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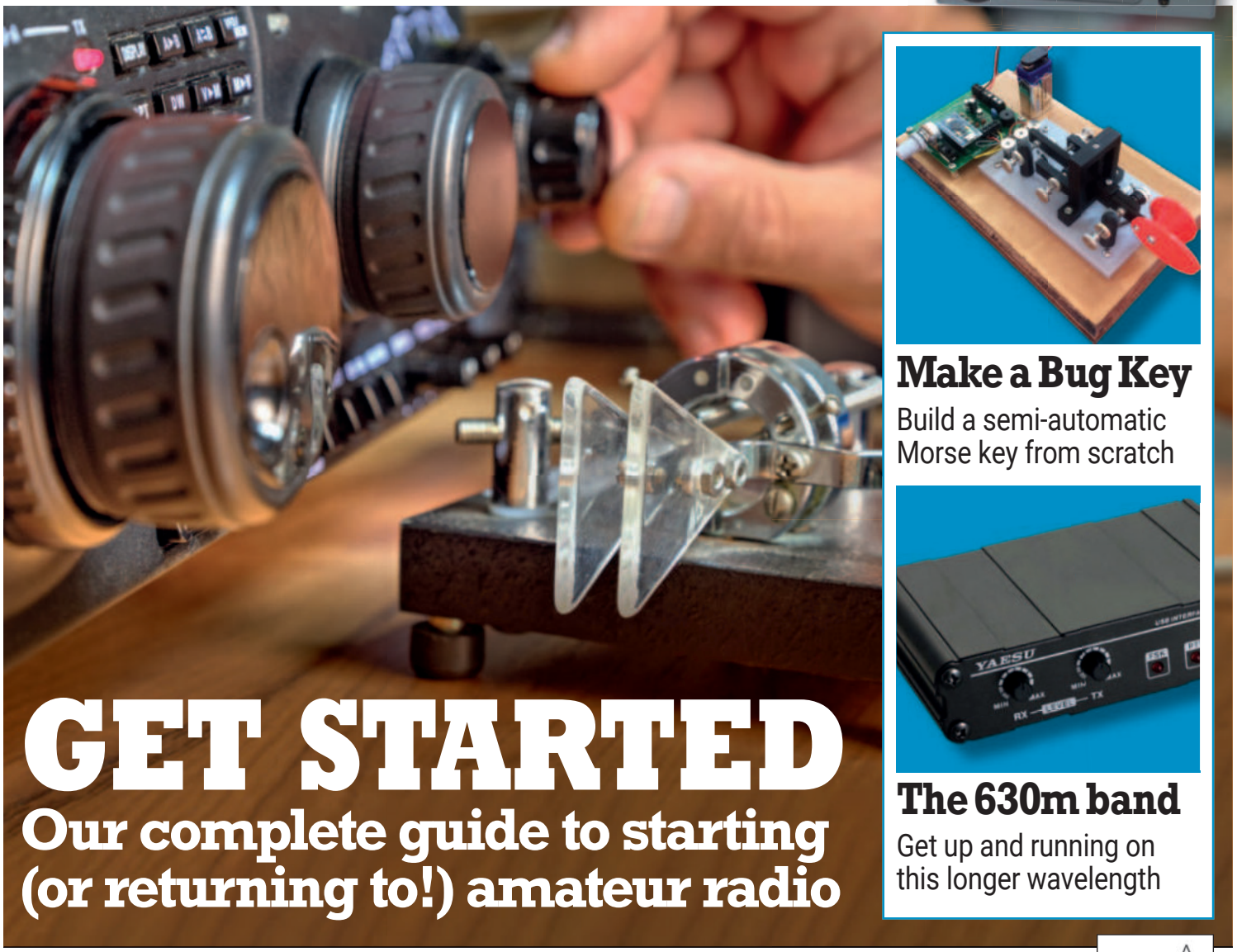

GET STARTED
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Build a semi-automatic Morse key from scratch

The 630m band
Get up and running on this longer wavelength

TEST DX Commander ABV Multi-Band Vertical
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PRACTICAL WIRELESS

August 2020 Vol. 96 No 8
On sale: 9 July 2020
Next issue on sale: 13 August 2020

ISSN 0141-0857

Practical Wireless
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Subscriptions are available as little as £11. Turn to our subscriptions page for full details.
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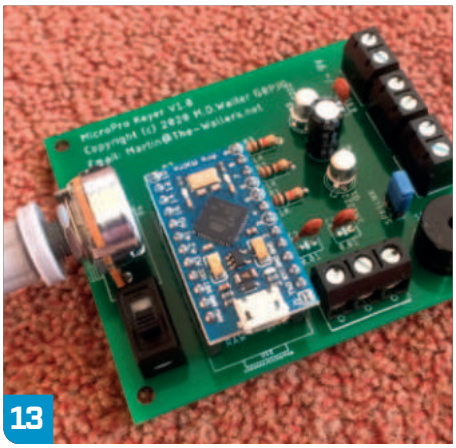

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Keylines

Another month of lockdown and although some of the restrictions are being lifted, the effects are likely to be with us for many months to come. Indeed, the organisers of the annual Visalia (California) Convention have already said that next April's event will be a 'virtual' one! Which reminds me that several readers have commented on the recent reduction in *PW*'s page count. I'm afraid this is a direct result of Coronavirus and the closing of many newsagents. So, sales are down but at least we have been able to keep publishing the magazine, mainly thanks to loyal subscribers. We do, though, look forward to resuming the normal page count once things get back to (the new?) normal.

EMC Consultation

Ofcom recently carried out a consultation on EMF (electromagnetic field exposure), inviting all radio users to respond. I apologise for not having alerted readers to this in time to respond but the RSGB seems to have been somewhat remiss in alerting the wider amateur radio community to the consultation. However, their own response (accessible via the 'open' section of the RSGB website) is extensive and I do know that many clubs and individual amateurs have responded.

There appear to be a number of issues as far as amateur radio is concerned. The consultation seems to have been initiated in response to a need for UK radio users to adhere to ICNIRP (International Commission on Non-Ionising Radiation Protection) guidelines on RF exposure. But in trying to consult with everyone from 24/7 broadcasting organisations to occasional users such as yachties, taxis and, of course, radio amateurs, the survey seems to be rather heavy-handed.

I don't intend to comment in detail here. But radio amateurs are not trained to measure or analyse their levels of radiation, there is no evidence (despite numerous studies) of health problems resulting from exposure to radiation (other than high levels at microwave frequencies and above) and, in any case, amateur radio transmissions are, by nature, sporadic.

Let's hope that common sense prevails because a heavy-handed approach could be the death-knell for our hobby. We would, in an extreme case, be required to submit results for every band, every direction in which we turn our antennas and so on. I will I report back to readers once we know more.

Antennas for 80m

In his column this month, **Joe Chester MW1MWD** is trying to put out a decent signal on 80m to join various nets and activities around the UK. He settles on a (largely) vertical antenna, almost certainly because this is all he can manage within the confines of his QTH. But it got me reflecting on my recent experiences on the band, with the real estate to try various antennas.

I started after moving here last year by putting up an inverted-L (around 50ft or so high) for 80m, mainly for DX chasing. And very well it has worked too, netting me contacts with ZK3A (Tokelau), VP6R (Pitcairn) and others. But when I used it in one of the RSGB 80m CC events the results were extremely disappointing – with 100W I was having trouble being heard around the UK.

Instead, I erected an inverted-vee dipole at about 45ft, a veritable 'cloud warner' (i.e. radiation is predominantly vertical, rather than towards the horizon). The results have been nothing short of amazing, with wins in the Unassisted section in the past two months' CW events.

And in the CQ WPX CW Contest at the end of May I had both antennas up and available. Perhaps not surprisingly, the inverted-vee had the edge out to, roughly, Russia and similar distances, but the inverted-L definitely came into its own for greater distances (e.g. to the USA). None of this is remarkable – it's all well-known – but its nice to have it proved in practice!

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 Moonraker

Moonraker have recently introduced the Baofeng UV-9R Plus Dual-Band water-resistant handheld. This covers the 2m and 70cm bands as well as having an FM broadcast receive capability. And, of course, all the usual features you'd expect. The price is £34.99 and full details are available on the Moonraker website: **https://tinyurl.com/yahyfmbk**

Moonraker also now sell the Shakespeare Dual-Band inflatable antenna for 144-146 and 430-440MHz. This is an end-fed antenna with a claimed gain of 3dB and sells for £99.95. Again, full details on the Moonraker website: **https://tinyurl.com/yd9zlxnc**

Radio News

RSGB SEEKS INTERFERENCE REPORTS FROM AMATEURS : The Radio Society of Great Britain has urged amateurs to contact Ofcom if they are suffering from interference on the HF bands that may be caused by VDSL interference. VDSL (very high-speed digital subscriber line) provides residential broadband internet in the UK and according to the RSGB the regulator is not aware of the widespread interference issue. Ofcom has said that it receives perhaps six complaints about it annually and has no plans to attempt to remedy the situation.

The request was made in a letter in the May edition of the society's *RadCom* magazine, which has been made available as a free sample downloadable PDF copy on the Society's website so that UK amateurs can access it whether or not they are RSGB members. In the letter, President Dave Wilson M0OBW said radio amateurs need to make the regulator more aware of the pervasive problem on the bands at frequencies up to and including 20m. The RSGB is asking amateurs to e-mail a copy of their complaints to the Society so they can track them and follow them up with Ofcom. The address for that is **vdsl@rsgb.org.uk**

COURT OKS SALVAGE OF TITANIC'S TELEGRAPH STATION: The Marconi telegraph station aboard the ill-fated Titanic may see the light of day this summer for the first time since the liner sank after striking an iceberg in the North Atlantic in 1912. A federal judge in Virginia recently granted permission to the salvage company that had told the court the radio transmitter could be damaged irreparably because of the time the ship's been underwater. The telegraph sought by the company, the RMS Titanic Inc, is the one used to send distress calls. The salvage company's mission has been challenged by the National Oceanic and Atmospheric Administration and others who believe the wreckage should be left untouched. The private company has exclusive salvage rights to the ship.

RALLY NEWS: Bob Glasgow GM4UYZ reports that Cockenzie Rally, scheduled for August 14th, has been cancelled.

The RSGB has cancelled this year's HF Convention at Milton Keynes, scheduled for October, and replaced it with a one day 'virtual' programme of presentations. Here is the announcement from the RSGB:

RSGB Annual Convention arrangements

In response to the UK's continuing social distancing regulations, the RSGB Convention Committee has changed the arrangements for the Society's Convention on October 9-11th. Instead of the physical Convention in Milton Keynes, the Society is instead holding an online Convention on Saturday October 10th. Whether you're a new licensee or have been enjoying amateur radio for many years there will be a range of topics from expert speakers that you can enjoy free throughout the day. The RSGB will announce further details of the presentations and how to take part over the coming weeks via its website: **www.rsgb.org/convention**

And even further ahead, next year's Visalia (California) Convention, normally held in April, has also been cancelled, to be replaced with a two-part 'virtual' convention:

Part 1, April 16-18 and part 2, April 23-25. Each will be a unique three-day event, without duplication. Registration will be in early 2021, registration dates to be announced. More information at: **www.dxconvention.org**

Enter our competitions at www.radioenthusiast.co.uk/competitions

Radio News

AMATEUR RADIO ARTICLE IN U3A MAGAZINE: Michael Meadows G4GUG reports that an article an article he wrote for the U3A (University of the Third Age) magazine *Third Age Matters* (Summer 2020 issue) has now appeared in print. He says, *"There has been a good response from licensed and lapsed radio amateurs, and enquiries from interested parties within U3A members"*.
www.u3a.org.uk

YASME FOUNDATION SUPPORTING GRANT TO ESTABLISH RBN NODES IN AFRICA: The Yasme Foundation Board has given a grant to set up RBN (Reverse Beacon Network) nodes in Algeria, Tunisia and Libya. The project will implemented by 'youth' in the radio clubs there:
http://amateurradiointunisia.org
This will increase RBN presence in North Africa for amateurs and scientists. The RBN is made up of software defined radio receivers around the world that monitor the amateur bands and report CW, RTTY and FT8 signals to a database:
www.reversebeacon.net

EURAO OFFERS THIRD PARTY INSURANCE BENEFIT: The European Radio Amateurs' Organisation, which brings together organisations, clubs and individuals across Europe, is now offering new members free third-party liability insurance.
Currently costing just 10 Euro per year, EURAO membership, including the insurance benefit, represents vital protection in the event that any of your field activities caused injury to someone else, or damage to their property. Anyone operating away from the home would, in today's litigious society, be foolish not to have such cover.
The terms and conditions for the insurance are currently being translated into several languages but should be available soon.
In the meantime, details are available in the EURAO newsletter, available from their website:
eurao.org

HOW FT4 AND FT8 WORK: Joe K1JT and associates are explaining the FT4 and FT8 protocols, figuring that operators may be interested in how WSJT works.
Joe says all the technical details are in a paper by Steve Franke K9AN, Bill Somerville G4WJS and himself published in the July-August issue of *QEX* magazine. A copy is on the WSJT website:
https://tinyurl.com/y8c7y9de

WSPR WATCH: WSPR watch is a new App from the Apple App Store for users of WSPRnet, PSKReporter or the Reverse Beacon Network (RBN). It quickly shows who can hear you and details of each spot. Tap a spot in the table to look up the call on qrz.com
Export produces a tab-delimited CSV file that can be used for later analysis. PSKReporter, of course, carries FT8, FT4 and other WSJT spots, while the RBN includes many CW spots.

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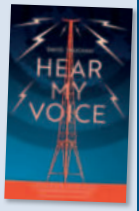

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DX Commander 10m ABV Multi-Band Vertical

Steve Telenius-Lowe PJ4DX
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Steve Telenius-Lowe PJ4DX reports on a multiband vertical suitable for both home and portable operation.

The DX Commander 10mABV, **Fig. 1**, is a multiband vertical antenna, designed and marketed by 'Mr DX Commander', **Callum McCormick M0MCX [1]**. The distributor for DX Commander poles is Martin Lynch & Sons **[2]** and the 10mABV may soon also be available from them. The antenna consists of a fibreglass pole, which supports several vertical wire elements separated around the pole by a series of spacers, **Fig. 2**.

When I heard that **Peter de Graaf PJ4NX** had ordered a 10mABV vertical I was interested to see the antenna and find out more about it.

The antenna arrives as a kit, which the user must assemble. The kit includes the fibreglass pole, sufficient DX10 Mil-Spec wire to make the radiating elements and ground radials, two pre-drilled aluminium plates for connecting the radiating elements and the radials, three UHMWPE (ultra-high-molecular-weight polyethylene) plates that keep the elements spaced from each other, plus all the necessary hardware, cord, carabiners, etc to allow you to make the antenna. The kit includes extra hardware in case any pieces are lost during assembly. An SO-239 socket assembly is provided to allow you to connect your 50Ω coax with a standard PL-259 'UHF' connector. The aluminium and UHMWPE parts appear to be of excellent quality.

Which Bands?

10mABV suggests the pole is 10m long. This is not quite the case because the pole extends to 9.3m, which is slightly too short for a full-length quarter-wave vertical for 40m, although this is not an issue as we'll see later.

Up to six wire radiating elements can be used, but some work on more than one band so anything from one to nine bands can be provided and the user chooses which of the bands he wishes to use. The wire elements are cut by the user from the 100m length of wire supplied, so some thought is necessary about how the antenna will be configured before getting to work with the wire cutters!

If the user wishes to include 80m, a 19.5m-long wire is cut but, because this is longer than the overall length of the pole, it must be configured as an inverted-L. The top sections of the pole are too thin to support the weight of the horizontal part of the element so it is suspended from a point about 6.7m high, where the pole is more substantial. The remaining 12.8m of wire should be pulled out horizontally (or sloping as gradually as possible) and tied off to a suitable support.

If an 80m element is used, it will also function as a 3/4-wave inverted-L on 30m. However, if the user does not wish to use 80m, a conventional quarter-wave 30m element can be cut instead. In either case there should also be a resonance close to 6m, although Callum notes that if an 80m element is used, you are likely to need to use the auto ATU in your transceiver on 30m and 6m.

There is no separate wire for 15m. The 40m wire is also used for the 15m band. As the pole is 9.3m long, it's slightly too short for a full-length quarter-wave on 40m. However, Callum discovered that by extending the wire beyond a quarter-wavelength to 11.15m and folding the top 1.85m of wire back down from the top of the pole a good match can be achieved on both 40m and 15m.

The 20m and 17m elements are conventional quarter-wave vertical wires.

In the assembly instructions Callum writes that if you are happy to use an internal ATU, you should not need to add the 12m and 10m wires because the SWR will already be comparatively low on those bands just by using the four other wires. However, for those wanting a better than 1.5:1 match on 12m and 10m, additional quarter-waves for those bands can be added, making up the total of six wires.

Construction

Once you have decided whether or not to include the 80, 12 and 10m wires, the wires for the bands to be used should be cut to the lengths given in the instructions. Callum wisely suggests adding a short additional length on each band to be


1


2

Fig. 1: The completed DX Commander 10mABV vertical. Fig. 2: The vertical wire elements are separated around the pole by spacers. Fig. 3: During construction a short additional length of wire is wrapped back to allow for fine tuning and temporarily held in place with insulating tape.

wrapped back at the top to allow for 'fine tuning' of the element. Initially this can be temporarily held in place with insulating tape, **Fig. 3**, until you are satisfied you have all the correct dimensions. In the case of the PJ4NX antenna, Peter decided to cut wires for 40, 30, 20, 17, 12 and 10m, but not 80m.

Fork terminals are soldered to the ends of each wire and these are connected to the radiator plate using wing nuts, **Fig. 4**. Similarly, the radials are connected to the aluminium radial plate using fork terminals and wing nuts. Up to six radials can be connected to each terminal.

Hose clamps are provided to prevent the fibreglass pole's sections from telescoping down into itself. The spacer plates need to be fitted before the hose clamps, which also ensure these remain in their correct places on the pole.

The secret to the success of this antenna is the spacing of the wires and their relative position to each other. The important thing is that adjacent bands are separated as much as possible and in particular that the 40m element is placed opposite the 30m (or 80m) element. How the wires are placed is therefore dependent on whether three, four, or all six wires are used. In the instructions it also states that the 40m element should be placed opposite the feedpoint. The method of achieving the optimum placement of the wires is illustrated in **Fig. 5**, taken from the instruction sheet.

The wires extend up the pole, passing through holes drilled in the spacer plates to ensure that the correct spacing between the elements is maintained. Lengths of paracord or 'shock-cord' are attached to the top of each wire via clip-on plastic carabiners that also act as insulators and these are tied off to the next-highest spacer plate, **Fig. 6**. The shock-cord is stretchy and its use is a clever way of maintaining just the right amount of tension to keep the wires tight but without causing the pole to bow – a really smart idea.

Guy ropes can be attached to one of the three spacer plates. The completed antenna is very light and can easily be walked up by one person, **Fig. 7**. A second person to tie off the guy ropes makes life easier.

When you have completed the assembly, carried out SWR measurements and are satisfied the lengths of the elements are all correct, glue-lined heat-shrink (supplied) is used to fix the lengths for a permanent installation.

Measurements

After Peter PJ4NX had assembled the 10mABV we checked out the SWR using my RigExpert AA-54 antenna analyser. The results of the SWR measurements are shown in **Table 1**.

On 40m the antenna had a very low SWR (better than 1.4:1) over the entire band, **Fig. 8**. On 30m the SWR was 1.0:1 but at 10240kHz, suggesting the 30m wire needed to be made about 8cm longer to have a perfect SWR in the middle of the 30m band. On 20m the wire was also slightly too short. With the minimum SWR at 14275kHz it was fine for the SSB part of the band but at 14000kHz the SWR was just over 3:1 so for all-band use the wire should be extended about 4cm.

On 17m the frequency of minimum SWR was slightly below the bottom of the band but the SWR was still less than 1.5:1 at the top, so no adjustment was required. On 15m the SWR was 1.1:1 at 21000kHz and the tuning was very broad, being better than 1.9:1 over the whole 450kHz of the band. On 12m the frequency of minimum SWR was at the top of the band but at 24890kHz it had still only risen to 1.7:1 so once again no adjustment was necessary. On 10m there was a nice dip to 1.2:1 at 28420kHz and the SWR was below 2:1 over 370kHz, from 28260 to 28630kHz.

On 6m the 30m wire works as a 5/4λ vertical and there was a dip to 1.5:1 at 51.80MHz, making it useful for FM repeater working. If the 30m wire had been extended to provide an SWR minimum at the bottom of the band, the 6m resonance would also have been lower in the band but Peter found he could get a good match on both bands with the internal ATU in his transceiver so he did not adjust it further.

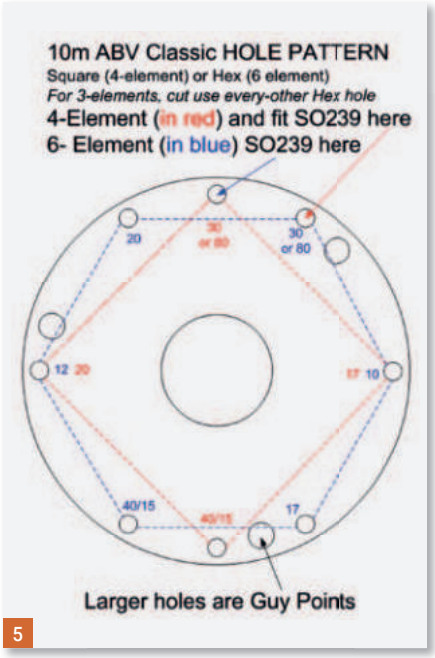

Fig. 4: The radiator and radial plates.
Fig. 5: Template for spacing of 3, 4 or all 6 wires (from DX Commander instruction sheet).
Fig. 6: The insulating cords are tied off to the next-highest spacer plate.

When measuring the SWR it was noticed that the precise value was varying slightly as the measurement was being taken, giving an unsteady or 'wavy' line on the display, such as that shown in **Fig. 8**, instead of the steady curve normally expected. This is almost certainly due to small variations in impedance caused by changes in the spacing between the various wires due to the wind. It may look strange on the analyser screen but it's of no concern as the variation is minuscule (e.g. from 1.10:1

Fig. 7: Bert PJ4KY walks the antenna up while Peter PJ4NX ties off a guy rope. Fig. 8: The SWR curve from 7000 to 7200kHz. The 'wavy' line is caused by the wind blowing the elements.

down to 1.05:1 then up to 1.15:1) and the dip showing the frequency of the minimum SWR can still clearly be seen.

In Use

I live only 0.5km from PJ4NX and have a single-band 40m quarter-wave vertical with elevated radials. With similar antennas we felt comparative reports would be useful although this was only possible on 40m as I do not have verticals for the other bands. With each of us using 100W we made several semi-local contacts with stations on Trinidad, St Lucia and Antigua. All reported that our signals were either the same, or that I had a slight edge (not surprising because Peter's 10mABV was mounted temporarily against the side of his house).

Later, after Peter had moved the antenna to a better location, we contacted **Ross ZL1WN** in New Zealand on 17m SSB. In order to attract Ross's attention I called him first using 1kW to a Spiderbeam (two elements on 17m) and received a 55 report from Ross. As Peter was only using 100W to the vertical I was surprised that Ross was clearly also copying Peter well. He gave him a 52 report: only 3 S-points difference between 1kW and a beam and 100W to the vertical – that's quite impressive performance. On 6m Peter has made many FT8 contacts with Europe using just 100W.

Pros and Cons

You've read the pros, there aren't really any cons, although I did feel the instructions provided with the kit could be improved. Those not as fluent in English as Peter, and perhaps some native English-speakers too, would probably prefer the instructions to be a step-by-step construction guide rather than the chatty explanation of the antenna that is provided. Nevertheless, the antenna was assembled with no problems from the instructions, although Peter mentioned that he watched some YouTube videos showing how the antenna is put together, which also helped.

And not so much a criticism but more an observation: the fibreglass pole used with the antenna is not as substantial as those from some other manufacturers. The lightweight pole certainly helps to keep the overall weight of the antenna down and makes it a lot easier to manhandle than a heavier-duty pole would be. Callum notes in the instructions: *"The pole... is substantial enough for this use. Be careful if a storm is forecast"*.

Summing Up

Several years ago **John 9M6XRO** (SK) and I attempted to build a multi-band vertical for a DXpedition using single-band wires spaced around a fibreglass pole, very similar to the 10mABV design. After spending many hours experimenting we found that the interaction between the wires made it difficult to get a low SWR on more than two or three bands and we eventually gave up. The fact that the DX Commander vertical allows you to use up to nine bands shows the thought, time and effort that Callum put into the design.

There is no doubt that the DX Commander 10mABV vertical antenna works, and works well. As it uses monoband elements, this antenna should outperform those multi-band verticals on the market that instead use traps (which potentially introduce loss to any antenna design). The tests we did on 40m comparing the DX Commander vertical with my monoband vertical suggests their performance is very similar.

Callum tells me that Peter received the *'2020 Mk 1'* kit. Since then, the kit has been upgraded as follows:

- SO-239 connector now has longer thread for better fit to PL-259;
- Shock-cord upgraded to Marlow Ropes marine grade shock-cord;
- Shock-cord now supplied in 3m lengths so that paracord is no longer necessary;
- Longer tab on the aluminium radiator plate;
- More glue-lined heatshrink to cover the fork connectors (useful in harsh environments).

Band	Freq kHz	SWR
40m	7100	1.05:1
30m	10240	1.0:1
20m	14275	1.2:1
17m	18050	1.15:1
15m	21200	1.1:1
12m	24990	1.15:1
10m	28420	1.2:1
6m	51800	1.5:1

Table 1: Initial SWR measurements (see text).

By making the 10mABV a kit the cost to the end user is kept as low as possible and at £189.00 it represents excellent value for money.

For those wanting to get on almost all HF bands (and have 6m as a bonus) with a single antenna and feedline that will fit into the smallest of gardens, both Peter PJ4NX and I can recommend the DX Commander 10mABV. It would also be ideal for use on DXpeditions at sea-front locations (where verticals work extremely well), particularly if size and weight are important considerations.

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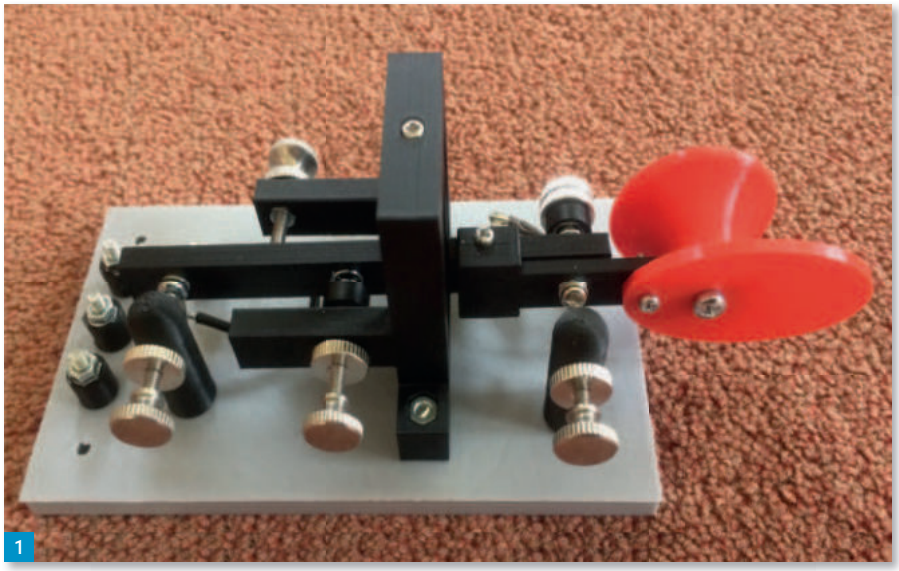
1. www.m0mcx.co.uk
2. www.hamradio.co.uk

Semi-Automatic Bug Key

Martin Waller G0PJO creates a bug key from the ground up!

Martin Waller G0PJO
Martin@The-Wallers.net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Morse keys and paddles come in many shapes and sizes. The most fascinating of these are the range of semi-automatic 'bug' keys – the ones with the wobbly arms – offered by Vibroplex. Although these are a manual key the dits are created by a horizonal pendulum. When the operator moves the key to the right the pendulum – wobbly arm – starts to swing and a series of evenly spaced dits are generated. Dahs are created by the operator moving the key to the left and he/she is responsible for the timings. As many operators will tell you, on air, they have a very distinctive sound.

On the odd occasion in the past I've had a chance to play with one of these keys but struggled. My favoured key is an iambic paddle and the change of mindset required to move from automatic dits and dahs to automatic dits and manual dahs of a bug was too much, and I gave up. Recently I've become more determined and thought about buying a bug key, but they do tend to be very expensive and investing such money without knowing I would be successful was off-putting. They also run quite quickly with the minimum dit rate, without adding further weights, being around 20wpm. I went looking for an alternative.

My alternative turned out to be a hybrid of mechanics and electronics. A mechanical key and an Arduino based keyer in 'BUG' mode. Ideally the mechanical key would be, visually, as close to a Vibroplex 'BUG' as possible to provide a similar look and feel. Coincidentally a friend at the Felixstowe and District Radio Club had been encouraging me to look at OpenSCAD, free software for creating solid 3D objects. I had always discounted doing my own 3D design because freehand drawing was never my forte. OpenSCAD claimed to be different though. It claimed to be aimed at the 'Programmer'. Being a 'Programmer', I wondered how easy it would be to use OpenSCAD to design a mechanical key? It turned out to be very easy indeed, **Fig. 1**.

OpenSCAD

OpenSCAD provides a window-based interface. A text editor window for the programmer, an object viewing window that displays your design, and a console window that displays progress message and error messages. The object viewing window show three axes, X, Y, Z, and can be moved around with the mouse to view it from any angle. The programming language is functional and not the usual imperative, but don't let that put you off, it is very easy to use. As an example, a one-line OpenSCAD program could be as simple as:

```
cube([10,20,30]);
```

This creates a cube 10 x 20 x 30mm based at 0,0,0 on the axes. The language supports other 3D objects such as cylinder, sphere, and polyhedron. All of which take arguments applicable to the shape. For example, the argument for a sphere is the required radius. Also supported are transformation functions. These allow objects to be moved in space, rotated, and scaled, etc. Then – the most interesting of all – are the Boolean operators. These allow for the union, difference, and intersection of objects. This sounds complex but let us look at an example.

An Example

Fig. 2 shows a sample contact post. It is round with a spherical top. It has a horizonal bolt hole and a recess for a nut at the top.

Where do you start? The basic 'Modus Operandi' is stick shapes together to make the object you want and then remove shapes to add the detail. The post is built from two shapes, a cylinder and a sphere. Note that the lower half of the sphere is buried in the cylinder. The two shapes are stuck together using the union operator. The union operator takes multiple shapes, sticks them together, and returns a single shape as the result. Code wise this looks like:

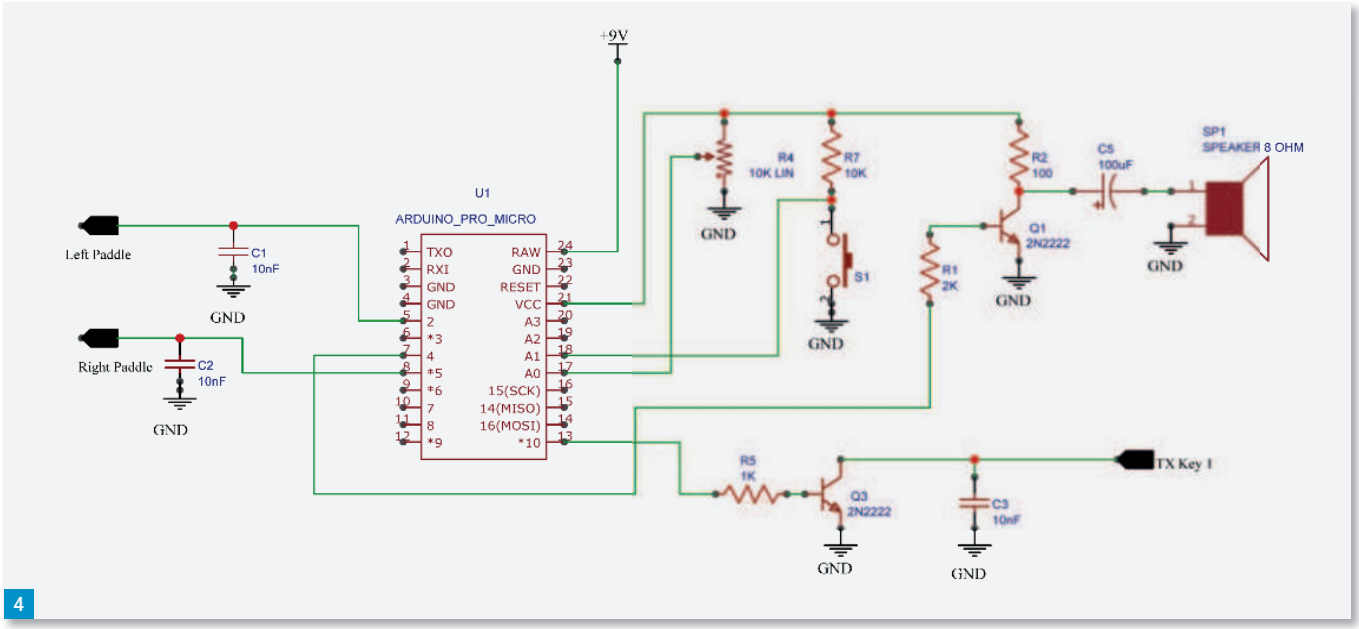
```
union()
{
cylinder(r=5, h=24, $fn=50);
translate([0,0,24]) sphere(5,$fn=50);
};
```

Ignoring the $fn parameter for the moment this reads as: create a cylinder, radius 5mm and height 24mm centred on the axes. Add to that a sphere, radius 5mm moved up the Z axis 24mm. Then stick them together as one object. The $fn parameter controls the number of fragments used to form the shape. Typically, circles are created by lots of little straight lines. The more lines you have then the smoother the circle.

Moving on, looking at the top of the post we need to create a hole for a bolt and a recess for a nut. The hole is created by forming a cylinder where we want the bolt to go using the code:

```
translate ([-6,00,20])
rotate([0,90,0])
cylinder(r=1.6, h=12, $fn=50);
```

This creates a cylinder, rotates it through 90° in the Y axis, and then moves back along



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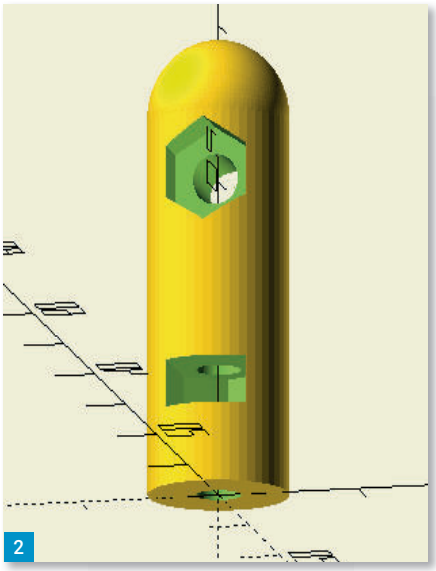
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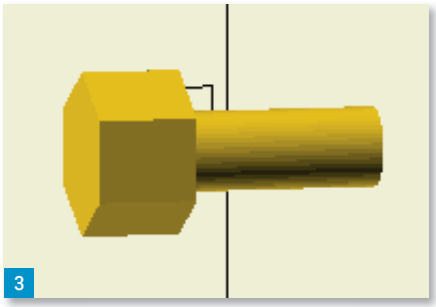
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the X axis and up the Z axis. The recess for a nut is created by forming another cylinder where we want the recess using the code:

```
translate ([2,0,20])
rotate([0,90,0])
cylinder(r=3.3, h=4, $fn=6);
```

This is very similar to the code for the bolt except for the translation and the $fn parameter. The translation is different because we want the position to be slightly different. The $fn parameter is different as we want the cylinder to be built from six sides – and hence a hexagonal.

Pictorially these two shapes look like **Fig. 3**.

If we then use the Boolean difference operator to remove these shapes from the result of the union we get Fig. 2! The complete code is:

```
difference()
{
// Build the post with a spherical top

union()
{
cylinder(r=5, h=24, $fn=50);
translate([0,0,24]) sphere(5, $fn=50);
};

// Make a hole for the bolt.

translate ([-6,00,20])
rotate([0,90,0])
cylinder(r=1.6, h=12, $fn=50);

// Make a hole for the nut.

translate ([2,0,20])
rotate([0,90,0])
cylinder(r=3.3, h=3, $fn=6);
}
```

Using these techniques, and a little imagination, it is possible to create all the parts necessary to build the key – Fig. 1. When you are happy with your design, then the 3D object can be exported as an STL file and imported into a slicing application, such as Ultimaker Cura, for printing on a 3D printer.

All the files required to print the key along with a complete parts list and detailed construction photographs can be found on my GitHub page – see references below. The only software required to print the key is a slicing application. The nuts and bolts are all M3 or M2 and readily available. In all, the keyer requires less than 20m of filament, probably less than £1 worth!

Radio Artisan Arduino CW Keyer

Once the paddle was complete my attention turned to the keyer. I went looking for something that was open source, supported Bug mode, and ran on a processor that had open source development tools. I decided upon the 'Arduino CW Keyer' from 'Radio Artisan'. The keyer is very extensive, the list of features is almost endless! Most of the builds that I found on the internet used the classic Arduino, but I was hoping to make use of the Arduino Pro Micro as I wanted it to be as small as possible. Looking at the circuit diagram I quickly concluded that it could easily be cut down, and the only software changes would be minor. I built a breadboard prototype to test it.

The cut down circuit, **Fig. 4**, provides for speed adjustment, the command button, a speaker, and one transmitter keyer line. From the prototype I designed the PCB, **Fig. 5**, using the free version of EAGLE.

Software

As mentioned above the software is based on the 'Arduino CW Keyer' from 'Radio Artisan'. Because this software is always being updated, I decided not to clone the software but detail the required, and

Fig. 1: The completed key.
Fig. 2: A sample contact post.
Fig. 3: The bolt.
Fig. 4: Circuit of the keyer.
Fig. 5: The keyer on its PCB.
Fig. 6: An alternative version of the paddle.
Fig. 7: And another version, this time using magnets.
Fig. 8: The completed keyer on a board.

optional, changes to the software to have it work with the circuit. These changes, and details on how to program the Arduino can be found on my GitHub page – see references below.

Conclusion

As projects go it proved to be quite a learning curve. I'd always been put off designing my own 3D prints, but I feel quite confident now. So much so that I didn't stop with the one keyer and went on to design, and build, two more! The first based on the Vibroplex Standard Iambic, **Fig. 6**, and the second where springs have been replaced with magnets, **Fig. 7**.

They are all perfectly usable but do benefit from attaching to a base of some sort because, being plastic, they do not weigh a great deal! My completed project is shown at **Fig. 8**.

Now I need to knuckle down and get to grips with the BUG key. I have a few spare PCBs that I'm more than happy to pass on for the cost of the postage.

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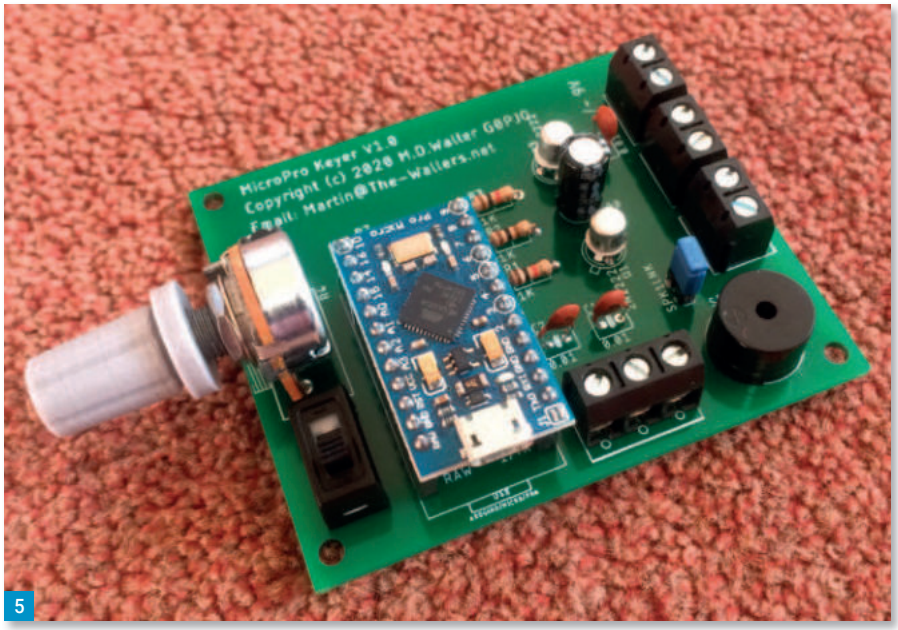

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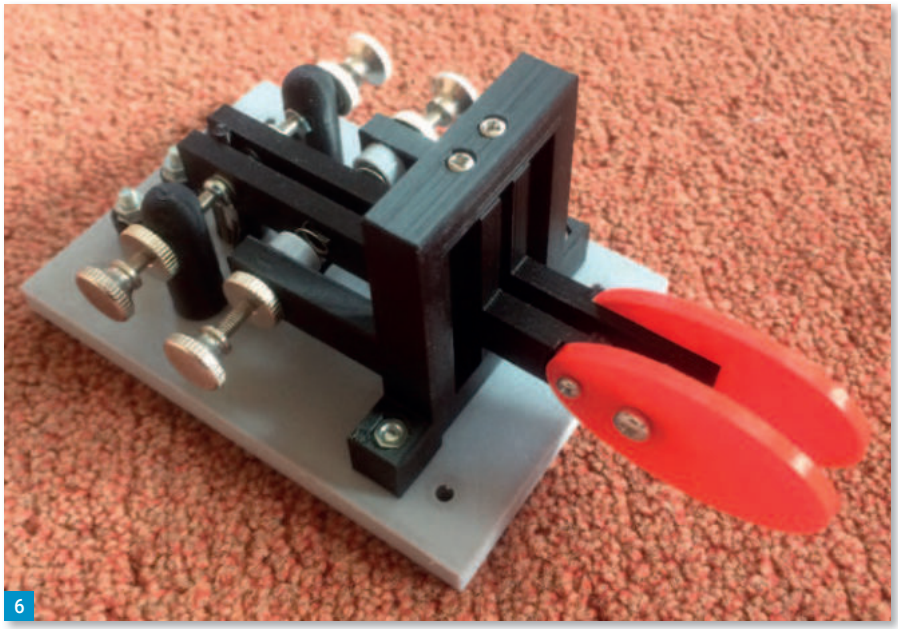
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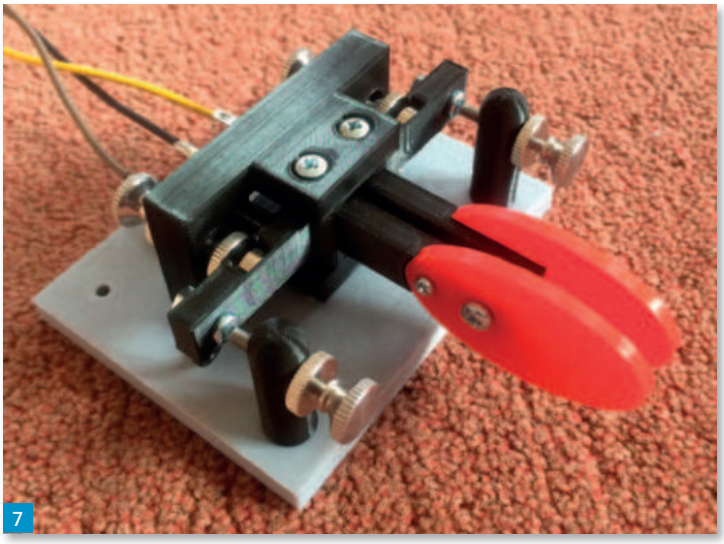
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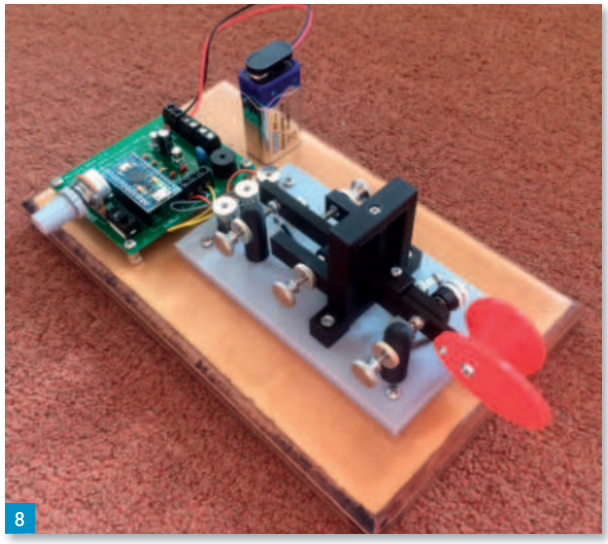
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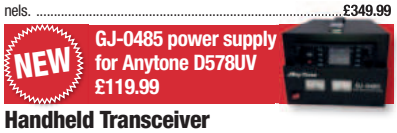
AT-D578UV Pro FM/DMR mobile radio This AT-D578UV-pro is a true TWIN band radio for digital DMR radio systems, compatible to MOTOTRBO Tier 1 and 2. Traditional FM is of course equally supported. In contrast to many other DMR radios the AT-D578UV offers real VFO operations, which makes it much more suitable for amateur radio. Here you can adjust frequency and other parameters as you are used from traditional radios, instead of just using pre-programmed memories. Ofcourse the AT-D578UV offers these memories as well, quite a lot: 4000 to be precise. But you are not limited to those memory channels. **£349.99**



Handheld Transceiver

AT-D868UV handheld radio is a VHF and UHF radio with both Digital DMR (Tier I and II) and Analog capabilities. Includes GPS Offering a total of 4,000 channels (Analog and Digital), 10,000 Digital Talk Groups, and up to 150,000 contacts, as well as multiple DMR ID numbers (Radio ID's) for a single radio. **£129.95**
AT-D878UV PLUS BLUETOOTH Digital DMR Dual-band Handheld Commercial Radio with Roaming and GPS VHF/UHF Dual-band Digital/Analog Part 90 DMR commercial transceiver with 1.77 inch colour TFT display and GPS. This model includes DMR Roaming, faster processor and larger memory for future enhancements. Ideal for Fire, Search & Rescue, EMS, Police, Sheriff, Forestry and Security operations. Frequency coverage 140-174 / 400-480 MHz **£199.99**

Accessories

CPL-02 Battery eliminator for AT-D868UV **£9.95**
CPL-01 Car charger ofr AT-D868UV **£8.95**
CPL-05 Speaker microphone for AT-D868UV **£19.99**

VGC

Vero Global Communications compant is a science and technology enterprise in Fujian Province, specializing in R&D, production and sales of electronic products and accessories such as radio communication equipment, alarms, radio frequency smart cards, and GPS equipment.

Mobile Transceiver

VR-N7500 is a brand new 50 watt VHF 40 watt UHF Headless mobile transceiver with a solid build quality. It is very different in design compared to any other radio used mobile or base The VR-N7500 uses a smartphone as a control panel and the body is installed in the boot or similar with the mobile phone connected to the body through Bluetooth. The cars hands-free intercom can be utilised through the vehicle Bluetooth and PTT is by th esupplied Bluetooth PTT **£189.95**

BAOFENG

Started in 2001,Baofeng has always been aiming at creating user value and innovating products. From the first small factory of more than 30 people, Baofeng has deveoped into a high-tech enterprise specializing in R&D, production,sales and after-sales service of handheld wireless walkie-talkies as well as accessories.

NEW JUST IN

UV-9R PLUS Dual Band Handie, 140/174/400-470MHz, IP67 waterproof and dustproof (Not diving), Relay Forwarding Confirmed, Dual Band, Dual Display and Dual Standby, High & Low Power Switchover, Includes everything you need in the box for just ..... **£34.95!**

Handheld Transceiver

UV-5RC PLUS Latest version of this ever popular dual band handie - and now with a 4.5W on 2m - Comes complete with desktop charger, antenna, belt clip & high power 1800mAh battery .. **£29.95**
BF-888S is a professional UHF transceiver with good performance and reliable quality. Extra functions such as Noise Reduction and Scrambler make it as a cost-effective transceiver covering 400-470MHz and including desktop charger for an amazing **£12.95**
DM-9HX DMR radio Tier II VFO digital & analogue dual band UHF/VHF handheld transceiver ..... ~~£89.95~~ **£69.95**

Accessories

UV-5SM Branded speaker microphone for all listed Baofengs **£9.95**
UV-5PC Branded software cable with USB for all listed Boafengs **£9.95**
UV-5BE Original battery eliminator for UV-5RC+ **£9.95**
UV-5AT Original replacment antena for UV-5RC+ **£4.99**
UV-EP Original replavement ear piece for UV-5RC+ **£4.99**
UV-5SC Original soft case for UV-5RC+ **£9.95**
BL-5 Original 1800 mAh replavement or spare battery for UV-5RC+ **£9.95**
GT-5 Original GT-5 2000 mAh replaement or spare battery for GT-5 ..... **£14.95**
GT-3 Orginal GT-3 1800 mAh replacement or spare batery for GT-3 ..... **£12.95**
BF-8 6 way charger for BF-888S **£44.95**

LEIXEN

Leixen having developed a full range of "LEIXEN" series of radios. widely used in transport, construction, telecommunications, security, restaurants, residential property management and other departments and areas, especially popular in the HAM's world.

Mobile Transceiever

VV-898 136-174/400-470MHz mobile transceievr. What a great entry level dual band rig, with only 10 Watts it is ideal for the new foundation pass holders. Comes complete with radio bracket and keypad microphone **£59.95**
VV-898S as above but with 25 Watts **£69.95**

Handheld Transceiver

NOTE is a rugged 400-480 MHz handheld transceiver with a massive 20W output! Comes comlpetre with antenna, belt clip and drop in charger – are you ready to be heard! **£69.95**

SenHaiX

SenHaiX was estabished in 2012 and is in located in the located in the hometown of two way radio Quanzhou city, Fujian Province, China. The company is a high-tech enterprise specialising in radio communications R&D, manufacture of two way communications and accessories.

Mobile POC Network Radio

SPTT-N60 is a 3G network android mobile radio with wifi, bluetooth, zello, sos, phone function, gps function, with touch screen and large LCD **£249.95**
4G version **£299.95**

Handheld Transceiver

8800 Dual band, dual watch, dual standby, 5W Sport radio. This is a rugged and reliable, waterproof, dustproof and shatterproof handie with lots of extras including bluetooth progarmmoing option – amazing avlue at just **£64.99**

Inrico

Inrico Electronics is a high-tech enterprise which focuses on the design, construction, production and sales of radio communication equipment.

Mobile POC Network Radio

TM-7 PLUS is the first 4G mobile network Radio. Great for amateur radio use with the new IRN platform, for Zello, Team Speak 3 and Echolink via 3G or WiFi. And it works as WiFi hotspot too! ... **£159.95**

Handheld POC Network Radio

T199 is a 3G / WiFi Android Radio, without display, for basic operation. You can install apps from your computer to the radio via the USB port. Great network radio at a great price **£99.95**
T192 is an IP-67 rated 3G / WiFi Android Radio as above but with the IP rating **£109.99**
T320 is the current best seller 4G / WiFi Radio. I t has a host of features and a great szie screen including Intelligent global intercom, Front & rear camera with auto-focus function, Longer standby time more than 80 hours, 36mm-diameter speaker with double chambers, Positioning system supports, Support WIFI, Micro 5pindata cable, Support MP3 / MP4, Sturdy and durabable with military quality **£169.95**

New Yellow Frog service

NOW AVAILABLE

Yellow Frog is a nationwide PTT service from Moonraker powered by Push To Talk International and is aimed at the community, hobbyist and club based radio market, Yellow Frog offers users both community based shared channels, accessible right across the Yellow Frog community, as well as private dedicated channels and a rich selection of features that can enhance your radio experience and service capabilities for your own activities.
Yellow Frog packages include device, sim, application licence, one private channel and access to the Yellow Frog Community channels and the equipment is ready to use out of the box, all pre-configured to connect to the nationwide Yellow Frog service. An additional menu of feature enhancements is also available to subscribers who want more in depth functionality, such as private address book, group and priority calling, status messaging, device location tracking, alarm and SOS and lone worker management, There is even a PC dispatching solution for connecting your PC or control room to your Yellow Frog device fleet. Hop along to the friendly team at Moonraker to find out more about the Yellow Frog service, its capabilities and the community of users it serves.

INRICO T320 + SIM + YELLOW FROG SERVICE + 10 FREE CHANNELS + 1 PRIVATE CHANNEL £249.95

Mobile Antenna Mounts

TRIMAG-S Triple magnetic mount with SO239 antenna fitting with 4m RG58 and PL259 fitted – ideal for those larger antennas..... **just £39.95**
TURBO-S single 170mm magnetic mount with SO239 antenna fitting with 4m RG58 and PL259 fitted – will suit most antennas upto 5ft. **£19.95**
HKITHD-SO Heavy duty hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted **£32.95**
HKITM-S Mini hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted..... **£32.95**

Multiband Mobile

Why buy loads of different antennas when Moonraker has one to cover all! SPX series has a unique fly lead and socket for quick band changing

SPX-100 9 Band plug n' go portable, 6/10/12/15/17/20/30/40/80m, Length 165cm retracted just 0.5m, Power 50W complete with 38th PL259 or BNC fitting to suit all applications, mobile portable or base - brilliant! **£44.45**
SPX-200S 6 Band plug n' go mobile, 6/10/15/20/40/80m, Length 130cm, Power 120W, PL259 fitting..... **£44.95**
SPX-300S 9 Band plug n' go mobile, 6/10/12/15/17/20/30/40/80m, Length 165cm, High Power 200W,PL259 fitting **£59.95**

VHF/UHF Mobiles

GF151 Glass Mount 2/70cm, Gain 2.9/4.3dBd, Length 78cm complete with 4m cable and PL259 ..... **£29.95**
MRM-100 MICRO MAG 2/70cm, Gain 0.5/3.0dBd, Length 55cm, 1" magnetic base with 4m coax and BNC **£19.95**
MR700 2/70cm, Gain 0/3.0dBd, Length 50cm, 3/8 fitting..... **£9.95**
MR777 2/70cm, Gain 2.8/4.8dBd, Length 150cm, 3/8 fitting..... **£19.95**
MRQ525 2/70cm, Gain 0.5/3.2dBd, Length 43cm, PL259 fitting (high quality)... **£19.95**
MRQ500 2/70cm, Gain 3.2/5.8dBd, Length 95cm, PL259 fitting (high quality)... **£26.95**
MRQ750 2/70cm, Gain 5.5/8.0dBd, Length 150cm, PL259 fitting (high quality). **£36.95**
MRQ800 6/2/70cm Gain 3.0dBi/5.0/7.5dBdBd, Length 150cm, PL259 fitting (high quality) **£39.95**
MRQ273 2/70/23cm Gain 3.5/5.5/7.5dBdBd, Length 85cm, PL259 fitting (high quality) **£49.95**
MRQ900 10/6/2/70cm Gain 10m (2.15dB) 6m(2.5dB) 2m (2.8dB) 70cm (5.5dB)
Length: 125cm PL259 fitting **£49.95**

Coax Cable Drums

Save money buying in bulk – handy
50m as well as 100m drums at discounted prices

RG58-DRUM-50 standard RG58 6mm 50m reel..... **£19.99**
RG58-DRUM-100 standard RG58 6mm 100m reel..... **£29.99**
RG58M-DRUM-50 military spec RG58 6mm 50m reel **£24.95**
RG58M-DRUM-100 military spec RG58 6mm 100m reel..... **£44.95**
MINI8-DRUM-50 military spec MINI-8 7mm 50m reel **£34.99**
MINI8-DRUM-100 military spec MINI-8 7mm 100m reel..... **£64.99**
RG213-DRUM-50 military spec RG213 9mm 50m reel..... **£64.99**
RG213-DRUM-100 military spec RG213 9mm 100m reel **£119.99**
WESTFLEX-DRUM-100 military speck Westflex 103 10mm 100m reel..... **£159.99**
RG174-DRUM-100 military spec RG174 2.8mm 100m reel..... **£59.95**

Masts – Push Up

Lightweight medium and heavy duty swaged masts sets from 1.25-2" diameter 5ft sections to create a lovely 20ft mast – choose the correct size needed for the antenna installation. Masts have a lovely push fit for easy of use and to give a strong connection

MSP-125 20ft Medium Duty (set of 4 poles) 32mm dia 1.6mm gauge.... **£44.99**
MSP-150 20ft Medium Duty (set of 4 poles) 38mm dia 1.6mm gauge.... **£49.99**
MSP-175 20ft Medium Duty (set of 4 poles) 44mm dia 1.6mm gauge.... **£59.99**
MSP-200 20ft Medium Duty (set of 4 poles) 51mm dia 1.6mm gauge.... **£69.95**
MSPX-150 20ft Heavy Duty (set of 4 poles) 38mm dia 2.65mm gauge..... **£69.95**
MSPX-200 20ft Heavy Duty (set of 4 poles) 51mm dia 2.65mm gauge..... **£89.95**

GRP Fibreglass Base Antennas Diamond quality – Moonraker pricing

These high gain antennas have been pre-tuned for your convenience, easy to use, easy to install, and a choice of connection … look no further

SQBM100P 2/70cm 3.00/6.00dBd, RX 25-2000MHz, Length 100cm SO239..... ~~£49.95~~ **SPECIAL OFFER £39.95**
SQBM200P 2/70cm, Gain 4.5/7.5dBd, RX 25-2000MHz, Length 155cm, SO239..... ~~£54.95~~ **SPECIAL OFFER £44.95**
SQBM500P 2/70cm, Gain 6.8/9.2dBd, RX 25-2000MHz, Length 250cm, SO239..... ~~£74.95~~ **SPECIAL OFFER £69.95**
SQBM1000P 6/2/70cm, Gain 3.0/6.2/8.4dBd, RX 25-2000MHz, Length 250cm, SO239..... **£84.95**
SQBM223N 2/70/23cm, Gain 4.5/7.5/12.5dBd, RX 25-2000MHz, Length 155cm, N-Type **£79.95**
SQBM3000N Triband 2/70/23cm, Gain 4.5/8.3/10.7dBd Length 1.55m **£79.99**
SQBM3500N Triband 2/70/23cm, Gain 6.8/9.2/11.8dBd Length 2.70m **£119.99**

HF Wire Antennas

Our HF wire antennas are made with complete waterproof potted baluns and high quality "original" flexweave antenna wire.

MDHF-80 3.5MHz balun matched mono dipole, length 40m..... **£59.95**
MDHF-40 7.0MHz balun matched mono dipole, length 20m..... **£44.95**
MDHF-20 14MHz balun matched mono dipole, length 10m..... **£39.95**
OSHF-80 3.5-30MHz balun matched off set dipole, length 40m **£59.95**
OSHF-40 7.0-30MHz balun matched off set dipole, length 22m **£44.95**
OSHF-20 14-30MHz balun matched off set dipole, length 11m **£39.95**
LWHF-160 1.8-50MHz unun match end fed antenna, length 42m ... **£49.95**
LWHF-80 3.5-50MHz unun match end fed antenna, length 20m ... **£44.95**
LWHF-40 7.0-50MHz unun match end fed antenna, length 10m ... **£39.95**

Yagi Antennas

All Yagis have high quality gamma match fittings with stainless steel fixings!

YG27-35 Dual band 3/5 element 3.5/12.5 dBd gain with one feed! **£79.95**

Masts GRP Fibreglass

Ideal heavy duty fibreglass masts for those antennas that need to be insulated from metal hardware or pole – convenient 2m lengths in a light grey

GRP-150 2m 37mm OD..... **£29.95**
GRP-200 2m 51.7mm OD..... **£39.99**

Masts Telescopic

We offer both aluminium and GRP fibreglass push up masts ranging from 20-50ft to suit your needs. The aluminium versions are for portable/occasional use and the fibreglass versions can also be used for fixed instillation

LMA-M 26ft open 5.5ft closed 50-25mm aluminium mast **£109.99**
LMA-L 33ft open 7.2ft closed 50-25mm aluminium mast..... **£119.99**
TMF-1 20ft open 5.6ft closed 50-30mm high quality GRP mast..... **£199.99**
TMF-1.5 30ft open 7.5ft closed 57-30mm high quality GRP mast..... **£299.99**
TMF-2 40ft open 9ft closed 57-30mm high quality GRP mast..... **£349.99**
TMF-3 50ft open 8ft closed 65-23mm high quality GRP mast..... **£399.99**

NOW IN STOCK
Superior Connecter Adapter Pack
£129.95

QRP Antennas

The Moonraker Whizz range are great for getting on HF in a neat compact and totally portable way

Whizz Whip HF/VHF/UHF portable antenna with telescopic whip - ideal for any situation where a long wore or vertical antenna is just not an option - get on air today for **just £99.95**

Whizz Loop 20-60m compact loop is ideal for QRP Transceivers when space is limited or using portable with a Yaesu FT-817ND or similar. Can be used indoors with surprising results and handy for travelling due to its "pocket" size antenna ideal for indoor or out and can be packed away and all for just **£69.95**

Whizz Loop V2 (right) same as above but with a frequency range from 40-10m..... **£79.95**

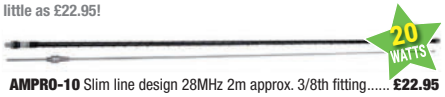
Base Antennas

Simple plug and play HF antennas radial free and at a great price

GP2500 All Band 80-6M Vertical TX 80-6M RX 2-90MHz, Power 250W Length 7.13M **£199.95**
GPA-80 budget version of GP2500 80-6M Length 6.0M **£99.95**
GPA-80F fibreglass version of GPA-80 ..... **£129.95**

HF Mobiles

Get great results with the Moonraker range of HF mobiles! From as little as £22.95!



AMPRO-10 Slim line design 28MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-11 Slim line design 27MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-12 Slim line design 24MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-15 Slim line design 21MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-17 Slim line design 18MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-20 Slim line design 14MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-30 Slim line design 10MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-40 Slim line design 7MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-60 Slim line design 5MHz 2m approx. 3/8th fitting..... **£24.95**
AMPRO-80 Slim line design 3.5MHz 2m approx. 3/8th fitting..... **£27.95**
AMPRO-160 Slim line design 1.8MHz 2m approx. 3/8th fitting... **£59.95**

Other frequencies available. Call or see online for more details.

Make Your Own? Wire, insulators & bits

Have fun but making your own antenna system and see how it works against the commercial designs

SCW-50 Enamelled copper wire, 1.6mm, 50m length **£24.95**
HCW-50 Hard drawn copper wire, 1.6mm, 50m length **£29.95**
FWPVC-50 high quality flexweave with PVC coating 4mm, 50m **£44.95**
300-20 Ribbon feeder 300 ohm high quality slotted, 20m..... **£17.95**
450-20 Ribbon feeder 450 ohm high quality slotted, 20m **£19.95**
DPC-W Wire dipole centre with securing clamps **£5.95**
DPC-S Wire dipole centre with SO239 socket for PL259 ..... **£6.95**
DPC-38 Dipole centre for 2 x 3/8th whips antennas to make dipole **£6.95**
DOGBONE-S small plastic insulator **£1.00**

Hardware

We offer all type of mounting hardware to help get you rigged up at home – if you cant see it listed chances are we have it. Check www.moonraker.eu or just give us a call

TRIPOD-HDA heavy duty collapsible tripod to suit base mats up to 67mm **£149.95**
TK-24 wall bracket offers 18" clearance **£29.95**
TK-12 wall bracket offers 12" clearance **£19.95**
BB2 mast base plate to suit up to 2" masts/pole **£22.99**
JOIN-200 clamp 2" poles back to back **£17.95**
PTP-20 2" to 2" mast clamp **£5.95**

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and start earning WATTS now!

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Don't miss out – Register now and start enjoying free WATTS

Roger Cooke G3LDI
roger@g3ldi.co.uk

Lockdown

Roger Cooke G3LDI says lockdown is a great opportunity to brush up your CW!

Having been in lockdown now for several weeks, what better time could there be for learning CW? Everybody has time on their hands, no places to go, and no people to see. You can't take a holiday, go to any events, shops, cinemas, pubs or clubs – heck, even NFD has been a non-starter.

Make use of the time you have now, because hopefully it will never occur again! Your age does not matter. If you are starting at a ripe old age of 60+, or if you are a mere youngster, there is fun to be had for all. Obviously, the younger you are the better. Your brain is like a sponge and you could be a proficient operator in a relatively short time. It takes longer the older you are, but is still achievable.

For those that are learning and have achieved around 12 to 15 wpm, get on the air and have some fun. The more QSOs you have the better the operator you will become. Your speed will increase without you noticing and with that you will find you will be spending more time on CW than any other mode!

During lockdown there are a number of HOPE contests, so gaining experience there is something that occurs frequently. Scores are irrelevant but the fun you have by taking part is the all important bit. Speeds don't have to be 30wpm plus. If you call CQ at 15 wpm a good operator will return to you at that speed.

Lockdown Morse

A former student of mine from some years ago, **Matt M0PTO**, **Fig. 1**, is offering a YouTube service call LOCKDOWN MORSE. Matt is a young guy who is a very keen CW operator, and it is very satisfying to see him putting something back into the hobby. If only a lot more would do the same!
https://tinyurl.com/y9yyu4qp

GB2CW Classes

Classes in Norfolk continue to produce good results. We have a light-hearted approach to teaching here and have instigated a couple of new ways to have fun with the teaching.

Jim G3YLA takes a class called Learn CW at 25 wpm. He does not send anything at less than 25 wpm, but has a way of teaching the very beginner in short bursts, repeated several times, including all the usual prosigns, punctuation and abbreviations. I must admit I was very dubious whether there would be any takers for this class so I offered to eat my hat if it was successful! It is simmering in the microwave……

Jim, **Fig. 2**, is known as the 'good cop' with this approach, whereas when they join my class, I adopt the 'bad cop' approach! I don't take prisoners, won't accept excuses as to no practice, plus chastise them for not trying harder. It's all tongue-in-cheek, and the students know it, but it does seem to work. I'm not all bad, however, and do give praise when earned!

I take a headcopy class as well, and that really is quick-fire stuff up to 30 wpm, with lots of E I S H and 5 groups thrown in. We have a lot of fun with that!

Culmination is the 'Executive Club' with **Malcolm G3PDH** on Thursday evenings, plain language up to 30 wpm included!

It really is paying off, because we are getting 20 logs for most of the RSGB CC contest entries with NARC split into two teams now, Nelson and Boudica.

With this Lockdown situation remaining for some time, perhaps it might be a great idea for clubs to consider setting up Morse classes. As the RSGB GB2CW Coordinator, I could quickly send out a letter of authorisation for you to use GB2CW. The advantage is the fact that you are not allowed to broadcast using the normal amateur licence. If you have half a dozen in your class, the only legal way of conducting that class is by using GB2CW. It's simple, easy to get used to and it might encourage a lot of students to take part. The only requirement is that the tutor has to be an RSGB member. Give it some thought, your efforts would be appreciated and you can have a lot of fun as well.

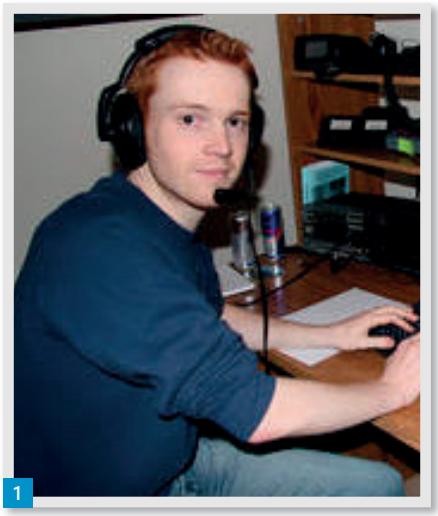
FISTS CW Club : The International Morse Preservation Society

FISTS supports the use, preservation and education of Morse code. The club is devoted exclusively to CW operators, CW operating and people who are passionate about Morse code.

FISTS will support those making their first QSOs on CW. Most members have lots of patience and will devote the time to a ragchew type QSO rather than the usual 59973 heard on the bands so often these days. It is much like a club for beginners and improvers, with lots of activities and shorter contests. I would recommend joining and making yourself known. Members use all types of keys, straight, semi-automatic bugs and paddles. Take a look at this video from onboard *SS SALEM* in Quincy, Massachusetts, USA. Recognising FISTS for its work in promoting the use of Morse Code, the video shows a range of amateurs of different ages using various keys.
https://youtu.be/yi-OlyR7ErM

The main page for FISTS is here:
https://fists.co.uk

There is now a Fists Sked page for UK/EU if anyone wants to arrange a sked; our US partners have got this up and running for us. On the log on you will see various clubs, including SKCC, FISTS, etc. A lot of these


1


2

Fig. 1: Matt M0PTO. Fig. 2: Jim G3YLA. Fig. 3: Begali paddle featured on the CW Ops website.

are mainly American and we also have the FISTS 'down under' sked page.

Serve your apprenticeship well, and as your speed increases you may also wish to look at becoming a member of CW Ops. https://cwops.org

The picture, **Fig. 3**, shows a recent front page of the website featuring a very nice Begali Sculpture paddle (the picture is changed from time to time).

CW Ops feature The CW Academy: https://cwops.org/cw-academy

Quote from that page:

"For those having experience with CW who want to improve or regain proficiency:

1. *I am getting bored with voice and digital modes*
2. *My CW skills are not what they used to be*
3. *I'm too rusty or embarrassed to get back on CW*
4. *I want to be able to copy in my head*

If you know the code but are rusty, can't copy or send as proficiently as you once could, then CWops CW Academy is right for you".

The teaching is done online and in similar fashion to schools with teaching broken down into semesters over the year.

If you can have QSOs at 25 wpm you can join CW Ops. You can ask to be sponsored for CW Ops, but make sure you are capable of 25 wpm first so as not to embarrass the person sponsoring you. Then you might like to take part in their weekly activity periods, Wednesdays at 1300UTC and 1900UTC and Thursday mornings at 0300UTC. There are various awards to be won and these short activity periods are not contests as such. If you make ten QSOs in a period you earn a point, which totalled over the year will win you a medallion, bronze, silver or gold.

Norfolk ARC is quite active in these, including the early morning one (!) and there were four gold medallion winners this year, Jim G3YLA, **Roger G3LDI**, **Mike G4DYC** and **Peter M0RYB**. We are aiming at five or even six next time.

So, get your mojo working, put some brain cells into gear and learn something really worthwhile! 73 and May the Morse be with you! Roger, G3LDI.

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

Applied Theory

Eric Edwards GW8LJJ starts a new series taking readers through the basics of electronics.

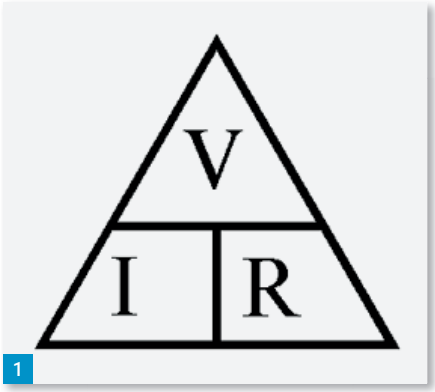
The purpose of this series is to explain electronic theory with practical examples that you can try yourself. You need no previous knowledge of electronics or practical experience in construction of circuits. This article will show you how to build working examples that will bring the theory to life and make it much more interesting than just reading theory alone.

Most electronics books and publications explain the theory in great depth with all the formulae and mathematics. The theory presented here will be minimised throughout to the extent of necessity and I will give reasons for why it is there in the first place. It is pointless in learning a formula without knowing the reason for it and for further theory study, there are lots of very good books available on electronic theory.

The Basics

Electronics is about electron flow. That is the stuff that runs through all types of conductors and the nature of its flow has been argued about among many engineers and technicians. Some textbooks explain the flow of an electric current as being from positive to negative, and there are others who claim it flows from negative to positive. I do not think it is quite as definite as that as in reality there are electrons and protons in copper or any metallic conductor that are of equal importance and equal charge. Metals are actually composed of positively charged atoms immersed in a sea of moving electrons. This sea of electrons flow from the negative terminal on the battery towards the positive terminal but the protons within the positive atoms do not move. Metals are not the only conductors and there are other substances where positive atoms do move in creating a flow of current.

We could say that the current is in the conductor to start off with and is just lying there idle until a voltage is applied, usually referred to as an **electromotive force** (EMF), because that is what it is, a force to push the current through. It is better to understand why it flows and what to do if it doesn't rather than get involved in trying to work out which way it flows.... Who cares? As long as it flows! Incidentally, the convention that current flow is from (what we now know to be) negative to positive dates back to the early days before the existence of electrons and protons was known.



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Testing It

If a battery is connected across the ends of a piece of wire, current flows through the wire and the battery and the amount is determined by the resistance of the wire. This is not really practical to set up as the battery will soon run flat when a piece of wire, which will get very hot, is connected across its terminals. We will look at this in a more practical way. We will need a voltage supply with sufficient current capability for our experiment and the conductor will be replaced with a **resistor** as used in any electronic piece of equipment. To see the results of this test, a voltmeter and ammeter are required. The purpose of this experiment is to show how **Ohm's law** is applied. You have to know the Ohm's law formula because it comes up very often in everyday working in electronics. (Ohm's law is based on a discovery made by **Dr Ohm**.) It is presented here in unit form... $V = I R$ (I multiplied by R), which is the same as $R = V/I$ (V divided by I) and $I = V/R$ (V divided by R). Where V is voltage measured in Volts (V), I is current measured in Amps (A) and R is resistance measured in ohms (Ω). These are the symbols used universally, well almost, as the V is sometimes replaced with E (Electromotive force).To replace the second equation with numbers, we can say that a resistor of 1 ohm will have a current of 1 amp flowing through it when a potential of 1 volt is placed across it. Taking the first equation, we can find the voltage across the resistor of say, 220 ohms (220Ω) with a current flowing through it of 0.5 of an amp (0.5A or 500mA). The voltage is 0.5 multiplied by 220, which is 110 volts (110V). Conversely, the resistor has a value of 110/0.5, which is 220 ohms and the same can be found for the current flowing through the resistor by V/R, 110/220, which is 0.5 amps.

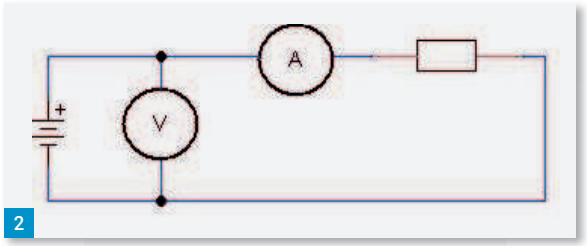
The Formula

A good way of remembering this formula is with the triangle method, **Fig. 1**. By placing your finger over any one of the letters, you can immediately see how the formula works.

The knowledge of this information means you can easily work out a value of an unknown resistor. It is possible to make a potential divider to supply a lower required voltage to another part of a circuit taking all the guesswork and trial and error out of it simply by applying this formula. It will also be useful in determining if the battery (or power supply) is man enough for the job. All this can be gained simply by knowing how Ohm's law works and you do not even have to be a mathematician! For our experiment, we will use a 12 volt battery (or power supply) and a selection of resistors used universally in amateur radio.

Refer to, **Fig. 2**. On the immediate left in the diagram is a battery with a voltmeter connected directly across its terminals. An ammeter with its positive terminal connected to the positive terminal of the battery while the negative terminal of the meter is connected to the test resistor. (Because the ammeter, battery and the resistor are in series, the resistor can be placed before or after the meter). The other end of the resistor is connected to the negative terminal of the battery to complete the circuit. To put some values in here we will use a 12 volt battery, a voltmeter with a full-scale deflection of 15 volts and an ammeter with a full-scale deflection of 5 amps.

If the resistor has a value or 15 ohms, then with 12 volts connected as shown, a current of 0.8 amps or 800mA will flow, and if a 1/4-watt resistor were the type used, it would get very hot and burn out. Why? To answer that we must now **modify** Ohm's law to take in account of the **wattage** dissipation of components. Wattage is the product of voltage and current. W = V I. It can also be expressed as $W = V^2 / R$ and



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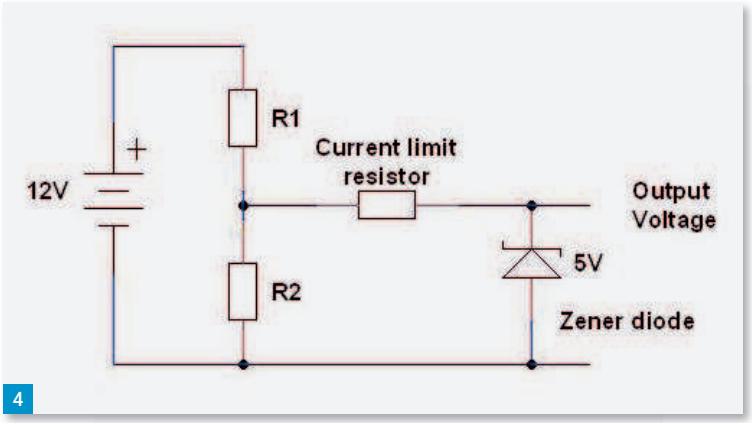
$$V_{out} = \frac{R2}{R2 + R1} V_{in}$$
3



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$$R2 = \frac{V}{I}$$
5

Fig. 1: Ohm's law as a triangle. Fig. 2: Simple circuit for demonstrating Ohm's law.
Fig. 3: Formula relating to a potential divider.
Fig. 4: An application for a potential divider.
Fig. 5: Ohm's law restated to calculate resistance.

$I^2 R$. So, if a current of 0.8 amps is flowing through our resistor with 12 volts connected across it, then the wattage dissipated is 12^2 divided by 15 ohms (144 ÷ 15) = 9.6 watts. Or as $I^2 R$ the formula will become $0.8^2 \times 15$ (0.64 × 15) = 9.6 watts. It would also be true to say that the wattage is also the same when the 12 volts is multiplied by the current of 0.8 amp which is yes, that's right, 9.6 Watts. That is why our ¼ Watt resistor got very hot and burnt out. If we had used a battery with a small current capacity of say 1 amp, it would have soon flattened, especially if a larger wattage resistor was used. The larger wattage resistor would have taken longer to burn so the battery would have been flattened instead.

Further Tests

To carry out similar tests it would be better to replace the battery with a regulated power supply with current limiting. Using low resistor values and current in amps is not the normal units used in electronics. These values *are* used, but you are more likely to meet resistors with values in kΩ (thousand ohms) and current in mA (one milliamp is 0.001 of an amp). The 12 volts used is typical in electronic circuitry. Let us now substitute the resistor for a value of 10kohm (10,000 ohms) and the ammeter for a full-scale deflection of 1mA. Using Ohm's law again substituting the letters with any two known values, we can find the third. Set the voltage on the power supply for 10 volts (to keep the sums easy) and with the resistor and milliammeter previously connected, look at the reading on the milliammeter. It will be showing 1mA (Full scale). I = V/R where V = 10, R = 10,000 (10/10000,) = 0.001A, which is 1mA. Your meter may *not* be reading 1mA, as it will depend on the tolerance of the resistor you are using! All components have a percentage (%) tolerance and your resistor could have a tolerance of as much as a plus or minus (±) 10% which means the actual value of your 10kohm resistor could be as low as 9kohm and as high as 11kΩ so the meter could give any reading between 1.1mA (9kΩ) and 0.9mA for a resistor value of 11kΩ. For a more accurate reading, a resistor of a closer tolerance is required and ±0.1% resistors are now quite common. Other percentage values are ±0.01 % and even ±0.001% types. If the voltage from the power supply was reduced to say, 5 volts, what will be the reading on the milliammeter allowing for resistor tolerances? Yes, that's right, 0.5mA ± resistor tolerance.

Let's put the voltage back to 10 volts on the power supply, switch off the supply and change the resistor for a value of 20kΩ. Switch on the power supply and look at the current reading on the milliammeter. It will be showing 0.5mA allowing for resistor tolerance. Changing the resistor value again to 30kΩ while leaving the voltage unchanged will give a reading on the meter this time of 0.3mA. This is, in fact, the principle of an ohmmeter (or multimeter) that is used for measuring resistors. The voltage remained constant with the current changing in relationship with the resistor on test. The voltage is a lot lower (1.5) and the meter is usually a 100µA (0.0001 amp) movement. To keep the mathematics at a sensible level when using ohms law, all resistors will be shown as ohms and the current as mA. This will take away all the zeros and decimal points. Using this idea we can have a resistor of 27kΩ across a supply of 12V, which will give us a current flow of (V/R) 12/27 = 0.44mA, which is better than working with values 12/27000 = 0.00044 amp. Similarly, a resistor of 270Ω across a 12V supply will give a current flow of 12/0.27 = 444mA which again is better than 12/270 = 0.044 amp. The 270Ω is equal is to 0.27kΩ.

Dividing the Potential

Knowing Ohm's Law puts you in a very good position in understanding electronic circuits. You will soon realise why resistors are used in transistor circuits and their uses in voltage divider circuits to provide a lower voltage to another part of the circuit. To give an example of a voltage divider, take a typical circuit that is powered by 12V and further down the circuitry is a component that needs a 5V supply. It is pointless building another power supply just to feed one part, so a tap is taken from the 12V power supply by means of a potential divider. This is two resistors wired in series fitted across the 12V with the values selected by Ohm's law to give 6V at the junction of the two resistors, **Fig. 3**. This is a circuit of a potential divider and the same current will be flowing through all the components, including the battery. The formula will enable you to work out the tapped voltage. We will give our battery a value of 12V and the resistors the value of 10kΩ each. From the formula R2 (10kΩ) is divided by R1 (10kΩ) and R2 (10kΩ) added together and the result (0.5kΩ) is multiplied by the input voltage (12). The answer is 6V. The resistors could have been 10MΩ each and the answer would have been the same because it is the **ratio** of the two resistors that is important. A small value series resistor is placed in the output and a 5V zener diode wired across the output can be used to supply a stabilised voltage for say, an integrated circuit, **Fig. 4**.

All formulae can be used in different ways, which is good news for us because

we will probably want to use it to make a smaller voltage from a larger one such as a regulated 5V as in Fig. 4. This time we know what voltage we need to feed the regulator, say 6V. To find the values of the two resistors is easy because we know the input voltage, which is the voltage across the two resistors, which is 12V. We will have to invent the total value of the resistors so we can make it a value that is readily available such as 10kΩ (although there is no need to write **kohms**, or even kΩ, just the 'k' will do). We now know the voltage input, the voltage output and the total value of the resistors and we haven't *done* anything yet! There is just one calculation to make and that is from Ohm's law to find the current. You remember Ohm's law? (Fig. 1 again.)

Using the Formula

Put your finger over the I, and you can see that you have to divide R into V and in our case will be divide 10(k) into 12(V) and that is 1.2(mA). With electronics, resistors are usually in k's and the current in mA (milliamps). It is easier to work with these units when using formula. If we used ohms and amps our calculations would have been dividing 10,000 into 12, which will give the answer as 0.0012 amps. This is a bit messy so stay with k and mA. We now know the voltage required, the input voltage, the total resistor value and the current through the circuit. All that remains to be done is to replace *our* resistor with two separate ones and as they both share common factors that is an easy matter. Let's find R2, which we will put as our bottom resistor. From our magic formula, **Fig. 5**, R2 will be the result of the current (1.2) divided into the output voltage, which is the required volts drop across the resistor, which in our case is 6V so 1.2 divided into 6 is 0.5. The resistor R2 is 5k, as we are working in volts and mA, and resistor R1 is found by the same method but the voltage drop is across R1 which is 6 from 12 whereas the voltage drop across R2 is from volts output to chassis or 0V. The voltage across R1 and R2 in this example is the same.

Let's look at a different value of volts output to show the working out of R1.

We will use 9 volts as the output and keep the input as 12 volts. R2 will be 9 divided by 1.2, which is 7.5k and R1 will be volts drop across R1, which is 9 from 12 and that is 3 so R1 is 3 divided by 1.2, which is 2.5k. If you add R1 and R2 together, you will find it is our original 10k total resistor (7.5 + 2.5).

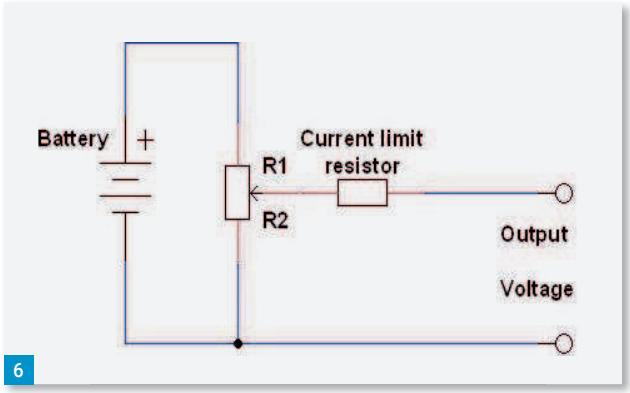


Fig. 6: The circuit of Fig. 4 but with the resistor chain replaced with a potentiometer (variable resistor).
Fig. 7: Using a current meter as a voltmeter.
Fig. 8: Using a current meter to measure higher currents.

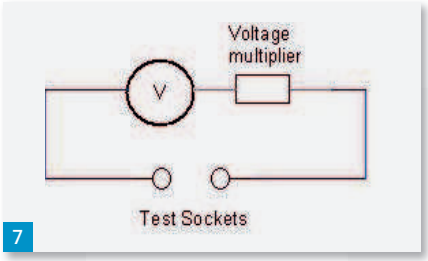
The resistors R1 and R2 could be replaced with a potentiometer and adjusted to the required value by looking at a voltmeter connected in place of the zener diode. When it has been set for about six volts, the meter can be disconnected and the zener diode fitted in its place, **Fig. 6**.

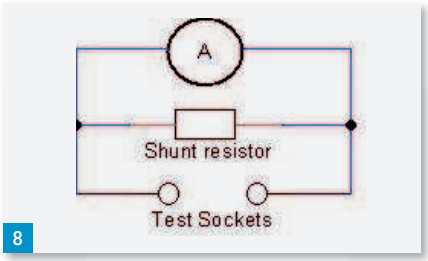
I have no intention of boring you with theory that you will probably never use, that is why I have called this 'Applied Theory'. This is the stuff that will be useful to you as a hobbyist, radio amateur, experimenter or someone who is just starting a career in electronics. Ohm's Law and how to apply it is a very useful and powerful tool. I fully recommend you to learn it. Volts, Current and Resistance are what electronics is all about and so is Ohm's law (Just remember the triangle).

Resistors and the Meter

All electronic circuits use resistors. The sole purpose in life of a resistor is to reduce current flow, that's all, nothing else. The fact that we get a trade-off is a bonus. Well, not really, as it is down to you know who … that's right, Ohm's Law. A resistor is placed in a circuit to reduce the current and in doing so provides a voltage drop across the resistor that can be used in a circuit to provide a necessary voltage for perhaps a transistor to conduct or to provide a required level of amplification and many other uses. A very common use is in the analogue (moving coil) multimeter where, depending on the location of a resistor, it allows the meter to read volts, amps or resistance. A selection of resistors when placed in series with a moving coil meter will read voltage when it is applied across the resistor and the other terminal of the meter by working out the third unknown (the voltage) with the two known (current measured on the meter and a fixed series resistor). It is then a simple matter of re-scaling the meter to call it volts, **Fig. 7**.

When the multimeter is connected in a circuit to measure voltage, the current





through the circuit is multiplied by the series resistor and will be the voltage drop across the resistor (Ohm's law). The meter is calibrated by the voltage drop across the resistor and then becomes a voltmeter. The current is measured with the same meter movement but with different resistor values placed in parallel with the movement coil to shunt it (sharing the current flow) and allow a greater current to be measured than that of the basic meter of say, 50µA (microamps), **Fig. 8**. The same **deception** is created when using a multimeter to measure a resistor value. This time, however, in simple terms, a low voltage battery is used to supply a small flow of current through the resistor under test to measure the voltage drop across the resistor. This voltage drop is re-scaled on the multimeter as resistor values (resistance). All this is done using Ohm's law, so you can see how important it is to learn and know about this useful formula. It is more common today to see the use of digital meters in place of the moving coil analogue types. This is because they are more accurate and much more robust. In days gone by, the more accurate meter that was the forefather of the digital meter was the valve-voltmeter.

Sporadic E Time

Steve Telenius-Lowe PJ4DX reports that the higher bands have been enlivened by summertime Sporadic E propagation.

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Welcome to the August *HF Highlights*. My QSL Manager **Tim Beaumont M0URX** is also the QSL Manager for the VP8PJ South Orkney operation, which took place in February-March, one of the last DXpeditions before the almost global lock-down. If you worked that station you will be pleased to hear that Tim tells me that he recently sent out all the VP8PJ QSLs, **Fig. 2**, that had been requested, either direct by post or through his OQRS service, by May 20th.

m0urx.com/oqrs

10m Sporadic E

With the lack of DXpeditions or other rare DX stations to work, the highlight of the month has been the great propagation on 28MHz during May and the early part of June. At the bottom of the solar cycle many amateurs abandon the higher HF bands such as 28 and 24MHz, yet there are often excellent conditions during the spring and summer months on those bands, and this year was no exception. Although Sporadic E (Es) propagation is often thought of as a VHF propagation mode, in fact it is more prevalent on the higher HF bands than on VHF.

If it were solar maximum, most amateurs operating on 28MHz would not necessarily know whether the stations they are working are by E-layer or F-layer propagation, but now with the solar flux as low as 68 to 72 SFI, 28MHz is incapable of providing propagation via the F-layer. Such contacts must therefore be being made by Es. From the UK contacts may typically be made all over Europe, though usually only to one part of the continent at a time, such as Scandinavia on one day and the Balkans another.

However, there can also be cases of double or multiple-hop Sporadic E, and then North American or Caribbean stations can be worked from Europe. I experienced this from here in Bonaire on several occasions in May and June when I worked many European stations on 28MHz SSB. As the closest part of Europe (Portugal) is around 6500km away and I was also contacting stations as distant as OD5TX and OD5VG (Lebanon, about 10,500km) and HZ1TT (Saudi Arabia, around 11,500km away), these QSOs must be by multiple-hop Sporadic E.

Signals are not there every day, but when they are they are characterised by rapid and deep fading.

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Several contributors to the column this month took advantage of the summer Sporadic E propagation on 28MHz, as reported in 'Readers' News' and 'Around the Bands', below.

Readers'News

The first of those was **Kevin Stock M0YRX**, who wrote that *"May was a cracking month here for 10m SSB. I managed to work 62 DXCC in the month alone and, of course, the bigger stations [will] have done even better I guess."* On June 2nd Kevin wrote again, *"What an amazing day yesterday was for 10m SSB, I worked VE1TK at 1411UTC, then A61HA at 1434, and ended up running a backscatter net with **Tony M0IQD** and **Iain MM0TFU** from 1507, which lasted about an hour, working UK stations."* Kevin also sent in **Fig. 1**, showing what the UK 10m SSB group as a whole managed to work in the first five months of 2020 on that band and mode. I was pleased to contact Kevin on 28MHz SSB on a couple of occasions during May.

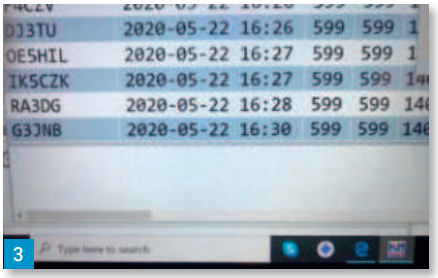
Tony Usher G4HZW reported *"beautiful weather during May, which was the sunniest month ever, not just the sunniest May, since records began. 10 metres responded and was in fine form; so much so that I never ventured on to the 7MHz standby during the whole of the last period! Sporadic E on most days plus South America in the evening and North America later, right up to and beyond midnight."* Tony reported 353 QSOs on 10m, with 351 in 83 DXCC entities on FT8 plus just two contacts on SSB – with me, and **Bert PJ4KY**. Tony concluded by saying *"I think some UK stations worked JA, VK and the west coast of North America but I'm saving those for later!"*

2a


2b

Martin Evans GW4TPG has been using

Fig. 1: Contacts made by the UK 10m SSB group on that band and mode from January to May 2020. Fig. 2: The VP8PJ double-sided QSL card being sent out by QSL Manager Tim Beaumont M0URX. Fig. 3: 3G2HOME's logbook screen shot, the ultimate in QSLing for G3JNB! Fig. 4: Fancy a walk up there? Kevin ZB2GI did just that for his permitted exercise during the lockdown in Gibraltar.



his lockdown time in the garden to improve his antennas, saying: *"I am QRV on 40/80m again – the big vertical is back up in the air, the feed is sorted out and new guy cabling/stakes all done to keep it up in the air this time. All I have left to do is to run some new radials in for 80m. As the lawn is bone dry and the ground is set hard like concrete, I need a few days of rain to soften the turf up so I can get the lawn edging tool to cut into the lawn properly. The match on both bands is spot on, bandwidth on both bands is excellent too and the receive noise is not too bad, so good all around so far. The other bit of news for this month is Sporadic E on 10m. The last couple of years I have concentrated on 12m. This year I decided to concentrate on 10m and I have managed to add six new DXCCs in May, which admittedly are all Europe, but every little helps! 10m is now up to 163 worked for me. When I started looking at DXCC on 10m seriously during a sunspot peak (more years back than I care to remember!) I decided to prioritise DX entities and leave European entities for another day when the sunspot cycle was low and as a result I still need a few of the rarer European entities on 10m, which are good to add during summer Es, and it's good to see at least one band heading upwards this year even if the others are a bit shabby!"*

Victor Brand G3JNB also reckoned that May was a great improvement on April. *"We opened with a remarkable increase in activity and an avalanche of RP75 stations to entertain us as the VE Day celebrations approached. The ubiquitous 'STAYHOME' and 'STAYSAFE' calls abounded and nature relented with some moderate DX. Tuned with a tiny MFJ 16010 tuner against the central heating radiator, my temporary 100ft long wire with 20W of CW on 20m netted NE1QP the 'Saratoga Springs' contesters,* ***Jeff TZ4AM*** *Mali and 4X75V, Israel's 'Victory in WW2' call, as well as EUs like OZ75MAY/88 up on topband. Dipping into a contest, I worked* ***Andy 5Z4/G3AB*** *Kenya. Then, by twiddling my WOLFWAVE and going QRO with 50W to the wire, I plucked JV2L Mongolia from beneath the ear-splitting sideband of a powerful LZ who remained oblivious. Switching to my multi-band vertical, I worked KP2M who seduced me from the US Virgin Islands. But I really felt for the CW operator of IS75STAYHOME in Sardinia as we had a faltering QSO. He was in dire need of a memory keyer!*

"Bedtime CW DX restarted on 30m with ***Didier FY5FY*** *French Guiana and* ***George SY8CDV*** *operating from Hermoupolis, Syros Island (EU-067). The band also produced HK7AAG Colombia, UA9MA Asiatic Russia and 4U9STAYHOME from Brindisi. On 20m simplex, the wonderfully named 'Valley Swamp Club' in Massachusetts, with their special call WY1ITU, were worked though it took some doing... At 1630UTC on 22nd I found myself receiving both VU3NXI India on17m and 3G2HOME in Chile on 20m. I called them both and heard 'G3JNB' come back faintly from Chile before I got smothered again. In their log? Five hours later,* ***Luis CE2ML*** *kindly mailed confirmation with an iPhone photo of his log,* **Fig. 3**, *a lifetime first for me!"*

Regular correspondent **Carl Gorse 2E0HPI** has been conspicuous by his absence all year but wrote to explain: *"I've been sorting out my equipment for HF and have been back on air after a break doing my photography. Here* [in 'Around the Bands'] *are some contacts made over the past few days on the Xiegu G90 and the MFJ-1979 vertical in the garden. We are currently in isolation due to the pandemic and hopefully will be able to get out portable later in the year. I hope to get an Icom IC-7300 for home and just waiting on delivery of a Cushcraft R9* [vertical antenna] *to arrive in the next few weeks. But it's nice to be back on the air!"* Welcome back Carl.

Etienne Vrebos OS8D/ON8DN says he *"made about 250 QSOs this month"* with *"nothing more to do: lockdown has been very aggressive and controlled in Belgium until today. Great weather for the last three months, sometimes exceeding 30°C, but conditions on HF again decreased dramatically, though I do keep in my mind that it can't be worse and can only become better... A short comment: a huge increase of the use of digital modes, especially on 28 and 50MHz, but I still believe human SSB contact is the real QSO (CW too of course, though I don't practice). I still have difficulties to accept as valid a computer QSO to another computer, though again for sure it is the only solution for a large number of operators who do not have space for efficient antennas or are using only low power."*

Owen Williams G0PHY says *"It was another month of increased activity with more rounds of the RSGB Hope QSO party and the Covid-19 activity. 10m showed signs of life towards the end of May although all the contacts I had were with European stations. At the same time there was short-skip propagation on 20m within the British Isles and near-continent with GD, EI and PA stations audible at good strength. There was some DX about with contacts being made with A2, A7, W and PY on 14MHz and PY on 7MHz... I'm still practising CW using AA9PW's website and I've also succeeded in chasing up an old outstanding IOTA QSL."*

Kevin Hewitt ZB2GI writes that *"Gibraltar remains in lockdown... I remained at home for eight weeks and only ventured out to Morrisons once a week. Exercising has always been allowed and with easing of restrictions I walked up the Rock* (**Fig. 4**) *to the shack and operated on 10m. I also operated from the club station one evening. The majority of my operating this month has been from my home station: the Outbacker* [mobile antenna] *has performed well on both SSB and FT8."*

Finally, we wish a warm welcome to new contributor **Mike Wilson EA7KIP/G4GOU**. Mike works in Gibraltar but lives 15 miles north of the Rock on the other side of the border in Andalucia. He wrote: *"I am usu-*

Fig. 5: Mike EA7KIP/P operating from the beach in Andalucia with Gibraltar in the background.
Fig. 6: eQSL from Jaime PY2BT in Sao Paulo, received after a 20m SSB contact with Kevin ZB2GI.

*ally helping out with the Gibraltar ARC, but due to the lockdown have not been able to get over to the club for a couple of months. Just before the lockdown (at the recommendation of **John ZB2JK**) I purchased a uBitx kit, which arrived just before the postal service shutdown in India. With the relaxation of the lockdown rules in Spain allowing visits to the beach I took the new rig for a try out on the beach,* **Fig. 5**. *After putting up a 40m end-fed half-wave supported by two 6m fishing poles and connected to the uBitx with a 49:1 unun I put out a call on 20m SSB. First contact was with YO1STAYHOME at 59. I also tried out the built-in WSPR beacon and got reports from as far away as ZL at 19,500km. Definitely going down to the beach again soon as the noise level is very low compared with that at home, but next time I will remember to bring a chair!"*

Around the Bands

Kevin M0YRX: 28MHz SSB: 4L/G4ENL, 4X1TI, 4X6HU, FM5DN, HC5DX, HZ1SK, JY5HX, N1RR, OD50SH, OD5TX, PJ4DX, PT9IR, PU2FDC, PY2TMV, PY4BZ, PY4JW, RM8A, TA7EB, TA7I, TA7OHM, W1NA.

Tony G4HZW: 28MHz SSB: PJ4DX, PJ4KY. **28MHz FT8:** 4J75DJ, 4L6QL, 5T5PA, 8P2K, 9K2BM, 9Z4Y, A61DD, CA4COQ, CN8SG, CP6UA, FG8OJ, HC1E, HC5VF, HI8S, HJ3SUA, HP2BWJ, HZ1SK, J35X, J68HZ, LU8HGI, OD5VB, PJ2BR, PJ4NX, PZ5RA, RW0AR, TI2CC, WP4QQJ, XQ1KN, YB2DX, YV1SW, ZP5DBC.

Martin GW4TPG: 14MHz FT8: 4S7AB. **18MHz FT8:** 5C1WTIS (Morocco), HL3GOB. **21MHz FT8:** 5H3DX, 5Z4/G3AB. **28MHz FT8:** C31CT, EK1KE, FG8OJ, IS0KNG, J68HZ, VO1NC, Z61DX, ZA/IZ7PMQ.

Carl 2E0HPI, 7MHz SSB: OS0STAYHOME, OT7STAYSAFE. **14MHz SSB:** 4U2STAYHOME, OH1STAYHOME to OH6STAYHOME, OQ4ANGELS, OR7STAYHOME, PC19STAYHOME, YO1STAYHOME, ZW5STAYHOME.

Etienne OS8D / ON8DN, 14MHz SSB: 3V8MN, 4L6DL, 4S7JL/MM (South Atlantic), 8J1ITU, AT2SH, BG7AJH, E20WXA, E2STAYHOME, JR7COP, KL7KK, OJ0A, R207RRC (AS-207), S01WS, TT8FC, UN7OD, VU2AU, VU3WEW, WA6QDQ/KH6, XE1CQ. **21MHz SSB:** YB0IBM, ZA/IZ7PMQ. **28MHz SSB:** OH0STAYHOME, OJ0A.

Owen G0PHY, 7MHz SSB: ZW5STAYHOME. **14MHz SSB:** A25SL, A71AM, N2I/STAYHOME, W2I/STAYHOME, ZW5STAYHOME.

Kevin ZB2GI, 5MHz FT8: 9A2X, DK6XR, EA5NK, F4AYI. **14MHz SSB:** 5Z4BU, EA8ZV, FG4SO, PP1WW, PY1CV, PY2BT (**Fig. 6**), PY4BZ, TA2LG. **14MHz FT8:** PA75FREEDOM. **21MHz SSB:** TI2JS, PY2FZ. **21MHz FT8:** LX2SM, LZ177GL. **28MHz SSB:** GW5NF. **28MHz FT8:** C31KC, CT3MD, EA8AR, GB1945PE, HI8CJ.

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Signing Off

Thank you to all contributors. Please send all input for this column to **teleniuslowe@gmail.com** by the 11th of each month – photographs of your station or activity would be particularly welcome. For the October issue the deadline is August 11th. 73, Steve PJ4DX.

Tim Kirby
longworthtim@gmail.com

More amazing QSOs from D4VHF

Tim Kirby GW4VXE has a packed column as a result of some remarkable propagation during May and early June.

The Monteverde Contest Team's VHF activity continues with some fascinating contacts being made. On May 29th, there was an extensive Es opening throughout Europe with the MUF well in excess of 144MHz. You'll find plenty of reports in the band reports section of the column. D4VHF from Cape Verde was heard on 2m FT8 by SP5XMU in Warsaw at a distance of 5600km. Unfortunately, a two-way contact did not take place. However, other contacts were made. The furthest appears to be DJ7QZ (JN58) with DL5MCG also in JN58 a fraction closer. A screenshot from the D4VHF computer on EI7GL's blog, **Fig. 1**, shows many DX calls, including SQ5AAG (KO02).

It looks as though this opening was a combination of an Es opening over land and, probably, a marine duct over the sea. A number of UK stations from the south-west G4RRA (IO80), G8BCG (IO70), GW7SMB (IO81), G3NJV (IO70) and G7RAU (IN79) all worked D4VHF shortly before the propagation changed allowing the QSOs to be made into Germany. When SP5XMU heard D4VHF, he was working Es QSOs into Portugal at a distance of around 2700km which, of course, is good going, though not unheard of, for single hop Es.

I've included a screenshot from F5LEN's tropo prediction site (below and **Fig. 2**), also taken from EI7GL's blog which shows the marine ducting taking place from the Cape Verde Islands, passing the Canaries, to the coast of Portugal – where, it's probably reasonable to surmise that the Es took over!

https://tropo.f5len.org

A few days earlier, there had been a tropo opening from the western UK and Ireland to Cape Verde and there are some details in the band reports section.

Germany on 50MHz

In early May, the German PTT announced changes affecting the use of the 50MHz band in Germany. The whole 50-52MHz band is now available (previously only 50-51MHz could be used) and power limits have been increased: 750W for CEPT 1 licences and 25W for Novices. Additionally, contest operation is now allowed without restrictions.

It was immediately noticeable that signals from Germany became very much louder and more stations were active following this announcement, which is great news.

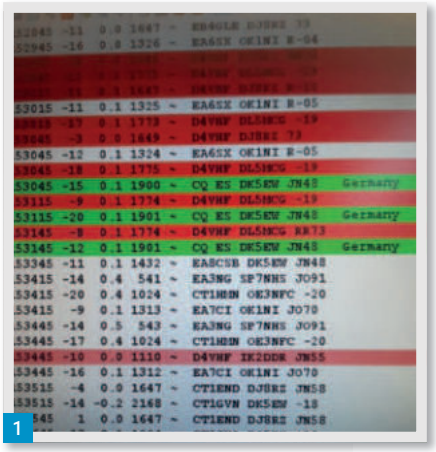
Pictures on D-STAR

Jef Van Raepenbusch ON8NT 'listened' to a D-STAR picture net on the REF072D reflector on June 3rd and reports that although the net took place in the middle of the night for Europeans, there were 15 pictures waiting for him in the morning!

The 6m Band

Unfortunately, I managed to miss out **Kevin Hewitt's ZB2GI** report for May from the last column – sorry! Kevin has been operating with an Outbacker multiband whip with a 2.5m counterpoise wire. The antenna is clamped to a broom handle stuck out of the window. Kevin found an opening into the UK and Europe on April 28th and says that during May he had over 200 FT8 contacts in the log and only two SSB contacts. I am amazed how well Kevin is doing with the simple antenna – I have heard him regularly on the band with really good signals.

On May 24th, Kevin replaced the Outbacker antenna with a Ham Tenna 6m mono-band whip. On May 26th, there was an opening to North America and Kevin was pleased to work into the US and Canada. Highlights of the log include GW4VXE (IO71), GB1PBL (IO80), PA4VHF (JO32), GB1PBL (IO80), G4XEE (IO90), DF70DARC (JO40), W1JJ (FN41), VE1PZ (FN85), NN4X (EL98), W4SO (EL98), K1TO (EL87), AD4ES (EL98), N4WW (EL98), 5B60ALJ (KM64), SV3DCX (KM08), TK4LS (JN42), NR1DX (EL87), K4CVL (EL87), W5GJ (EL87), N2TU (EM95), W4DXX (EM70), W4WT (EM74), K4XP (EM84), N0FW (EM79), WA4IXW (FM06), AC4TO (EM70), K4RX (EM70), WB4HIE (EM95), K4MOG (EM73), K9CT (EN50), W3CP (DN05), K1SIX (FN43), NW1B (FN43), IK1MDF (JN44), K1UO (FN54), 5B60AIF (KM64), MM0OKG (IO86), TF1A (HP94) all on FT8. Kevin also went onto SSB working F4BWJ (IN93), F4OQK (IN96), F4CXO (JN61), M0COM (IO91), G4PEO (IO91), F5CBY (IN88), F6IHA (JN05), F5VY (JN04), M5BXB (IN91), G3LTF (IN91), F4BYF (IN97), F4FKR (IN88), I0SJX (JN61), IZ8FDH (JN70), IZ5EME (JN52), DL3GD (JN38), M0GHZ (IO81), F4IHL (IN94), ON4LG (JO20), M0CGF (IO91), IK5DNF (JN62) and PA3HGT (JO22).



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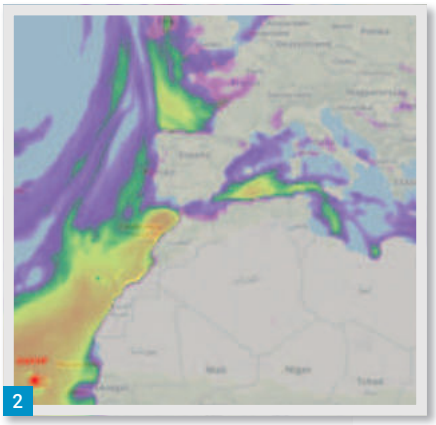
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Kevin also mentions that he is using an app on his Android phone called WSJT-X Monitor, allowing him to see the decoded messages on his phone connected by WiFi to his shack computer.

Jef ON8NT worked some nice DX with his IC-7300 and V-2000 vertical, the highlights being TA9J (LN10), ZB2GI (IM76), EA8A (IL18), CT3HY (IM12), 7X2KF (JM06), OY1OF (IP62), CT3MD (IM13) and LA9VFA (KQ40).

Dave Hobro G4IDF (Worcester) was pleased to catch the Es opening on June 18th working DF8SM (JN58), ES7GM (KO28), OE3DSB (JN78) on SSB, all of which were new squares for Dave, along with several Italian stations. Dave keeps a tab of his grids/squares worked using the ARRL's VUCC system and has 116 confirmed.

Fig. 1: A screenshot of the D4VHF FT8 screen during the opening to Germany and Poland.
Fig. 2: A screenshot from the F5LEN propagation website showing the marine duct between Cape Verde and Portugal.
Fig. 3: Bernard G4BXD has been working on his 3.4GHz system.
Fig 4: It's good to see Patrick WD9EWK back on the road again.

Robert van der Zaal PA9RZ caught the Es opening on May 19th, working EI7BMD and then on May 31st, IZ4DRP. Robert runs 10W of SSB from his IC-7300 to a 49-72MHz log periodic antenna made by AnJo Antennen in Germany.

Phil Oakley G0BVD (Great Torrington) says he has had a great month on the band, working his best ever DX on 6m, HI3T (FK49). Other nice contacts were with KP4TG (FK68) and W3LPL (FM19). Phil worked 96 stations during the month in eight new squares. He comments that of those 96 stations only nine were on SSB.

Steve Macdonald G4AQB (Bolton) says that the last few weeks have provided the best Es conditions that he can remember (a number of us have been saying the same, Steve!). Steve says he has worked dozens of Italian, Spanish and Eastern European stations on FT8 on the band.

Andy Adams GW0KZG (Letterston) has been running 85W to a 5/8 wave vertical and has worked some nice DX, including A71AE, CU2AP, CT3HY, N4TB, OD5KU and KP4EIT

The 4m Band

Jef ON8NT runs 10W to a halo antenna on his balcony and lists so much nice DX that I am regretting my decision not to get going on the band this year! Highlights, all on FT8, are EA6XQ (JM19), SV2DCD (KN00), 9H1CG (JM75), GM8IEM (IO78), TF8SM (HP84), EA8DBM (IL18), LZ2HM (KN12), YO5TP (KN16) and OY1OF (IP62).

Simon Evans G6AHX (Twyning) found a number of openings on the band – the highlight being S01WS on May 19th and EA9IB on May 29th. Another nice one was OH0Z on June 1st. Simon continues *"the most amusing incident occurred on May 30th when the squelch was broken on my 4m FM transceiver tuned to 70.450MHz. It was a couple of Danish guys on the Island of Bornholm chatting and unaware of the lift conditions. Fortunately, they knew their locator and we had a chat"*.

Robert PA9RZ worked into EI on May 19th, working EI7HBB and EI3GYB, both in IO53. Robert tried to work EI3GYB on FM, but felt that the MUF was only just supporting propagation at the bottom of the band! On May 31st Robert worked EB1A (IN53) on SSB. Like a number of others, Robert is disappointed by Icom's decision to omit 70MHz from the new IC-705 portable and as a result, he has cancelled his order.

Roger Daniel G4RUW (Newbury) caught the Es opening on May 29th, working SP6RLA (JO81) and DH1DA (JN48). Roger says that some good ones got away, such as EA8 and TF, but as he uses his 10m delta loop for an antenna he is not too surprised.

Dave Thorpe G4FKI (Ampthill) says he worked 28 squares between May 27th and June 1st, running his IC-7300 and a quad-band vertical. The best DX was 9H1PI (JM75). Dave says that in each opening he tried CW and SSB but silence was the only reply.

Steve G4AQB says that conditions on the band have been very good at times and he made some nice QSOs on FT8: HG2DX (KN06), S51RM (JN76), 9A3TN (JN85), EA1TX (IN71), EC1R (IN72) and EA4EJR (IM68). Steve runs 25W to an HB9CV antenna.

Gordon Smith GW6TEO (Castlemartin) sends a really interesting log as he's been concentrating on the band during the Es this year and seems to have found lots of openings. Gordon noticed the first opening of the season on May 10th, working DK5EW (JN48). Another opening on May 12th brought EA1YV (IN52), 9A3TN (JN85) and HA3GR (JN86); May 18th HA, 9A and S5. May 19th saw 21 stations worked ranging from CT in the west to OZ in the northeast; May 20th 25 stations worked ranging from the east around to the south, SV8JNL (KM39) and SV2JAO (KN10) were particularly nice catches. May 24th, 26th and 27th saw smaller openings to 9A, DL, SP, HA and CT. On May 28th the highlights were EA8BPX (IL18) on SSB and EC6DX (JM29). Next day on May 29th another 14 stations were worked with the best being OH3CT (KP21), SP2CHY (JO94), TF8SM (HP94) and LA7DFA (JP33). There were more EAs on May 30th and then on May 31st Gordon's highlight was working 4X1TI (KM71) at a distance of 3844km – a possible GW to 4X first on the band? June 1st saw another opening to the east, ranging from Finland around to Romania. Perhaps the highlight of the month came on June 2nd when Gordon worked A92HK (LL56) at a distance of 5407km and hopefully another GW 70MHz first for Gordon.

The 2m Band

Ken Churms G4VZV (Sheffield) wrote for the first time to say that he'd enjoyed the 2m Es

opening on May 29th, working into I, IT9, EA6, 9A, IS0, YU2 and best of all Algeria 7X. Ken was using a 10-element delta loop antenna. On May 31st, Ken caught another short opening, working IK7LMX (JN80), IK7JNM (JN80) and IK7XWJ (JN90). Please keep your reports coming, Ken!

Simon G6AHX lists three Es openings: May 20th when he worked 9H1LO, May 29th when he worked IC8AJU, IT9YLF, I7OXH, S55OO, IK7LMX and IU7EDW and May 31st when he worked CT1HIX. Simon runs an IC-9700 to an 8-element ZL special.

Robert PA9PZ writes, "*On 2m I tend to give my old pal from University, **Jelke PA0FEI** in JO33BC, a 'point' in the various activity contests like the 2m one on June 2nd. Strangely, for the 145km between us I always need my full power (100W) and have difficulties working each other, while with OZ1ALS (JO44) 471km away, signals are usually fair or even strong both ways. I've been to their contest QTH, a hilltop in SW Denmark. But for these contests I need QRO so as a QRP operator they are of little value to me apart from the sociable aspects*".

Roger G4RUW enjoyed the opening on May 29th working IK0OZY (JN61), YU1AL (KN04), LZ1RO (KN13), IZ6RCR (JN62) and IS0PGF (JM49). Roger found another opening on May 31st, but it was very unstable. Roger stayed on FT8 and was called by E73CV but sadly lost him. Roger was disappointed as that would have been country 49 worked on the band while running 10W.

Phil G0BVD has his beam antennas up now and is enjoying being back on the band. It was all done just in time for the Es opening on May 31st when Phil worked E77AR on Es, his best 2m DX since moving to Devon from Worcestershire.

Ian Bontoft G4ELW (Bridgwater) caught the May 29th Es opening and worked IK0FTA, HA6NQ, OK1ADT and 9A7JCY, all on FT8 running 15W to his V-2000 vertical.

Gordon GW6TEO worked D4VHF (HK76) during the tropo but also caught Es openings with highlights being IW9CTJ (JM77), IC8SQS (JN60) both on May 20th, 9H1BT (JM75) and IH9YMC (JM56) on May 29th and E77AR (JN94) on May 31st.

The highlight of the **GW4VXE** (Goodwick) 2m log took place on May 25th. I'd just returned from a walk to find a message from **Andy GW0KZG** to say that D4VHF was audible. The problem was that I had taken my 2m beam down a day or so before. I dropped the mast down quickly, removing the 6m beam and replacing it with a small Diamond 10-element Yagi kindly given to me by **Dave M0GIW**. Into the shack and to my delight D4VHF was coming through beautifully and responded to my first call! I'd left the FT-847 monitoring 2m, on the V-2000 and while I was back outside, swapping the antennas over again to put the 6m back up, D4VHF hit –5 on the vertical antenna! Of course, by the time I got back into the shack the signals had faded. But I had a new challenge in my mind. In the meantime, I messaged **Richard Brooks GW1JFV** just down the road from me in Haverfordwest who has made some great QSOs with his vertical antenna and I really hoped that he would be able to work D4VHF. Over the next hour or two, we both saw D4VHF fade up and down several times but not sufficiently strongly to attempt a QSO. Finally, around 2100UTC as the sun was setting, with the air cooling over the warm sea, the signal from D4VHF climbed to –10 with me and I started to call. It took a couple of periods, but they responded and we were able to complete the 4280km QSO using 50W to my V-2000 (it should be remembered that the system on Cape Verde is very much more capable and was doing all the hard work!).

While I was working D4VHF, Richard GW1JFV had not seen such a strong signal from them, but I was delighted that within a few moments they peaked for Richard, who started to call. Richard's QSO went through easier than mine and was easily completed. It just shows, if you are in the right place at the right time, with a good station at the other end, almost anything is possible! Thank you D4VHF – what a day! I was also lucky enough to catch the Es opening on May 29th with a good number of new squares and countries being worked – the highlight was IH9YMC (JM56) with 9H and 7X being missed in the melee of the opening!

The 70cm Band

Robert PA9RZ took part in the contest on June 9th and noticed very slow fading (more like 4m) when working PA0FEI. Robert also worked PA1TK and PA0MIR, both in JO22.

Microwaves

Bernard Nock G4BXD writes, "*I'm taking a break from Oscar 100, though I have built a new uplink of DXPatrol and amplifier for it, I have been working on other bands and am now operational on 23, 13, 9 and 3cm. 20W on the three lower bands and a basic 300mW from the Kuhne transverter on 3cm at the moment. 9cm is very interesting, using the SG Labs transverter with its 2W output alone to a homemade horn, **Fig. 3**, has produced good results; best so far is a 153km contact. I have a 20W amp and an LNA to add to the SG Labs to make what should be a potent setup*".

Satellites

Dave G4FKI says that he managed to get a packet through the International Space Station's digipeater on 145.825MHz while running 25W into a collinear antenna.

Patrick Stoddard WD9EWK (Phoenix) is back on the road again, **Fig. 4**. He writes, "*After a few months of stay-at-home orders and lockdowns due to COVID-19, satellite operators are starting to get out and operate from other locations once again.*

"*My road trip was a quick trip, where I operated from two grid locators south of the Phoenix area (DM32 and DM42). The first stop on my drive was south of the Phoenix area, just inside the north-eastern corner of grid DM32. I worked AO-91 and AO-92 from there. The AO-91 pass was a very shallow one, only popping up 4° above the horizon. After that, AO-92 came by. I worked a total of 20 stations on those two passes. I drove east, parked at a shopping mall near a freeway in grid DM42, and worked two more passes. Once again, it was an AO-91 pass followed by an AO-92 pass. I logged 19 QSOs on these two passes, before having lunch. This was a nice restart to my satellite roving.*

"*In May, IARU Region 2 started hosting online workshops covering different facets of amateur radio on Wednesday evenings in the Americas. The workshops have been hosted in English and Spanish. Satellite operating was covered in two workshops in late May. These workshops have used Zoom and are streamed in real time via YouTube. After each workshop, videos are posted on YouTube.*

"*More information about these workshops are available from the IARU-R2 website:* **https://tinyurl.com/ya3go88r**

"Videos of past workshops, along with the live presentations, are available at: **https://tinyurl.com/y8rkw2x7**

"The YouTube video of my satellite workshop from May 27th is at: **https://tinyurl.com/y8dsgfrl**

"*Along with all of this, there are still lots of transatlantic QSOs being made via AO-7 and RS-44. **Guillermo OA4/XQ3SA** has been active from Lima in Peru, and more stations across that continent are showing up. And not too long ago, KI7UNJ in the western state of Oregon worked EB1AO in Spain via RS-44, covering a distance of just over 8300km. At its highest point in orbit, RS-44's footprint is slightly larger than what we have with AO-7, making for more DX opportunities for those of us not able to enjoy QO-100.*"

That's it for this month. Let's hope the coming month will be just as exciting. Please keep your news and photos coming – your input is very much appreciated. Keep healthy!

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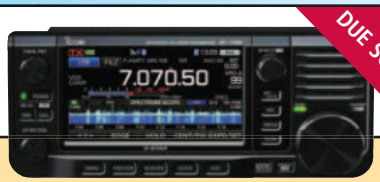

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Advanced Scanning Receiver
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144 MHz Solid State 1kW Amplifier
German engineered high spectral purity
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Outstanding performance and power handling. With 2 High quality coaxial relays & RF filtering. Fed via T bias or direct DC. Requires 12V DC @ 750mA

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Portable Vector Network Analyser
- Covers 100kHz-700MHz
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- Measures R, Z, X (sign), SWR, Phase, Return Loss, TDR, L, C
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900 MHz-1.3GHz

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- Mast dia. 48-63mm
- Vertical load 700 kg
- Horizontal load 1,000 kg
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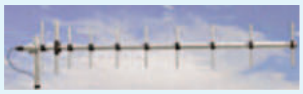

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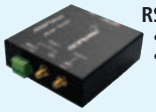

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- 50-1300MHz
- 500W
- Gain: 10-12dBi

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- 500W

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Fibreglass Telescopic Poles

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Aluminium Telescopic masts *German engineered!*

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Hy-Gain

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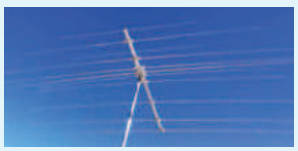

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7 Band compact Beam

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- Frequency: 20m/17m/15m/12m/10m/6m/4m
- Boom: 3.5m, Turning radius 4.84m
- Gain: averages 11.24 dBi
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Commercial Grade Antenna Analyser
- Frequency: 1.8 - 500MHz
- Colour TFT display shows: Frequency, SWR, Impedance, Resistance, reactance, SWR graph
- Auto Sweep Mode

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4 Band Dipole
- Power: 1kW
- Use as V or straight
- Vee: 7.4m
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~~£1999~~
£1699

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- Small footprint: 15.5ft turning radius, 4ft boom
- Supplied with the SDA-100 controller

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Large range of spare parts in stock

PRICE PLEDGE WE ALWAYS AIM TO BE COMPETITIVE - SEEN IT CHEAPER? LET US KNOW!

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Getting Started

This month **Colin Redwood, G6MXL** provides the absolute basics for those starting out in the hobby.

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

The first step to getting started in amateur radio is to obtain a Foundation licence. It is issued by Ofcom who regulate the radio spectrum in the UK. You need a licence in order to transmit. To get your licence you'll need to pass the Foundation exam. During the current Coronavirus pandemic, the Radio Society of Great Britain (RSGB) have obtained agreement from Ofcom to offer online exams with remote invigilation using webcams. This is proving to be incredibly popular. The RSGB have also obtained a dispensation to drop the need for the practical element of the training. I'll be focusing on some of these practical aspects later in this article.

To prepare for the Foundation Exam you should obtain an up-to-date copy of *The Foundation Licence Manual for Radio Amateurs* by **Alan Betts G0HIQ**, **Fig. 1**. The book covers just about everything you need to know to pass the exam and quite a bit more. You can obtain the book from the *PW* Bookshop or the RSGB. You should also visit the RSGB website and download the reference data booklet for the Foundation Exam. You'll need to have this booklet available to you when you sit the exam, as you'll find it will assist you in answering several questions – so print it before your exam.

https://tinyurl.com/yalq9rob

To help focus your learning, I think it is also a good idea to download a copy of the Foundation Exam syllabus from the RSGB website. It clearly distinguishes between things you need to just remember ('Recall') and topics where you need to understand something.

https://tinyurl.com/ycafug76

Training Courses

If you would prefer to get some online training, then Essex Ham and **William McFarland GM6DX** both provide courses. Most people find a combination of a course and the book a good way to learn:

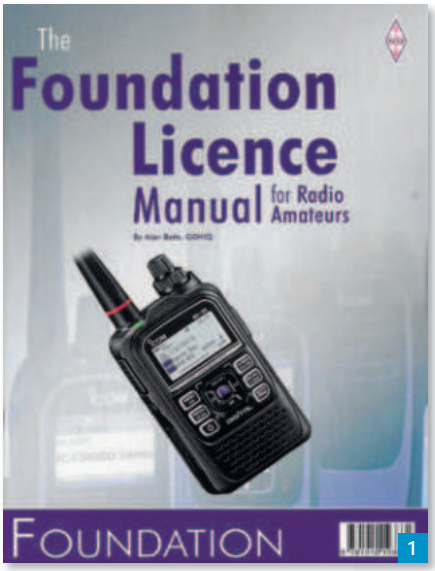
https://tinyurl.com/yambdmon
https://gm6dx.thinkific.com

In addition, some local clubs are using Zoom or Skype to deliver training for the amateur radio exams.

The Exam

Once you have completed your studies, the RSGB have a couple of mock exams you can download. Don't be tempted to try these until you have covered the full syllabus and feel ready to sit your exam. Try to do them under exam conditions, making sure you have printed out the reference data booklet I mentioned earlier:

https://tinyurl.com/ycvnoroj



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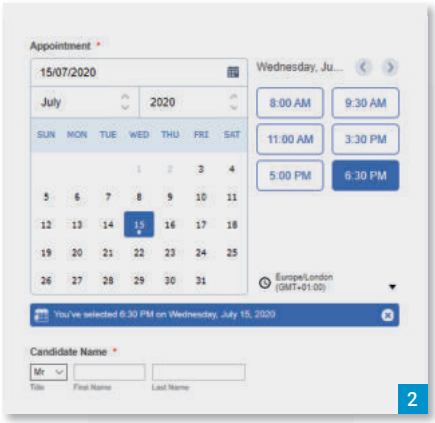

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Booking Your Exam

You can book and pay for your online exam on the RSGB website, **Fig. 2**. I should warn potential candidates that the exam slots can get booked rapidly. For example, all 600 of the June 2020 exam slots were booked up well before the end of the May.

https://tinyurl.com/y7pxyn44

Apply for Your Licence

Once you have taken your online exam, you'll know within a few minutes whether you have passed (typically 90% pass). You'll need to wait a few days before you can apply for your Foundation Licence and callsign on the Ofcom website.

Choosing Your Equipment

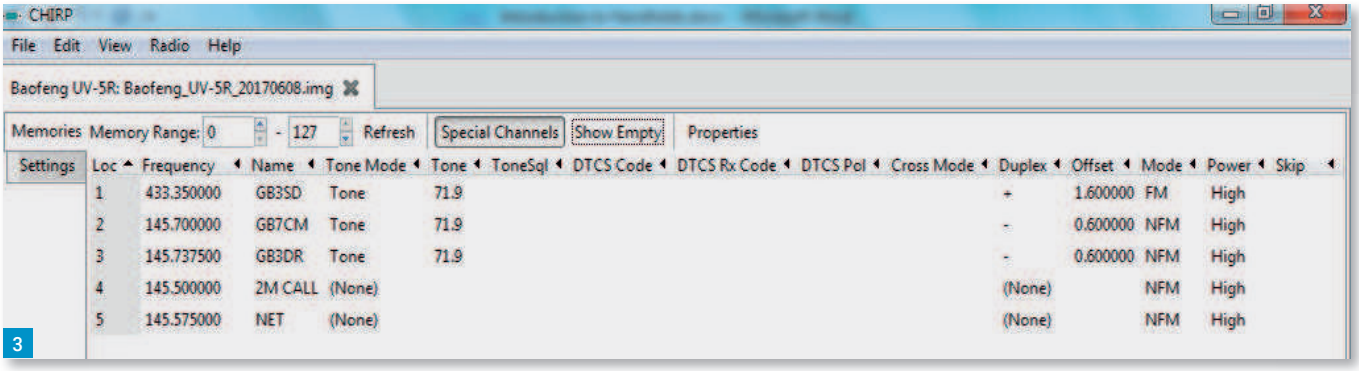
Provided you can see the transceiver working, then buying second-hand can save a lot of money. Spares for equipment over about 10 years old are often difficult or impossible to find, so while buying older equipment can be a good idea, you'll need to be particularly careful not do anything that might damage it.

VHF/UHF Handheld

If you live in a large town or city and are content to just have contacts with local amateurs, then a VHF/UHF FM hand-held transceiver (a combined transmitter and receiver) is the cheapest way of getting on the air and usually comes with a basic antenna. These generally need to be programmed with the local repeater frequencies and their associated CTCSS tones. Please be aware that older VHF/UHF equipment may not support CTCSS tones. I'd strongly recommend getting hold of a computer program called CHIRP, **Fig. 3**, and the correct programming lead so that you can program the relevant information from your computer. Make sure you get a suitable power supply/charger to charge the internal battery of the transceiver. Try to find the dates, times and frequencies of local nets, so that you can listen and then join in.

HF

If you want to have contacts beyond your immediate locality, then you'll need to look at a transceiver that covers at least some of the HF bands. Some people have modified equipment to allow it to transmit outside the frequency range that the equipment was originally designed for. This may be termed 'wide-banding' in adverts. In many cases this has been done to enable the amateur transceiver to operate on UK CB frequencies. Personally, I would avoid buying such equipment unless it was done by a reputable dealer, as you don't know what else may have been tinkered



with while the covers were off. There are some legitimate reasons for opening up frequencies, such as to enable operation on the frequencies between 7.100 and 7.200MHz, which are relatively new for UK amateurs.

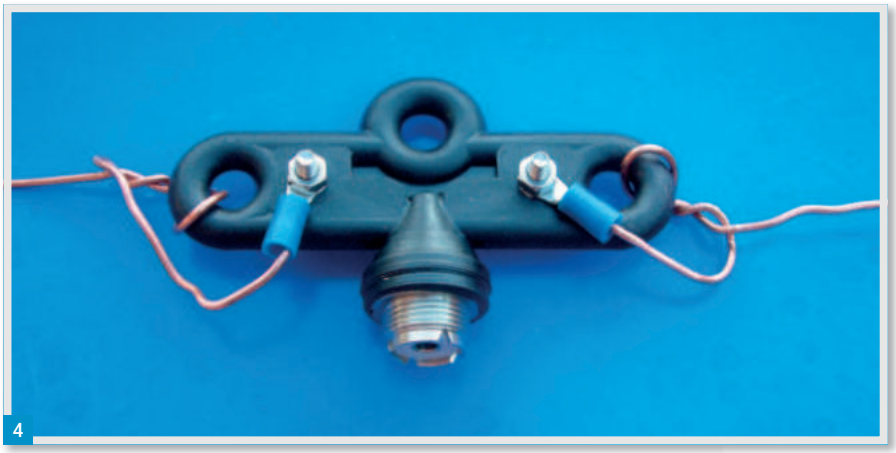
Power Supply

While you are looking at equipment, you'll need to consider a power supply. Some transceivers have a built-in mains supply, but for the rest you'll need to provide an external power supply capable of delivering 13.8 Volts with enough current. Transceivers are not very efficient, so you should choose a power supply which can deliver at least 20 Amps for a transceiver capable of transmitting up to 100 Watts, although with a Foundation Licence you'll need to turn the transmit power down to 10 Watts on most amateur bands – you should read your licence schedule.

Antennas

You can save some money by using a resonant antenna so that you don't need an Antenna Tuning Unit (ATU) to match the antenna to the transmitter. If you look on social media, you'll see all sorts of antennas mentioned. Personally, I've stuck with half-wave dipole antennas cut for the HF bands I wish to operate on, and this is certainly a cheap and effective single-band antenna. With no more than 10 Watts into a 20m half-wave dipole (about 10m in length), about 5 or 6m above the ground, I've made contacts around Europe and a few beyond. It is easy to make your own.

For the 20m (14MHz) band you'll need a piece of wire 10.03m (32ft 10in) long. Cut the wire exactly in half (i.e. 5.02m for the SSB part of the 20m band) and attach each half to a dipole centre, **Fig. 4**. Any reasonably strong wire will do – it doesn't need to be anything special to get started. Attach the 'free' ends of the wires to insulators and attach the other ends of the insulators to some string or rope that you can fix to somewhere reasonably high (e.g. house fascia, washing line pole, tree).


4

There are two main types of dipole centre available, one of which is 'hard-wired' so that no connectors are required and is therefore lighter. This is best suited to balanced feeder. The other has a SO239 socket, which enables easier changing of the coaxial feeder. I prefer the latter as I find it easier to make a waterproof connection with it, but it does add some weight, so may not be so suitable for installations where the centre is not supported. Some are available with a built-in balun. Alternatively, for a really temporary arrangement you could use a choc-block connector, but make sure that you don't allow rainwater or other sources of moisture to get into the coaxial feeder and ruin it.

If you don't have twin feeder, then you can use 50 Ohm coaxial cable to feed the dipole. You should use a balun when connecting unbalanced coaxial feeder to a balanced antenna such as a dipole. To get started, you can make a choke balun by making a few turns of your feeder into a loop, **Fig. 5** – it doesn't need to be on a metal former.

Feeder

For feeder I aim to use one where the loss is below 3dB (half) for the relevant band and length. For short (up to 20m) feeder runs on the HF bands, I think a good quality RG58 is perfectly adequate. Look for feeder that has a proper interwoven screen. Most main dealers that advertise in *Practical Wireless* will have something suitable. For the VHF bands, I'd suggest RG213 for runs up to 20m. While buying feeder, don't forget you'll need connectors. I'd suggest buying these at the same time as the feeder to ensure that they properly fit the feeder you are buying.

Fig. 1: The Foundation Licence Manual for Radio Amateurs by Alan Betts G0HIQ. Fig. 2: Booking your exam on the RSGB website. Fig. 3: Using CHIRP to program the memories of a hand-held transceiver. Fig. 4: A dipole centre. Fig. 5: A choke balun.

Erecting Antennas

Before putting up your antenna, I'd strongly recommend reviewing the Safety and EMC parts of the Foundation course, particularly if this involves climbing a ladder. If you have any doubts, some local television aerial contractors may be willing to erect amateur antennas. Just remember to make sure the feeder is properly connected to the antenna before the contractor comes. The contractor will also have suitable tools to drill holes through walls to pass the feeder through into your operating position.

5

Listening

Once you have connected everything, I'd suggest switching on and having a listen around the band you've chosen for your antenna. You'll need to adjust the band, mode, squelch and volume controls on your transceiver so that you can hear signals. Don't forget to switch off any attenuator unless you are on the 40m or 80m bands. Then tune up and down the band, and when you find a signal, very carefully adjust the tuning, so that you can hear the signal clearly.

Remember that the signals you hear on the HF bands may be Morse Code or data modes such as FT8, RTTY and PSK31 besides SSB voice contacts – refer to your schedule and the relevant band plan. If you are listening on 40m or 80m, then you'll need to use lower sideband (LSB) to clearly hear the voice contacts. On 20m and higher frequencies (shorter wavelengths) you'll need to use upper sideband (USB).

Take your time and do plenty of listening. I'd suggest having a paper notebook to jot down callsigns you hear. Don't be tempted to transmit until you have got a few hours of listening under your belt. Remember that the 20m band and higher frequencies will 'close' overnight, particularly in the winter months.

Your First HF Contact

Before going any further, make sure you have memorised your callsign using the phonetic alphabet. Then plug in your microphone. Tune around the band to find the strongest station you can hear and make a note of their callsign (for this example I'll assume their callsign is IK8UND in Italy). Wait for them to call *"CQ"* (not *"CQ DX"*). Then transmit your callsign phonetically. As you are transmitting, keep an eye on the display on your transceiver, looking for any warning signs that there is a mismatch with your antenna. If there is, you'll need to stop and check all connections. If there is little or no RF output power, check the microphone gain and power setting. If IK8UND does not reply to you, don't get disheartened, try again when you next hear him calling *"CQ"*. Again, if he doesn't reply try again when you next hear him calling *"CQ"*.

If after several tries you don't succeed, tune around to find another really strong station. This time I'll assume it is S51AD in Slovenia. Again, make a note of his callsign. When he calls *"CQ"* try calling him. Let's assume he returns your call. You can then move on to exchange reports (*"S51AD you're 5 and 9 from M7ABC"*). He'll no doubt come back with your report (don't surprised if he also gives you 5 and 9). You can then move on to exchanging names, QTH (your town), and some details of your station (*"S51AD thanks for the report, my name is Fred, my QTH is Hamton, and my transceiver is a Yaicwood YZ123 running 10 Watts into a dipole, from M7ABC"*). He'll probably respond with similar information about his station. Then you can finish the contact (*"S51AD, thanks for the nice contact, I look forward to working you again, 73 from M7ABC"*). He'll no doubt respond in a similar manner, and you've completed your first contact. Keep a note of the date, time, callsign, reports and band so that you can enter the contact in your log.

Logbook

Whilst you don't need to keep a logbook, I'd strongly suggest doing so. It's up to you whether you keep a paper logbook or use a computer log. I'd start with a paper logbook, and then as you get comfortable operating look into computer logging.

I think I have covered the absolute essentials to get you from a total beginner to completing your first contact. Good luck and good DX!

Correction

In my piece last month on returning to the hobby, I stated that those located in Wales, Scotland, etc would need to add the relevant letter after the number in the callsign. I had in my mind the situation with Intermediate callsigns, where the letter goes before the 0 or 1 (e.g. 2E0ABC, 2M0ABC, etc.) and forgot to consider the Foundation and Full callsigns where, as a reader has pointed out, the letter goes before the number (e.g. GM0ABC, MM7ABC). My apologies if any confusion was caused.

Radio Round-up

WORKSOP AMATEUR RADIO SOCIETY ACTIVITY: Worksop Amateur Radio Society Chairman Martin Fearn M0ZMF recently suggested running an amateur radio activity between three operators at separate portable locations.

The event took place on Sunday June 21st 2020. Martin operated the club call G3RCW/P from Clarborough in Nottinghamshire, Mark Edge 2E0FKB/P was on Carr Hill near Maltby in South Yorkshire and Donna Buck M7DON/P was at Highoredish in Derbyshire.

Calls were put out and there was no shortage of stations calling in! New M7's were given preference and there were over 65 QSOs logged. The activity was well publicised on Facebook, Twitter and on the air, and there were many reports of new licence holders that were listening and learning even if they didn't or couldn't call in.

Martin, Mark and Donna were also supported by two other portable operators from the area. John Siddall the newly licensed M7OJS/P was in Palterton in Derbyshire, and John Matthewson M0HXH/P was in Kirton in Nottinghamshire.

The activity was even heard using the RAF Hack Green VHF & UHF WebSDR, which is run by Stoke-on-Trent Amateur Radio Society, enabling people as far away as Mid Suffolk to listen. Newly licensed Neil Wadsley M7NOW contacted Donna while the activity was happening to say he was listening via the WebSDR and that he was learning a lot.

The session started at 10:00, lasted until 16:30, and was extremely successful and well supported by the club members and general radio community.

The Club also received a good level or feedback and engagement on Social Media.

The photo shows Donna operating portable.

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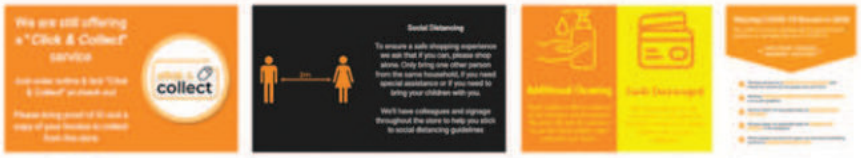

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Please observe the current government guidelines for distancing from each other & keep at least 2m or 6ft apart at all times. This will limit the amount of customers entering the building but please let staff know you have come to collect & they will bring your orders to your car if required.

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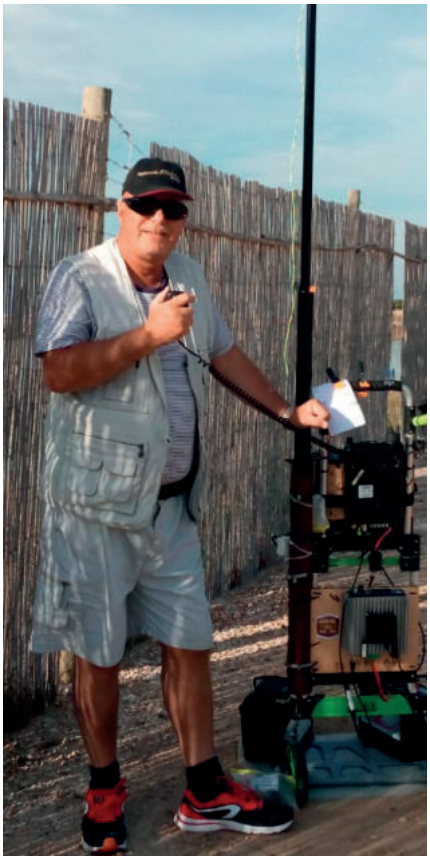
Ken Churms G4VZV
practicalwireless@warnmersgroup.co.uk

Pedestrian Mobile

Ken Churms G4VZV can often be heard on the HF bands using his reciprocal call EA5/G4VZV/ pedestrian mobile. He can be found around 14.215MHz calling CQ DX. Here is his story



My background is that I've been licensed since the late 70s as a G6 station and after passing the Morse test obtained my G4 callsign and have been involved as a keen DXer throughout this time.

The main interest to me has always been DXing on the HF bands and the ability to work lots of DX, in effect to get a quart out of a pint when it came to designing and then making my own antennas for the HF bands. How to catch that elusive DX.

Over the years I've built HF wide-spaced Yagi beams to cubical quads and later experimented with ground plane antennas. I've read hundreds of articles about antennas, and through experimenting I've gained vast knowledge on antenna building. I soon realised that location, location, location was also important with your amateur station and not confined to buying a house! With this in mind I decided to experiment with vertical antennas close to the sea.

Seaside Location

The location of our amateur radio station is crucial in putting out the very best signal while attempting to work that all elusive DX call. This led me to think about operating my station by the sea and ever since I started to do so nothing has matched the extent of DX stations I can work. I visit Spain quite often, having a holiday home very close to the sea. Here's the story.

For the HF bands I knew the saltwater of the sea and the close-by salt lagoons south of Alicante, on the Costa Blanca coast of Spain, could work in my favour.

I'd read up all about the fresnel zone (more about that below) so I decided to build an HF station on a two-wheeled trolley that I could wheel down to the local beach. I bought a sack trolley from a local DIY place here on the Costa Blanca. The beach is only some 200yds from my house and the salt lagoons about a mile away. So, I could easily wheel it down with all the kit mounted on board.

If you don't know about the 'fresnel zone', it's the area that creates good low angle take-off and works relative to your distance from the water's edge. The saltwater acts like a perfect ground plane and extends to several wavelengths from the water relative to the frequency you are working on. This effect is greater the closer you are to the water's edge and is evident by the sea or salt lakes/lagoons.

This means quite simply that if you can get your station within, say, 100yds or less of the water's edge, be it on a trolley device or in your car (as a static mobile station), the opportunities to work vast numbers of DX stations are just endless.

My Station

I built my station, which consists of an FT-857D transceiver, ATU, GTU, and specifically vertical wire antennas. The transceiver and ATU are straightforward but the key to making this station a potential DX machine is the GTU and the vertical antenna.

The GTU is a ground tuning device consisting of variable capacitor and inductor. Both can be made easily and put into a waterproof box and this device is your RF ground, which is close-coupled directly to the frame of the trolley. The trolley then becomes the 'ground bus'. It is important it's kept totally separate from the DC earth of your equipment. To this extent when mounting the equipment to the trolley, place all devices on plastic board or even wood but make sure there is no connectivity to the trolley. Use plastic wire fasteners if need be. Now to the earth system. In my case I leave the DC earth floating and not in any way connected to the RF earth. So, the transceiver, ATU and power source have a looped DC earth by way mainly of its coax and

PL259 connectors. Some of you may be wondering at this point how this all works!

The antenna is a quarter-wave vertical wire. It could be a commercial whip such as the MFJ 1979. For me, I prefer separate wires for each band to avoid having to constantly alter the telescoping length of the MFJ. What you are now about to achieve is to emulate the perfect efficient quarter-vertical antenna. In my case I connect a vertical wire onto a DX Commander pole, the wire running up the pole fastened or hooked through the top eyelet. My power source, a couple of car batteries, will generate between them 140Ah. That's enough to keep me going for four hours at between 50 and 100W. The batteries sit on the base plate of the sack trolley, which has a sheet of plastic unrolled out to create a capacitance to ground. The plastic is 18in square.

Tuning Up

Starting with low power (approx. 5W) check the antenna SWR, and with the ATU bring this to a perfect 1:1. Then with the GTU, alternate the controls between the inductor and capacitor of the GTU to see a steep rise in the current meter reading. Trust me when I say the meter reading will peak. It will do this easily as you alternate rotation of the controls. What you're doing now is forcing RF current to ground. What does this mean? It means you're creating an image in the ground equal to the real quarter-wave antenna above and producing as near to maximum efficiency as you can get with the ground plane effect on a quarter-wave and hence producing the low angle of radiation. I hope the readers of this article are now getting it – the close proximity to the saltwater or the sea or lagoons gives you the near perfect ground plane and DX like you've not heard before with an almost zero noise level. Yes, that's no noise floor and combined with strong DX signals. It's quite magical. Low noise floor because you're not close to the built-up areas.

When I change to another band I simply lower the commander pole, change the wire for another, pre-cut and appropriate quarter-wave wire. I follow the same process and hey presto, 1:1 match, peak the GTU and listen to the signals coming in at 59++.

Putting your station together like this is not difficult and gets you away from the high noise levels of close neighbourhood living. No towers are involved, a simple pensioner's shopping upright trolley can be used and it can be done anywhere, not just here on the Costa Blanca. I chose here because it has the advantages of the warmer climate compared with the UK. There are several guys already doing this pedestrian mobile working, and a WhatsApp group led by G4AKC has been set up where we make frequent arrangements to go out with the trolley stations.

More Information

If you're still not sure how good this is, can I suggest you look at my web page (below) and click on the link near the top of the page. It will direct you to my 'YouTube'. You can listen to the signals and very low received noise floor.

www.qsl.net/g4vzv

My qrz page has additional information on this way of working, which can be replicated in the UK because none of us are too far from the sea to have a session of superb DXing.

And here is the extra magical bit – you will break pile ups! You will feel that you have a big amplifier behind your signal. You do indeed, as some stations have said to me – you're using God's amplifier given to all radio amateurs. It's called saltwater!

I have included some pictures of my trolley and for extra reading on the critical points here are some links:

https://tinyurl.com/p76zc9l
https://tinyurl.com/y8a29p28

An alternative to making a GTU can be the purchase of a similar device like the MFJ 931 doing the same job as detailed in this article.

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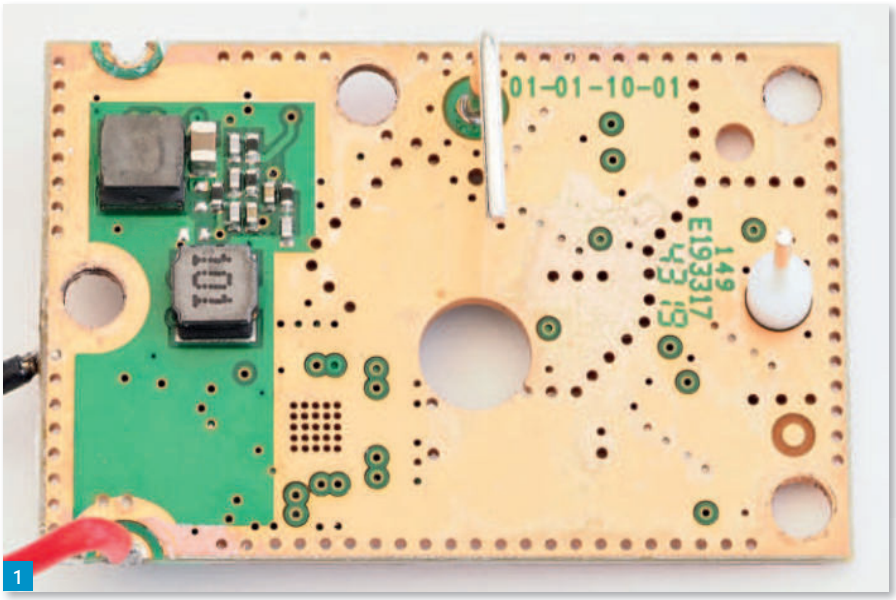
Bullseye OS-100 LNB Update

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk

Mike Richards G4WNC has quite a collection of topics, starting with an update on the Bullseye LNB.



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Regular readers will be aware that I've been tinkering with this new LNB with a view to further improving its frequency stability. Since the last column, I've attempted replacement of the TCXO with a higher spec device. That turned out to be a failure for two reasons. First, the output loading was too high for the replacement oscillator so it could only deliver 600mV pk-pk instead of the 800mV pk-pk of the original device. It was not easy to change the loading because some of the TCXO components were mounted on the underside of the PCB, **Fig. 1**. The lower oscillator drive was unable to drive the mixer reliably so it would only occasionally burst into life! The second, and more significant, reason for failure was the fact that the original oscillator was a VCXO (Voltage Controlled Crystal Oscillator) device, not a simple TCXO! The Bullseye LNB also has a tiny, 6-pin, microprocessor on board that provides a PWM (Pulse Width Modulated) control signal to the VCXO. This is used to factory trim the oscillator to within 10kHz at the 10GHz LNB operating frequency. If you'd like to read more on this, **Pascal F4DAV** has published a full review on his excellent LNB testing site at:
https://tinyurl.com/yb5ejsb8

Following my LNB tests, I have concluded, as has Pascal, that the best way to improve the stability of the Bullseye LNB, or any other LNB for that matter, is to provide improved temperature control. In **Fig. 2** I've shown a day/night temperature chart showing the temperature measured at the LNB. The measurements were taken using a Lascar temperature logger set to take a reading every 10 seconds. The measurement period was from 12 noon on June 8th to 12 noon on June 9th. As you can see, the peak temperature was 38.5°C and the minimum was 7°C. That's a temperature swing of 31.5°C, which is asking a lot of any TCXO. The weather forecast for the same period was for sunny intervals and a day temperature of around 17°C! However, the real challenge for the LNB TCXO is the rapid daytime fluctuations that are at their worst on a windy day with sunny intervals. Between 10.25am and 10.49am on June 9th, the temperature at the LNB increased by 15°C. To protect the LNB from these changes, you can use some aluminium foil insulation blanket wrapped around the LNB, but not the antenna! The only snag with this approach is the lack of air circulation to dissipate the heat from the LNB electronics. The ultimate solution could be to create a temperature-controlled environment using a small microprocessor, temperature sensor and a fan. So, it looks as though that could be the next project in this continuing saga.

Sporadic E and WSJT-X

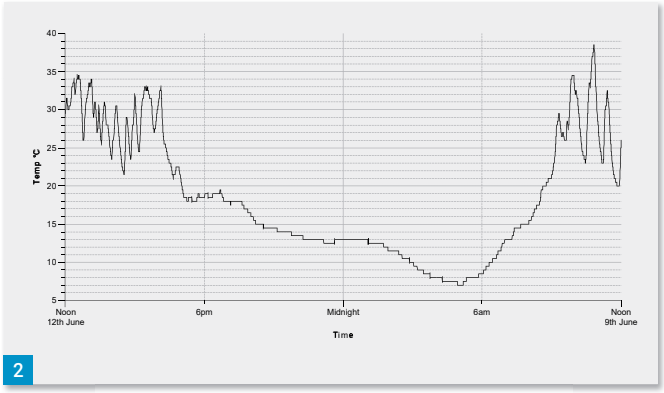
With so much Sporadic E propagation over recent weeks, I thought it was timely to remind you of an important FT8/4 operating convention that could improve your transatlantic success. All European stations should be using the 1st/Even sequence, **Fig. 3**, when using both FT8 and FT4, while North American stations will be using Odd. This ensures the best chance of securing a contact on both sides of the Pond. It's also well worth using FT4 instead of FT8 as the QSO time is halved so you will be able to complete more contacts during the, short-lived, path opening.

iGATE Receive Node

Apologies to readers who have been patiently waiting for the iGATE receive node SD cards to appear on my site. I wanted to make the system as easy as possible for the operator, so I decided to write a Python GUI (Graphic User Interface) wizard to collect the operator and station details, create the config file and start the node as a service, **Fig. 4**. I did this because the standard Dire Wolf configuration file is long and rather intimidating for a new user. The approach I have taken is to generate a new, slimmed-down, config file that only contains the configuration necessary for a simple iGATE receive only node. However, it has taken me rather longer than expected to write and debug the wizard, but it's now ready and the card is available from my website. For those that are interested, I used PySimpleGUI to build the GUI because it is the easiest framework to get to grips with and the resultant code is quite readable. I've put a commented copy of the Python code on my github site and you can see and download it here:
https://github.com/g4wnc

Counterfeit SDRs

An old friend of mine, **Phil Bridges G6DLJ**, wrote to the editor recently pointing-out that counterfeit SDRs have been appearing on the market leaving a confused situation for the buyer. This is a serious problem and



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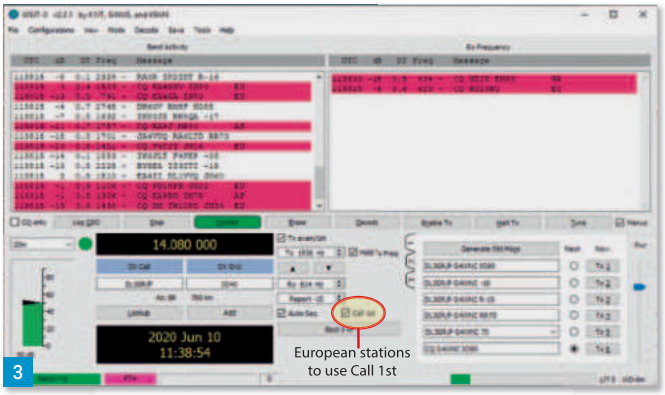

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it's important to avoid buying the 'clones' because it damages the original innovator that produced the design and discourages any further development. In most cases the 'clones' will also be sub-standard units. In addition to leaving the customer disappointed it also unfairly damages the reputation of the real manufacturer.

Most of the popular SDRs, such as those from Airspy, **Fig. 5** , SDR Play, **Fig. 6** and RTL-SDR.com, **Fig. 7**, are already competitively priced, so any significant savings offered by a counterfeit unit will be delivered by reducing the quality of the components. These SDRs rely on meticulously designed RF filters to maximise the performance and deliver the high-quality results we're accustomed to. These filters will use carefully selected and expensive High-*Q* RF capacitors and inductors to achieve the intended responses. However, the counterfeiter will happily substitute these critical components with cheap alternatives. On first examination, the performance may appear to be fine, but it will let you down under difficult operating conditions. You will also find that decoupling components are frequently compromised by using lower quality items or omitting some entirely!

Producers of clones clearly have low moral values so are not averse to outright lies. A good example is the SDRPlay clones that claim to be RSP1As but are in fact poor quality copies of the original RSP1! The same happens with the RTL-SDR V3 dongles and there are some green cased models on eBay that are little more than a standard DVB-TV dongle. Although they claim to have a bias-tee feed, and the HF mod, they're not provided! Another common problem is the use of sub-standard active devices.

The manufacturing process for today's complex integrated circuits results in devices of varying performance from the same production line. An example could be the manufacture of a TV set-top box chip such as those used in many SDR receivers. While the production run will be set to deliver top quality devices, there will inevitably be variations between devices caused by slight impurities in the materials and other imperfections. An important part of the manufacturing process is the binning of the chips coming off the production line. In this process, each chip is tested using high-speed ATE (Automated Test Equipment) and the devices sorted into bins according to their measured performance.

The devices are then sold as different models from the same range. At the top-end will be military grade devices that will attract a premium price. At the bottom end of the process will be duds that are discarded, but there is a range of sub-standard units that fall between the lowest specification that the manufacturer sells and the outright duds. It is these low specification devices that are likely to find their way into counterfeit goods. The clone manufacturers will be attracted to these because of the low cost and they don't see the loss of performance as their problem! I've seen this for myself when buying cheap development boards from Chinese sellers on eBay. In most cases, the devices supplied have been out of specification. The best way to avoid buying a clone is to start with the manufacturer's website and either buy direct or use one of the authorised resellers. Other than HackRF, none of the popular SDR receivers are available as unboxed units, so if you see an unboxed RSP or Airspy, it's a fake.

SDR Price Range

I have also been asked why is there such a wide range in SDR prices? It's true that you can spend anywhere between £5 and £50,000+ on an SDR, so what's the difference? The easiest way to explain the variation is to divide the range of SDRs into broad groupings.

At the bottom end of the price range

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Fig. 1: Local oscillator components for the Bullseye LNB on the underside of the PCB. Fig. 2: LNB Temperature graph showing the wide variations over a 24-hour period. Fig. 3: WSJT-X selecting the correct operating mode for FT4/FT8. Fig. 4: IGATE configuration wizard. Fig. 5: SDRplay RSP-duo.

are the SDR receivers based on the RTL TV tuner chipset. Although designed to produce digital TV and DAB radio receivers, an undocumented feature was discovered that gave access to the raw IQ data from the analogue, direct conversion receiver. This simple discovery spawned an entire range of low-cost, SDR receivers, of which the RTL-SDR.com V3 is one of the best current examples. SDR receivers in this group range up to around the £50 mark. The low price being possible because of the consumer mass market for the chips.

The next band is a range of highly developed SDR receivers that still use an

analogue front-end. The performance of these receivers has been honed with careful attention to switchable filtering, gain control and frequency stability. These receivers are designed and produced by small teams of talented individuals that take great pride in their products. They are responsive to improvement suggestions and the products enjoy continuous development. Good examples of receivers in this group are the models from Airspy and SDRPlay. Receivers in this group are priced up to about £300.

So far, the receivers I've covered all employ analogue front-ends with direct conversion or low IFs prior to being digitised. For the next group of SDR receivers, the digitisation stage is moved closer to the antenna. This causes a significant price hike due to the extreme demands on the digital processing stages. Instead of digitising the output of a direct conversion mixer and sending the data over a USB port to the PC, these receivers will often digitise the entire LF to low VHF spectrum, 1kHz to 50MHz. Another factor that drives a significant price increase is the bit depth of the ADC (Analogue to Digital Converter).

The better quality and more expensive receivers will use 16-bit ADCs to provide a wider dynamic range. When you digitise a 50MHz wide band to 16-bit, the data rate from the ADC is challenging. Here's a simple example: To digitize the range 1kHz to 50MHz we have to sample the signal at 100MHz or more. As we need both I and Q signals, the ADC output will comprise 2 x 16-bit samples, 100 million times per second. That gives us a data rate of 16 x 2 x 100,000,000 = 3.2Gb/s. Not only does the receiver need to transport that data, but it also needs to be filtered and processed to a more manageable rate for demodulation in a connected PC. Currently the only way to manage these high-speed signals is to use an FPGA (Field Programmable Gate Array). In addition to being expensive devices, FPGAs also require specialist (and expensive) programming skills. One of the interesting examples of a low-cost receiver of this class is the Hermes Lite 2 transceiver. This costs around the £300 mark and covers LF to 30MHz bands with 12-bit digitisation. There are lots of other examples such as the popular Elad range of 16-bit sampling receivers and transceivers.

At the very top end of the SDR market are receivers designed for commercial and government surveillance work. These are used to digitally receive and record wide chunks of spectrum that is subsequently computer processed to identify signals of interest. Receivers in this class are often rack mounted, required to comply with military specifications and are used 24/7. These are the most expensive receivers that are often in the £10,000+ category.

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Fig. 6: Airspy HF+.
Fig. 7: RTL-SDR.com V3 SDR Dongle.

The Eddystone S750

Dr Bruce Taylor HB9ANY
bgtaylor@ieee.org

Dr Bruce Taylor HB9ANY describes a classic receiver that makes a versatile tuneable IF for VHF/UHF converters.


1

Eddystone amateur radio receivers manufactured during the golden era between the end of WW2 and the takeover of the company by Marconi are now highly collectable, and they are regularly offered at hamfests and on eBay at affordable prices. The better models are well engineered, a pleasure to operate and quite straightforward to maintain. To be restored to original performance specifications, a neglected set usually just needs realignment, after treating switches, potentiometers and valve holders with contact cleaner and replacing any low emission valves and leaky capacitors and carbon resistors that have drifted in value. Since the electronic design of these receivers is quite orthodox, fault tracing requires no more than a signal generator and a multimeter, and most components (often better than the originals) and replacement valves are quite readily available. While a digital frequency meter and wobbulator can be useful for optimising the IF response, they are by no means essential.

Several of the Eddystone models from this period have sharp CW crystal filters, and in some cases 800Hz or 1kHz audio note peaking filters as well. With its ±3kHz tuneable BFO, independent RF, IF and AF gain controls and continuously variable selectivity, the classic Eddystone S750 is versatile enough for RTTY and SSB as well as CW and AM reception, **Fig. 1**. Its bell-shaped IF shape factor, produced by just two double-tuned 85kHz IF transformers, falls short of the ideal requirements for today's crowded HF bands. But in many regions, adjacent signal interference is (all too often!) rarely a problem in the DX segments of our 144MHz and 432MHz allocations. For radio amateurs who enjoy experimenting with homebrew transmitters and VHF and UHF converters, Fig. 2, and who have a penchant for fine classic valve receivers, the S750 makes an entirely satisfactory tuneable IF. An added bonus is general coverage of most of the medium and short-wave spectrum, including the 5, 10, 18 and 24MHz WRC-15/WARC bands that aren't covered by amateur band receivers of this vintage.

Production

After unveiling the prototype in 1949, Stratton & Co manufactured more than 2050 Eddystone S750 receivers between 1950 and 1958. The serial numbers, which may be located on the rear of the coil box or on top of the internal screening cover (if fitted), were prefixed by a two-letter code, which identifies the date of manufacture. Normally the first letter (A to L) indicates the month from January to December, while the second letter (A to J) indicates the year from 1949 to 1958. Hence a receiver with Serial No. LB0035 was made in December 1950, for example. On some sets the letters for the year and month appear to have been inverted, but the dates printed on the electrolytic capacitors can help to resolve any ambiguity. The 'S' prefix to the Model No. 750 was used somewhat erratically in Eddystone documentation. It stands for 'Specification', not for 'Stratton'.

Unlike many other Eddystone receivers that are AC/DC models, the S750 is AC-only. A plug panel on the mains transformer allows 50/60Hz supply voltages of 220-250V, 195-215V or 100-125V to be selected. A stabilised HT supply is provided for both local oscillators (LOs), the BFO and the 1st mixer screen grid, and 20 minutes after switch-on the frequency drift is less than 300Hz for a change in mains voltage of ±5%.

Note that the rare 750/1 variant is designed to operate from a 110V 25Hz supply. The 750/2 version was badged as a Marconi HR100 and supplied by that company to coastal radio stations. (The receiver coverage includes the former international Morse code distress frequency of 500kHz, as well as 2.182MHz and other maritime voice channels.) 650 examples of that version were manufactured.

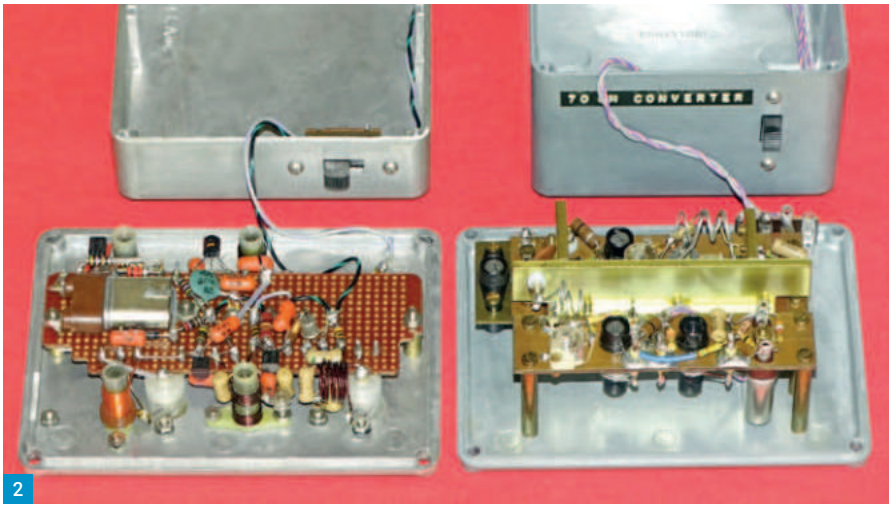
Modifications

I've provided a high-resolution pdf of the S750 circuit diagram for download here: https://tinyurl.com/y964t4jm

The receiver was originally manufactured with a two-core mains lead and provision to connect an optional earth to a terminal on the rear of the chassis. While this non-compliant arrangement could result in lower noise in some situations, I suggest fitting a three-core mains lead unless the set is always powered via a 30mA RCCB. Exercise due caution when testing under the chassis with power on. The connections to the main switch are not protected by sleeving, the HT rail is near 235V DC and there is 485V AC between the anode pins 4 and 6 of the rectifier.

Relatively few modifications were introduced during the eight-year production run. Early models don't have a screening cover over the main tuning capacitor, while they have a 500pF capacitor wired across the primary of the output transformer that was deleted later. (In some *Instruction Manuals* this component is shown as C85

Fig. 1: Using an Eddystone S750 as tuneable IF with a homebrew VHF converter and transmitter, this RTTY station achieved the first 144MHz QSO between Scotland and the Netherlands in 1965. (GM3NZI)
Fig. 2: Low-noise converters for 144MHz (left) and 432MHz (right) turn the S750 into a versatile VHF communications receiver.
Fig. 3: The S750 selectivity control (arrowed) mechanically varies the coupling between the primary and secondary windings of the 2nd and 3rd IF transformers.
Fig. 4: Type 774 diecast aluminium mounting blocks tilt the S750 to a convenient operating angle.
Fig. 5: The Eddystone S750 features a wide slide-rule dial with mechanical bandspread and a near-linear frequency tuning scale.



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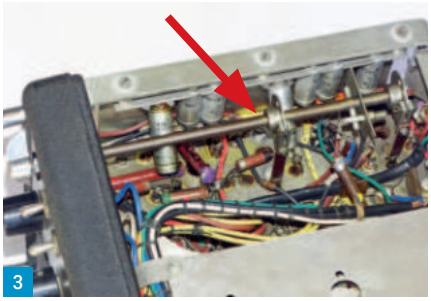
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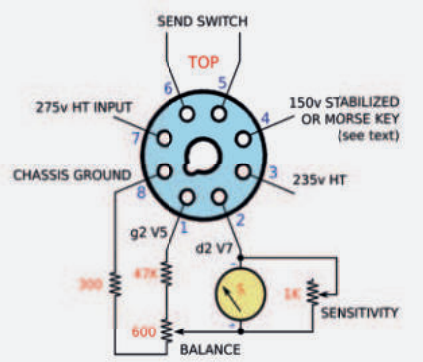
in the circuit diagram but omitted from the components list.) From January 1952, the RF amplifier cathode bias was modified to give greater control of the RF gain by the addition of a 100kΩ 0.5W resistor R55 between the HT rail and the junction of R18 and R19. Although the undersides of the valveholders mounted on the coil box are quite difficult to reach, a convenient tag strip allows this resistor to be added without dismantling the band change switch for access.

Apart from the octal 5Z4G HT rectifier and VR150/30 voltage stabiliser, and the two Rimlock (B8A) ECH42 frequency changers (replaced by B9A ECH81s in some very late models), all of the 11 valves used are miniature B7G types and they are very reliable. According to the supply situation, 6AM6/8D3/Z77, DH77/6AT6 and D77/6AL5 valves were fitted interchangeably for V3, V6 and V7 respectively. In addition to the frequency changer replacement, the 1st LO V3 may be a 6C4 triode in very late models. (The original 6AM6 was triode-connected.)

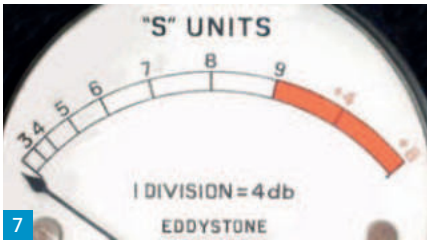
While short-term stability is more important in radio amateur service, long-term drift is equally critical in many professional point-to-point links and watch receiver applications. Before the advent of affordable frequency synthesiser technology, high stability in a tuneable general coverage receiver could only be achieved by very careful mechanical and electronic design. The S750 has rather a compact cabinet for its 70W heat load. While the receiver doesn't suffer from the problems of the early S680 model (which tended to burst into flames if left permanently operational in high ambient temperatures), the ventilation can be improved by cutting additional slots in the case or by fitting a quiet fan. Thermal drift can also be reduced by replacing the screening cans of the valves by the matt black type.

Some modifications were made to the 1st LO circuit to improve its temperature coefficient. Silvered mica capacitors C26, C29 and C30 were changed to negative temperature coefficient (NTC) ceramic types. 100pF (later 80pF) tracking capacitor C37 was changed for a parallel combination of a 50pF mica and a 40pF ceramic one, selected for drift compensation. Some sets have an additional 10pF or 12pF NTC ceramic capacitor designated C87 wired in parallel with the oscillator gang of the tuning capacitor C40.

To increase the BFO injection for enhanced SSB reception, C59 may be paralleled with a 100pF capacitor. For a more radical improvement the 6BA6 BFO can be replaced with the pentagrid 6BE6 product detector circuit of the Model 888A, which is an amateur bands only version of the S750. Both valves have a B7G base, but the valve holder must be rewired.



6 Socket 'A' viewed on outside of chassis



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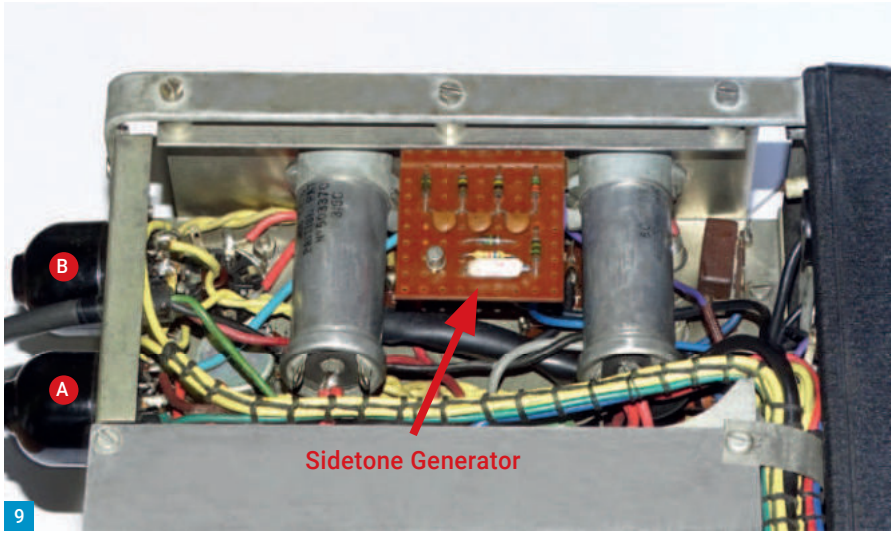

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Tuning

The S750 was Eddystone's first true double-conversion communications receiver, and the first model to have the iconic open 'slide-rule' dial extending almost the full width of the solid diecast front panel. With a reduction ratio of 140 to 1, the flywheel-loaded tuning control is very smooth and a delight to use, although some dexterity is required on the highest frequency band. To prevent wear in the tuning drive bushing, it should occasionally be lubricated with light oil. The split-gear drive has no detectable backlash, and the ingenious logarithmic ratio arm that drives the three-gang tuning capacitor results in a near-uniform frequency scale on all ranges.

The receiver has continuous coverage in four bands from 480kHz to 32MHz, with an IF gap from 1465kHz to 1.7MHz. The high first IF of 1620kHz ensures adequate image rejection of better than 40dB at 30MHz, while the second IF of 85kHz provides the selectivity, which can be adjusted by a front panel control that mechanically varies the coupling between the primary and secondary windings of the 2nd and 3rd IF transformers, **Fig. 3**. (A technique that Eddystone appears to have copied from the Hammarlund Super-Pro Series.) Unlike single conversion superhets with a 455kHz or 465kHz IF, it should be straightforward to extend the MF range down to 475kHz or even 472kHz to cover the WRC-12 600m band if desired. The 5th position of the band change switch, marked 'G' for gramophone, desensitises the RF section of the receiver to allow a pick-up to be used without breakthrough.

Although lower frequencies could also be used, the 28 to 30MHz range is a common tuneable IF for 2m converters covering 144 to 146MHz. Over this range, the S750 vernier dial has an effective length of over one metre, with 240 divisions, allowing quite accurate frequency resetting when read in conjunction with the lower logging scale. LO injection in the converter should be on the low side (e.g. 116MHz for 2m, 404MHz for 70cm) so that the tuned frequency increases in the same direction as the IF. The 2nd LO of the S750 runs at 1.535MHz, which results in a strong 2nd harmonic birdie at 3.07MHz and weaker signals at 4.605MHz et seq, but the harmonic at 29.165MHz is undetectable!

Accessories

At 18kg the S750 is no lightweight, but that is much less than half the weight of an AR88. To allow the receiver to be used portable on field days, a Model 687/1 vibrator unit was available that could power it from a 6V accumulator. Although the unit incorporates a rectifier and RFI filter, it uses the HT smoothing components inside the receiver. If an external power supply is not connected, an international octal plug with four jumpers (1-2, 3-4, 5-6, 7-8) must be inserted in the right-hand 'B' socket on the rear panel of the receiver to complete the heater circuits. (In order to ensure that no hum is introduced by the noise limiter diode, its heater is powered by a separate DC-biased transformer winding, and both heater circuits are balanced.) The noise limiter is quite effective for the type of impulse noise that can be encountered on 2m and 70cm.

Although they are somewhat rarer than the receivers themselves, the Type 774 diecast aluminium mounting blocks that can be attached under the S750 case, **Fig. 4**, allow the set to be mounted at a convenient angle for viewing the dial and operating the controls. Other accessories that are suitable for this model include the Model 652 (5in) and 688 (7in) loudspeakers and the Model 669 S-meter, which are housed in separate matching diecast cases.

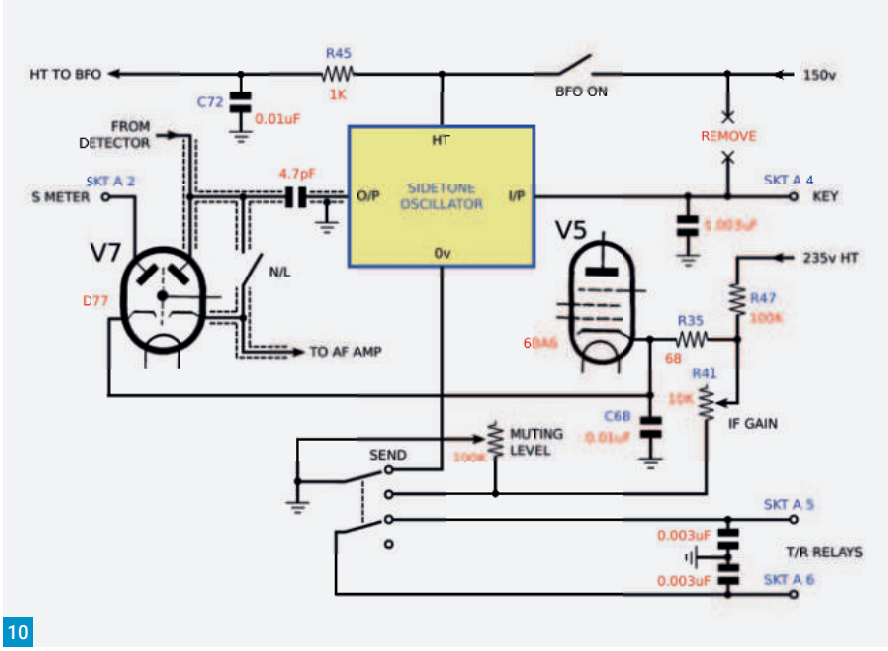
For later Eddystone receivers, such as the EA12 amateur band model, a plinth accessory (Type 906) was produced that can also be fitted to the S750 if new holes are drilled in it for the fixing screws. In addition to tilting the receiver at an angle of 13°, the plinth incorporates a 3Ω elliptical loudspeaker that gives excellent reproduction in spite of its small size, **Fig. 5**.

S-meter

Since the Model 669 S-meter was quite expensive when new, not many were sold and they are almost as rare as the mounting blocks. When looking out for one, don't confuse it with the Eddystone Model 678 modulation level indicator, which looks rather similar if its telescopic antenna and coils are missing.

As the 906 plinth is made of sheet metal, it can easily be customised to accept ad-

Fig. 6: S-meter circuit diagram and connections to octal socket 'A'. Fig. 7: The Eddystone 669 S-meter is calibrated at 4dB per S point. Fig. 8: After displacing the fuse holder, the muting level control can be mounted between the voltage stabilizer and the HT rectifier. Fig. 9: A matrix-board sidetone generator can be mounted under the subchassis carrying the receiver power supply. Fig. 10: Modifications for sidetone generator and muting level adjustment. Fig. 11: Single transistor phase-shift oscillator.



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ditional sockets, switches, other station controls, or a home-made S-Meter. An octal plug is used to connect the S-meter to the left-hand 'A' socket at the rear of the receiver and the circuit and plug connections are indicated in **Fig. 6**. The original Model 669 used a 200µA FSD meter and as shown in **Fig. 7** it was calibrated at 4dB per S-point, allegedly because Eddystone's Technical Director thought it made the receivers look more sensitive than they really are! A shunt potentiometer can be wired across the instrument and adjusted for the more usual 6dB per S-point. If the S-meter is mounted on a 906 plinth speaker (see Fig. 5), the components can be accommodated on a small board attached directly to the terminals of the meter.

Because the bottom bend characteristic of the D77 series protection diode results in sluggish action at low signal strengths, the needle of the meter should be offset below the zero mark on the scale by means of its mechanical adjuster. Then with the BFO off and RF and IF gains at maximum, the balance potentiometer is used to set the pointer to zero with the antenna input of the receiver shorted. Calibration of the sensitivity is best done with a signal generator. The S-meter can be used for the realignment of all stages except the 2nd 85kHz IF transformer.

Muting

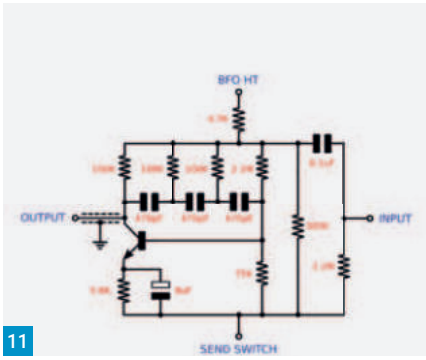
Unlike today's expensive microprocessor-controlled black box radios, these classic receivers are relatively easy for experimenters to work on, enhance and customise. The circuit diagram indicates that in the 'Send' position of the long dolly switch on the receiver front panel, contacts 5 and 6 of the octal socket 'A' are shorted to energise the station transmit/receive changeover relays. A 51kΩ resistor R40 is also switched in series with the 10kΩ IF gain potentiometer R41 to desensitise the receiver in order to monitor the outgoing signal when sending CW. Unlike later Eddystone models, which have a muting level control on the rear panel, the S750 lacks any means of adjustment to suit the strength of the transmitted signal.

The receiver has a fuse holder mounted on the chassis between the rectifier valve and the voltage stabiliser. Since this fuse is wired between the centre tap of the HT transformer secondary winding and chassis, a blown fuse generally indicates a serious fault requiring investigation and repair work. So, there is little extra inconvenience in replacing the fuse holder by an in-line type under the chassis, thus vacating the original location for a muting level control. A 100kΩ potentiometer can be used, wired in place of the original 51kΩ resistor. With a long shaft fitted with a small diameter knob (see **Fig. 8**), the control can easily be accessed by lifting the lid of the cabinet to adjust the muting level to suit local conditions. To avoid charging current pulses circulating in the chassis, wire the new fuse directly to a case tag of the reservoir capacitor C81.

Sidetone

Direct monitoring of the transmitted signal is satisfactory when transmitting and receiving on the same frequency. But for split frequency or crossband operation it is useful to have a separate sidetone source to send good quality Morse code, especially when using a classic mechanical semi-automatic bug key!

In order to prevent any change of frequency, the HT supply to the receiver is not interrupted in the 'Send' position so that the oscillator valves continue to operate under normal conditions. As a result, the audio stages remain alive and can be fed with the output from a sidetone generator that can be accommodated under the power supply/



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BFO sub-chassis, as shown in **Fig. 9**.

The required circuit modifications are shown in **Fig. 10**. Note the rewiring of the Send switch and that the muting level potentiometer is now moved to the ground side of the IF gain control. If the BFO is switched on for CW reception, the sidetone oscillator is powered when the Send switch is closed. Then when the transmitter key is depressed the oscillator is activated and a low-level tone is injected into the audio circuit at the anode of the noise limiter diode V7. Contact 4 of socket 'A' can be used for the connection to the key if the unnecessary link to it from the 150V regulated HT supply is removed.

With suitable power supply and key input arrangements, the sidetone generator could comprise an oscillator IC with very few extra components. As shown in **Fig. 11**, I used a single-transistor phase-shift oscillator powered from the BFO HT supply. The transistor can be any high voltage NPN AF type and the oscillator is DC isolated from the transmitter keying circuit. The key should contact to ground when depressed and the imped-

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Fig. 12: The heart of the S750 is a diecast coil box, which is rigidly secured to the front panel and flanked by a pair of nickel-plated brass subchassis carrying the IF and AF stages, the power supply and the BFO.

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Fig. 13: For use as a tuneable IF, the original antenna input terminal should be replaced by a coax socket.

ance of the external circuit on key up should exceed 10kΩ.

Breakthrough

The signal frequency circuits of the S750 are housed in a diecast aluminium box, **Fig. 12**. Hence 1st IF (i.e. 28-30MHz) breakthrough when using a converter is generally not a problem unless another amateur in the vicinity of the receiver is operating on HF with very high power. The 6BA6 RF amplifier valve should be fitted with a screening can provided that its valve holder has the appropriate skirt, which may not always be the case.

This pentode is a little noisier than the cascode front end configuration that was used in later Eddystone receivers. So, VHF/UHF converters should have a bandpass tuned output stage that delivers a solid signal to the S750, well above the threshold of 5µV required for a signal-to-noise ratio of 20dB. The receiver front end has a reasonable dynamic range and the RF gain control can be used judiciously to avoid intermodulation at the 1st frequency changer. Originally, the antenna connection to the receiver was made via a screw terminal on the rear of the chassis. As shown in **Fig. 13**, this can easily be replaced by a standard coax socket, allowing a short well-screened coax cable to be used for interconnection with the converters.

On one occasion during a VHF Field Day in Scotland I thought that the receiver had developed an IF breakthrough problem when I noticed several continental stations coming through. Only when I heard an Italian calling me did I realise that there was a superb Sporadic E opening, and the stations really were on the 2m band, not on 10m!

Conclusion

In their day, the best Eddystone receivers were considered benchmarks for British-made shortwave radios. Like the eponymous lighthouse, they earned a reputation for solid construction, stability and reliability, and many sets are still performing satisfactorily 70 years after they left Stratton & Co's Birmingham works.

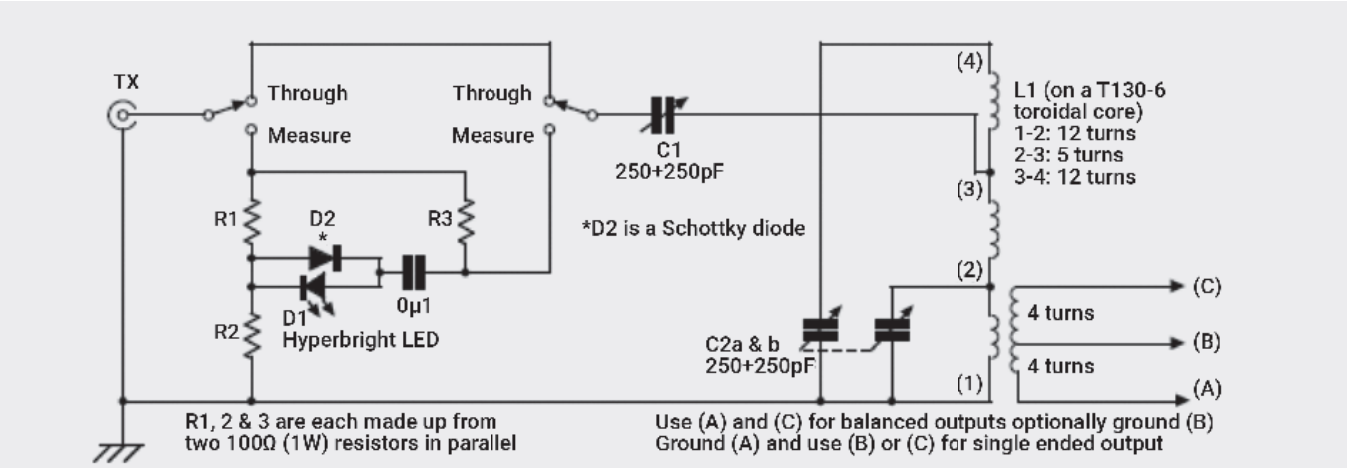
They have an enthusiastic following among a large number of amateurs who enjoy experimenting with their radio equipment, since that can be rather challenging with expensive modern transceivers using current microelectronics technology. The Eddystone S750 is a classic design that lacks the features of a modern SDR, and that has an IF shape factor that isn't well suited to crowded HF band conditions. But it is a fine receiver that can still give much pleasure to its owner and render very capable service as a tuneable IF for experimenting with VHF and UHF converters. Perhaps for many more years to come.

Radio Round-up

EXERCISE BLUE HAM 20-2 UNDER LOCK-DOWN CONDITIONS: UK Cadet Stations took part in Exercise Blue Ham over the weekend of June 6th and 7th 2020 using the 5MHz (60m) shared band channels. Blue Ham has been running now for a number of years now and was introduced to enhance the Cadet experience of radio operation and to reach out to radio amateurs who may wish to join the Cadet organisations as radio instructors. During Exercise Blue Ham, Cadet Forces Adult Volunteers operated HF stations making contact with radio amateurs to exchange specific information during their QSOs.

During Saturday pretty well most of the stations suffered QSB, QRN and lightning crashes. One station had to close down for two hours due to a local thunder and lightning storm. This was a wise thing to do as a lightning strike was recorded just five miles from the station! A look into the online log page on Monday morning saw the Cadet stations had logged some 690 calls/QSOs during the period of operation. Well done to all who put Cadet stations on-air and the /P amateur stations that braved the weather and social distancing conditions.

So far, the Blue Ham team have issued out 20 PDF Participation Certificates to amateur callsigns that have requested them by e-mail. Again, the Blue Ham team would like to thank the considerable time and effort put in by all callsigns that took part in the Exercise. There is another one planned for October 20th. The map shows a plot of contacts made during Blue-Ham 20-2.



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The Z-Match

Lee Aldridge G4EJB says, "Here's one I've wanted to build for a long time".

Lee Aldridge G4EJB
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With my W3EDP antenna up and working, I had the excuse to build a matching unit that has such a good reputation and **George Dobbs G3RJV** had mentioned while discussing the W3EDP antenna – the Z-match. George had written an article or two on matching units but the one that I really liked about the Z-match appeared in *PW* January 2012.

Here's what George had to say about matching: *"To over simplify the explanation, an ATU* (or matching unit – **Ed.**) *attempts to match the impedance of a receiver or transceiver to the antenna, thus improving the power transfer between them. It's never as good as a naturally resonant antenna on the frequency in use – but resonant antennas are relatively rare in amateur radio usage; very often because of space restrictions".*

And his brief description of this particular gem: *"The Z-Match tuner is shown in the right-hand section of* ***Fig. 1****. It has only three parts; two two-gang variable capacitors and a coil. The circuit is based upon a design from* ***F G Stewart Sims G3WQW*** *in* Sprat *from summer 1998. The G3WQW single coil Z-Match has become a classic circuit appearing in many journals and websites; often without mention of G3WQW. In my example featured here, I used a T130-6 core for the coil and a pair of polyvaricon 250+250 pF variable capacitors. My source for the polyvaricon capacitors was Spectrum Communications. The Z-Match is a parallel-tuned circuit with link coupling to the antenna. The signal is coupled into the Z-Match via C1; a variable but high value of capacitance. The two variable capacitors with the tapped tuning coil offers a wide tuning range. It should be possible to use the tuner on all high frequency (HF) bands from 3.5 to 28MHz (80 to 10m) to match balanced or single-ended antennas".*

My Z-Match

My Z-match had to fit in an old headlight bulb case. Initially I would use my VSWR bridge to match my equipment to the antenna rather than the hyper-bright LED shown in George's circuit. The input of the Z-match was to be a piece of RG58 50Ω coax terminated with a BNC connector and connected onto a couple of ceramic standoffs inside the Z-match case. The output terminals were to be 4mm posts to take 4mm plug connectors from the W3EDP antenna and counterpoise wires (as required).

The 'heart' of the matching unit, the coil wound on a T130-6 core, was to be mounted on a piece of fibreglass matrix board and use a few of my PCB terminal pins for the winding connections. My reasoning for using the matrix board was to keep the *Q* of the coil as high as possible.

Even though George had specified how much wire would be required for the main coil, I thought I would wind one section of the coil at a time and then join on the next section. My reasoning was, I had found the wire gauge (20swg) was quite heavy to work with and thought I would struggle to wind and tap the coil in one. So I guesstimated how much of the wire specified would get me to the first tap (and a little extra) and if I had got it right, I could use the same amount for the final part of the winding. Well, to be honest, I nearly did but, finished up re-using that length of wire for the second section. Yes, I know I could have been more precise by using a little maths. Anyway, one method I do use with heavy gauge wire prior to winding is to use a bit of paper between finger and thumb and pull the wire as true (kink free) as I can through the paper – you don't get friction burns.

I took my time with the coil windings and scraped off the enamel at the ends of the windings, then tinned the wire and made twist-joints at each tap connection, ready to solder. With the main coil completed, I soldered the tap connections. I spaced the coil around just over three-quarters of the core. Next, I paid attention to what George had written about the link winding. It was to be in the centre of the first part of the winding. Again, I made the link winding in two parts using the same technique as before. Then a continuity check of the windings with my DVM for no 'unexpected' readings. With both coils complete, I cropped them to fit on to the PCB pins on the board, and then soldered them in place. I hope you can see a resemblance of the coil I wound with the one George showed in his original article. See **Fig. 2**.

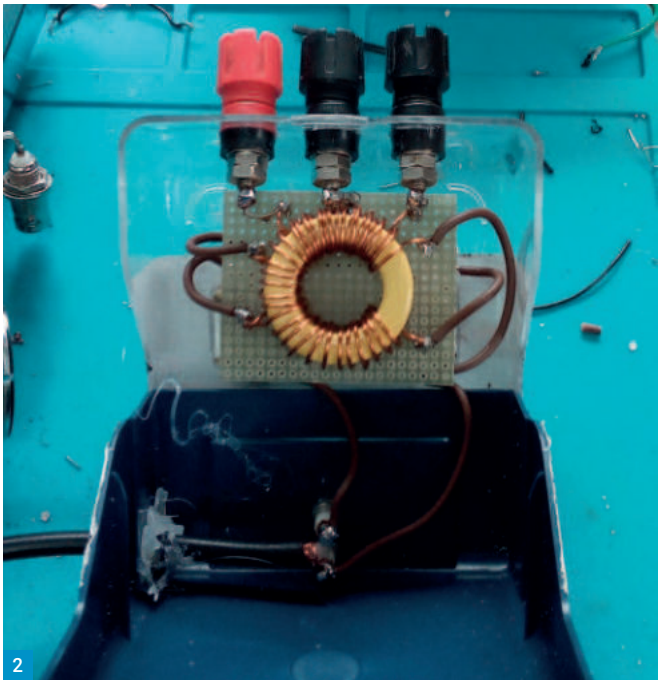

Fig. 1: Circuit from January 2012 PW with Z-match on right. Fig. 2: Inside the Z-match Fig. 3: The completed Z-match ready for use

I had mounted the polyvaricon capacitors on the front of the case and attached heavy duty copper wires ready for the board to be put in place and set all internal trimmers for minimal capacitance. A little double-sided tape held the board secure on the rear of the capacitors. The wires from the capacitors were then soldered onto the windings as shown in the circuit.

You can see the old ceramic stand-off pillars fixed to the lower part of the case for the 50Ω coax termination. The RG58 coax was secured through a drilled hole with a cable tie and some hot glue. The three 4mm fixings for the antenna and counterpoise wire mounted on the top of the casing were wired again with heavy duty copper wire and soldered to the link winding.

A final visual check and the matching unit was ready for use, **Fig. 3**.

In Use

Now for the tricky bit – getting used to tuning the Z-match.

I say tricky but as George said, it is a two-handed job and just takes a little time to get used to. First peak it on receive as a starting point but you'll probably be surprised by the SWR. Don't settle for any old SWR. If your transmitter PA can handle it, keep trying to find the point where the SWR dives down and then adjust each capacitor a little to see if it will reduce even more – it is an acquired knack.

To give you an insight, when I first used the Z-match I wasn't convinced it was working that well with my W3EDP antenna. But what a difference a couple of weeks made. Eventually I found the antenna matched well on a number of HF bands when connected to (C) and the counterpoise to (A) as shown in Fig. 1. The success I've had with two configurations of the W3EDP has been really satisfying and now I wouldn't part with the Z-match – but the two hands approach is critical. Sometime soon I will fit the LED indicator so that I can eventually dispense with my VSWR bridge in line and place this Z-match in a more ideal location.

For a quality complete kit of parts based on this Z-match, G-QRP club members can purchase the Limerick Sudden ATU. Do have a look on the G-QRP website – it's a bit better than mine.

The final words from George: *"The Z-Match is an excellent antenna tuner. And when you've got used to steering it you may never want to use another tuner and you can lay lossy baluns aside!"*

The *Carrying on the Practical Way* CD is available from the Radio Enthusiast website at:
https://tinyurl.com/y8m4bu79

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Who are Sommerkamp?

Harry is asked, "Who in Tarnation are Sommerkamp, are they the same as Yaesu?"

A rather upset customer came into the shop holding what looked like a Yaesu FT-707 HF mobile rig, which he had bought via a private reader's advert from a CB operator, 'complete with all accessories'. On the front of it was stamped Sommerkamp FT-767. He thought he had bought a Yaesu FT-767 with all accessories, which would have been a 100W mains-powered HF rig with modules for 6m, 2m, and 70cm, quite a package. However, all he had got was a mobile HF rig and ATU, **Fig. 1**. Well, the advert did not say it was Yaesu, so I told him the story and left him to sort out the problem.

Sommerkamp were a German/Swiss company who had most of their CB and amateur radio equipment made for them in the Far East. Some of it was made by Yaesu, but just to confuse everyone they sometimes used different numbers and had slight alterations from the standard setup. Yaesu's FT-707 mobile HF rig was often supplied fitted with CB crystals and, as my customer found out, was stamped Sommerkamp FT-767. The FT-101ZD was rebadged as a Sommerkamp FT-277ZD and came ready fitted with the optional extra Yaesu fan and CW filter, but was factory set on 220V and did tend to eventually explode if the user did not read the instruction manual and reset it.

Some of their equipment was sold with the normal Yaesu type numbers, some rebadged with different numbers, while other Sommerkamp CB and amateur radio items were made by different manufacturers, all very confusing. I had rigs brought to me, the owner having been assured by the supplier, *"It was made by Yaesu and if you have any trouble with it in future, Harry will repair it"*. One rig came for which I had no circuit or technical information, and it looked to me like a rats nest inside; definitely not made by Yaesu. I had to explain to these customers that these were not made by Yaesu and hence I was not familiar with the equipment and could not help. By that time the seller had disappeared so the moral is 'Check exactly what you are buying before parting with your cash'.

Sowing the Seed

In the early 1950s, when I was about 11, I started reading the *Eagle* comic. This was in full colour, and carried the adventures on Dan Dare, astronaut 'Pilot of the future', on the front page. It was edited by **Marcus Morris** who, possibly to prove that fact was even stranger than fiction, serialised in cartoon strip form the fascinating life of St Paul on the rear cover. The Eagle was an immediate hit. It encouraged me to take an interest in things technical and fascinated me with the life of St Paul. 40 years later we decided to have a two week holiday in Cyprus, and investigated the idea of having a week at each end of the island. It seemed too much hassle. Later I remembered that Paul had visited the same two towns on a preaching trip. He had walked. He must obviously have been made of sterner stuff!

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Back to the 1950s. I heard that Dan Dare was being serialised by Radio Luxemburg in the early evenings on 208 metres, but unfortunately in the centre of Blackburn the signal was too weak and I was disappointed. About a year later events happened that greatly affected my future career. We moved house to the village of Guide just outside the town, dad purchased a new radio with short wave coverage, and I started listening to stations all over the world, including radio amateurs. I had always been curious about electricity but this radio steered me in the direction of experimenting with radio.

Back to 208 Metres

Near the back of our 250 year old cottage was a farmer's fence running almost due north/south for about a couple of hundred yards. I tried running a length of thin wire along this, and connecting it to the aerial socket of our new radio. It worked, Dan Dare came up out of the mush, and I was able to brag at school that I was listening the program. Even then, however, reception was not always clear, and some voices where much easier to copy than others. This fired my interest in clear speech and years later, when in my late teens I became licensed, I spent a lot of time reading about and experimenting with various methods of processing speech for the best results.

BBC Quality?

In the days of AM, to be told that your transmission was 'Of BBC Quality' was a compliment, but now with the poor sound quality of some news bulletins, I am not so sure. Do we really want Hi-Fi quality on the amateur bands, however, as quite apart from the increased bandwidth required, it would actually reduce readability!

In the 1970s, I was experimenting with speech processing on 80m SSB and sat in my car with my FT-101 HF rig and a box of various microphones. I asked for reports not of the quality of my speech, but of its clarity under weak signal conditions. Some of the microphones were quite expensive, but the clear winner for readability although not quality, was a 50p crystal microphone insert, the standard Yaesu FT-101 microphone being way down in the list.

The microphone input impedance of the original FT-101 was 50kΩ but crystal

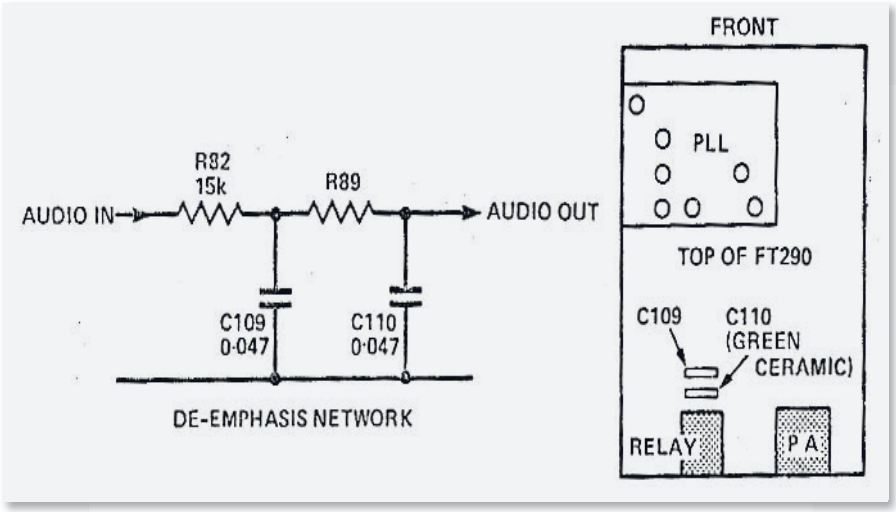


Fig. 1: The FT-707, sold as the Sommerkamp FT-767. Fig. 2: How to 'brighten up the receive audio by crunching up C110. Fig. 3: FT-230 de-emphasis.

microphones are intended to give their optimum flat response when fed into a microphone input socket with an impedance of over 1MΩ. Why then was it so good?

Most of the power in the male voice is concentrated in the frequencies below 1kHz and yet in European languages these sounds contribute very little to clarifying the individual words. Operating a crystal microphone into a low impedance load greatly attenuates these frequencies and emphasises the higher ones. You can get the same effect with a standard amateur radio microphone and produce rather 'tinny' but easy to copy speech if you connect a capacitor in series with the live microphone lead. It should have a reactance approximately equal to the input impedance of the microphone socket at 3kHz. With a 50kΩ input impedance I used 2000pF but the optimum value will depend on your voice. For local contacts, however, your speech will sound harsh, and hence you should then switch it out. I started selling a modified Shure 444 microphone wired like this and labelled the switch 'Local/DX'.

In the past Yaesu and other Far East manufacturers seemed to think that if the sound seemed OK to them, it was correct, but have now realised that their language and voice pitches are different to ours, and some have even started fitting a switchable series capacitor to some of their microphones.

FM De-emphasis and Pre-emphasis.

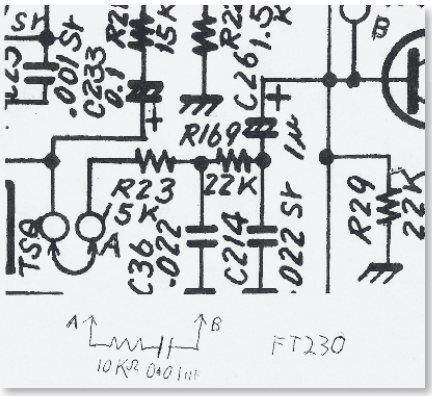
If FM signals are weak, there is an annoying hiss in the background. You can, of course, reduce this by adjusting the treble control to cut the high frequency response, but then the audio becomes somewhat muffled. If, however, the high audio frequencies are emphasised at the transmitter (pre-emphasis), the receiver can be set to have an amount of built-in treble cut (de-emphasis), that cancels out the boost, flattens the audio response and reduces background hiss.

This was brought to my attention in the early 1970s when we started selling American stereo Hi-Fi tuners and tuner/amplifiers. Stereo FM radio had only just got going here, and most UK stereo tuners consisted of an existing mono FM tuner, into which had been added a stereo decoder. They may have been fine in the south of England, but Blackburn was in a valley full of reflective and signal-blocking mill chimneys and buildings, and they were just not up to the job. American tuners, or ones made for the American market, however, had been designed for stereo from 'the word go', did not have a decoder just 'tacked on' and gave very much better results. They sold well but when listened to on good quality speakers seemed a little short of 'top' unless the treble control was set at about ten-past. This was no real problem, but I was curious and found out that the American standard for FM broadcasts used more pre-emphasis than that set in Europe (75µs as opposed to our 50µs).

What has that to do with Amateur Radio?

Well, if there is a standard for the pre-emphasis and de-emphasis in 2m FM transceivers, I am not aware of it. And when I started using 2m FM rigs in my car in the 1970s I found that often I could not get enough volume to overcome the engine noise without driving the speaker into distortion. This was particularly bad if my contact had a deep voice, in which case they sounded muffled, and my thoughts went back to my experience with Hi-Fi tuners.

Many engineers tend to think that if it sounds fine to them, it is fine, but when selling equipment to people speaking another language, this is not necessarily the case, hence some problems with Japanese equipment. I decided to try reducing the value of the de-emphasis capacitors in the rig I was using, and with my FT-290 ended up removing them altogether. This made a dramatic improvement, and I tried altering other rigs, and then started selling them ready modified. I stole a bit from a toothpaste adverts claim and boasted



"G3LLL Adds Brightness".

Swapping component values on small printed circuit boards is not that easy so I looked round for ways to bypass the problem. While several older FM rigs suffered from a lack of top, I mostly experimented with the rigs current in the 1980s (well, like most retailers, I was in it for the money!). Two of the worst sufferers from this problem were the Yaesu FT-290 and early samples of the FT-230. With the FT-290 I came up with a '*cracking*' modification. Disconnect the rig from the power, remove the batteries, grab the ceramic capacitor C110. Squeeze the pliers until the capacitor shatters, remove and shake out the bits, and the modification is done, resulting in much brighter audio, **Fig. 2**.

If there is a problem getting at the de-emphasis capacitor, sometimes the de-emphasis network can be partially bypassed by connecting a capacitor and resistor between the tone squelch terminals marked 'A' and 'B' in **Fig. 3** as we did on the FT-230. Perhaps you might want to experiment, by modifying the ideas in the examples shown. After all, amateur radio is still about learning and experimenting, as well as communicating. 73 for now, Harry.

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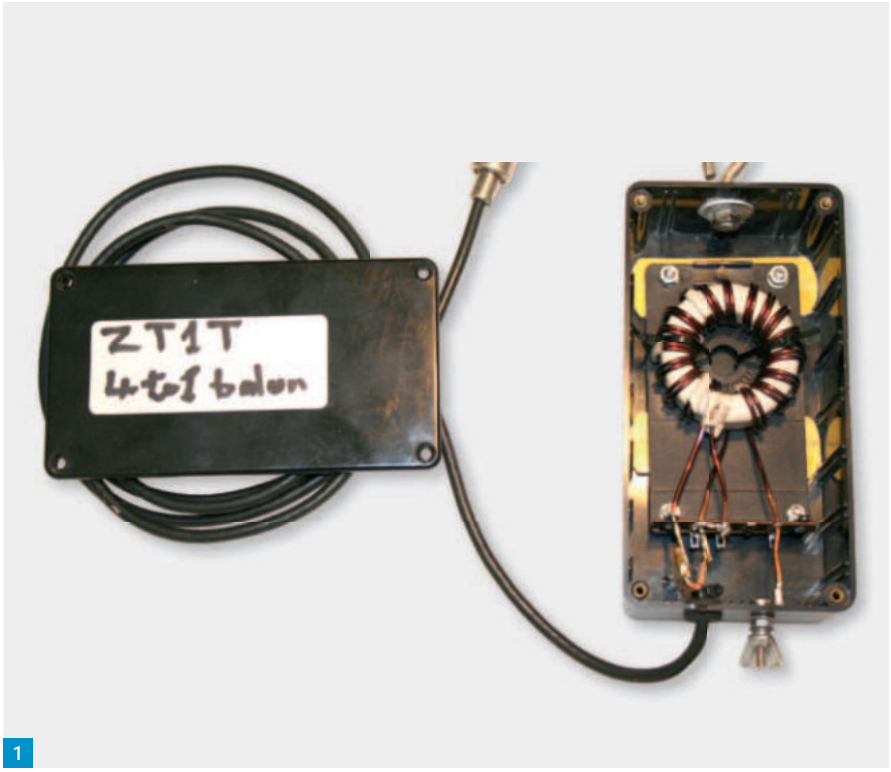

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The Magic Box on the Piece of Wire

Tom Morgan ZS1AFS/ZT1T describes a 4:1 transformer for terminating an end-fed wire.

The 'Magic of a Piece of Wire' has been featured in *PW*, April and May 2020. As a follow-on, I would like to present a cost-effective practical alternative to buying the matching balun. In Blue Peter style, *"Here's one I made earlier"*.

As featured in *PW* [1] I run an Expert 1.3k linear. One feature not tried, initially, was a listening antenna (end-fed wire) on the dedicated receive antenna socket. There are three transmit/receive sockets. A nice feature is that if there are two radios connected, the non-operational one is attached to the listening antenna. The isolation between inputs is over 35dB. I planned to have a PTT-controlled relay to ground my ELAD DUO when using it as a pan-adapter and I transmit with another rig. Of course, I never know when I may want to use the receiving antenna to transmit some time in the future. And as MW1MWD points out – matching is essential.

Some time ago, I'd had another read of **Alan Chester's** original 1994 article *Taming the End-Fed Antenna*. See also the *Antenna File* for G3CCB's article (RSGB 2001). The graph shows what lengths of wire present 'lower' impedances to the feeder [2]. ZS is so far away from many countries that the best listening antenna is needed. Unfortunately, I became a little confused by all of the differing 'advice' proffered on the Net.

Some commentators recommend a 9:1 balun. But the problem is often practical. If the windings (trifilar) have to be twisted together, it precludes using heavy gauge wire. Obviously, this restricts the level of power. And if the impedance presented by the 'Piece of Wire' at the transformer is 36Ω, the impedance seen on the transceiver side will be 4Ω! So, I opted for 4:1. Finally, I followed at a design by VK6YSF. Most literature about longwire antennas recommends a 4:1 balun when using a longwire as a transmit antenna. So, what's in the box? Basically, it's an autotransformer. A turns ratio of 2:1 gives an impedance ratio of 2^2:1 or 4:1, see **Fig. 2**. I started to collect the bits. Out in ZS, there is a shortage of 'bits' of all sorts. Then I had a bit of luck! One of the businesses in our farming town is Robertson Armature Winders. They had drums and reels of lacquered wire for sale. Of course, being South Africa they weighed the piece before working out a price. The principle is *"You've bought it coz I've cut it"*.

As the wire is all metric and the drums read in mm² I was really pleased to be able to consult the wire tables in my Babani book, *Coil Design & Construction Manual*. When I had asked the winders which wire gauges they worked with, I got blank stares. That's progress?

I settled on 2mm diameter in the end. That's about 12SWG. We're allowed 1kW nowadays [3]. I had obtained two ferrite rings T-200-2 from Spectrum Communications, one year when I was in the UK for the National Hamfest. It was difficult getting the turns close to the ring but I managed using a spoon handle as a boss.

Before winding the coil I had read that covering the toroidal core would avoid chips. I still had some glass tape left over from the transformer in my phasing unit (Glass Cloth tape by Electro Tape Specialists, inc.), which came in handy. That's why the T200-2 is white, **Fig. 1**. Apart from guessing the lengths of wires, one neat trick is to cut two lengths long enough and then tape them together at intervals. It keeps the wires together, instead of fighting two wayward ends!

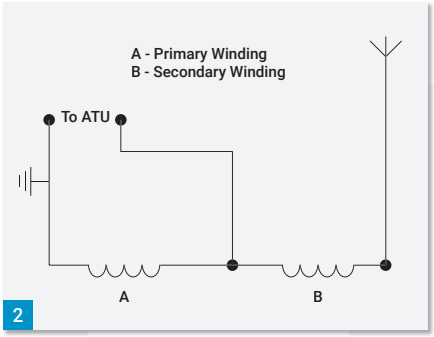

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Fig. 1: The finished assembly.
Fig. 2: Schematic of 4:1 transformer.

As you can see, the construction is simple, 18 bifilar turns. I happened to have a suitable box from one of my previous

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Getting onto the 80m Nets

Joe Chester MW1MWD struggles to be loud on 80m.

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I spent an evening with a single malt recently doing blue skies thinking. I guess we all do this from time to time. I imagined all sorts of interesting projects. Moonbounce, for example. But this is just too difficult (for me). I know I would not be happy with just JT/FT or CW stuff, I would want voice contacts. This would mean a really big dish – think Goonhilly or Jodrell Bank. And remote operation is also off the menu – it would be nearly as cheap to just move house, which is forbidden! I've done a lot of VHF stuff in the past, including field days and even contests. My best performance was into central France, from a hilltop in Ireland 25 or more years ago. Satellite work also requires extensive mechanical engineering – think poles, beams and rotators with all their controllers. Oscar 100 looks an interesting mode – but, still, too much precise mechanical work needed.

Getting on to 80

My main interest these days is HF. My attic fan dipole covers 40, 20 and 10m, running 100W from my IC-7300. My 10W KX3 used to be my portable station. I have also used it for the fun of working the 'big guns' in contests. But with lockdown, I'm using it in the afternoons from my 'office', mostly on 20m. I might think about setting it up for digital work at some point. The attic also holds a 6m Moxon beam, which I used recently during that amazing week-long Sporadic-E opening. So, I'm not unhappy with what my little station achieves, but I think I can do better. I believe there is DX out there that I'm not even hearing – yeah, I know, you're not hearing it either. Some of you are doing well with large towers, and high gain beams. My small station is really just the corner of a table, with a few wires hanging off a telescopic fishing pole. As a first step to improving my little station, I decided to get on 80m.

Easy, said the little man inside my head. Push a button, spin the dial, and you're on! So, I did what he said, and indeed there I was. Or wasn't. Yes, the radio was receiving 80m signals, and I could hear a few stations buried in the most awful background noise. Clearly, getting on 80m wasn't as simple as I thought. Of course, I didn't have an antenna then for 80m. I was just trying to use my ATU to find a match on my fan dipole, which clearly failed dismally. Of course it did; resonant antennas don't tune on bands lower than that for which they were designed. I did a project last year that needed an 80m portable antenna so my first real attempt was to repurpose that fishing pole thing I built for that project. To say it worked would be an over-estimate. But I struggled to achieve a couple of brief signal report type QSOs – a 51 and a 43. Not encouraging. Clearly, I needed a better antenna. No problem, as I had put up an inverted-L (see *PW* May 2020).

With this I started making contacts on 80m. I got a few QSOs, including what I would call DX on that band – Russia and Ukraine. There you are, up and running on 80m, easy. Well not so fast. I'm making the odd contact, but 80m is more than that. It's the home of lots of UK nets every day; and the number of nets has increased enormously since lockdown started. Some of these are clubs or other well-defined groups such as AFORS, or ROTA, but there are other ad-hoc groups too. There are lots of almost BBC-quality stations operating on these 80m nets, with signals booming into South Wales at 59+ levels every morning., and from all over the country. If I want to join in with this activity, I will need to put out a better signal. And I also need to be able to hear these stations above the noise level more clearly. But, one step at a time. As these are two quite separate issues, I decided to deal with my transmission level first. Height was my first target.

Achieving Height

Fortunately, the current public health emergency has resulted in a slightly more relaxed attitude by my Accountant (!) to off balance sheet spending here, on the principle that if the worst happens, we can't take it with us. The lockdown also means that I can grab the annual travel budget, now unused, and repurpose it! It seems I am not alone. I spoke with a supplier recently, and he told me he can't keep stuff on his shelves any more, it just flies out of the warehouse. *"We haven't an aluminium pole left"*, he said!

I got fed up with the frequent collapsing of the fishing pole, so I bought an expensive GRP pole instead. With this, I was able to get the inverted-L out of the tree. This produced an immediate benefit. For example, I was able, just, to call into **Callum M0MCX's** (now world famous!) daily Lockdown Net on 3.755MHz – I got signal reports from *"couldn't hear the Welsh station"*, to 52, 53 on some days (daytime conditions on 80m, I assumed – but maybe not). I'm hearing many of the stations on this net, but some are very weak. For example, **Jim G4WSH**, from the Lizard, is never less than 59+ with me, but stations in the far North are mostly barely readable. To fix this, I resort sometimes to the Hack Green SDR. Many other stations are also listening on this and other SDRs, as a way to beat the QSB, and the weak propagation in daytime on 80m at this time of the year. I'm not doing anything wrong here. After I give my report to the net, by means of a brief QSO with net control, I just listen to other weaker station on the SDR – I'm not making contacts or trying to have QSOs with them. I intend to return to the issue of reception of weak, below the noise level signals later.

Compared to the regulars getting 59 reports, my reports are a bit disheartening. For example, one morning the NRC net was particularly strong, and the background noise level was lower than usual too. I had a couple of quick overs with **Nigel G4RWI** before the QSB killed me. Nigel is almost directly east of me. My inverted-L is nearly omnidirectional, but with a slight preference to the East. And transmissions to the north of me are attenuated by my roof (note to self – get that pole up higher!). I'm running 100W, and many others are doing the same.

I did another check one Sunday, when I found a contest in full swing, and worked OM4MM, 9A7C, OK2ZA, UY3U, SP9M, YP0C and a few others, on 20m, with the KX3 and 10W on the inverted-L. So, I am getting out; my inverted-L is working. So why am I struggling when others are chatting at BBC quality levels? One answer is that they are all within a few kilometres of each other but this is not completely true, as there are stations from Devon and Peterborough joining in regularly.

An Amazing Net

A brief aside: it's an amazing net, that NRC one. On-air seven days a week around 3.730MHz at 0930UTC, and with up to 20 call-ins some days. It was started by a few operators who also volunteer at the RSGB National Radio Centre, Bletchley Park, but everyone is welcome to join in. And the range of topics is definitely 'eclectic', as one caller put it – an amazing range of knowledge and expertise is demonstrated cheerfully each day. Everything from impedance matching a 6m Moxon, to a short lecture on satellite power operation, rotators and how to repair them, electronic logbook integration, microphones, descriptions of how to build patch antennas for Oscar 100 and, of course, the dreaded interference experienced by some and generally blamed on xDSL. And 'how to paint a fence' (to Sistine Chapel standard, of course)! And then there are the discussions about Hamfests, past, absent and future, how to get there and where to find the free beer when you do. Amazing!

Reciprocity?

Now I wish I could say that the stations on this net were using massive beams on towers, and full legal power. But they are not. The net controller, 120 miles away, is always a good signal with me, running just 100W into a G5RV, up at about 10m. So, is the G5RV a better antenna than the inverted-L? What does better mean, in that context? Is Nigel getting substantially more RF energy into the air than I am? Is his antenna significantly better than mine? Or is it purely propagation? The reciprocity theorem, as applied to the science of radio, says that the transmission and reception performance by any antenna system should be the same. In other words, all antennas work equally well as transmitters or receivers. If I'm hearing net control well, and using the same power, why is he having trouble hearing me?

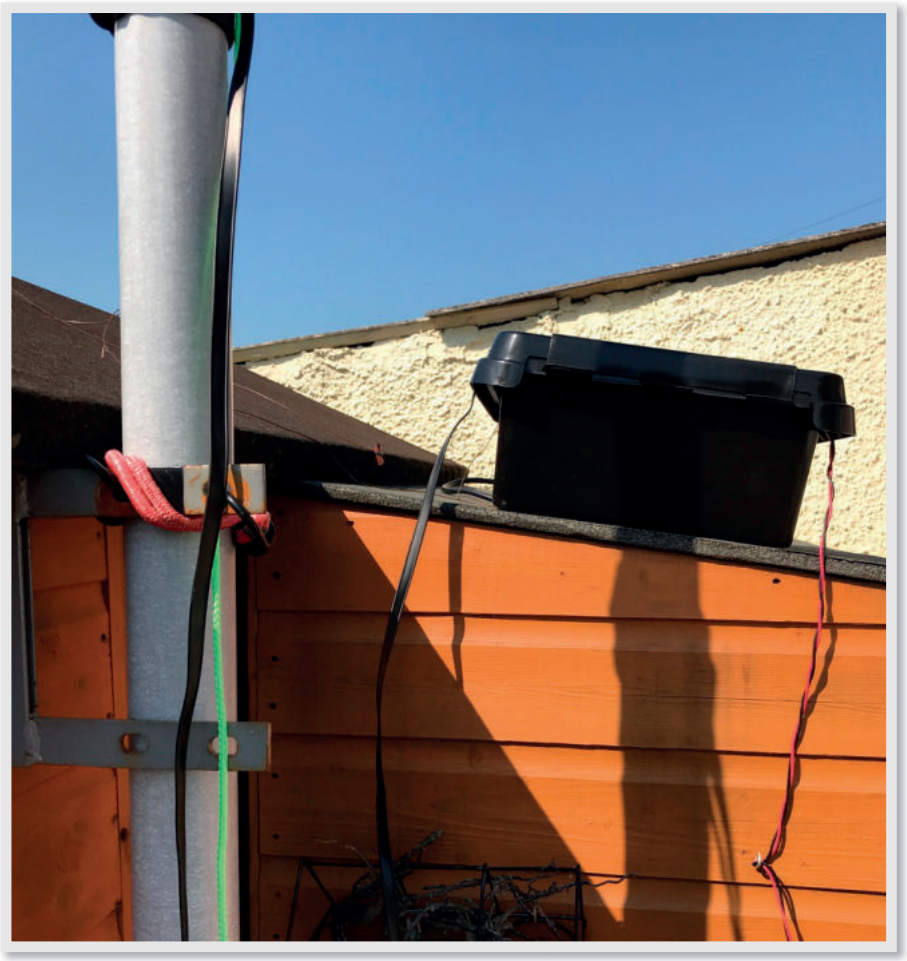
Theoretical calculations of reciprocal propagation between two stations, such as those by **Thomas NW7US** (available at the URL below), do indeed show that the signal strength is almost exactly reciprocal, within about 1dB or so. So how come I am hearing 59 signals and only getting 53s in return? https://tinyurl.com/yd3gnp79

It isn't that the reciprocity theorem is wrong, it's all about noise levels, or more specifically the signal-to-noise (S/N) at both ends of the transmission path. So, getting back to that net, if I am hearing him at 59, then the S/N at my end must be reasonably good. I have lots of mush here, so I assumed my S/N was poor. Maybe not, and my receivers are doing their job. So why am I not getting 59 reports from others? Another answer is variations in atmospheric noise levels, as the propagation changes. The effect of

these changes can be clearly seen on the spectrum display, and the S-meter, even in the course of a single over. A typical over can start at 59, drop to S0 and come back up again in the course of a sentence.

And it also doesn't help that my system is probably inefficient, and watts are being lost on the way to the ionosphere. I'm just not putting out a good enough signal, even if the wattmeter says 100W. So begins another chapter in the search for improvements in my small station. The 80m station consists of an Icom IC-7300, an MFJ manual tuner, a 6m length of coax feeder, a 9:1 unun, a 19.8m inverted-L up 6m vertically in the air, and a long counterpoise running around the garden 2m off the ground on a wooden fence. There is also a 10-turn coil of the RG58 coax at the feedpoint to act as a current balun. Where to start? The feeder runs from the tuner, through a hole in the wall, out to the antenna. There is a joiner half-way along this (I used two lengths of coax early on, to make it easier to thread through the hole in the wall). Clearly, I can do better here. So, I ordered a suitable length of RG58U, and new PL259s to make a single length of feeder. A few fractions of a dB gained here.

I also spent some time studying current baluns, both commercial and DIY. I found nothing convincing, so decided to stay



with my ten turns of coax. Next up was my earth connection, where the feeder exits the 'shack'. This was just a spare offcut of copper pipe hammered a foot or so into the ground during the rebuild of the bungalow. Improvements could be made here, but with lockdown and self-isolation, this will have to wait. I also put my antenna analyser to work, and by adjusting the length of the counterpoise by a centimetre or two, got a good match on 3730kHz, the net frequency. I use an external ATU with this setup, not the internal one in the IC-7300. I get a 1:1 match most mornings.

Height is everything, for radio communications. So, I pushed up my new pole an extra 2m – surely another dB at least. Last up was the radial issue, the dreaded digging up of the prize garden to lay down 30 or so ground radials. But this is going too far for now, and hardly considered essential work during lockdown. Instead, I added a second radial, going the opposite way to the first one.

The Acid Test

Weeks of test test test followed (where did I hear that phrase before?). Then came the crucial on-air day. Trepidation, to say the least. At the appointed hour I answered the net controllers QRZ?, and was very pleased with the reports I received – **Nigel G4RWI** gave me a 58, **David G4HMC** a 58, a 53 from **Martin G0GMB** and **Kim M0KMV** said *"53 but hitting 58 at times"*. I also got a 53 from **Ken G7FTD**, up in Peterborough, so that extra height is getting me out to the north as well. Then on to the Lockdown net, where Callum said I was *"booming in here this morning, 57-58"*.

As an experiment, the NRC net moved to 1630UTC a couple of evenings. And what a difference that made to propagation! 59 signals both ways, and armchair copy. Of course, it's easy to say that conditions were good that day – indeed a week later and no one is hearing me at all (but that's another story!). There is clearly more to do. And 80m daytime operations are going to start suffering as 'high summer' (or whatever approximates for that in these parts) rolls around. But I think it fair to say that at last, I am beginning to achieve my goal of improving the signal from my small station, but at the expense of an ever-lengthening to-do list here!

Ah, the benefits of being locked down! Who knew?

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trips to the Hamfest. The mount plate inside was from a composite display board holding a sailing block and the yellow offstands came from GRP extrusion used in locally-made ladders for Fire & Rescue Services. The connection board came from an old domestic radio, parts of which one of the locals brought to my door. He was being helpful because he heard I was a radio amateur. In ZS you use what is available. It's a long time between visits to radio land.

Yes, it does look like many other constructions except for four things. One, I used a bolt held by washers and nut, and wing nut (with washers) for the long wire attachment. Two, I made a coax tail and used a rubber grommet in the hole through the box. It makes it a lot easier than having to contend with a run of coax at the top of a pole or tower. Three, I used a cut-down eye bolt for an attachment point. (Large fender washers spread the load.) Of course, you can still use big cable ties to secure the box to the pole but the eye stops it from slipping.

And it's great for holding the box still, while attaching the long wire. Fourthly, I could decide to run the antenna wire into the station and have the balun sitting on a shelf or the bench. So, I used toilet seat rubbers to raise the box above the cheese heads of the bolts. Every hole and opening was sealed against the elements using marine sealant.

Postscript

I'm sure several amateurs will question if the plastic box will be OK for transmission. So, I'm pleased to say that since then I've obtained a diecast box in which to put the balun if it is used for transmission. Fortunately, I ended up with a stock of insulated posts with screw heads for attaching the antenna wire. They were left over from a silent key sale I managed.

I'd like to mention that I have a number of Babani books in my library that older amateurs may remember. Most of them seemed to have easily accessible tables and measurements that constructors can use. Yes, I know the information is probably on the Net somewhere, but information in a book is instantly accessible. Deciding what is progress is another question ...

References

[1] PW June 2017, p.16.
[2] Reproduced in PW April 2020, p.68.
[3] The red and black from 'twin and earth' could be a more cost-effective (but bulkier) choice with a 400W limit.

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DSO Kit

Ian Dilworth G3WRT describes a digital oscilloscope kit that is the basis of a future project.

This kit provides a small digital oscilloscope with a high-quality colour display measuring 5 x 4cm. The maximum frequency response is, however, only 200kHz at one megasample per second employing a 12-bit A to D. The time base (horizontal sweep) is variable over an exceptional range i.e. 10 microsecond to 500 seconds per division. The input vertical response is switched in discrete levels from 5mV to 20V per division and can be switched between AC or DC coupled. The triggered timebase can be set on auto, rolling or triggered according to the voltage level of the vertical input voltage. The trace level can be varied over the full range of the screen. There is a dynamic numeric display of the actual input levels and set parameters simultaneously shown on the screen. These can be disabled so that the whole screen is available for the input display. The display shows a window of the whole data buffer that is recorded. The viewing window can be moved to the beginning, the end or anywhere in between. This is very useful for examining stored waveforms.

By placing the window at the right-hand side of the buffer the input signal may be seen in real time. The data record is related to the horizontal timebase period. A full buffer occurs before the display updates on a rolling basis. There is a stop button that can freeze the display. Then with the adjustable horizontal window the whole of the recorded data may be examined. There is also a facility to store the displayed waveform in EEPROM and to recall it in a held state. This can be repeatedly overwritten. Intriguingly, there is a reference to outputting the recorded data via a serial line. This is not implemented in the hardware/software in the unit I received.

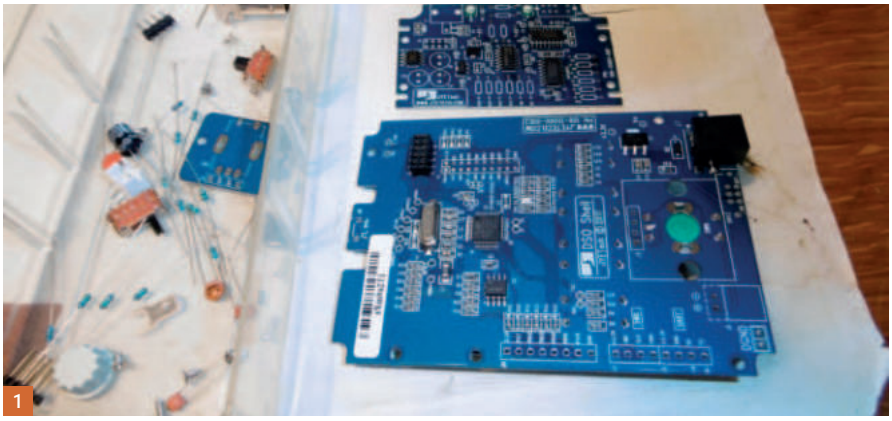
There is a built in 1kHz square-wave signal source, which is useful to check operation or for injecting into audio equipment or similar. The oscilloscope runs off 9V at 120mA.

When first powered on the oscilloscope quickly boots up on its inbuilt software. The unit returns to the last settings used, which can be very convenient in some applications.

The photo, **Fig. 1**, shows the kit prior to construction, while **Fig. 2** shows the assembled oscilloscope with a display from the inbuilt 1kHz oscillator and parameter display.

Availability

This is a partial kit costing about £15 from JYE Tech (website below). It is a state-of-the-art design first produced in 2017. The kit comes with all the surface mount components already mounted and soldered on two PCBs. One, smaller, PCB is analogue and the other digital. There are wire-leaded components to solder as well as a few other parts. The kit is well thought out and of good quality. The instructions are minimal but adequate. However, the pictures supplied need to be carefully studied before assembly. There are 16 eighth-watt leaded resistors which vary from 5MΩ to 15Ω and these are very small items. I found it near impossible to determine their value by looking at the colour rings, even though I have been doing that for decades. It really is necessary to measure each accurately before soldering them in place or mistakes are easy to make. I could only identify the 5MΩ resistor by elimination as I assembled the kit due to the limitations of my multimeter and I found a good magnifying glass unreliable, the colour bands are indistinct. There are 15, 30, 100, 120, 1.2MΩ values, for example, so accuracy is required.



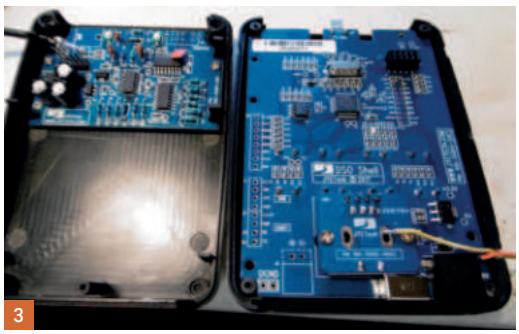


Fig. 1: The kit. The surface mount components arrive already mounted and soldered.
Fig. 2: The finished and working oscilloscope showing the on-screen parameters along with the inbuilt 1kHz square wave. The on-screen parameters can be switched off to enjoy the full screen.
Fig. 3: The assembled unit internally with PSU wires and input bypassed.

The kit does require care in construction but is simple enough and only requires the usual tools. It does, however, require a small 20-25W and a 50-100W soldering iron, the latter for just two parts. There is no supplied circuit diagram.

jyetech.com

Performance

As a digital storage oscilloscope (DSO) with an analogue input from DC to 200kHz and a maximum input voltage of 50V it performs very well. The colour display is small, 6cm on a diagonal, but it is crystal clear and superb. The screen photographs do not do it justice, neither do they show the different colours it actually displays, a result of aliasing between a digital camera and a digital display. The only evident weak points are, perhaps, the two slide switches, which will not last if roughly handled. Overall, it is well designed, has very useful facilities and represents excellent value for money.

Making a start on the 630m band

John Adams G3ZSE explains how to get started on 630m.

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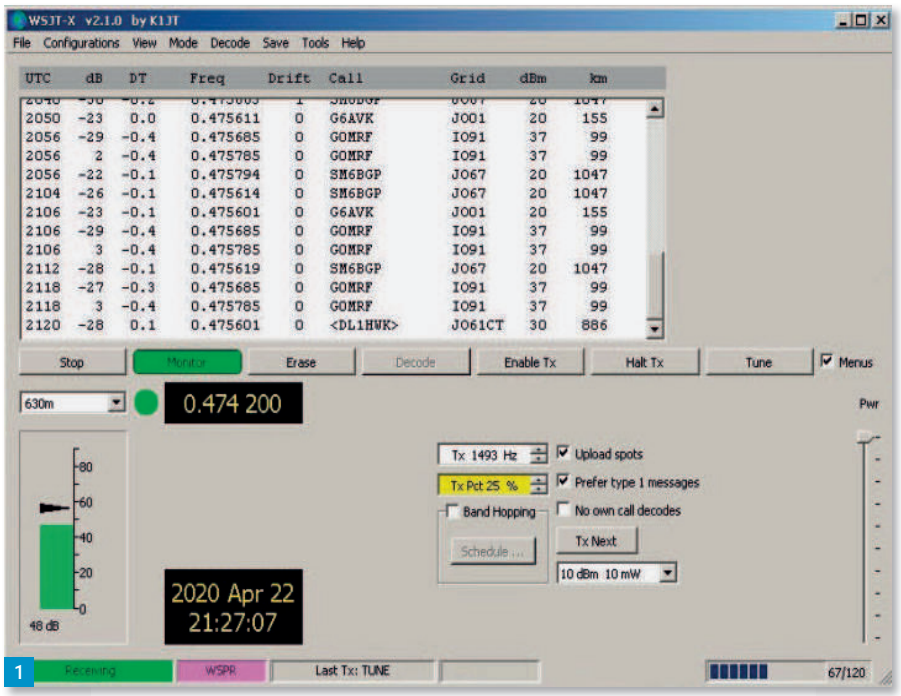
It is well known that at the birth of 'wireless' the much longer wavelengths of the lower frequencies were the first to be used. Marine applications have always figured prominently in the history of the development of radio and, in particular, frequencies of around 500kHz remained in use until the end of the twentieth century for distress calls. In recent years frequencies close to this have been released to amateurs around the globe. So, in the UK, and many other parts of the world, we now have the 472 – 479kHz band available, or 630m as it is often known. When I was first licensed in 1970 I started out, like many then, on 160m. That band still remains a challenge for anyone except for those with very large grounds. How, then, do we go about using much longer wavelengths? The answer is to combat the puny signal from a very inefficient antenna with state-of-the-art processing technology of received signals. Believe it or not, many of you will have the means to make a start on 630m in your shacks right now. My station is not one of the big ones on 630m, nor am I a trail-blazing expert on low frequencies, but I can point you in the direction of what has worked and produced good results.

Propagation

Propagation on 630m is not much different to propagation on 160m – both are officially classed as MF, or 'medium frequency'. Distances are typically only 40 to 50 miles in daylight but, like medium wave stations, distances can be real DX at night, when the ionosphere is usable at MF. In winter the longer hours of darkness make for better propagation. After dark I expect to be received at a distance in excess of 1,000km, and to likewise receive others at this distance.

630m and Very Narrow-Band Modes

As the 630m band is only 7kHz wide, it follows that only very narrow modes can be accommodated. So data modes, and in particular some of the newer ones, are the ones that are used. True QSO data modes, like FT8 and JT9, are possible, even with a limited setup on this band. However, WSPR – pronounced 'whisper' – is the mode that can give the most satisfying results. It stands for Weak Signal Propagation Reporter, and is cutting edge technology for the radio amateur, that allows the reception of extremely weak signals. Developed by **Joe Taylor K1JT** at Princeton, it allows us to receive and decode data signals that may be neither heard in the speaker, nor show up on a waterfall display. WSPR signals are only 6Hz wide. The UK licence allows stations to use an EIRP (effective isotropic radiated power) of 5W on 630m, although most stations only manage between 5 and 200mW! (The signal from G3ZSE is usually 10 – 20mW.) WSJT-X is Joe's software and WSPR is one of the modes it offers. There was debate as to whether WSPR contravened the rule about general transmissions but it is now accepted that it is a valid mode.



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The WSJT-X Software

WSJT-X runs on your computer and I use an ageing Acer Aspire One notebook-style laptop. Via a USB interface between the computer and receiver/transceiver the programme controls both receive and transmit functions and displays received decodes on your computer screen. The photo, **Fig. 1**, shows a screenshot of some received signals. Download and set-up of WSJT-X is both quick and straightforward – see the web link. WSJT-X is a software suite that contains WSPR and other data modes. It will run on various Windows versions from 7 upwards. You will also need to read some of the very comprehensive *User Guide*, and it's probably worth downloading that too. You will need to go into Settings and put your basic details (such as callsign) in the General tab. The Radio tab will be needed to set up transmit later. The Audio tab requires information on where the FSK (frequency shift keying) tones come from and go to – this will probably need to be set to CODECs. The programme will automatically capture the time, incoming callsign, locator and allocate the signal report you are going to give. The report is generated as a figure in dB and is the ratio of the received power in the 6Hz signal width to the total power in the noise across the whole received audio passband, usually 2.5kHz. Mostly reports will lie in the range from −30dB to +3dB.

Frequency and Time

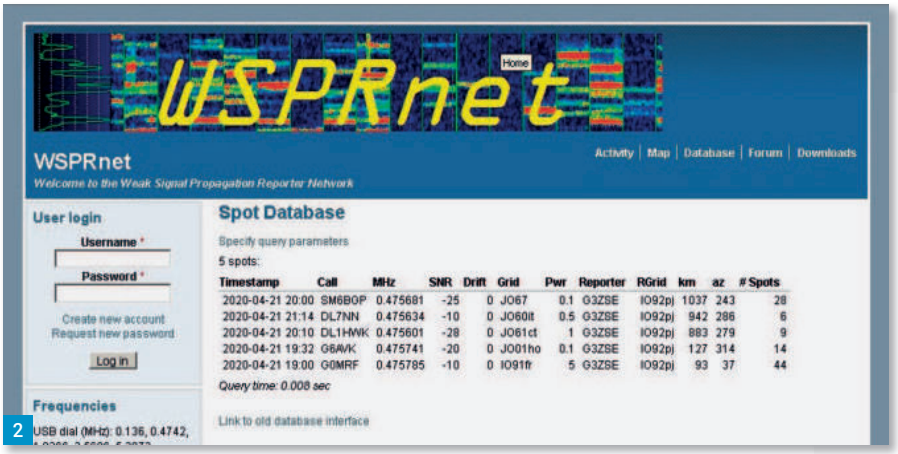
Do note that your receiver frequency and computer clock both need to be set very accurately for all WSJT-X modes. Frequency at MF is seldom a problem for any receivers or transceivers made in the last 30 years. PC clocks these days automatically keep themselves set via the internet, although this is often not accurate enough, being typically up to ten seconds out against real time. As a rule of thumb you need better than two seconds for WSPR and better than one second for other modes. Each WSPR transmission lasts two minutes, starting on an even minute. You can set your PC clock by forcing a sync with internet time, or by using a background programme, or, like I often do, by manually setting the time against the shack radio-controlled clock. You may want to Google how to set your own computer clock. Some operators use Meinberg or similar software to automatically sync their computer clock. I've never found it problem-free, but many swear by it. You can Google for various sync applications. You'll know if your time is out, as the difference in time (DT) from the received station is displayed in WSJT-X modes.

The WSPRnet Website

There is also the WSPRnet website, which you can use whether or not you register with it, and this holds data from all stations that are transmitting or receiving. The default setting in WSPR is to automatically send a report of every signal you receive to this website. This is very useful to those transmitting. Stations using WSPR are not in a QSO, so transmitting stations will see all who have received them using WSPRnet, whether or not they decode them directly. Receiving stations can also use the WSPRnet site to see a summary of their signal reports – see **Fig. 2**. Play around with the settings in its Database section – it's very intuitive. (The WSPRnet site receives a lot of traffic, and often disappears when it no longer detects any keystrokes or clicks from you. Refreshing it brings it back up though.)

Receiving 630m and Data

I use both my IC-706 MkII and my FTdx1200 for data modes. Both sets have been used for receiving on 630m. You can use almost any modern transceiver or receiver to receive at 472kHz. Most have the receive capability, and most will be sensitive enough to perform adequately. There are still some Datong VLF converters about second-hand, and such converters convert



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low frequencies to allow reception using the 10m band. You may have an SDR in the shack, and this is clearly another option, especially as some cater directly for data modes. I generally use my IC-706 MkII for 630m, since I have also modified it to allow transmit on 630m – more on this next time.

You will also need to have a PC or laptop available to run the WSJT-X programme on, and to also access **WSPRnet.org** via the web. WSJT-X needs to be fed with audio from the receiver, and the surest way of doing this is by using a dedicated USB interface box between the receiver/transceiver and the computer. I use the Yaesu SCU-17 interface, see **Figs. 3** and **4**, as I bought this with the FTdx1200. I made up a second lead to allow connection to the IC-706 as well. Many interface units are available, SignaLink ones being very popular. If you already run data modes, then you will have a suitable box already. If not, then browse the advertisements or eBay. Various designs for building simple units are also around. You will normally have to download drivers for your computer to run the interface box.

The Antenna

Nearly all activity on 630m is basically vertically polarised, although virtually all amateur installations fall far short of achieving good efficiency or good polarisation. Ideally, we would have a largely vertical

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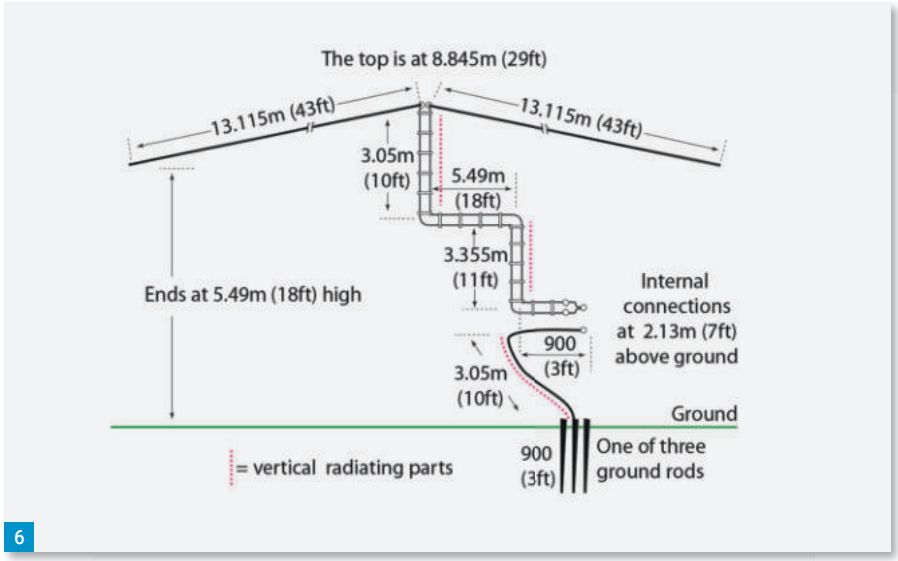

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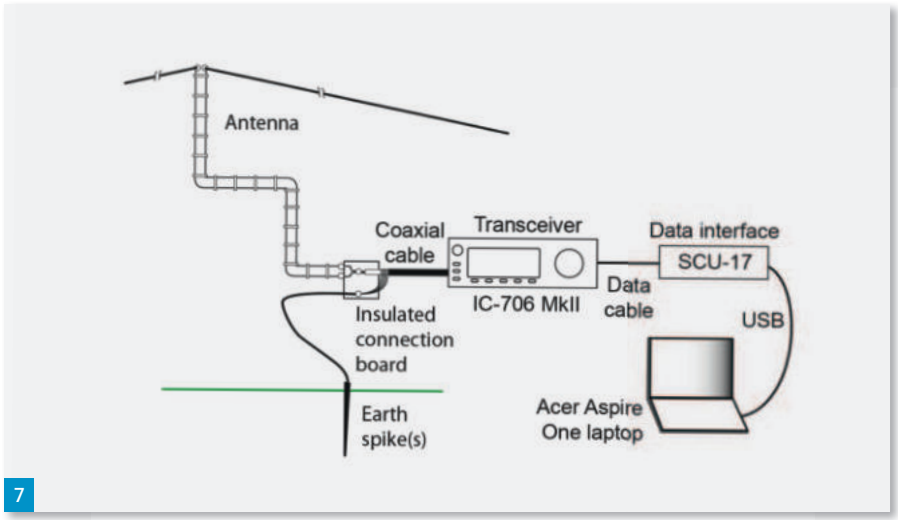

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antenna, several hundred feet in height, with or without a few hundred feet of horizontal top section. Add to this a vast array of long radial wires! Most of us, however, see what can be done with what we have. In my case, it's an HF wire doublet antenna with each largely horizontal leg being 43ft long, and the twin feeder downlead being around 42ft. The ends are strapped together at the shack end to form a top-loaded 'tee' antenna. This is fed against a true earth connection, see **Fig. 6**. The top loading adds a capacitive path to ground and improves overall efficiency. The effective vertical part of the antenna is about 29ft. Other options for receive (and maybe transmit) are any high vertical wires. For example, a VHF beam, with strapped coaxial feeder, will often work. End-fed wires, particularly an inverted-L, are often very successful. Take heart that a number of stations have modern small gardens. Do note that if your antenna has a ferrite balun as part of it, then this may reduce its effectiveness, since the ferrite will generally be very lossy at lower frequencies.

The Earth Connection

With vertical antennas there is always the option of radials, a counterpoise wire or one or more earth stakes. Radials are not really manageable for this frequency for most of us. A counterpoise, untuned or tuned, would seem possible, but the author's experience on 160m has been that a good true earth connection will outperform this. The photo, **Fig. 5**, shows my three 3ft earth stakes, all connected in parallel.

For receive I recommend starting with a single stake. This could be pure copper (mine are 28mm water pipe) or copper-coated steel, as used in mains safety earthing. I prefer the 28mm copper as the surface area of earth contact is high, and a short stake is often easier and safer to install. I am always loath to bang long stakes into the ground for fear of what might be there! You then have two options: one is to dig out a hole and fill it in around the stake, the other is to work the stake into the earth while irrigating around it. I do the latter. First, I cut a point on the end of the pipe with a hacksaw. Then work it in a few inches into the soil, followed by watering around it while turning it backwards and forwards by hand and pushing downward. It's surprisingly effective. I have very heavy clay soil, and the last 9 to 12 inches requires me to get some extra leverage by clamping mole grips around the top of the pipe.

You must make your own mind up on the best approach for your situation. My first earth stake has been there a long time, as best HF practice when running 100W is to have an earth to the transmitter that is independent of any other mains earth. If you're uncertain about progressing to transmit on 630m at this point, you may want to try a simpler earth arrangement first – maybe a 1ft copper or aluminium stake, or largish piece of copper or aluminium buried in the ground. Depending on the actual antenna you use, the impact of the earth connection may not always be large on receive, but it will be critical when you come to transmit.

Fig. 1: WSPR screenshot.
Fig. 2: WSPRnet database screenshot.
Fig. 3: Interface box – front.
Fig. 4: Interface box – back.
Fig. 5: The tee antenna.
Fig. 6: Earth stakes.
Fig. 7: Overall receive setup.

The Complete RX Setup

Fig. 7 shows the overall receive set-up. There is no ATU in the line-up, and this will not matter unduly on receive. Do however

Continued on page 65

Piloting a Software Defined Radio with Ham Cockpit

Steve Ireland VK6VZ/G3ZZD
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SDR pioneer Alex VE3NEA has released an exciting software program, which will host a range of plug-ins to perform just about any function a 21st century radio amateur needs. **Steve Ireland VK6VZ/G3ZZD** investigates.

Going back 14 years or so, **Alex Shovkoplyas VE3NEA** dragged me kicking and screaming into Software Defined Radio (SDR) with his free Rocky software used on a Softrock 40 kit receiver.

Although VE3NEA is now best known for his CW Skimmer software, which decodes CW signals and displays their callsigns alongside a bandscope, Rocky was equally revolutionary. Not only did Rocky offer a bandscope, which had a high resolution in frequency, but came with an alternative waterfall display that had such a high resolution in time that CW signals could be read off the screen of the personal computer running the software. Every single dot and dash was perfectly rendered.

Waterfall displays had been around for a while but not with this kind of resolution. To make life easier for the operator, instead of the waterfall going from top-to-bottom of the screen, Alex's flowed across the screen from right-to-left. Even better, the Rocky bandscope was so sensitive you could see very weak signals which were basically inaudible.

Up to this point, despite the enthusiasm shown by my good friend and co-writer **Phil Harman G3WXO/VK6APH**, I had dismissed SDR as something only for the technical enthusiast. Now, finding it could be used visually for locating weak DX signals on my favourite 1.8MHz band, SDR was a mountain I definitely wanted to climb.

One of the main reasons Rocky – and its later big brother CW Skimmer – were so good for a serious DXer to use was because VE3NEA himself is a DXer. Both programs were originally developed so Alex – who has a relatively modest station and antennas – had an extra edge when it came to finding and working new countries.

The main reason for writing Ham Cockpit [1] comes from exactly the same place. Alex needed Bouvet Island for his last country to make DXCC Honour Roll (i.e. all existing countries worked) and developed the program so he could break the huge CW

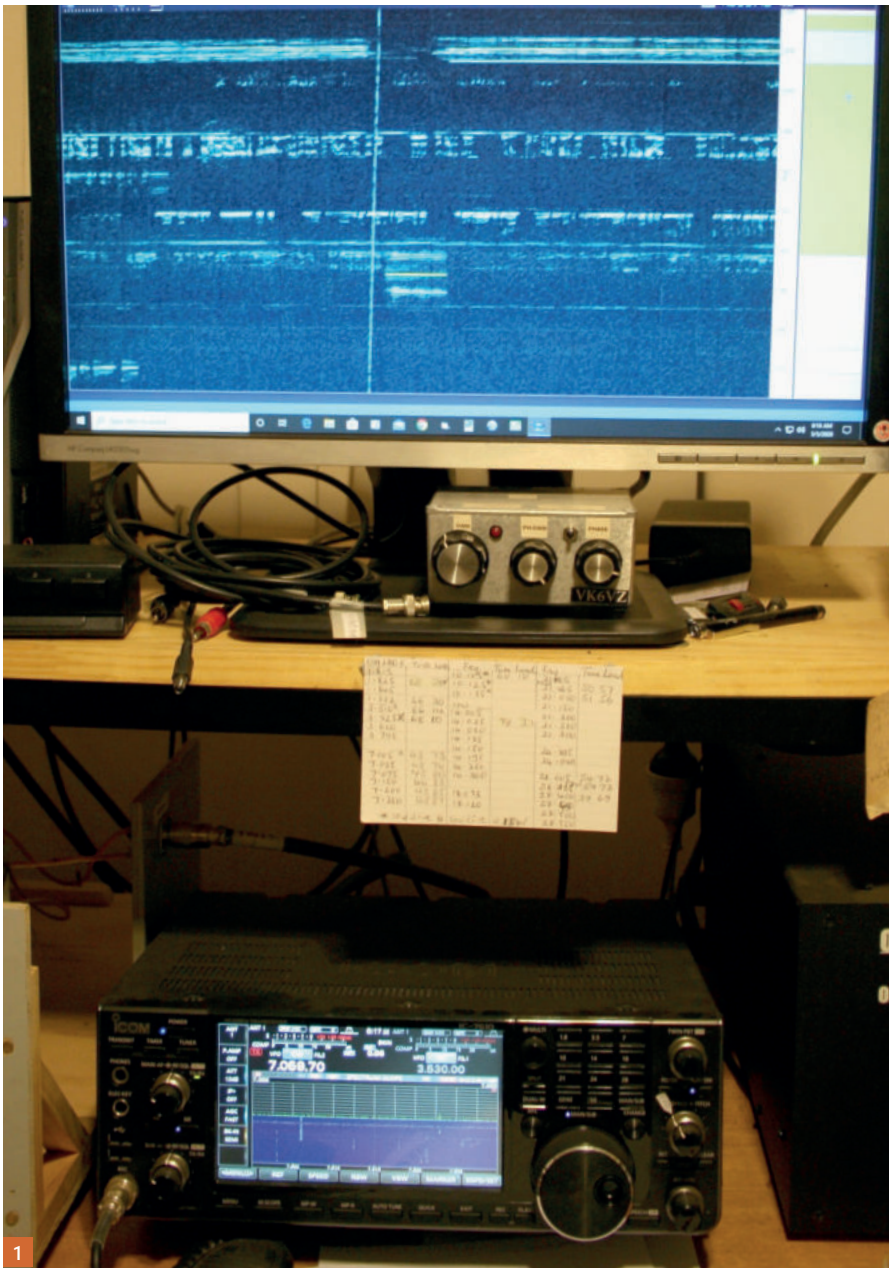

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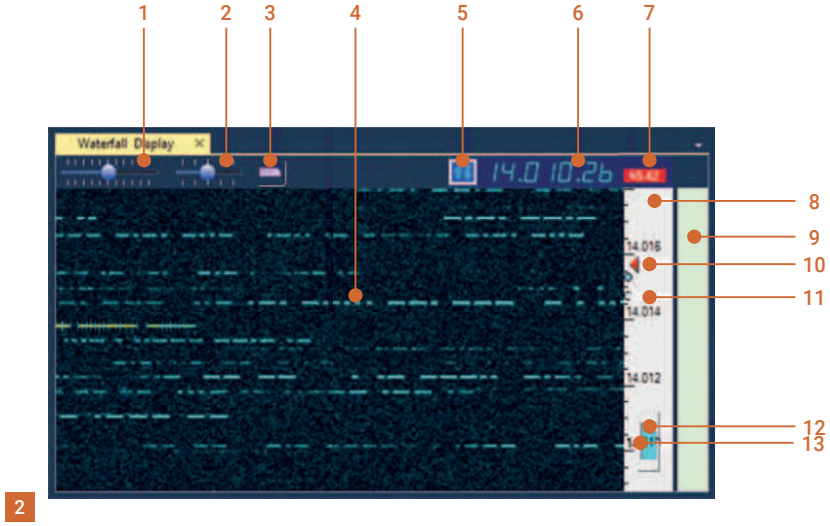
Fig. 1: IC-7610 and Ham Cockpit in use at VK6VZ
Fig. 2: Waterfall Display controls and indicators, see text. (courtesy VE3NEA)



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pile-ups he could foresee coming with the 3Y0I DXpedition while using his IC-7610 SDR.

While the 3Y0I DXpedition had troubles with its first attempt, Alex is now armed and ready with Ham Cockpit when they make their second trip. You can be too!

Now you have heard the expression 'CW' a lot already in this article and if you are an SSB or RTTY operator may be thinking Ham Cockpit is not for you. The good news is Ham Cockpit has CW, SSB and RTTY demodulators, which will take in-phase and quadrature (I/Q) signals and turn them into audio.

Note that Alex designed and tested the program for Windows 10, but it may also run on earlier Windows versions.

How it Works

The main Ham Cockpit program, **Fig. 1**, has the job of loading and integrating a series of separate plug-in programs, which work with wideband I/Q signals produced by SDRs and related devices in what VE3NEA calls a 'DSP [digital signal processing] Pipeline'. Alex intends to write most of the plug-in programs but has opened the software interface up to third parties – either individuals or groups – to encourage them to write/add their own.

Alex has also made a *Plug-in Developer's Guide* available for downloading on the Ham Cockpit website and is working on a complete set of related API (application programming interface) documentation, including the source code of selected plug-ins. An API contains the protocols, routines and tools for building applications and is also used for writing graphical user interface (GUI) components.

As Alex says, for those radio enthusiasts interested in writing software, *"What kinds of plug-ins can you create? Not just the signal processing ones. Any function useful for radio amateurs could become your next plug-in. QSO logging, cluster monitoring, award tracking, propagation prediction, contesting, SO2R operation – the choice is limited only by your imagination."*

Already **Graham Alston VK3GA** has created an addition to Alex's Ham Cockpit Band Plan plug-in program in by writing a file [2] that provides frequency details of the Australian amateur radio band plan. The Band Plan plug-in provides band data to other Ham Cockpit plug-ins. Only two band plans are currently available for selection – for the Australian and the USA/Canada frequency allocations – which are displayed by colour coding on the right-hand side of the Waterfall display. VE3NEA remarks: *"We need band plans for other countries, broadcasting band plans, UHF band plans, etc."*

Alex has provided 13 different software plug-ins for the initial release of Ham Cockpit, which allow the radio to work fully with the Icom IC-7610 HF transceiver and the Afedri-822 SDR receiver. Ham Cockpit uses the IC-7610's USB-3 output to connect to your personal computer and provide a high-resolution CW-grade bandscope (using the Waterfall Display plug-in), transmit/receive switching and control 'split frequency'/independent transmit frequency operation.

When working with I/Q signals, as provided by the IC-7610 USB-3 output, Alex describes the DSP operation of Ham Cockpit in the following manner: *"The signal source receives I/Q data from an external device and controls the radio settings (for example, the IC-7610 I/Q plug-in). I/Q processors then process I/Q data received from the signal source and the demodulator converts this to audio, suitable for listening.*

"The audio processors of Ham Cockpit then process demodulated audio in a number of different ways, for example through the Bandpass Filter and AGC plug-ins. The Audio Output plug-in sends processed audio to a soundcard or another device. The IC-7610 Transmitter plug-in controls the transmit frequency, split mode and transmit/receive switching.

"If you have a radio that provides already demodulated signals, such as the audio output of a conventional transceiver, the pipeline includes only a subset of stages, for example as used in the Conventional Receiver plug-in." One of the next plug-ins Alex will release is a Conventional Transmitter plug-in, which when used alongside the former will enable the use of Ham Cockpit by a wider range of transceivers.

The DSP Pipeline is represented visually by the Ham Cockpit toolbar. By clicking with a mouse pointer on the toolbar's buttons, the user can start and stop the signal source, turn the audio on and off and switch the radio to the receive or transmit mode.

The drop-down lists associated with these buttons allow the user to select the signal source demodulator and transmitter. In the case of an audio data source, the program receives audio signals already demodulated in the receiver and the demodulator plug-ins are not used. Note that by selecting a reception mode on Ham Cockpit's Mode drop-down listing, a command is generated

Waterfall Display Controls and Indications

Further information on the controls can be found in the Waterfall Display Plug-in page of the online/PDF manual.

1. Vertical zoom slider, **2.** Horizontal speed slider, **3.** Relative frequency scale button, **4.** Signal trace (right-click on to enable the Split mode and set transmit frequency), **5.** Tune button (for paging the waterfall up and down), **6.** Frequency display, **7.** Transmit split offset display, **8.** Frequency scale (shows absolute frequencies or offsets), **9.** Band map, **10.** Transmit frequency indicator, **11.** Frequency marker (Ctrl-click on waterfall/band map to make up to four marks to track the listening pattern of a DX station), **12.** Bandpass filter (represents the filter in the Bandpass Filter plug-in), **13.** Dial frequency indicator (Left-click on the waterfall/band map to change the frequency)

Fig. 3: Waterfall Display showing CW signals can be read on-screen Fig. 4: Display from IC-7610 showing movement of signal traces when tuning its frequency dial (courtesy VE3NEA).

that can change the reception mode of a radio via its CAT interface.

How to Install It

Downloading and installation of the zipped setup package from the Ham Cockpit website [3] is simple. However, there are a couple of potential pitfalls when installing the associated, separate zipped 'additional plug-ins' files, which are needed for the aforementioned Conventional Receiver (receiver interface, which outputs demodulated audio), Frequency Display (displays and controls the operating frequency and TX Split offset), Clock (adds UTC/local time clock to toolbar), Plug-In list Panel (listing all installed plug-ins and interfaces) and S-meter (analogue meter showing audio output level). As Alex says, the best thing is to forget about downloading/installing the additional plug-ins until you have got the basic Ham Cockpit installation working. When you are ready to load these plug-ins, read the specific instructions on the manual's Installation page carefully.

Now as the Icom IC-7610 is the transceiver that currently integrates fully with Ham Cockpit and many readers (and I) have one, I will first concentrate on using the two together. One key here is in contrast to using the Icom IC-7610 with HDSDR [4] (and CW Skimmer [5] via HDSDR), which requires connecting your radio to your personal computer using USB1 and USB2 ports, only the USB2 port is needed with Ham Cockpit.

Beware that while the IC-7610's USB2 port has a fast USB-3 data speed, your computer, particularly if several years old, may have what appears to be a USB-3 port but only works at USB-2 speeds. Also, you must use both a USB-3 certified cable [2] (between the radio and the computer) and your computer must have a genuine USB-3 port for Ham Cockpit to run correctly. Alex warns: *"Attempts to use a USB-2 cable or a USB-2 port on your computer will likely fail."*

In order to try out Ham Cockpit as a bandscope with radios such as those from Kenwood, Yaesu and Elecraft, the Conventional Receiver plug-in is used, along with VE3NEA's free Omni-Rig interface [6]. This setup uses the soundcard in your computer to handle the audio signals from your radio. The excellent Ham Cockpit manual contains details of how to carry out this installation. Note that I have not tried the Conventional Receiver plug-in.

Of the additional plug-ins, four of them are visual/graphics and effectively supplement Ham Cockpit's waterfall display – the frequency display, clock, S-meter and Plug List Panel. These may be opened and closed using Ham Cockpit's View menu and securely docked on icons located in the main area of the program's visual display, **Fig. 2**, or left floating. Note when you close Ham Cockpit using the exit command, the program should save the layout and restore it when the program is next started.

How to Operate It

As with all new software and hardware the key to success is to RTFM (read the free online/downloadable manual)! The next step is to join the Ham Cockpit e-mail users group [7], which can be done via the program's web page. Among the group are the program's beta testers, who can offer supporting advice on settings, and VE3NEA himself.

Most of what you need to know about operating Ham Cockpit can be found in the Configuration, DSP Pipeline and Waterfall Display sections of the manual. The rest can be found in the manual's other plug-in specific pages. Here are a few basics to help you on your way.

As Alex says, virtually all the functions in Ham Cockpit are implemented in the plug-ins – and to configure the program you need to configure the settings of the plug-ins. First click on the Ham Cockpit icon on your personal screen to start the program and click on the View/Plug-in Settings command in the menu to open the Plugin Settings dialog box. You need to tick all the boxes of the plug-ins you think you will need on the left-hand panel – which hopefully should be fairly obvious – and then edit their settings if necessary on the right-hand panel. Then click on the Save button, which saves all the changes and closes the dialog box. Note the Apply button will save the changes but doesn't close the dialog box.

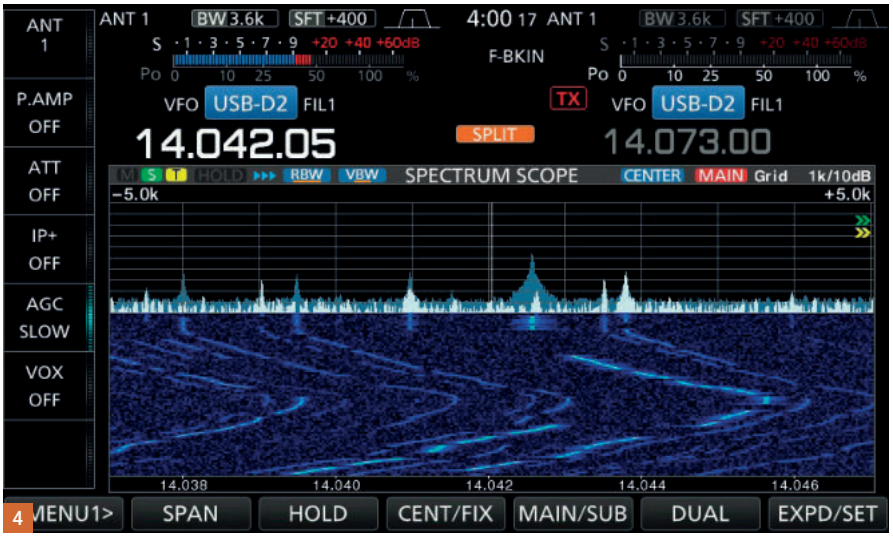
Now it is time to switch your IC-7610 on and start using Ham Cockpit operationally. First, take a good look at the toolbar at the top of the screen, which is basically a visual representation of Ham Cockpit's DSP Pipeline.

By clicking on the toolbar's buttons the program's signal source can be started or stopped, the signal source selected, the type of signals we wish to demodulate changed and the radio switched from receive to transmit. However, we must first use the drop-down menus associated with these buttons to select the signal source, make a selection of the modes we wish to demodulate and whether we wish to use Ham Cockpit to work with the IC-7610's transmitter or disable its transmit function (i.e. to work with a generic transceiver/receiver on receive only).

Note the receive and transmit selections in Ham Cockpit are independent of each other. For example, Alex points out the IC-7610 could be used for both, or an Afedri-822 SDR or a conventional receiver could be used for reception (using the appropriate plug-ins/selections) and the IC-7610 for transmission.

Enough. Let's get started and select the Waterfall Display from the View menu. Now this is where the fun really starts – and the manual's Waterfall Display Plug-in pages are our guide – see also the Waterfall Display controls and indicators section nearby.

The waterfall should appear after a few seconds and what you will see is very impressive and simply operated. At the top of the waterfall, from left to right, are a slider that controls the vertical zoom (i.e. how much of the frequency spectrum you are



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watching) and a slider that controls the horizontal speed of the waterfall (i.e. how quickly you wish signals to pass across the screen). Alex has an excellent YouTube video [8] that shows the basic zoom-pan operation of the waterfall, its excellent refresh rate and how well it works on SSB.

What is unique about the Ham Cockpit waterfall display is that it moves as a whole when the IC-7610 is tuned – unlike the IC-7610's front-panel display. As **Fig. 4** shows, when the IC-7610's dial frequency is changed, the traces of signals that should be straight lines become ugly 'S' shapes.

I know of no other personal computer-based add-on bandscope software in which the waterfall moves as a whole and the signal traces stay as straight lines like this. From what I've read – and seen briefly – the Kenwood TS-890S bandscope apparently also achieves this. For those of us with IC-7610s it seems we now have access to a similar performing display using free software!

The screenshot, **Fig. 3**, shows how CW signals can, quite literally, be read off screen.

Of the 13 different controls/elements on the Ham Cockpit waterfall display, at least one-third are central to the ability of Ham Cockpit to control the IC-7610 in split frequency mode. Keen DXers will have a lot of fun working out how to make the best possible use of these.

Conclusions

Ham Cockpit is a fascinating, collaborative work-in-progress and shows a glimpse into the future of SDR, where carefully integrated software capable of running all the shack tasks will take over from discrete applications and the need for virtual COM ports decline. Its waterfall, which moves as a whole with no signal trace 'smearing' when my IC-7610 is being tuned, makes operating the radio even more pleasurable than before. Like all new free software there will be glitches, but plenty of support is available from the associated website manual and user group.

Alex's immediate plans are to produce plug-ins that will control the transmitter in a conventional transceiver, support an analogue I/Q output from a conventional radio-fed sound card, display the text of decoded CW/RTTY/digital signals and provide a conventional bandscope displaying frequency and signal amplitude. After this should follow more adaptors for SDR radios, spot provision and management, cluster monitoring, CW Skimmer-type decoder, a logging interface and log entry box.

Join in, have fun and live on the leading edge of SDR!

References

1. The Ham Cockpit website is at:
https://tinyurl.com/yahgxczn
2. Note the *Users Guide* can either be downloaded as a .pdf or is available online at:
https://tinyurl.com/y9u3y4op
3. The Australian Band Plan file can be downloaded at:
https://tinyurl.com/yayx6oda
4. HDSDR was formerly known as WinradHD and is at:
www.hdsdr.de
5. CW Skimmer is at:
www.dxatlas.com/cwskimmer
6. Omni-Rig is at:
http://dxatlas.com/OmniRig
7. The user's forum devoted to Ham Cockpit is at:
https://groups.io/g/hamcockpit
8. VE3NEA's waterfall video is at:
https://tinyurl.com/y9rqwlb2

Continued from page 61

take care not to click on the 'transmit' or 'tune' buttons in the WSJT-X programme. Your receiver should be accurately set to 474.200kHz in the USB or USB DATA mode. (That's 'upper sideband', not the computer USB!) You may need to experiment with the receiver settings, but will probably have any preamp off, noise blanker off and any DSP noise reduction off. The receive width (if variable) should be set to about 2.5kHz. Check your computer clock for accuracy before starting a session. Ensure that WSJT-X is set to receive WSPR. (You may need to widen the display window in the programme.) Check you have selected 630m in the program, and check how you have the option for reporting 'spots' to heard stations set.

The interface box you are using will normally have a control to let you set the audio from the receiver to the correct level. Aim for about '50' on the display in the bottom left-hand corner of the WSPR screen. Most signals will be detected from about sunset to sunrise, so leave the setup running and see what happens over the course of a few hours. You may find that there are times when the noise level is very high, but WSPR deals with this in most cases. I will often leave my system running on receive and transmit through the night. I am technically in attendance (in bed) should I be notified to close down. I also leave it unattended some evenings, but then my XYL is there in the unlikely event of a notification to close down. You can listen in daylight hours but there may be little activity then. You can also try listening for FT8 mode, which sends 15-second long transmissions. If you haven't used FT8 on HF, then read the *User Guide* and try listening for it, and maybe working it, on 20m, where there is a lot more FT8 activity.

NextTime

Next time we'll look at how to progress to transmit on 630m. An ATU will be needed, and you might want to sort out some 68mm (or larger) plastic pipe for a coil former and a large variable capacitor. Old valve receiver types, for example 3 x 500pF, are ideal for low power use. Have fun!

References

For everything about 630m, including an excellent 'Useful Links' page:
http://472khz.org
WSJT-X Installation Package and User Guide:
https://tinyurl.com/ybugrd7o
WSPRnet:
http://wsprnet.org/drupal

Power Controller, USB Microscope & Test Probes

Geoff Theasby G8BMI
geofftheasby@gmail.com

This time round **Geoff Theasby G8BMI** offers a power controller, a USB microscope and an alternative test probe for his bench meter.

First is a powerful DC controller, handling 6-60V DC and 30A (20A continuous) it is claimed, with two memories, and a three-digit, seven-segment LED readout expressed as a percentage of maximum power. I can't measure the absolute maximum current, but it is good for 10A on my electric go-kart, otherwise works fine, and costs about £11, **Fig. 1**. Add to any plain vanilla source of power, battery, solar cells, wind turbine, treadmill, water turbine or similar. In use, preset the current and volts offline, choose a memory and press 'On'.

*(**Editor's comment**: I didn't find this actual one when I searched on eBay, but did find something very similar, albeit without the readout).*

USB Microscope

Next is a good USB microscope, which costs about £13 and contains its own lighting. It has a magnification of 40 to 1000 times and the images are viewable on a computer. It is suitable for Windows, Android and Linux. A 'Photo' button allows a view to be saved. It is complete with a small stand, **Fig. 2**, which is completely useless. Cast this to the outer darkness and go for the geared mount, **Fig. 3**, costing about the same again. It is ideal for inspecting PCBs and reading surface mount component part numbers, as well as the usual microscopic subjects.

A small (box of matches) sized device, hand-held, and illuminated, which uses two LR1130 coin cells and costs about £16. It has adjustable focus and magnification but is difficult to use because the lowest power available (40x) is too high for holding steady, and it also needs to be in contact with the subject, therefore is suitable only for studying two-dimensional items, **Fig. 4**.

*(**Editor's comment**: You'll find these and lots of other USB microscopes on eBay – all, no doubt, useful considering their low price).*

Test Probes

My Heathkit IM-25 is a great bench meter, but the probe disappoints. Mainly because

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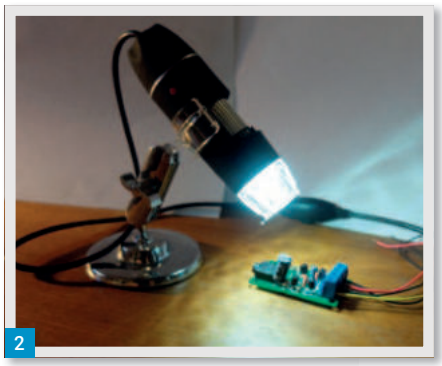

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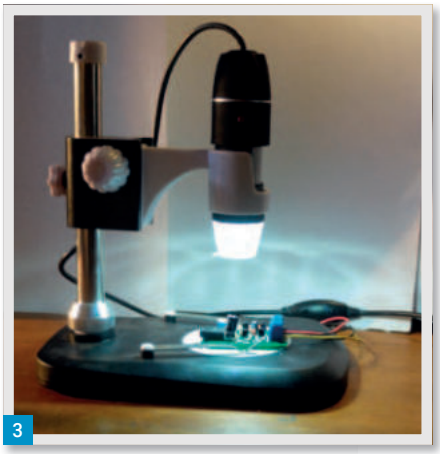

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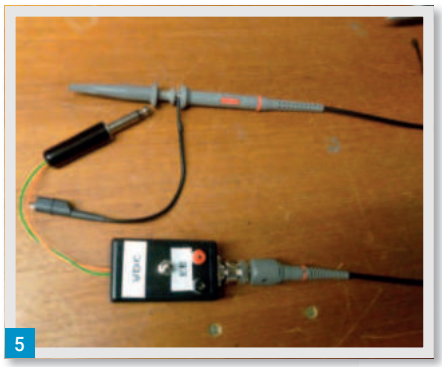

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Fig. 1: Power controller on my electric go-kart.
Fig. 2: USB microscope on poor stand.
Fig. 3: USB microscope on a better stand.
Fig. 4: Pocket microscope.
Fig. 5: Test probe.

I can't properly see the switch on the tip. I made my own, **Fig. 5**, using a small plastic box 2in x 1in. I fitted a SPST toggle switch, two 2mm sockets to take most multimeter probes, and also a BNC socket so I can use a scope probe as well. (Only on the X1 range!) It has a 1MΩ resistor built into the probe (1% tolerance, the meter is 3%). The switch selects the resistor for DC voltage measurements, and for current and resistance tests, (EE – Everything Else) the resistor is shorted out. As with many Heath products, it uses a ¼in jack plug to connect the probes to the meter.

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Do Transistors Wear Out?

Dear Don,
In response to **Bill Kitchen's** letter in the July 2020 edition of *PW*, *"Do Transistors Wear Out?"*, I think the answer is, in fact, yes, they can (and do) wear out for a variety of reasons. Be it due to age, thermal stress, abuse or whatever there are times when a transistor will stop working over a period of time.

Andrew Emmerson's excellent book *Electronic Classics, collection, restoration and repair* (page 107) goes into why transistors can fail with age. I quote directly from his book:

"Most people harbour a notion that transistors are reliable, stable devices, which, if not mistreated, will last for ever. In the main this is so but there are two major exceptions to this rule.

"One concerns plastic signal transistors made around 1970. Some of these have become hydroscopic and have absorbed sufficient atmospheric moisture to cause serious problems. The only solution is to replace them by metal-cased devices (which are hermetically sealed). Plastic devices were never used in products made to military specification, for these metal-cased and ceramic-cased integrated circuits were always specified."

Older germanium transistors certainly can and do fail with age. Again, quoting from Andrew Emmerson's book:

"Dead, intermittent or microphonic AF117 germanium transistors are well-known among those who repair radios of the 1960s period. These are of the same mechanical construction as types AF114, AF115, AF116, OC170 and OC171, which are found in televisions. The cause of death or fault mechanism is rather interesting. From the inside wall of the can in the air space grow microscopic hairs (0.008mm across) of an unidentified medium, which is tough, springy and electrically conductive. After some 25 to 30 years these conductive hairs reach the internal lead construction, giving the fault symptoms described."

I have seen circumstantial evidence of transistors 'wearing out' mainly due to prolonged thermal and/or electrical stress over a number of years. In particular I can recall in the early 1980s a TV line timebase transistor (the oscillator, not the power output stage) failing such that it still produced a sawtooth waveform, but refused to lock to the sync pulses. Replacing the transistor cleared the fault.

A frequent example of transistor wear and tear being in my youth (again, early 1980s), repairing VHF commercial AM base stations, which used planar transistors in the PA. The modulation would become distorted with typically 20% positive modulation and 80% negative modulation by the time it arrived on my bench. The planar PA transistor would slowly lose its gain (planar transistors exhibited a decent amount of gain and were popular in the days between valves and RF power FETs). Again, replacing the transistor and a quick tune-up would cure the problem and return the transmitter to 120% positive, 80% negative modulation. Or maybe I was just overdriving them? The repaired base station would be good for at least another year or two of continuous commercial service as far as I can recall.

These days we are fortunate to have affordable handheld transistor test and measurement boxes available to us and when restoring an old set I will still check the transistor as a potential point of failure once the usual suspects have been excluded (electrolytic capacitors being the first port of call).

Andrew Work PA8NPT/G8NPT
Hillegom, The Netherlands

Dear Don,
Regarding **Bill G4GHB's** letter about 'transistor wear out' in the July issue. No, in general, unlike heater emission in valves, transistors don't degrade with use. However, many early transistors did fail with a variety of faults, mainly due to impurities and contamination during manufacture. The most common was 'whiskering' of the junction and this is common in germanium alloy types such as the OC44/45 and the OC170/171.

In the early 70s I was given a very nice up-market Philips car radio (it had a built-in cassette recorder that could be used to record programmes). It had a persistent problem which was hard to fix. I tested it on a bench with off-air signals and a signal generator and all seemed well, so I installed it in my car. All was fine until one day I went underneath a bridge and it cut out even after emerging from the bridge. The only solution was to turn the radio off and back on after a few seconds, a harbinger of what was to come with personal computers! I decided that the trigger for the fault had to be the current and hence gain being increased by the AGC on loss of signal. Changing the first OC45 IF transistor solved the problem and testing the device showed it to be very leaky, probably due to whiskers. Obviously, a thief was waiting for me to fix the radio because about a week later it was stolen from my car!

While I was working for Mullards in the mid-70s a salesman mentioned to me that he was getting large orders for the silicon planar BFY90 transistor, from a radio company based in North Kent. It transpired that the Home Office had a requirement that all police personal radios were serviced every six months and this involved a performance check and a random valve replacement. As the UHF Handheld didn't have any valves to change, somebody decided that they should change a transistor and as the easiest to get at was the RF amplifier, this led to the large order for BFY90s.

PW seems to go from strength to strength please keep up the great work.

Terry Giles G4CDY
Mullion Cornwall

Dear Don,

Reading about the Zenith 7000 radio problems described by **Bill Kitchen** In the July edition of *PW* struck a chord with me. When at college from 1967-70 and then in my first job at Ferranti Semiconductors I was involved with transistor manufacture and testing. At that time the industry was moving from germanium to silicon. Germanium had proved relatively easy to make in the early days by diffusing doping materials into a germanium substrate to form the P and N layers. The problem was that the diffusion process was carried out at elevated temperatures but never actually stopped at ambient temperatures. The result was that over a long period of time the transistor characteristics would change, at worst resulting in the two layers forming collector and emitter meeting. All you were left with was a three-terminal diode with the base. I guess that Bill's Zenith Radio had suffered this problem. The effect still happens with silicon devices but at a much slower rate.

Bob Hayter G4OAC
Rochdale

Dear Don,

In response to **Bill Kitchen G4GHB**, capacitors may need reforming on idle equipment. For valve circuits use a rheostat or 240V incandescent filament bulbs in series and gradually increase supply to full over an hour. Not possible with transistor circuits so activate at least once a year. Source: **Norman G8ATO** of Verulam ARC. Transistors? Never underestimate the ability of dry joints to emerge decades after assembly. As a PS, despite coping with thermionic valves I used to struggle with understanding the operation of transistors until I heard **Carol Vorderman** on Open University with 'Transfer resistor'. Then it all made sense.

Bob Houlston G4PVB
St Albans

*(**Editor's comment**: Who would have thought that such a seemingly simple question would produce such a fascinating set of reader responses! Thanks one and all.)*

Suffixes

Dear Don,

I read your latest editorial and noted the comment about suffixes. The one that makes we wince is '/PM' for 'pedestrian mobile', when the definition of '/M' includes '...as a pedestrian'. However, this is perfectly OK, as far as the Regulator is concerned.

This cropped up when I was organising the IARU YOTA UK event in 2015. We were conscious that only a small number of UK youngsters could join in, so we asked Ofcom if it might be possible for Clubs to add '/YOTA' to their callsigns for the duration of the YOTA event. To our amazement they agreed and pointed out the there was nothing in the UK Licence to prevent any suffix being used. The current Licence lists a number of recommended suffixes that may be used, but it does not rule out any others.

So, all of the historical (hysterical?) cries that signing '/QRP' is illegal are not true.

Steve Hartley G0FUW
Bath

Bruneval

Dear Don,

Let me clarify two references to wartime German technology (June *Letters*). Würzburg is a UHF (c. 560MHz) dish-aerial radar. Knickebein (literally crooked leg) is a VHF radio navigation beam developed from the Lorenz blind landing system (30-40MHz). **Prof RV Jones** explains these (and more) in his book and TV series *Most Secret War*. As a young scientist he was gifted with an understanding of existing technology, an open mind that could adapt that knowledge to the discovery of unanticipated developments and the ability to speak about these in a way that could be followed by Cabinet ministers and, on TV, the general public. Fortunately, his abilities were recognised by Churchill. I remember his TV documentaries. They made him a technological hero in my eyes – even if he did always inexplicably appear with a watch on each wrist!

Godfrey Manning G4GLM
Edgware

Temporary Antenna

Dear Don,

With the current situation, I am dusting off my 'stored' equipment. My main shack with various items and a reasonably high antenna is in a room above the garage, which has seen little use of late. As well as intending to fire it up more, I wanted to be able to access the local Ipswich repeater from the house. The signal is not good as we live on the fringe so using a mobile mount on a metal tray from the microwave screwed to a beam. I have in effect a ground plane, which has improved the signal for my FT2DE handheld. The drawback is that I only have temporary planning permission from the XYL. Isn't adaptation what it's all about and I guess that there may be more 'dusty' callsigns appearing as time goes on. We are fortunate that our hobby allows us to talk to many other people outside our home.

John Sones M0AAO
Ipswich

Approved Kits

Dear Don,

In the July *Keylines* you mention Approved Kits for Foundation.

There has never been an Approval Procedure for transmitter kits that Foundation holders can build and we wouldn't want a bureaucratic and expensive procedure like that to be introduced. Kits just need to be commercially available and like ready-made equipment, Foundation holders should use them in accordance with the IR-2028 provisions.

Licence clause 7(2) regarding kits seems to do little other than confuse people as to what they can and cannot do. Hopefully that part can be removed at the next licence review?

It is worth noting that in 2019 Australia's communications regulator, the ACMA, scrapped the restrictions on Foundation holders building transmitting equipment.

Home construction is a vital part of

the hobby. We shouldn't be discouraging it by unnecessary restrictions. The UK should follow Australia's lead and permit all classes of licence to build equipment.
Trevor Hawkins M5AKA
Chelmsford

A Question

Dear Don,
I do hope that you don't mind me writing, but I have an issue that I have been unable to resolve. I hope that you or one of your colleagues/readers may have some ideas/suggestions.

In a nutshell – I use an FTdx3000, which I linked to an SDRPlay RSP1A to use as a panadapter and it works great. I then added an LDG YT1200 Autotuner and I was unable to get it to 'communicate' with the radio. After weeks of struggling I disconnected everything and started from scratch! I then found that the Autotuner works perfectly, but when I connect the SDRplay the Autotuner will not 'communicate' with the radio.

The Autotuner connects to the radio using the Serial socket and the External Tuner socket. The SDR connects to the radio via the USB and uses the RF(Out) socket.

LDG came up with the following *"Unfortunately, I have no idea about the protocols used in the SDR play. I'd looking the serial control area of the SDR program. There may be something about timeout or retry time"*.

SDRplay came up with *"Thank you for contacting SDRplay support. I honestly have zero experience using the YT-1000, but looking at the back of the device it seems its using serial ports. If you're using these com ports and assigned them to the same com port numbers as the rig and within omnirig, then you will need to use VSPE with the splitter function, which will allow you to share end to end com ports amongst other applications"*. But this involves some cost and it may not work!

Matt M0DQW, who does a great YouTube video about using the SDR as a panadapter for the FTdx3000, came up with *"Unfortunately I do not own the FTDX3000 any longer and when I did, I did not try an external auto-tuner. Strangely enough, I had someone else report about connection issues with the LDG tuner and the 3000, but they did not use a panadapter.*

"The only suggestion I can think of, would be to try using a USB line isolator between the radio and the PC. I've never used these before personally, but if the autotuner stops working when the PC USB cable is connected, then possibly there might be a ground signal issue? I don't know for sure, but it's worth a try".

I have tried a USB isolator but with no difference. I have checked all the connections, no change. I have checked the grounding for each item in use. I have tried to ensure that all the menu settings on the radio are correct.

I am stumped! Any suggestions would be most appreciated!
Mike Bevan G4TWW
Ripley

Thanks

Dear Don,
On behalf of my colleagues at the York Radio Club, G4YRC, I wish to express appreciation to **Alan G1VIZ**. Alan has taken on the role of Events co-ordinator/manager (he gets things done) and during our 'lockdown' when the club, G4YRC, was unavailable he organised club meetings on the air, including a Zoom contact. These meetings covered most days of the week and he encouraged us to use frequencies and modes not often used by us, including 2m AM, 6m FM/SSB and 4m. this also meant antenna construction and some ex-PMR use.

So, without VIZ's encouragement more than a dozen people who would have been doing little were exchanging signal reports and more with their fellow club mates while keeping the hobby alive.
Tony Skaife G4XIV
York

ML&S Customers' Comments

Listed below are GENUINE emails received about our level of service. We receive dozens each week and these are some of the recent highlights.

I ordered an Icom IC-9700 on Wednesday morning. Spoke to a very helpful guy called John who was remote working. He confirmed stock was available and took my order over the phone. I am pleased to advise the 9700 arrived Thursday afternoon, I was amazed considering the current Covid 19 situation. Many thanks for an excellent service. I am looking forward to receiving the bonus of a free Icom speaker as part of the offer.
Regards, Paul

Just to let you know the shipment arrived here today all appears ok will take me a few days to set it up and my tower needs a refurb. Very many thanks for your good comms and please convey my regards and 73's to all concerned at Martin Lynch and sons.
Regards, Kevin DU2/G0KFA

I just wanted to say a big thanks for the great service that I received from you on my recent purchase and popping out the missing part so quickly in the post. Hope you're all keeping safe and well.
Best wishes, Liam 2E0MQK

Received my 7100 today and all was pristine. Looking for the mic that was out of stock in the near future. Thanks very much for your professionalism and swift customer service! I elected to become a returning customer after such a positive experience with the 7300 purchase.

Can't say enough in praise of everyone with which I have delt at your place of business. Please tell Mark Kenton a special thanks and let him know that the 101MP purchase will have to be relegated to another time. Dstar and the 7100 will be first. Much appreciation and many thanks.
73, Darrell L Wilson KO4DRJ

Many thanks for the very quick service on my power supply here to spain, 10/10.
Michael Murray

Thank you very much for delivering my FT-891 in person - it is very much appreciated. Good to have the opportunity to chat with you too! I have been a customer of ML&S for many years - this example of exemplary service reminds me why. Let me know if I can give formal feedback. Best regards,
Malcolm Porter G4TJK

Just wanting to thank you for the help & service I received recently from you. I was looking for 2nd hand FTM-100 so called your sales line and was answered by Martin. Although you had none in stock, Martin informed me that a last delivery of the sets were due & if i wanted one you would let me know. (After a few minutes chat about the old days both having similar aged calls!) Martin took my details and promised to let me know when stock is held. About 2 weeks later I received an email with the info that stock was now being held. I went on line that evening, ordered a FTM-100DE plus extension cable and the programming software. Payment was made I got updated emails & texts from yourselves and the carrier and even in these weird times within 36 hours the order was here. Thank you for prompt delivery with no problems Next step is to program the rig. Class me as another very satisfied happy customer. Regards,
Chris Baker BA - G4LDS

I just wanted to say, thank you for you and your staffs' fun Utube videos. Very uplifting during corona virus. Thanks also for your help when I meet you in the store a few times. Gary, Jonathan, Steve and can't remember his name, wonderful Eastern European gent, all helped over and above with my station. Stay safe to you guys and your families.
Paul 2E0PPJ

Just wanted to thank you for keeping open for business and supplying all us amateur radio enthusiasts throughout these most unusual times. Even your orders seem to get through promptly and the service remains as good as it has always been. Whilst missing a good browse through your store from time to time, your comprehensive and regularly updated website is also very tempting. Thanks and 73,
Brian G1FNS

My Alinco SMPS and IC-7300 arrived this morning - thanks for your swift turnaround! I must say, the 7300 is an incredible piece of kit. My late father (G3XQU, and, some time in the early 80s, 3V8DX) insisted on building all his own kit and although I occasionally saw him drooling over glossy pictures of the latest Yaesu in RadCom, he never succumbed. Funny to think that this radio does everything he had in his shack - and considerably more!) I'll be getting my callsign later this week, and am very excited about pushing the button.
Cheers 73, Chris

Thank you for taking the time to call me with regard to my message about an order for a Icom IC-R8600 receiver. You will be pleased to know that I have now placed a firm order for the receiver. I very much appreciate the work your staff are doing to keep the firm going during this difficult time, although judging what is being said I think the lockdown will be with us for some time, it would be foolish for the government to stop it right now for it to start deteriorating again. On a lighter note, the last time you contacted me personally was by letter dated 9-10-1995! It was when I purchased a TS-870S and a FT1000MP at the same time! My kind regards to you and all at ML&S.
Ted Allen G3JHP.

Just to say a big thank you to you and ML&S for helping me out with my BHI desktop speaker. I sent it off Thursday has instructed by you just got it back today before 4.00pm. What a cracking service, I couldn't get there and back myself in that time .
Thanks again, Pete GOPJY

I wanted to say a big thank you for getting my new Yaesu FTM-3207D Digital UHF radio to me so quickly! Ordered on Sunday arrived at my door at 10:30 on Tuesday - fantastic service given the current situation! Being in lockdown has rekindled my interest in amateur radio I have been wanting to get into the digital modes for a long time having used DMR for quite some time and really enjoyed it. I bought a ZumSpot USB from you a few weeks ago and then decided to try Fusion as I am fairly close to a fusion repeater (GB3BV). I now have enough toys to try and bring it all together and build a proper digital station so thanks for helping to keep me sane during this challenging time! Wishing you all the best and looking forward to visiting the shop when this is over to invest in some HF equipment!

The radio... YAESU

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