T) code, serial number and locator. The RS(T) code consists of readability on a scale of one to five and signal strength from one to nine. The serial number starts at 001 for your first contact and increases by one for each subsequent contact you make. So, the fourth contact you make will have serial number 004. For Morse contacts there is also the tone (on a scale of one to nine).

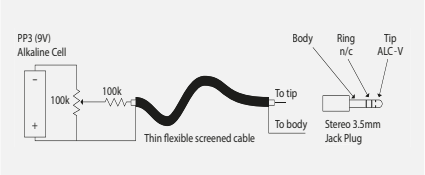


Fig. 1: A useful technique to reduce power to 5W on higher power transmitters.

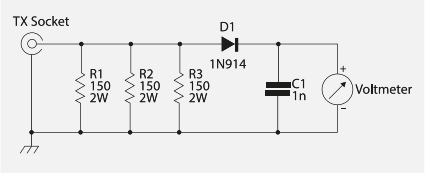


Fig. 2: A small power meter, to verify the power output. A 21.7V level indicates 5W output. 2W metal film resistors are available from CPC

Exchange Example

Imagine your callsign is M7ABC/P and you are located in IO91GI and have a contact with M6ZXT/P as your fourth contact. You might transmit, "*Mike six Zulu X-Ray Tango Stroke Portable from Mike seven Alpha Bravo Charlie Stroke Portable, you are five and six, zero zero four, in India Oscar nine one Golf India*". Using phonetics will make sure that similar sounding letters (e.g. B, D, P, V) are clearly understood by the station you are in contact with.

Hints and Tips

Most newcomers to contesting find that replying to other stations' *"CQ Contest"* calls is a good way to start. As your confidence in exchanging reports, serial numbers and locators increases, then finding a clear frequency and calling *"CQ Contest"* and waiting for stations to reply to you is also a good technique. A mix of the two techniques can be an effective strategy.

Make a point of accurately recording in your log the details of each contact as required by the rules – in particular the callsign of each station you contact, **including any /P suffix**, their locator and the time in UTC (not BST). If you are transferring a paper log to a computer log, be careful to transcribe the details accurately. The format of locators is letter letter number number letter letter.

Directional Antennas

If you use a directional antenna, then I would strongly recommend that you rotate it to point in different directions during the contest (e.g. South West England, Northern Ireland, the Republic of Ireland and Scotland). This will not only enable you to make more contacts, but will likely increase the number of different locator squares you contact, which is a part of your overall score.

Batteries

Many entrants use rechargeable batteries for power. Make sure you have enough power to run your station for the full duration of the contest. I'd suggest making three diary entries: the first a couple of days before the contest as a reminder to charge your batteries, the second for the day of the contest (Sunday 13 June 2021), and the third a few days after the contest to remind you to submit your entry.

The rules appear on the next page. The contest website is also a valuable source of information and has a link for downloading log sheets and an online entry form (known as a cover sheet).
www.pwcontest.org.uk

Submitting an Entry

Don't forget to submit your entry after the contest. Although electronic entries via email are much preferred and make the task of adjudication easier, paper entries are also welcome. All entries that provide an email address will be acknowledged.
entries@pwcontest.org.uk

Have a Go

There will certainly be plenty of other *PW* readers on the air, keen to exchange reports, serial numbers and locators. Good luck in the contest!

The 2021 Rules

1. General: The contest is open to all licensed radio amateurs operating fixed or portable stations, using SSB, CW, AM or FM in the 2m (144 to 146MHz) band. Entries may be from individuals or from groups, clubs, etc. The contest runs from 0900 to 1600UTC on **Sunday 13 June 2021**.
All stations must operate within the terms of their licence. Entrants must observe the bandplan and must keep clear of normal calling frequencies (144.300MHz and 145.500MHz) even for *"CQ"* calls. Entrants must allow other users of the band to carry out their activities without hindrance. Please avoid frequencies used by GB2RS (144.250MHz and 145.525MHz), ATV talkback (144.750MHz) and other frequencies in use for non-contest purposes.
The station must use the same callsign throughout the contest and may not change its location.

2. Contacts: Contacts will consist of the exchange of the following minimum information:
- callsigns of both stations **(including any /P suffices)**
- signal reports, standard RS(T) system
- serial numbers: a 3-digit number incremented by one for each contact starting at 001 for the first contact.
- locator (i.e. full 6-character IARU Universal Locator for the location of the station.)

Information must be sent to, and received from, each station individually using **just** the 2m band, and contacts may not be established with more than one station at a time. Simultaneous operation on more than one frequency is not permitted.
If a non-competing station is worked and unable to send their full Universal Locator, their location may be logged instead. However, for a square to count as a multiplier (see rule 4), a full 6-character locator must have been received in at least one contact with a station in the square.
Contacts via repeaters, satellites, or using digital voice modes (including D-STAR, Fusion, DMR and Echolink) and data modes or machine-generated modes such as FT8, JT65, RTTY and PSK31 are not permitted. Neither is the use of DX Clusters, ON4KST chat (even just logging on), social media or any other method of enabling contacts or contest exchanges.

3. Power: The output power of the **transmitter or transverter** final stage must not exceed **5 Watts** peak envelope power (PEP). If the equipment is capable of higher power, the power must be reduced and measured by satisfactory means. With most modern transceivers, power can be reduced by using a menu setting.
An alternative is to apply a (variable) negative voltage to the transmitter ALC line reached via the accessory socket, **Fig. 1**. Stations cannot rely on feeder loss to meet the 5W power limit.
The output power can be accurately measured using the simple circuit of **Fig. 2**. Connect this to the 50Ω output of the transmitter and adjust the power so that the voltmeter does not exceed 21.7V on a 'good whistle' into the microphone.

4. Scoring: Each contact will score one point. The total number of points gained during the contest will then be multiplied by the number of different locator squares with which contacts were made (a 'square' here is the area defined by the first four characters of the IARU Locator).
Example: 52 stations worked in IO81, IO90, IO91, IO92 and JO01 squares; final score = 52 x 5 = 260.
Only one contact with a given station will count as a scoring contact, even if it has changed its location, e.g. gone /M or /P. If a duplicate contact is inadvertently made, it must still be recorded in the log and clearly marked as a duplicate (not necessary in computer log files).

5. The Log: Logs must contain the following information for each contact:
- time (UTC – not BST)
- callsign of the station worked **(including any /P suffix)**
- report sent (e.g. 56)
- serial number sent
- report received (e.g. 54)
- serial number received
- locator received.

The preferred form of a log is a computer file in REG1TEST, .log, adi or .edi formats sent by email. This may be generated by contest logging software such as MINOS or EI5DI's SDV, provided it contains all the information listed above. Alternatively, a file in any other suitable format (such as the spreadsheet available on the contest website) or in plain text, provided each of the items above is separated by a separating character such as a comma or tab, is acceptable. Give the file a name including the station callsign (e.g. g6mxl-p.log), and send as a standard email attachment to
entries@pwcontest.org.uk
email entries will be acknowledged within 8 days. If there is any problem with your entry, you will be contacted by email.
Log sheets and covering information sheets for paper-based entries are available for downloading from the contest website:
www.pwcontest.org.uk

6. Entries: The covering information listed below must be provided with each entry. Please submit this using the online facility on the website. For postal entries, it should be written on a separate sheet of A4-sized paper.
- The information required for every entry is:
- name of the entrant (or of a club etc. in a group entry) as it is to appear in the results table and on the certificate
- callsign you transmitted during the contest, **including any /P suffix (e.g. G6MXL/P)**
- name and address for correspondence
- location of the station during the contest
- full 6-character locator you transmitted during the contest
- whether single or multi-operator (a single operator is an individual who received no assistance from any person in operating the station, which is either his/her permanent home station or a portable station established solely by him/her); if multi-operator, include a list of operators' names and callsigns
- a full description of the equipment used, to include transmitted PEP output power
- if the transmitting equipment (including any transverter employed) is capable of more than 5W PEP output in the 144MHz band, a description of the methods used to (1) reduce and (2) measure the 144MHz output power
- antenna used and the approximate station height in metres above sea level (ASL)

the following declaration must be included in the email text or written and signed by the entrant: *"I confirm that the station was operated within the rules and spirit of the event, and that the information provided is correct"*.
Failure to supply the required information may lead to loss of points or disqualification.
Entries by email must be sent to
entries@pwcontest.org.uk
Paper entries should be sent to: Practical Wireless Contest, c/o Colin Redwood G6MXL, 53 Woodpecker Drive, Poole BH17 7SB.
Entries must be received not later than Tuesday 6 July 2021. Late entries will be disallowed.
Any other comments about the station, the contest and conditions during it are welcome along with photographs. Please note these cannot be returned and may be published in *Practical Wireless* or on the contest website. Please send them by separate email or post, **to arrive by Tuesday 6 July 2021**.
When entering, you will be asked to agree to the storing and processing of your entry and to the publication of the results. Warners Group Publications data policy can be seen at:
www.radioenthusiast.co.uk/privacy-policy

7. Miscellaneous: When operating portable, obtain permission from the owner of the land before using the site and observe any restrictions on access. Always leave the site clean and tidy, removing all litter. Observe the Country Code.
Take reasonable precautions to avoid choosing a site which another group is also planning to use. It is wise to have an alternative site available just in case.

8. Poor Signals: Make sure your transmitting equipment is properly adjusted and is not radiating a broad or poor-quality signal, e.g. by over-driving or excessive speech compression. On the other hand, be aware that your receiver may experience problems due to the numerous strong signals it will have to handle, which may lead you to believe that another station is radiating a poor signal. Before reaching this conclusion, try heavy attenuation at the receiver input. Using a high-gain RF preamplifier is likely to worsen strong-signal problems, so it is best to be able to switch it off when necessary.
If after making the checks above, you are certain that another station participating in the *PW* 144MHz QRP contest is radiating poor quality signals, please call the station, giving your callsign, and tell them about the problem. You cannot expect a station with a poor signal to do something about it if they are unaware!
If you receive or send a report of poor-quality signals, you must record on the cover sheet full details of the complaint, including time, callsigns of stations involved, nature of complaint and actions taken **during** the contest to investigate and resolve.

9. Adjudication: Points will be deducted for errors in the information sent or received as shown by the logs. Unmarked duplicate contacts in paper-based logs will carry a heavy points penalty. Failure to supply all the information required in rule 6 may also lead to deduction of points. A breach of these rules may lead to disqualification. In the case of any dispute, the decision of the adjudicator will be final.

Complex Numbers for Dummies

In our Letters pages, Michael Jones GW7BBY recently asked about Complex Numbers. Here we have an answer.

Dr Doug Fenna M0DSF
practicalwireless@warnersgroup.co.uk

What are Complex Numbers? They are a convenient way of doing mathematical operations on quantities that require two numbers, such as speed and direction, amplitude and phase, resistive and reactive impedance. To do that we need some kind of 'number' that embodies two numbers. Let's start at the beginning: where can we find such a thing?

The Number Line

We all know about the Number Line. We can stand at the zero point and look along it to our right to see 1, 2, 3, 4 and so on without limit. In between 1 and 2 there will be 1.5, the square root of 2 and countless other numbers. Somewhere between 3 and 4 there will be pi. If we need negative numbers, we can turn around and look the other way. They are all there, points on the Line. We can add and subtract by walking one way or the other. If we want to multiply, we have to move to the right the given number of times, unless one of the numbers is negative. In that case we have to turn around 180° and walk the other way. Turning round by 180° has the effect of multiplying our move by −1. That's fine because turning 180° twice takes us to 360°, back to where we started, and we know that multiplying by −1 twice is the same as multiplying by 1, i.e. it has no effect. We're all familiar with all that, now let's be adventurous.

Moving off the Line

What would happen if we turned by 90°? Would we see a whole plane of numbers instead of just a line? Would we be like a ship at sea, able to turn in any direction, rather than a train on a track that can only go one way or the other? If we want to explore this plane, we'll have to devise a way of labelling the points on it because a single number can only refer to a point on the Line. We could label a point in the plane by describing the route we took to get to that point: maybe we went along the Line by 3 then turned 90° to the left and moved another 4. Or we could say we went 'East' 3 units then 'North' 4 units. We could write this like this: E3+N4. Maybe we could then build some rules about adding, subtracting, multiplying and dividing. Adding and subtracting are easy: if we start at E3+N4 and move 5 parallel to the positive Line, then turn left 90° and go a further 2, we end up at E8+N6 so (E3+N4) + (E5+N2) = E8+N6. If our last turn had been to the right, towards the number line, we would have (E3+N4) + (E5−N2) = E8+N2. That seems easy, **Fig. 1**.

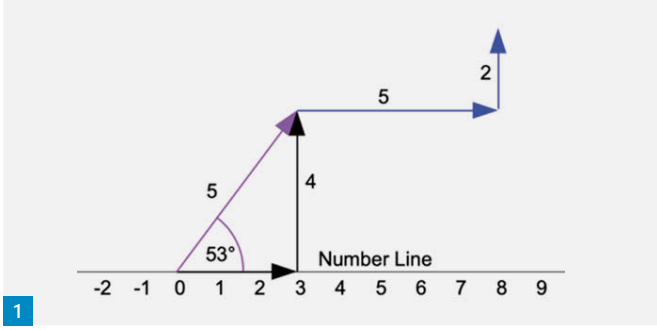
Alternatively, we could say that to get to E3+N4, instead of moving East and North we can say (starting from the zero point looking along the Line in the positive direction) we turned 53° to the left then went 5 in that direction. We could write this as 5∠53°, '∠' meaning angle. We have 5∠53° and E3+N4 as two 'names' for the same thing, like 24 inches and 2 feet are two ways of saying the same thing.

So What Use is it?

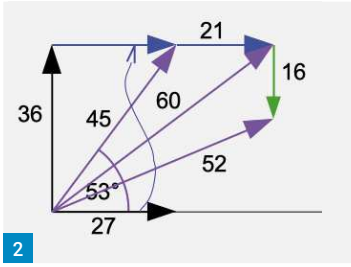
Before we go any further, though, is all this any use? There are very many applications of this concept, but let's focus on the one that's of interest to radio enthusiasts: analysis of AC circuits.

We imagine that our alternating voltage is generated by a simple magnet spinning inside a coil. If we connect a resistor to the coil, we'll get a current, and the voltage and current waveforms will have their peaks and zeros at the same time; we say they are in phase. If we connect a capacitor instead, we'll get some current but its peaks (positive and negative) will occur at the same time as the zero points of the voltage, because the instantaneous current in a capacitor is proportional to the rate at which the voltage is changing. At its peak the voltage is not changing much so the current is near zero; when the voltage is near zero it is changing rapidly so the current is at its peak. An easy way to picture this timing difference is to say that the current behaves as though it was generated by a magnet that is at 90° to the voltage magnet, and we say it is 90° out of phase. If we replaced the capacitor with an inductor, we would again get a phase difference of about 90°, but in the opposite direction. We say that current leads voltage in a capacitor and lags in an inductor. (These terms should not be taken too literally. The peaks of current in the capacitor are due to the rate of change of voltage at that time; they are not forecasting the voltage at a future time.)

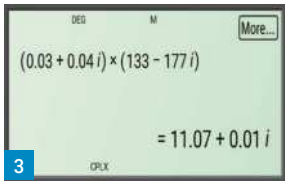
It is helpful to picture these relationships with a diagram, but first we need to be clear that although we have just been talking about instantaneous current and voltage in a capacitor, from here on all references to voltages and currents are rms values, i.e. what you see on an ordinary meter. To draw the diagram we start at the centre and draw a line to the right representing one pole of the voltage magnet, that's our zero phase, and we can draw an arrow along that line representing the voltage. We imagine the whole diagram rotating like the magnets, anti-clockwise, so an arrow representing the capacitor current is drawn upwards from the centre so that as the diagram rotates it is ahead of the voltage arrow. Likewise, we can draw an arrow downwards for inductor current.



1



2



3

This all becomes useful if we have components in parallel. For example, if the resistor current is 27mA and the capacitor current 36mA the total current would not be 63mA because of the phase difference. If we make the length of the arrows proportional to current, then we can find the total current by adding them geometrically. We could use a scale of 2mm to 1mA, **Fig. 2**.

We draw an arrow from the centre to the right 54mm long to represent the resistor current (in phase with the voltage) and one 72mm long upwards from the centre for the capacitor current. We find the total by copying one of the arrows and adding it to the end of the other one. We see that the result is at 90mm at an angle of 53°, which we can measure with a ruler and protractor, or we can calculate them using Pythagoras's Theorem and the inverse tangent function. This means the total current will 45mA at 53° phase. If we added another parallel resistor carrying 21mA, we could add that to the previous result and see that the total current would be 60mA. Finally, if we added an inductor taking 16mA, its arrow would be pointing downwards so the total current would be reduced to 52mA.

Vectors

When we use arrows like this to represent quantities that have both a magnitude and a direction we call them vectors. In this example we are dealing with currents in components that are wired in parallel, so we need to add the currents to get the total and we do that by drawing vectors of the scale length and appropriate direction, with the first one starting at the centre of the diagram then each other one starting from the end of the previous one. The total current is then found by drawing a vector (a line) from the centre to the end of the last one. If we were dealing with components in series, we could use the same method to add the voltages, noting that in a capacitor the voltage phase lags the current so capacitor voltages are drawn downwards, and inductor voltages upwards.

What's the connection with the number plane? They are the same! If we think of resistor current as E27+N0 and the capacitor current as E0+N36 then we can add them to get E27+N36. The magnitude of that (i.e. what we would see if we connected an ordinary meter) is $\sqrt{(27^2+36^2)} = 45$ and the phase is $\tan^{-1}(36/27) = 53.13°$. Adding a further E21+N0 gives E48+N36 and the magnitude is then $\sqrt{(48^2+36^2)} = 60$.

Can we simplify the way we write these numbers? Do we need to put E3 if we just mean 3? We do need some way of distinguishing E3 from N3, but it would be good if we could just write 3 when we mean just 3. We can drop the E so long as we keep something to make the N part different, we can't just put 3+4. It doesn't have to be an N though. The usual symbol here is italic *j*. So, we write (3+*j*4) + (5+*j*2) = 8+*j*6. The symbol *j* means a move away from the number line at 90°, just like N did; the first part '8' means a move along or parallel to the number line.

So far this way of looking at the number plane and writing vectors in the form '27+*j*36' doesn't seem very helpful but that's because we've been adding. Suppose we take this network of R and C and connect it to a voltage that's not in phase with our zero line. We begin by working out the impedance of the RC network using Ohm's Law: divide the voltage by the current, using Amps instead of mA. The voltage in this example was 10V so with 27+*j*39mA the impedance is 10 / (0.027+*j*0.039)Ω or 10 / (0.045∠53°)Ω. What does this mean? Let's look at multiply and divide. To multiply by a simple number like 4 x (5∠53°) we would draw four arrows end-to-end in the same direction, 53°, so obviously we end up at 20∠53°. How would we multiply 5∠53° by 4∠17°? We know from the Number Line that multiplying by −1 twice by doing two 180° turns is equivalent to multiplying by $(-1)^2$, which is 1, or 1∠360°. Multiplying means adding the angles. The rule for multiplying these numbers is to multiply the magnitudes and add the angles. Hence 5∠53 × 4∠17 = 20∠70°. What about dividing?

Division is the opposite of multiplication so it has to be subtraction of the angles. The magnitudes are divided in the usual way, so 20∠70 / 5∠53 = 4∠17°, while 5∠53°/ 20∠70 = 0.25∠−17°. Getting back to our question of dividing 10V by 27+*j*39 mA, this current can be written 45∠53mA. To find 10 / (0.045∠53°) we note that 10 means 10∠0° so the impedance is

$$(10 / 0.045) \angle(0°-53°) = 222\angle -53°\Omega$$

(The angle or the *j* part is always negative for capacitive impedance; it's positive for inductance.) We can convert this to *j* form if we need to, either by doing a scale drawing or using trigonometry:

$$222\cos(-53°) + j\,222\sin(-53°) = 133 - j\,178\Omega$$

If we connect this RC network to a voltage of 5V at a phase of −60° the current will be

$$(5\angle -60°) \div (222\angle -53°) = 0.022\angle -7°$$

so we'll get 22mA, almost in phase with our original 10V.

Now we have a way of representing voltages, currents and impedances and doing arithmetic with them. It's a useful method but it's a bit inconvenient having to change between *j* notation for adding and ∠ notation for multiply and divide. Is there a way to multiply in *j* form? If we have a current (*a*+*jb*) and an impedance (*c*+*jd*) and apply the usual rules of algebra to find the voltage, it's:

$$(a+jb)\,(c+jd) = ac + j(ad+bc) + j^2bd$$

We've made a big conceptual jump here though. We introduced *j* as a notation symbol for denoting the 'North' part of a number, indicating that we turn 90° left; can we treat it as a number that can be manipulated by the normal rules of algebra? Going back to our original image of stepping off the number line, what does j^2 mean? Multiplying by *j* means turning left 90°. Where would we get to if we turned 90° twice before moving? That would be turning 180°, so multiplying 1∠90° by 1∠90° we get 1∠180° which is −1; we're back on the number line. Now 1∠90° is E0+N1, which we now write as 0+*j*1 or just *j*, so multiplying *j* by *j* we get −1. With j^2 being the same as −1 we can treat j^2 as an ordinary number and replace it with −1 in algebraic equations, but *j* itself has to be kept separate. Applying this to the multiplication rule we get

$$\begin{aligned}(a+jb)\,(c+jd) &= ac + j(ad+bc) + j^2bd\\ &= ac + j(ad+bc) - bd = (ac - bd) + j(ad+bc)\end{aligned}$$

So now we can multiply numbers in *j* form. For example, if we pass a current of 0.03+*j*0.04 through our RC network 133−*j*178, the voltage will be

$$\begin{aligned}&(0.03 + j0.04) \times (133 - j178)\\ &= (0.03 \times 133 - 0.04 \times (-178)\,) + j\,(0.03 \times (-178) + 0.04 \times 133)\\ &= 11.11 - j0.02\end{aligned}$$

so there will be just over 11V, and the waveform will be very nearly in phase with our original 10V generator. There is a similar rule for dividing but it's a bit more complicated:

$$\frac{(a+jb)}{(c+jd)} = \frac{(a+jb)(c-jd)}{c^2+d^2} = \left(\frac{ac+bd}{c^2+d^2}\right) + j\left(\frac{bc-ad}{c^2+d^2}\right)$$

(we can see this by multiplying top and bottom by (*c* − *jd*)) so if we use this method to divide 10 by (0.045∠53°) we would first represent this current in the other form, 0.045∠53° = 0.027+*j*0.036, then divide:

$$(10+j0) \div (0.027+j0.036)$$
$$= (10+j0) \times (0.027-j0.036) \div (0.027^2+0.036^2)$$
$$= 133-j178$$

This is quite a job to calculate but we don't have to do it by hand. There are apps for phones and laptops that can work directly with these 'complex' numbers, **Fig. 3**. I use HiPERCalc Pro on my phone. (It uses *i* rather than *j* and puts it after the number instead of before it; both symbols and both styles are in common use – the reason we generally don't use *i* in electronics is because it's already commonly use to denote current.)

So what Have we Achieved?

We have a system for doing calculations on reactive impedances and sinusoidal waveforms. All our usual rules such as Ohm's Law, components in series or parallel, etc. can be used for reactances though we have to interpret power carefully, see the example in the sidebar.

A note about symbols. We normally use *X* for capacitive and inductive reactances, where the non-*j* part is zero, and *Z* for impedance where both parts may be non-zero.

The formulae for reactances are:

Capacitor: $X_C = 1 / (j2\pi fC) = -j / (2\pi fC)$; Inductance: $X_L = j2\pi fL$

Sometimes these formulae are stated without the *j* and it's included afterwards, e.g.

$$Z = R + jX_L - jX_C$$

By using 'complex' numbers (those involving *j*) we can use all our familiar formulae. We just have to know how to add, subtract, multiply and divide, or get a calculator app that will do these sums for us. There's nothing 'imaginary' about it; it's just a set of rules that give useful answers.

$(a+jb) + (c+jd) = (a+c) + j(b+d)$	$(a+jb) - (c+jd) = (a-c) + j(b-d)$
$(a+jb) \times (c+jd) = (ac - bd) + j(ad+bc)$	$r\angle a \times s\angle b = r \times s\angle(a+b)$
$(a+jb) / (c+jd) = [(ac+bd) + j(bc-ad)] / (c^2+d^2)$	$r\angle a / s\angle b = (r \div s)\angle(a-b)$
$(a+jb) = \sqrt{(a^2+b^2)}\ \angle\tan^{-1}(b/a)$	$r\angle a = r\cos(a) + j\,r\sin(a)$
$X_C = 1 / (j2\pi fC) = -j / (2\pi fC)$	$B_C = j2\pi fC$
$X_L = j2\pi fL$	$B_L = 1 / (j2\pi fL) = -j / (2\pi fL)$
$V = I \times Z$	$I = V \times Y$

Remember that with $\tan^{-1}$ the answer can be 180° out; look at the signs of a and b.

Example: What is the current if 10V is applied to a 150pF capacitor in parallel with 370Ω resistor at 3.82MHz?

$1 / 2\pi fC = 1 / (2\pi \times 3.82 \times 10^6 \times 150 \times 10^{-12}) = 278$ so $X_C = -j278\Omega$.

Using the formula for impedances in parallel $(R_1 \times R_2) \div (R_1 + R_2)$ becomes $(Z_1 \times Z_2) \div (Z_1 + Z_2)$ so:

$Z = (370 \times -j278) / (370 - j278) = -j(370 \times 278) \times (370 + j278) / (370^2 + 278^2) = 133 - j178\ \Omega$

$I = V / Z = 10 / (133 - j178) = 10 \times (133 + j178) / (133^2+178^2) = 0.027 + j0.036 = 0.045\angle 53°$

So, the current is 45mA.

We could have avoided the two division calculations by working with admittance instead of impedance, because when admittances are in parallel they simply add rather than using the parallel formula. We then use susceptance $B = 1/X$, admittance $Y = 1/Z$ and conductance $G = 1/R$ and for Ohm's Law $I = V/Z$ becomes $I = V \times Y$ so here we have

$B_C = +j2\pi fC = j(2\pi \times 3.82 \times 10^6 \times 150 \times 10^{-12}) = j0.0036$, $G = 1/370 = 0.0027$ so

$Y = G + B_C = 0.0027 + j0.0036$. Then

$I = V \times Y = 10 \times (0.0027 + j0.0036) = 0.027 + j0.036 = 0.045\angle 53°$, that's 45mA.

If we calculate power as $V \times Z$ or $I^2 \times Z$, we get $0.27 + j0.36$. The 0.27 part is 'real' power, which appears as heat in the resistor (we could simply find $V^2/R = 10^2/370 = 0.27$Watts). The *j*0.36 part is known as reactive power and is not heat so not Watts; in mains power systems it's expressed as VAr.

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'Starting in the Hobby'

Dear Don,
As an Intermediate Licence holder, I was struck by the insightful letter from **Daniel M7EAU** in the April issue of *PW*. Having undertaken three Advanced exams and two Advanced courses, I haven't been able to gain my Full Licence. Thanks for persevering, **Steve G0FUW**!

Like Daniel, my interest in our hobby became clear, with the 'more is less' ethos of QRP. With this in mind, the Foundation licence completely caters for my interest, only needing the Intermediate level if I want to build 'non-approved' kits. The only downside of my current licence is that I can't operate abroad. This isn't something I envisage doing, but it would be nice to have in my back pocket.

I understand that IARU/ITU agreements mean that operating abroad means that candidates have to reach an agreed standard, but I am also mindful of the varying ways in which different countries satisfy this requirement.

Some of us are probably never going to pass that Full exam, but it doesn't mean we don't have good knowledge and skills. I have on more than one occasion responded on the G-QRP mailing list to a question from a Full licence holder, filling gaps in knowledge. Daniel makes some good points regarding alternative ways to recognise learning, broaden the appeal of our hobby to newcomers, and encourage all of us to explore new subject areas.

Building on his comments, I thought that the fairly recent introduction of the RSGB 'Beyond Exams' [0] scheme has huge merits. This is a starting point for building on the more practical side of what the licence holder has been taught. Rather than discussing the valid point of whether or not the exams accurately test anything useful, perhaps RSGB could have a scheme that a little like 'Beyond Exams', builds on real world matters of potential interest, in the spirit of advancing knowledge and experimentation. The formal structure will continue for the time being, but I'm not convinced that this is what will attract people to our hobby and grow the community. Perhaps we should be asking people what they would most like to learn. This doesn't have to be chiselled in stone, and this secondary framework could change, as required, a little more easily than the existing exam structure.

Proposal Number 1: Have a survey, which can be responded to by anyone with an interest in amateur radio, asking them what subjects they would be interested in learning more about. This is a blank sheet of paper, and any ideas are welcomed.

Proposal Number 2: List the subjects that we have elicited, and where possible, group them into slightly broader subject areas.

Proposal Number 3: Down-select the topics, by having an annual (?) survey of what interests people. This will help prioritise what subjects are included in the 'modules' list and removes 'cruft' from the list.

Proposal 4: Ask our community for 'subject leads', so they can be used to corral the interest in these modules. These should be anybody that has relevant knowledge, and/or enthusiasm, and should not be limited to those of us that are male/pale and stale. Diversity in our hobby is essential.

Proposal 5: Set-up areas that can be used as repositories of knowledge, and a forum for exchange. 'Groups.io' is an example, but having to subscribe to monolithic proprietary solutions should not be the first choice. Being able to migrate to a different platform is essential, vendor lock-in is not welcome, here.

Proposal 6: Introduce a scoring mechanism, so that people can pick a module and work to achieve new knowledge and to share it with others. This should be ratified.

As an Information/Data Architect, in my day job, I am used to planning things in an Agile [1] way, i.e., things are iterative, and the first step is to have a minimal viable product (MVP) [2], driven by User Requirements [3]. Bells and whistles can be added later, if they have been considered under MoSCoW [4]. Developing like this is much better than taking three years to document something, and then find out that nobody actually wanted what you built, and this is a waste of everyone's time and money.

The RSGB does a super job in many areas, but it could be argued that when it comes to flexibility and innovation, it's perhaps not as forward leaning as it could be. As an organisation relying mainly on volunteers, it will always be an uphill struggle just to stand still, never mind 'iterating'. I hope this initial response gives some food for thought.

Chris Andrew 2E0FRU
Corsham

[0] **https://tinyurl.com/2zaabb3k**
[1] **https://tinyurl.com/2y8mjmrk**
[2] **https://tinyurl.com/4u3c6r2n**
[3] **https://tinyurl.com/2vz34m3h**
[4] **https://tinyurl.com/bjf8m5zx**
[5] **https://tinyurl.com/4w8x339x**

(***Editor's comment***: *Thanks Chris, a great contribution to the subject. Maybe we can get the Exam Committee thinking outside the box, rather than just rehashing the existing question pool.)*

The Fitness of the Exam

Dear Don,

For the majority of people I wholeheartedly agree with **Daniel Keely M7EAU** that the current examinations are for most people no longer fit for purpose.

In fact, access to the airwaves using commercially available equipment requires very little technological knowledge. I believe that in much the same way as we licence people to drive a car (with minimal knowledge of mechanical technology) we could licence people to own and operate amateur radio equipment.

I envisage that to do this the syllabus would include only the information required to ensure safe, interference-free operation within the legislative licence framework. There would, of course, be both practical and theoretical elements to the training and subsequent examinations.

However, for me, I believe that I am privileged to be a radio amateur because I am entitled to operate, build, maintain and if I so wish, dream and innovate with no restrictions other than adhering to the current legislative framework.

John Nowell G4FUO
York

*(**Editor's comment**: Thanks John. You highlight nicely the dichotomy – some radio amateurs are happy only to operate commercial equipment, while others enjoy the privilege of being able to construct and use their own equipment. The latter does require sufficient knowledge to ensure no interference to other services. So, do we end up with two separate streams of exams? Hopefully not.)*

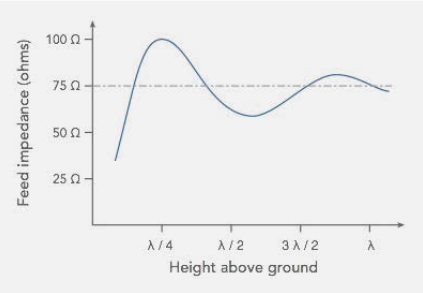
75Ω Feeder

Dear Don,

G3JRD makes a case for 75ohm feeder (April, p.34) because *"the feed impedance of a dipole is 73Ω"*.

I'm sure you are aware that is not necessarily the case, even though it was taught to me as that, during RAE classes. Once I realised that the feed impedance varied with height I gave up on dipoles (especially multiband ones) and went for a doublet with tuned feeders, and I've used them ever since. Getting any multiband antenna to give a good match on all bands, from one fixed height, requires some kind of fudge.

Given the weather in this country I prefer to spend as little time up a ladder as possible. Rather than messing about trying to get a G5RV or ZS6BKW to match at your own location, throw up a convenient length of wire. Attach twin feeder and a balanced ATU. back in the shack with a nice cup of tea, note the ATU settings for each band. Job done.



Once you move away from a simple wire antenna then yes, you have to do the outside hours, but the feed impedance is not always going to be 73Ω or 50Ω, see diagram, and you have to deal with whatever it turns out to be.

On a completely different topic, your interesting piece by G4AEE in March *PW* makes reference that 'CW is an inaccurate term because it is not a continuous wave, but an intermittent one'. Many years ago, probably back as far as the 80s, I saw reference to the fact it ought to be called 'ICW'. Intermittent carrier wave. Needless to say, old habits die hard and it never caught on.

There is an example at the 'Saltpits' Museum, along with a Naval mechanical semaphore device. Once restrictions allow visits I highly recommend going there. The vintage radio exhibit is huge, and includes a replica of **Gerald Marcuse's** shack.

I have a photo of Gerald Marcuse's son standing next to the exhibit, which I took when I represented RAOTA at the dedication of the new 'Marcuse bench' outside the church at Bosham.

David Reynolds G3ZPF
Wolverhampton

EMF Regulations

Dear Don,

Regarding the much talked about looming compliance with EMF as set out by Ofcom. I will say at the start of this letter I am not completely without common sense but conversely I am no mathematician. So far I have almost filled an A4 100 page (folder) presentation book with information downloaded from Ofcom, RSGB and other sites. With a smile on my face I can say that I now understand absolutely nothing about it!

The Ofcom information has an abundance of regulations within regulations, it's similar to having at least six bandspread controls on a radio.

Where it all goes and what it's all for, let's be honest as with many others out there, is a complete mystery. Will we next have to conduct an emissions test on the torch we all keep in the kitchen drawer? Well let's get 'real man' for a few minutes. OK this thing is here, or is it just at the proposal stage, conflicting information buried somewhere within the regulations that I fell asleep with while reading.

A few weeks ago a telephone call to Ofcom resulted in no assistance whatever, just an email the next day advising me to download the spreadsheet off their site. However, I did not have the appropriate formatting on my laptop, and Ofcom don't have PDF. Trying to download a free version of 'what was needed' off the net was unsuccessful unless I was prepared to wait until my white hair turned black again! Consequently, I paid for the version required to suit the Ofcom format. What a disappointment, I found the system impossible to understand even after the purchase of a book for seniors.

So where do we go from here without assistance in order to comply?

I found on the internet an Amateur Radio RF exposure calculator. I don't think with copyrights I should state exact details here, however the inputs needed were Watts to antenna/antenna gain in dBi/distance to area of interest/frequency of operation in MHz. Then click RF power density. All required answers given along with a yes (if appropriate) under comply.

Why cannot Ofcom that set up the above compliance ruling, not come up with a similar straightforward method and as a result all licensed amateurs that fall under the category will be able at a click to do the then simple task?

In conclusion, I do wish that Ofcom/RSGB or whoever can attend to this matter with urgency to allow amateurs to complete this item simply and speedily, without the need of spreadsheets or whatever and please gentlemen, not too much criticism of my letter, I hold your best interests at heart.

Denis Speirs 2M0DOI
Arbroath

*(**Editor's comment**: Denis, you have my sympathy, and I know you have actually been involved with radio for more than 60 years – yes, beating even me! As I said in my editorial last month, there remains a lot to be explained and clarified. Meanwhile,*

readers may be interested to know that I am currently reviewing the GQ EMF Meter sold by PW *advertiser Moonraker, which at least gives an idea of what the radiation levels are near and around our antennas.)*

Rag Chewers PTT

Dear Don,

In recent times headphones with a boom microphone have become very popular. An extra is an adapter to suit the particular radio you are running but no PTT is supplied.

VOX can be used or buy a footswitch or press button but these can be expensive. And for the older or disabled operator keeping your foot pressed down or your fingers keeping the button down can be a problem. Enter the bedside lamp switch! You remember I'm sure – push down once, light on, push down again, light off. So, transmit, receive.

These switches are available for £2 to £3 each, single hole fitting, so can be fitted in a small project box or tin, length of twin core cable and a 1/4in jack plug, you're in business! £5 or less should cover the cost.

Gerry Birkhead EI9DZ/G4KOQ
Carrick on Shannon

GE/ME Prefix

Dear Don,

I recently discovered that there are many hundreds of UK callsigns shown on QRZ.com with a GE or ME prefix. Try using a GE* or ME* search and you will see what I mean. The callsigns affected are mainly English clubs and are in addition to the regular listings. The data appears to have been added over five years ago and may be related to the time when new licences were issued, for a short time, with an ME prefix. I contacted the QRZ Admin team about the club licence I hold and the error has been corrected. However, it does seem that it is only being fixed on an individual basis. Some readers may remember the GE prefix being allowed for all UK stations to use in June 1977 as part of the Queen's Silver Jubilee celebrations. I do not believe it has been authorised since.

Steve Down G3USE
Honiton, Devon

*(**Editor's comment**: Thanks for your email Steve. I have no idea why 'E' should be included but, of course, qrz.com is by no means a definitive listing, and many folk may not realise their details are even on there, so won't have thought to correct them (but see this month's* What Next *column). As you say, they will only change things on an individual basis. Not the end of the world but certainly misleading and, yes, maybe a result of the time when Ofcom was including a regional secondary prefix with all callsigns issued.)*

Replacing SMD ICs

Dear Don,

Further to **Michael Jones GW7BBY's** excellent article on SMD soldering, a useful and 'safe' technique for removing large multi pin ICs (such as the type featured on the cover of April's *PW*) is as follows:

1. Pass a fine enamelled copper wire under the legs along one side of the device and anchor one end around some convenient point of the PCB, for example a connector, mounting hole etc.
2. Apply gentle tension to the free end of the wire, pulling it outwards from the IC, across the plane of PCB.
3. Starting where the free end of the wire emerges from behind the pins, carefully run a soldering iron along the pins pulling the wire under each pin as the solder melts.
4. Repeat for all sides and the device should fall off the PCB intact.
5. Clean up the pads with solder wick and a small amount of flux from a flux pen in preparation for installing the replacement device.

This approach minimises the risk of damage to the PCB and tracks through excessive heating or cutting of pins. The gauge of the wire needs to be fine enough to pass behind the pins, typically 0.3mm or less.

When soldering an SMD IC, sometimes solder bridges may develop behind the pins that are very difficult to remove with solder wick. An effective treatment of these without heat stressing the device or PCB is to:

a.) Take short piece of enamelled copper wire of small enough diameter to pass behind the pins to the bridge (0.3mm works well).
b.) Scrape off the enamel for about 1cm on the end of the wire.
c.) Dip the wire into 'no clean' flux and pass it behind the pins up to the solder bridge.
d.) Tin a low wattage iron and heat the pins in the area of the bridge.
e.) The solder bridge will melt and tin the end of the wire, remove it with the heat applied to prevent bonding.

For stubborn bridges you may need a couple of attempts. to ensure that the solder will flow onto the wire, a freshly cleaned section must be used each time.

On another topic, that of jargon, I fully agree with the views of **Neil Smith G4DBN** expressed in April's *Letters* column. Some of the nonsense that can be heard on the amateur bands that passes for voice procedure is an embarrassment and portrays a poor image of our hobby to the casual observer or potential newcomer. Consideration should be given to including standard voice communications protocol in any future revision of the licencing exam syllabus, which would typically include structure and keywords. All simple stuff.

Ron Taylor G4GXO
Penrith

19 Set Issues

Dear Don,

Readers might recall I bought a 19 Set about three years ago and it needed much work to get it going. I had an article in *PW* about it. I have made further improvements but two things are baffling me and raise several questions that your readers might have an explanation for.

1. When I got the set the BFO was disconnected. I checked it and found it to be working but the amplitude was going up and down as well as varying the frequency when I rotated the Heterodyne Tone control.

This led me to check inside the IF transformer where I found one capacitor of 140pF and one of 47pF across the windings. I have never seen two different values used before. I could see an imprint in the wax where something had been removed. The circuit diagram shows 140pF used in both transformers.

I bought three 47pF and wired them in parallel. The set was still pretty deaf and only when I connected a trimmer from the valve grid to earth did I get gain. I can't adjust the cores since they are solid, possibly glued, which makes sense in a tank going over rough ground to stop things being detuned.

My first question is whether two different values were normal in a 19 Set and why? My second question is if not, why did somebody do it? It makes me think I should check the second IF transformer.

Staying on the BFO I have another intriguing question.

I have been using the 19 Set often since Boxing Day on 60m CW starting with the G-QRP Club Winter Sports but last week it gave up oscillating. It had always been a

bit dodgy and not always working. A boxed NOS valve was tried first as a simple solution but it still didn't oscillate. I then checked voltages and found only 7V on the anode and assumed something must be pulling it down. I spent a few hours over two days re-checking the circuit and decided there was nothing faulty anywhere. It just didn't have HT.

There is HT at 240V on the unused number 1 valve pin feeding a 47kΩ resistor, let me call this R1, to a tag strip then onto a 470kΩ resistor, let me call this R2, to the anode with the BFO coax connected where they join together.

The 470kΩ (R2) had gone up to 940kΩ so I substituted four 2.2MΩ in parallel to make 550kΩ and the HT (!) went up to 12V but the valve was still not oscillating.

I bypassed R2 with my meter, which showed the valve taking 3mA, quite acceptable, and found 96V on the anode. The information I have says 89V. I replaced it with 47Ω but then the coax had to be connected to the valve anode to get a signal. The amplitude is now constant when rotating the Het. Tone knob.

My third question is why did the valve oscillate with what must have only ever been 7V on the anode through R1 and R2?

My fourth question is why did it stop and never work again? It has been working fine for a week now and see no reason it will not continue to do so.

Bill Kitchen G4GHB
Ashton Under Lyne

Ofcom and RF Exposure

Dear Don,

In reply to **Patrick M1BNH** (*Letters*, May), I would like to make the following points. However, I should say that although I am not an active amateur I need to re-apply for my licence as I let it run out. I have paid my RSGB subscription since the age of 14, and am now listed as over 50 years' membership.

There are those as M1BNH's letter shows who seem to think this voluntary organisation has huge financial and manpower resources at hand, and can take on government organisations, hire lobbyists, and launch judicial revues. Obviously, this is not so.

The allegation that the RSGB goes along with OFCOM's actions is supported by no evidence offered. Just uninformed accusations. Those who read *RadCom* know that there are many meetings and submissions made to OFCOM. The RSGB can only seek to influence decisions. It has no veto power, and cannot generally contemplate the cost of legal challenges even if it thinks there are due grounds.

Further, it is not true OFCOM does not take action on RFI issues. As correspondence shows from members, sometimes they are very helpful, sometimes not. What one may say is that they will not take action where the interference is to the AM broadcast bands, which is an illegal decision. Also, they were not prepared to take on BT who knowingly have issued PSUs for broadband units, which are non-compliant and caused widespread interference. It seems BT have, however, co-operated by replacing them where there is a complaint and the RSGB did start a fighting-fund to take judicial review here.

Finally, two more false statements. It is not OFCOM that want drive us off the airwaves and then flog them to the highest bidder. It is government policy, part of the obsession with the free market and of digital everything. The allegation that the RSGB is in collusion with OFCOM is defamatory, but as M1BNH knows there will be no real consequences for making them.

Generally, it can be argued that OFCOM do take the RSGB seriously. They include its representatives at ITU and WRC, and also take on board RSGB arguments made there. The RSGB has succeeded in gaining new allocations, such as in the 5MHz band, and above 240GHz.

The issue of the standard of the RAE was also brought up. True it was very reduced, though it appears many new and one may argue irrelevant topics have been added now, as you highlighted a couple of issues ago. What the Old Guard do not seem to understand is that there are only two legitimate criteria for the syllabus/exam: 1) That the candidate demonstrates they know enough not to be a danger to themselves or anyone else, and 2) that they know enough not to interfere with other spectrum users. And that is all. Not being able to design a PA stage in the black-box era is not now relevant.

Philip B Moss
Surbiton, Surrey

SMDs

Dear Don,

I was inspired by the SMD soldering article. **Michael GW7BBY** did a superb job encouraging SMD-shy builders to prepare for success. His jig tool in Fig. 5 inspired me on a Saturday while I took a break from some contest data analysis. I marvelled at Michael's ingenuity at solving a problem of keeping the tiny SMD part in the exact place on a circuit board.

Recalling that I had some old articulating arms in a junk box, I paired one with a slingshot bolt (arrow) to create a similar jig. I used a Dremel rotary tool to cut off the sharp tip of the bolt to create a very small flat tip. I use a thin sheet steel base on my homebrew soldering platform. The red magnet base I had used for a mount on the arm allows for a temporary setup for SMD soldering. The attached picture illustrates this version of GW7BBY's idea holding a small washer in place on a copper clad board. It took about an hour to make two of these jig tools: one for me and one for a ham friend whom I recently made a similar steel soldering platform (**Thomas N5WDG**).

Thanks again for publishing another great issue!

Frank Howell K4FMH
Ridgeland, Mississippi

5G Thoughts

Dear Don,

I somehow forgot to comment on G3ZVW's (January 2021, *Making Waves*) informative article regarding 'Mobile Phone Frequencies'. Better late than never.

Anyhow, I was particularly interested in Steve's comments regarding 5G operations. As far as future 6G coverage is concerned, this will entail a much larger RF infrastructure, if and when it happens. 5G will necessitate, as Steve points out, a lot more base stations for reliable communications. A great deal more. Being sited on every lamp post, etc because high hedges and yes, trees can block 5G signals too.

After all, at 3GHz or so, signals travel about 300m, hence the need for a load of RF transmission points here there and everywhere.

In passing, who is going to actually stump up the cash to pay for millions of 5G mini base stations that will be needed, when most people have super-duper fast broadband installed in their homes already? 5G's primary use so far as domestic use is concerned, is when huge numbers of users need access to social media data all at once – maybe at a football game or huge shopping centres, as Steve mentioned.

But of course, 5G is not about ensuring Aunt Sally up the road or Ted next door can access social media simultaneously, simply to catch up on what cereal their friends had for breakfast last week and touted to the public solely for entertainment purposes. It's really about creating an environment whereby 'artificial intelligence' will have a much greater impact on our lives, each and every day. Besides, do people really believe that fifth generation data transmission is just about streaming the latest blockbuster Netflix movie to their 5G smartphone?

So perhaps not unsurprisingly, to ensure that 5G coverage in all land-based areas is never compromised, **Elon Musk**, he of Tesla car fame, has been given the go ahead by the US FCC to launch a few thousand satellites (SpaceX/Starlink), which will provide global data broadband everywhere on the planet. To get the signal from these satellites to the end user it will, of course, go to a ground station on a different frequency first. And these satellites won't be transmitting 5G wavelengths directly to the user as is commonly believed. After all, again, 5G signals only travel 300m or so, not hundreds of miles. Elon Musk's black box's will be orbiting the Earth about 500km away! Musk's Starlink satellites won't be the only ones launched into orbit. Boeing and Spiral Global are two other companies ready to provide global broadband services. Geo-engineering on a grand scale. A bright and shiny electromagnetic future. But do we all need to be irradiated in yet more electromagnetic radiation, to satisfy an agenda that is questionable?

But to return to the logistics, will the 5G electronic eco-system land-based masts be using a phased array? Whereby a group of antennas will be co-ordinated to radiate signal pulses in this direction or that direction, in a specified time sequence? It makes some sort of sense. Or is there another smart solution to the same problem? Probably.

As already mentioned, although 5G is being marketed to the public as a tool to dramatically enhance their access to streaming etc, it's not about that at all. It's a blind acceptance that this technology will be good for them. However, what is conveniently left out of the equation are the health issues. One of which, is the higher the frequency the greater the absorption of electromagnetic waves into human tissue. 5G will be operating at 30GHz. Up until now, these frequencies have not been propagated widely. This will mark a very significant step in the type of electromagnetic smog that all of us will now have to face in the natural environment.

Lastly, a single 5G transceiver will have up to a thousand antennas in one small base unit. The actual unit will be small. Probably a few inches square. Well, they'll have to be small, not to be noticed. As for the 5G smartphone, they will have several antennas too. The last time I looked, Qualcomm makes a millimetre wave antenna unit that fits inside a 5G smartphone. Four antennas inside each one. It's tiny too. And I guess four won't be enough. So maybe two or even four units will be needed. More the better, if only to pinpoint to the nearest hidden 5G base unit. We wouldn't want anyone to lose touch with what someone somewhere had for lunch yesterday, would we? If only that were the case. But of course, it never was.

Ray Howes G4OWY/G6AUW
Weymouth

Next Month

in the UK's best & only independent amateur radio magazine...

REVIEW – YAESU FTDX10: The editor Don Field G3XTT takes a look at this latest exciting addition to Yaesu's range of HF transceivers.

REVIEW – ANYTONE AT-779UV: Tony Jones G7ETW has been playing with this dual-band FM mobile.

RECEIVER FRONT-END PROTECTION: Vince Lear G3TKN looks at ways of implementing separate receive antennas.

KITS & MODULES: Geoff Theasby G8BMI has some thoughts on comparing antennas and introduces the Flowerpot from Australia.

DOING IT BY DESIGN: Eric Edwards GW8LJJ has a design for an antenna analyser.

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* Photo shows the FTDX101MP

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The Battle of Britain
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THE BATTLE OF BRITAIN IN COLOUR

The Battle Looms

The Battle of Britain was one of the most iconic battles of the Second World War, embedding itself indelibly into the nation's consciousness. Earlier, the Battle of France could easily have spelled defeat before the air battles got underway in July 1940.

After the outbreak of war in September 1939, there followed eight months of what became known as the 'Phoney War'. However, it was clear that large-scale fighting would ultimately follow, and a British Expeditionary Force was sent to France before the end of that year. As part of that BEF, a large Air Component was supplemented by an Advanced Air Striking Force. In total, these air forces amounted to 25 squadrons, six of which were Hawker Hurricane-equipped fighter squadrons. The remainder of the RAF force in France comprised largely light bombers and Army Co-Operation squadrons. Eventually, however, the 'Stukageig' became the 'Blitzkrieg'

On 10 May 1940, German forces launched their all-out assault on France and the Low Countries and what followed in Belgium, the Netherlands etc. was the complete collapse of those countries under the overwhelming might of German military power. Across France, German forces rolled inexorably onwards towards the English Channel and while the French and British tried desperately to stem the advance, so the situation became ever more hopeless.

Predicted Catastrophe

When the fighting had broken out in earnest on 10 May 1940, aircraft of the Air Component were in almost constant combat, and losses had to continually be made good from squadrons based in Britain. The Commander-in-Chief of RAF Fighter Command, Air Chief Marshal Hugh Dowding, had already stated as early as September 1939, that if he was expected to defend Britain's skies, then he would need 52 fighter squadrons. At that time, he had only 32 under his command and was told it would be impossible to produce the number he required. However, efforts would be made to provide him with a further eight.

During the fighting in France, increasing numbers of fighter squadrons were sent across the Channel, urged on by desperate appeals from the French Prime Minister, Paul Reynaud. Dowding saw his resources 'slipping away like

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BACKGROUND TO BATTLE

Left A Hurricane of 501 Squadron starts-up for an operational sortie at Bethenville, France, May 1940. Air Chief Marshal Hugh Dowding argued successfully against further wastage of the home-based RAF fighter force by sending yet more fighters to France to bolster a futile defence.

Right As the unstoppable juggernaut of German military might advanced across Europe, the deadly Junkers 87 Stuka dive-bomber came into its own. However, the RAF quickly learned how aircraft, and this stood t when facing the Stuka a Britain.

Below right Panzer IV t France in May 1940. Th was rapid and overwhel weeks France had colla were evacuating from D

THE RAF FIGHTER PILOT

were not afraid that they were either liars or foolish. However, a strident jangling of the telephone could mean several things. Sometimes, to intense relief, it could send a message to 'Stand Down'. Other times, it called pilots to readiness, and then to the heart-pounding order: 'SCRAMBLE!'

Years afterwards, veterans of the Battle of Britain told how they hated the sound of a ringing telephone.

On the order to scramble, there was a mad rush by pilots to their allotted aircraft where the fitter and rigger were ready and waiting: the rigger on the wing ready to help in his pilot, and the fitter standing by with the starter plugged in on the starboard side of the engine. Heaving himself into the cockpit, the pilot went through a number of tasks: helmet pulled on, oxygen plugged in, radio jack-plug in its socket, magneto switches 'on', Ki-Gas cylinder priming pump given a couple of brief strokes and thumb ready on the starter. Meanwhile, leaning into the cockpit, the Fitter helped the pilot with his parachute harness straps, then his Sutton seat harness.

By this time, the starter button was pushed after a thumbs-up from the fitter, who unplugged the starter trolley, ensuring it was clear of the aircraft. Unable to communicate over the roar of the Merlin engine, the pilot and rigger exchanged thumbs up signals, the rigger slapping his pilot on the shoulder to convey reassurance and good-luck as he leapt from the wing. As he jumped, the aircraft was already rolling, and the rigger dodged out of the way of the tail-plane, buffeted by the slipstream which was kicking up dust and grass. Getting out of the way, he was hit by a blast of hot exhaust gasses. Now, the aircraft gathered speed ahead, into wind, bouncing and rocking across the grass airfield. Others careered along around it, in the organised chaos that was a squadron scramble.

Getting airborne, the pilots concentrated on keeping station as they selected 'Gear Up', closing the cockpit canopy while listening out for instructions from the CO or flight commander who was talking to the Sector Operations Room and garnering instructions as to heading, altitude and

Facing page Pilots of 19 Squadron are delivered to their dispersal point at RAF Duxford ready for operations early one morning during the summer of 1940.

Above Their relaxed look perhaps concealing the tension, these Hurricane pilots of 501 Squadron pose for the camera during the summer of 1940. All of them saw action. Several of them shot down enemy aircraft and some of them were killed.

what it was they were intercepting. It may have been an instruction along the lines of: "MITOR Squadron, ANGELS 18, Vector Two-three-zero, Fifty Plus. BUSTER." Listening in, the other pilots could interpret these coded instructions: "40 Squadron to climb to 18,000 ft on a heading of 230 degrees. Fifty plus enemy aircraft. Maximum cruising speed".

Mentally and Physically Draining

Settling into the climb, the pilots automatically slid into section order and the preferred squadron formation. Meanwhile, the CO or flight commander concentrated on setting course as the

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THE RAF FIGHTER PILOT

other pilots concentrated on what was going on in their cockpits: oil temperatures and pressures, fuel state, oxygen contents checked and selected to 'On', microphone not on 'Transmit' (this could effectively block all other transmissions), straps tight, gun-sight 'On' and illuminated, straps tight and canopy firmly shut. A surprising number could carry out a little good luck routine – the feeling for a lucky charm, or even crossing themselves.

Now, the workload was high, and still they needed to concentrate on formation keeping while permanently keeping a wary eye open for the enemy and quartering the sky in a relentless search. A moment of relapse could literally spell death. The squadron 'Weaves', winding from side to side, kept a rather more wary eye open than the rest, as the squadron got closer by the second to their quarry. Brief instructions might crackle through the headphones: 'Close up Red 2' or, on receipt of further instructions from the Fighter Controller: 'Turning to Port, Go!'

Meanwhile, pilots fiddled with the radio tuner, struggling to tune and re-tune their wireless sets in a constant battle to receive and properly understand the messages. Sometimes, a squawk of static drowned out everything, sometimes resulting in one section

having off suddenly, upwards or downwards, the rest of the squadron watching in bemusement and puzzled because they received no transmission, or else just couldn't understand what had been said. Meanwhile, constant juggling of the throttle setting with the left hand, and judicious adjustment of position through the control column and rudder pedal inputs, were all necessary just to keep station. It was incredibly hard work, and mentally and physically draining.

By now, the squadron was 'on oxygen', masks clamped securely to pilot's faces as cold began to permeate the cockpits. Now, with all the hard work of take-off, formation flying and getting to altitude, came further nervous tension with realisation that the enemy were near. Then, a tight knot of fear returned as the gunsight was checked and the SAFE and FIRE ring on the gun button turned, ready, to the FIRE position. Goggles pulled down. And then the shout:

'BANDITS! Ten o'clock, above. Coming down now! Break, break, break...'

Chatter Of Gunfire

Suddenly, to avoid the 'bounce' of fighters coming out of the sun, the squadron had dispersed in a pre-ordered plan. Now, the enemy fighters were among them. This time, there was no

Facing page Although posed for a news cameraman, the squadron telephone orderly shouts instructions for a 'scramble' as pilots lounge in the dispersal hut. The smartly dressed officer is Duty Pilot – the pilot rostered for ground-admin tasks such as recording take-off and landing times etc.

Above It was not unusual for aircraft to return damaged after an engagement and with pilots wounded. This brand-new Spitfire had just been delivered to 602 Squadron at RAF Westhampnett when it was hit by cannon shells from a Messerschmitt 109 in a combat on 18 August 1940. The aircraft was written off and Flight Lieutenant Dunlop Urie wounded in his feet.

chance of a well-ordered textbook 'Number One Attack'. Instead, it was every man for himself, but with 'wing men' desperately trying to maintain station and protect their section leader.

Now, the pilots were climbing and hanging on their props, the sun glaring and blinding as they turned, all the while listening out and looking out. Now, there were shouts: "Behind you Blue 3!", permeated by chattering gunfire. A cacophony of shouts and static made communication unintelligible. One pilot may be drawing a bead on a

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