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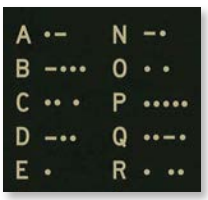

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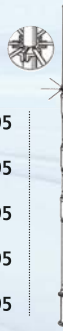

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Keylines

What a difference a month makes. Just a few short weeks ago I had a very pleasant visit from the TX Factor team, catching up with me to discuss *PW* but also how I am settling in to my new home and getting back on the radio. You'll no doubt get to watch that along with their visit to our VHF columnist **Tim Kirby GW4VXE** in a forthcoming episode.

But now things have all changed, with us all in lockdown as a result of the Coronavirus. As I write this, we can go out for essential shopping and one period of exercise a day but otherwise are confined to the house. The good news is that amateur radio is the ideal hobby in the circumstances. While we can't go to club meetings, we can sit at home building stuff and operating, keeping in touch with friends over the radio. Yes, maybe ragchewing will come back into favour, with nary a free channel on 80m or 2m.

PW Authors

I was checking recently and found that, as of last month's issue, we have had 149 authors contribute to the magazine since I took over as editor six and half years ago. I'm very proud of that but there's always room for more and, indeed, I have several articles in the pipeline from new authors.

That said, I get a lot of material for the *Valve & Vintage* slot along with expedition write-ups and the like. But I would love to have more input on microwave band operating, amateur TV and other specialist but relevant areas of the hobby. And always, of course, constructional projects, whether simple ones for our *Practical Way* slot or more complex for *Doing it by Design*. I have in mind a constructional article competition at some time on the future, when life returns to normal, but do think about what you might be working on or, indeed, about writing up a project that you already have in hand. Home construction remains a very satisfying part of the hobby and although we may not all be comfortable with surface-mount components and the like, there is much we can do with more familiar discrete components or with knitting together ready-made modules.

AM Operation

This month in our *Doing it by Design* slot we feature an AM transmitter for the 80m band. While AM may seem terribly old-fashioned, it's interesting how it continues to hold sway among some amateurs and there's no doubting that there is something about the sound of a good-quality AM transmission compared with SSB. The nice thing is that, as amateurs, we can choose to use 'legacy' modes such as AM and, as our article demonstrates, can use modern circuit design to enable it. Many of us, myself included, came into the hobby after hearing amateurs on AM on the 160, 80 or 40m bands. That route into the hobby is largely unknown nowadays but maybe we will see a resurgence of interest when casual listeners hear those modern-day AM nets taking place!

Remote Operation

Another article this month deals with remote operation for digital modes. Remote operation continues to be a bone of contention and this is not surprising. There really is no clarity on the subject despite it being feasible and extensively used for several years. The regulations vary from country to country and, quite apart from what the licensing regulations may be, there are different rules for various awards programmes and contests. But there is no doubt that remote operation has its place in the hobby, whether it is simply to allow you

Continued on Page 78

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Newsdesk

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

Coronavirus News

The coronavirus (COVID-19) situation has led to a number of consequences for the hobby. Many planned DXpeditions have been cancelled or postponed. And while most contests are going ahead, the RSGB has announced restrictions on multi-operator categories in their various contests. Obviously, a number of rallies and social events have been cancelled. These include (at the time of writing) the Newbury Rally, Dayton, the CDXC Social and AGM, the Yeovil QRP Convention, the RSGB AGM and others. So please don't rely on our Rallies page but check before heading to an event. The National Radio Centre at Bletchley Park has also been closed.

Meanwhile, the IARU Region 1 Executive Committee will hold 'virtual' meetings to replace their scheduled April get-together. IARU Region 2 has announced that online workshops will replace the Emergency Communications and Satellite Communications workshop that was due to be held in Trinidad & Tobago in May. And IARU Region 3 has cancelled its first Youngsters on the Air (YOTA) Camp that had been planned for Rayong, Thailand, in early October.

RAYNET report that many of the events for which they would normally be providing communications support have been cancelled.

On the positive side, Michael G7VJR reports that he has given over 100% of Club Log's computing resources to scientific research into COVID-19 proteins, as part of the Folding@Home project.

Also on the positive side, BATC is offering free use of the BATC Video Streaming Service and chat facility to any radio club or group of radio amateurs. This will help clubs to hold virtual meetings with HD video and audio streaming and a chat window for real-time feedback and discussion.

Interestingly, in a press release from HamRadioPrep.com on the Digital Journal website, HRP report that the number of people now studying to pass the qualifying FCC (US) exam has increased by more than 700% since news of COVID-19 broke. It will be interesting to see whether the same applies here in the UK.

Radio News

RSGB ANNUAL CONVENTION: Planning is underway for this year's RSGB Convention, which will take place from October 9th to 11th 2020. The feedback from the 2019 Convention was very positive and the Society is keen to ensure that it maintains the quality of the event. The Convention organising committee would like to receive your suggestions for the subjects and presenters for this year's lectures and workshops. Please e-mail convention@rsgb.org.uk with your thoughts and ideas. While the Society is unable to promise to take up every suggestion, all suggestions will help to provide a programme that truly meets the needs of those attending. The RSGB Convention is generously sponsored by Martin Lynch & Sons.
You can watch 90 lectures from previous RSGB Conventions on the Society's website: www.rsgb.org/videos

RSGB NEWS: Following the recent launch of an Ofcom Consultation on EM Field exposure, the RSGB has released a briefing paper for all UK amateurs. This gives more details as the proposals involve a change to licence conditions for any station operating with greater than 10W EIRP. The Society has formed a team to prepare a considered response to Ofcom's Consultation and will be offering further guidance ahead of the May 15th deadline. The briefing paper is available at: www.rsgb.org/emc-papers
Occasional PW contributor Chris Colclough G1VDP has been appointed to the role of the RSGB's Beyond Exams (BE) Coordinator. He was first licensed in 1986 and enjoys operating on HF using CW, is active on RTTY, CW and most other digital modes and enjoys working DX with the new FT8/FT4 modes. Chris is a founder member of the Strumble Head DX and Contest Club and an active member of the Hinckley Amateur Radio & Electronic Society.
And regular PW contributor Tony Jones G7ETW has been appointed as the RSGB's Amateur Radio Development (ARD) Chair. Tony was licensed in 1989 and was a RAYNET operator and group controller for some years.
For the last ten years he has been heavily involved in training, managing education programmes for two radio clubs. He was a member of the new Syllabus Implementation Group and is now a member of the Exams and Syllabus Review Group (ESRG).

MOTOROLA WINS CASE AGAINST HYTERA: ARRL report that a jury for the US District Court of the Northern District of Illinois has awarded Motorola Solutions damages of $764.6 million in its theft of trade secrets and copyright infringement lawsuit against Hytera Communications of Shenzhen, China—the maximum Motorola Solutions had sought.
In early 2017 Motorola filed complaints in federal court alleging that Hytera's digital mobile radio (DMR) products employed techniques and systems that infringed on Motorola Solutions' patents and trade secrets. Already known for its Land Mobile Radio Service products, Hytera entered the amateur radio DMR market in 2016. Motorola alleged that proprietary and patented information was taken illegally by three former company engineers who went to work for Hytera, as 'part of a deliberate scheme to steal and copy' its technology. The company said following the verdict that it would seek a global injunction to prevent Hytera from trade secret misappropriation and copyright infringement.
Motorola said technology features it developed started showing up in Hytera products soon after Hytera began hiring former Motorola engineers in 2008, according to the lawsuit. Read the full story at: https://tinyurl.com/ugor7pt

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Radio News

DAWN OF THE DRONE: Steve Mills contacted us on the radioenthusiast website to mention his book The Dawn of the Drone. You can find it on the publishers Text Cafe site:
https://tinyurl.com/tt72x3o
There are articles on various websites located by searching The Dawn of the Drone Steve Mills but you can also see photos of the IWM 1917 exhibits of the Royal Flying Corps drone in the book at the following URL if you scroll down to the Illustration pages:
https://tinyurl.com/ud6qecp

OTN 133: RAOTA has published OTN 133 (Old Timer News). There are several antenna articles in this issue: More on Doublets and Balanced Feeders, A Fresh Insight into Doublets, Matching and Standing Waves and Beverage antenna along with Servicing a Hy Gain CD45II (part 1). There still is some misunderstanding about qualifying for membership of RAOTA. There are two categories of membership – Associate and Full. Full members have a vote in the running of RAOTA whereas Associate members do not. Associate membership of RAOTA is open to anyone (licensed or listener) with an active interest in amateur radio (regardless of how recently they came into the hobby). Full membership of RAOTA is open to anyone (licensed or listener) with at least 25 years experience in amateur radio.

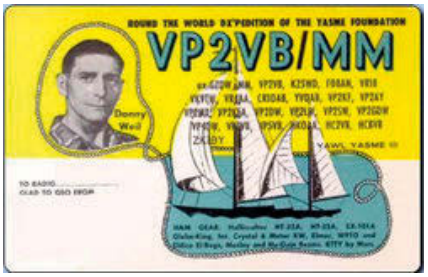
RANDOMISED ANSWERS IN EXAM PAPERS: Given that online exams are fully randomised, it was decided decided in August 2019 to enable the randomisation of the answers for each question in paper exams from September 1st 2019, when Syllabus 2019 was introduced. This ensures that there is no relative advantage or disadvantage between online and paper exams.
With hindsight, Exam Secretaries should have been made aware of this change for paper exams and the RSGB Examinations Quality Manager (EQAM) apologises for this oversight. It is important that Exam Secretaries inform all their invigilators of this change and also point out that, as per the existing wording in EX500: 14.3 Invigilators must mark Foundation and Intermediate examinations using the supplied Marking Keys (one for each candidate).Since the middle of 2018 those passing the RSGB exam for the Full licence have been able to apply for short call signs such as M5xx. This has provided a major incentive to upgrade to Full.
"An applicant for a new Full Licence (or a Full (Club) Licence) may request a callsign with three trailing letters, using any valid Full Licence prefix in the list, except 'G2'. Callsigns using formerly issued prefixes are not available via the licensing portal and must be requested on a paper application form (a fee is payable).
"A callsign with only two trailing letters or which starts with 'G2' is only available if the applicant previously held it. Our policy that a station may change its callsign only in exceptional circumstances remains unchanged though Ofcom may, on occasion, require a station to change its call sign." (Ofcom Announcement)
The change in policy affects the issue of old amateur callsigns that had been issued prior to the start of World War 2 but it is unclear why M5xx calls are also affected. Up until mid-2018, this call block had never been issued before.
The new policy does not affect any callsigns that have already been issued.

OSCAR 100 UPDATE: Bernard Nock G4BXD reports that since writing the article and its publication in the April issue of PW, Oscar 100 has changed slightly. The narrowband transponder has been opened up to 500kHz wide, three beacons in place of two and the full new band plan can be found at:
https://amsat-dl.org/neuer-qo-100-bandplan

REACTIVATION OF LEGENDARY YASME VP2VB CALLSIGN: On March 10th an international group set sail to the British Virgin Islands and activated the VP2VB callsign of Yasme fame for six days, focusing on the low bands with two stations. VP2VB was the callsign of the legendary Danny Weil VP2VB, skipper of the Yasme series of sailing vessels that carried the peripatetic adventurer as he travelled from one DX location to another in the 1950s and early 1960s. His activities provided the impetus to create The Yasme Foundation. British by birth, Weil was a watch and clock maker by trade, and had a sense of adventure. His initial Yasme (often rendered as YASME) sailing voyage was to the British Virgin Islands. Yasme derives from the Japanese word 'yasume', which means 'to make tranquil'. Another giant of ham radio history, the legendary DXer Dick Spencely KV4AA, became aware of Weil's aspirations and suggested that he combine amateur radio with his ambitious travel itinerary. Spencely taught Weil Morse code and helped him secure the VP2VB callsign, which was to become famous around the globe. Spencely secured the initial amateur radio gear for the Yasme and became a tireless fundraiser for The Yasme Foundation as well. Ultimately, there were three Yasmes. From 1955 until 1962, Weil operated from several ports of call in the Caribbean and the Pacific. This latter-day VP2VB DXpedition will count toward Yasme awards and marks the first activation of VP2VB in more than 60 years. Weil retired from DXpeditioning and settled in Texas in 1963, resuming his profession and becoming a US citizen. He was not to be heard on the air again although he kept an ear on the bands. He died in 2003 at age 85.

Midlands Inter-Club GMT Award

To encourage more local activity on the VHF bands during last winter, Solihull ARS devised the Midlands Inter-Club GMT Award, which in time became known as the GMT Contest. It started on the day we put our clocks back one hour to GMT, hence the name, and ran until the end of January. Members from 23 Midlands clubs participated during the three-month long contest, which received a major boost when Martin Lynch & Sons Ltd kindly donated a Wouxun KG-UVN1 DMR radio for the winner. The photo shows the overall winner, Pete Minchin G6NHW (on the left) from the Sutton Coldfield ARS, receiving the prize and a certificate from Stu G4KUR, the contest organiser.



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Senhaix 8800 Bluetooth Dual Band Handheld

Tim Kirby GW4VXE
longworthtim@gmail.com

Tim Kirby GW4VXE takes a look at a dual-band handheld that is colourful, includes a torch and can be programmed from your Smartphone!

There are any number of dual-band handhelds available these days, some of them available really cheaply. What's so different about this one and why might you find it of interest? I'm going to try to answer that below. For the features and specifications as supplied by the manufacturer, check out the sidebar on the last page of this review.

First Impressions

The first impression on unboxing the radio is of colour! The rig is a bright orange and has a rubbery, chunky feel to it, which makes it feel as though it's a good match as an outdoor radio for walking. Add to that the fact that the bottom of the radio is given over to a torch, which can either provide white light or flashing red, white and blue – definitely handy for those evening dog walks. It's a good torch too!

I can hear some tutting at the back about this being *PW* not *Practical Dog Walker*! Alright, so what about it as a radio? As it arrived, the rig was in memory mode with some non-amateur-band frequencies set up. I could see that the radio had both VFO mode where you can enter the frequency you want to use and memory mode. Long press the menu key and you can toggle between the two modes. It's in the instruction book, which is adequate but basic.

My first test then, was to put the rig into VFO mode, put the receiver on 430.950MHz and listen for EI7MLR, some 85 miles away across the water. I was delighted to note that within a few minutes, the receiver chirped into life. There's an on-screen S-meter by the way, which isn't terribly well calibrated, so don't expect to use it to give meaningful reports. The display is a quite attractive colour display that is easy to read.

Programming the Rig

The next thing I wanted to try to do was to program up some memories. This is where you have some options. If you are an Android mobile phone user, there's an App that you can download (I grabbed it from the Moonraker website), which allows you to manage the programming of the rig from your phone and Bluetooth the details between your phone and rig. This is a nice touch if you want to make some changes to the programming on the fly – maybe you find a CTCSS code is wrong on a memory and you don't have a PC and programming cable with you. I don't use an Android mobile phone but I was able to download and install the App onto a Network Radio, that runs Android and establish communication between the two, so that was great. Because the Network Radio has a very small screen, it wasn't great for programming the 8800 up but I was able to prove the principle. If you have a regular Android mobile phone, you won't have any problems at all.

When I first looked at the rig there was no app for an iOS device, so it was off to the PC for programming for me! There's no programming cable supplied with the 8800 but I had a look and the connection seemed the same as the Baofeng UV-5R for which I had a lead. The programming lead uses the Prolific PL-2303 chip and, as I'd just had a Windows update on the machine, naturally the lead and drivers were not recognised (sigh), but we can't blame the 8800 for that. If this happens to you, as it almost certainly will at some point, there are some excellent instructions on how to back-date your Prolific USB drivers back to version 3.2.0.0, which will resolve the problem. Try this website:

https://tinyurl.com/vy4tcrm

Having done that, the rig connected up through the USB cable and showed as a COM port in the PC's Port Manager. I downloaded the programming software from the Moonraker website and installed it onto the PC, pointed the program at the appropriate COM port and was immediately able to read from the rig.

The programming software works fine although it's reasonably basic. You can't copy and paste between entries and you can't import channel information as a comma separated variable (CSV) file, for example. But for programming up a few local repeaters (bear in mind that the 8800 'only' has 128 memories anyway) it's no problem and I quickly had four or five repeater channels programmed up and written back to the rig. For interest, I also programmed up a couple of channels where I could listen to the AO-91 satellite (145.960MHz down/435.250MHz up). It's a nice feature to be able to set transmit and receive frequencies on different bands – something not possible on all rigs.

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Fig. 1: The front panel of the 8800.
Fig. 2: Two PTT buttons – enough to confuse the reviewer!

I had a quick look to see if the excellent CHIRP software would 'talk' to the 8800, but it does not – at least at the moment.

The great news now, though, is that there is an app for iOS devices. Go to the App Store and look for SHX8800 and download it onto your iPhone/iPad. Switch on Bluetooth on the 8800 and then go into the app on your iOS device. You should see 'Walkie Talkie' or a similar name available as a Bluetooth connection. You should then simply be able to read from the 8800 and see the configuration data on your phone. You'll find there's a screen of data for each memory channel – a little different to the usual spreadsheet style presentation on a PC – but it works well with the phone's user interface. Make whatever changes you need to – or enter a new channel. Save the configuration (the app calls it a 'case') and you can then write it back to the 8800. Simple and very effective! I spotted a couple of places in the app, including the app icon where Chinese text is displayed rather than English, despite the language being set to English, but I did not experience any problems as a result of this.

On the Air

The 8800 comes with a reasonable antenna – although I suspect putting an after-market antenna on it might give you some benefits. The antenna you use will need to have a SMA-F connection.

Something that I found a little odd with the rig, which I have noticed on some other models recently, is that it has two PTT buttons. You have a PTT for each of the two VFOs. Until you get used to this, you may, like me, hit the PTT, start talking and then wonder why your QSO partner is not hearing you! PTT Button 1 is larger than PTT button 2, so you might want make sure that most of your activity happens on VFO 1.

Audio from the rig was pleasant to listen to and transmitted audio reports were good – thank you to **Martin GW3XJQ** and **Steve GW7FBV** for their reports through the GB3SP repeater. The receiver seemed to work alright for everything I tried. I mentioned that I programmed up the rig with the AO-91 satellite and I was able to hear it quite adequately on an overhead pass. I'm sure if things were quiet, you could probably make a QSO through the satellite, using the supplied antenna.

The menu key gives access to various basic controls: squelch, power,wide/narrow, busy lockout, time out timer under the 'Radio Set' menu item as well as the ability to change CTCSS, channel display, frequency search and Bluetooth. A long press of the 'hash/up arrow' key starts the rig scanning through your memories. Long pressing 0 gives you a voltage reading. Long pressing 'star/space' locks the keypad. The rig has a voice prompt too, which I tend to turn off, although I know this is a vital feature for some users. I turned it off in the software but managed to turn it back on, inadvertently from the keypad. I'm not sure what I pressed!

There's an FM radio built in, which covers 76-108MHz. It seemed pretty sensitive and I was receiving Irish stations quite adequately from here in West Wales. You can enter the required frequency from the rig's keypad, just as you would in the amateur bands.

I started off by saying that the rig had a 'rugged, outdoorsy' sort of feel to it. The various sockets are protected by plastic covers, which fit quite well, so the rig will probably comfortably survive a walk in the rain, although I'm not aware it has an IP rating unlike some of the more expensive handhelds.

Charging the Rig

The 8800 comes with a drop-in charger, which can be powered by either the supplied mains charger or a USB charging lead. Even better, if you are out and about, in the car, perhaps, you don't need the drop in charger – just the USB charging lead. There's a micro-USB socket on the back of the rig, so

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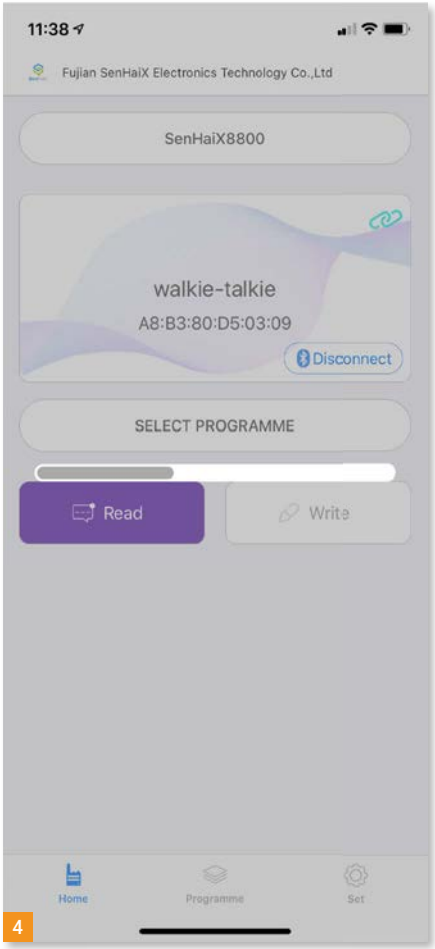

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Fig. 3: The bottom of the 8800 is given over to a torch. Fig. 4: Screenshot from the iOS app.

armed with the correct lead (not supplied) you can charge from a USB socket in the car, a phone charger or whatever you have.

Overall Impressions

In summary then, the unique feature of this rig is the ability to program it via Bluetooth from an Android/iOS device. If you don't have an Android/iOS device you probably won't get the best out of the rig, although it's a very serviceable basic handheld that will do what you expect of it. The user interface seems slightly quirky to me but this is something you will probably get used to.

I liked the rig's rugged feel and colourful looks for outdoor use. I can't believe I'm saying this, but the torch is excellent! I had mixed feelings about the two PTT buttons but this is something you'd get used to pretty quickly.

My grateful thanks to **Chris Taylor** at Moonraker UK for the loan of the rig and particularly for pointing me in the direction of the iOS app, when I thought that only Android smartphones were supported! The 8800 costs £64.99.

RADIO FEATURES

- Power Output 5W
- Dual Band
- Dual Watch
- Dual Standby
- LED Flashlight
- SOS Warning
- DTMF Tone
- ANI Code
- PTT ID
- FM Radio
- Encryption
- 1750Hz Tone
- Customize Channel Names
- Bluetooth Programming

GENERAL

FREQUENCY RANGE
UHF & VHF
CHANNEL CAPACITY
128 Channels
CHANNEL STEP
25kHz (Wide Band),
12.5kHz (Narrow Band)
FREQUENCY STABILITY
±2.5ppm
OPERATING VOLTAGE
7.4V DC ±20%
OPERATING TEMPERATURE
-20°C~ +60°C
ANTENNA IMPEDANCE 50Ω
DIMENSION
134×60×38mm
(with battery pack)
WEIGHT 270g
(with battery pack, antenna)

TRANSMITTER	Wide Band	Narrow Band
Output Power	5W	5W
Modulation Mode	16KφF3E	8KφF3E
Adjacent Channel Power	≥65dB	≥60dB
Signal Noise Ratio	≤-40dB	≤-40dB
Parasitic Harmonic	≤65dB	≥60dB
Spurious Emission	≤-36dBm	≤-36dBm
Audio Response	300Hz-3KHz	300Hz-3kHz
Audio Distortion	≤5%	≤5%

RECEIVER	Wide Band	Narrow Band
Sensitivity	-120dBm	-120dBm
Intermodulation	≥60dB	≥55dB
Adjacent Channel Selectivity	≥60dB	≥55dB
Spurious Rejection	≥60dB	≥55dB
Audio Response	300Hz-3KHz	300Hz-3kHz
Signal to Noise Ratio	≥45dB	≥40dB
Audio Distortion	≤5%	≤5%
Audio Output Power	1W	1W

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The InnovAntennas XR6

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Steve Ireland VK6VZ looks at a compact HF Yagi antenna suitable for Software Defined Radio and offers some general advice on putting together an HF Yagi antenna from a kit of parts.

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One of the great advantages of Software Defined Radio – as implemented in ANAN, Flex, Icom and other HF direct digital conversion transceivers – is the ability to monitor at least one other band in addition to the one you are operating on.

In order to take full advantage of this facility, an antenna is needed that is simultaneously perfectly matched/optimised for each band you are listening to or watching on your transceiver's bandscope.

There are few antennas that can provide this facility. The obvious ones are those using 'traps' (resonant parallel-tuned circuits) to electrically isolate parts of the antenna depending on the frequencies being used; the log periodic array (whose design offers continuous coverage over a broad section of the spectrum); and antennas in which a number of resonant elements are all fed in parallel.

Of these antennas, when it comes to balancing high efficiency with relative compactness, the third method is arguably the best. This kind of technology was pioneered commercially by the US company Force 12 during the 1990s and first used in its C3 Yagi, which provided two active elements – a driven element and a reflector (a director on the 10m band) – on the 14, 21 and 28MHz amateur bands, giving a gain of around 5dB over a dipole (dBd) on each band. The C3 also gave reasonable performance on the 18 and 24MHz bands with a suitable antenna tuning unit.

The major problem with this kind of parallel-fed Yagi antenna design is keeping the interaction between various element pairs to a minimum. This requires careful antenna modelling and subsequent adaptation of the actual physical antenna design to keep its gain, front-to-back and front-to-side ratios on a par with a conventional single-band two-element Yagi.

However, Force 12 had showed this goal was achievable – much more so than eliminating the inherent losses that occur in every trap of a trapped Yagi antenna. These trap losses add up, meaning that a three- or four-element trapped Yagi may only have the performance of a (physically much smaller) conventional two-element Yagi. Some years ago I used one of the more efficient triband trapped Yagis then available – a Wilson System 3 three-element Yagi – and had been horrified how much better my signal was when I returned to using conventional two-element quad/delta-loop antennas.

When it came to log periodic Yagis, my experience of them was also mixed. A good friend of mine had used a 14 – 30MHz log periodic Yagi for about 20 years and discovered their (very) broadband non-resonant nature meant that the antenna was equally good at picking up atmospheric noise over a broad band as it was signals. Having several resonant Yagi elements fed in parallel in a manner similar to the C3 should mean the antenna had inherently more selectivity to unwanted noise and signals than a log periodic.

Changing Over

For most of the last 30 years, the main HF antenna at VK6VZ has been either a two-element cubical quad, made up of a number of pairs of loops each covering a single band, or its three-sided delta loop equivalent.

Initially I simply connected the feedpoints of all the driven elements together and fed them in parallel. When it came to performance, I quickly realised the front-to-back ratio (signal rejection off the rear of the antenna) was reduced from a trial single-band version and varied considerably from band to band. To make matters worse, the match to the feeder also changed fairly wildly from band to band and was relatively poor.

Subsequently, in order to keep the interaction between the pairs of elements to a minimum and provide the best

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Fig. 1: XR6 element mounting plates and boom.
Fig. 2: XR6 part elements identified and labelled.
Fig. 3: XR6 element joints.

possible performance, I found it was necessary to remotely switch the single RG-213/LMR-400 grade coaxial feeder between each driven element, using high current 12V relays.

This meant the antenna only worked well on one band at a time and, even on receive, did not provide sufficiently good performance on the other HF bands I wished to simultaneously monitor on my SDR transceiver (originally a homemade HPSDR, then an ANAN 200D and now a ICOM IC-7610).

There were other reasons for me wanting to get away from the cubical quad and delta loop beams. Being made of wire, antennas of this kind tend to suffer breakages in high winds and, to make matters worse, where I live, end up being a 'flying trapeze' for the local galah and corella parrots, whose razor-shape beaks increase wire breakages.

Now fast approaching 65 years of age, the energy needed to crank the tower down and up down every six months or so to repair the wire breakages was getting too much for me. The wind and parrot issue also eliminated for me the prospect of using a wire parallel driven element Yagi such as a Hexbeam or a Spiderbeam.

Choosing a Parallel-Fed Yagi

As no-one was making a tubing parallel driven element Yagi in Australia at the time of my desire to purchase one and I had insufficient time to build one from scratch, it was necessary to import an antenna either from Europe or the USA.

After considering antennas from Optibeam (OB9-5, 1,349 euros) and DX Engineering (Skyhawk, US $1,199, three elements on 20/15m and four on 10m but no WARC bands or 6m) and looking at the potential freight charges for each antenna to Western Australia, I decided on the InnovAntennas XR-6 11-element Yagi, which would give me 20/17/15/12/10/6m coverage with two dedicated elements for each band except 12m and provide a gain of about 5dBd.

One of the golden rules of parallel driven element Yagi antennas [1] is the more bands/elements that are interlaced at any one point on the antenna boom, the more the performance of the Yagi will be compromised. As a result, InnovAntennas owner and designer **Justin G0KSC** has optimised the performance of the XR6 by having no more than the elements for three frequency bands interlaced at any one position on its boom.

Note that on the XR6 a traditional driven element and reflector configuration is used on the 20, 17 and 15m bands, whereas a driven element and director is used on 12, 10 and 6m. Doing this enables the 12, 10 and 6m elements to be placed at the front of the 3.5m-long boom and the larger 20, 17 and 15m elements to be placed at the back, enabling the latter group of elements to provide some additional directional properties to the former.

On the 12m band, the only dedicated element is the driven element, but the XR6 is still effectively a two-element Yagi because the 10m driven element does service as a director on 12m. In turn, the 12m driven element similarly serves as a reflector on 10m, effectively providing three elements on this band in combination with the dedicated 10m driven element and director. The XR6 is a very clever design!

When it comes to 6m, there is no direct connection between the driven element and the XR6's LMR-400 50Ω coaxial feeder. Instead, the 6m driven element is parasitically coupled to the feeder via the other driven elements of the XR6.

Parameter	Measurement
Weight	30kg
Turning Radius	4.84m
Boom Length	3.5m
Projected area of antenna	1.167m²
Wind Survival	172 km/hr
Average gain per band at 20m above ground	11.24dBi

Table 1: technical specifications

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Note that the XR6 uses relatively close spacing between all the pairs (driven element/reflector or driven element/director) of its elements, giving it a relatively wide bandwidth on all of its six bands.

The technical specifications are given in **Table 1**.

Antenna Construction

Western Australia can be a windy place, both during winter and summer. The summer here is cyclone season and, while most of these directly affect the north-western coast some 800-plus kilometres away from my location in south-western WA, the 'tails' of cyclones frequently cause 75 to 100km/hr winds here.

In order to make the XR6 elements as strong/wind-resistant as possible, Justin G0KSC has made the elements taper quickly. For example, as he outlines in the antenna manual, the centre section of the 20m elements are 35mm in diameter, tapering down four levels of tubing (30, 25, 20, 16mm) to the final 12mm section.

The boom is made from two sections of 50mm diameter square-section tube, with 2mm wall thickness. These are joined using 45mm square-section tube, using M6 bolts.

With the exception of 6m, each element is bolted to the boom using heavy-duty boom-to-element mounting plates, **Fig. 1**. In turn, the elements are mounted on the plates using Plasticos plastic blocks as insulators and Tornillo Allen stainless steel bolts and nuts. This makes for a strong construction.

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The Build

In order to make the XR6 antenna build as easy as possible, the first thing I did – and which should be done in the case of any antenna assembly – is to check that all the antenna components are present, right down to the last screw, **Fig. 2**. There is nothing more annoying in building an antenna than to find halfway through that several bolts, or similar, are missing. I was pleased to find that not only all the parts were present, but in the case of nuts and bolts there were even a few spares – vital as I have never built an aluminium antenna without dropping several nuts or bolts onto the ground and subsequently losing them. Thank you InnovAntennas for the spares – I ended up using them all.

The next step was to lay out the various antenna tube sections on the ground and put them loosely together, using the 'Element Sizes and Taper' diagram in the manual. Each individual element section was then labelled with a 'Sharpie' permanent marker pen to show which element it belonged to and numbered (i.e. '20m ref 1' for the centre section of the 20m reflector) and a corresponding key made using the manual's 'Element Layout' page. For example, the 20m reflector is made up of 11 different sections, so these were numbered from '1' to '11'.

Making up a diagram of this kind is vital when building an HF Yagi made up of multiple, tapered aluminium sections in order to keep track of individual sections.

When you are sorting the element sections prior to assembly, you will notice there are ten different lengths of 12mm tubing – ranging from 1410mm to 40mm. These are the element tips and, as you can guess, the longest ones generally belong to those elements which are the longest – the 1410mm-long tips belong to the 20m reflector and the 1104mm to the 17m reflector. The four 856mm tips belong to the 20m and 15m driven elements.

To make building the individual elements as easy and with as little back strain as possible, I built them on a pair of 'saw horses'. InnovAntennas thoughtfully provide two Allen keys (1.5 mm and 5mm) for tightening the Allen stainless steel bolts and nuts that secure the various antenna element sections together.

While these Allen keys are perfectly adequate for the job, I found using some T-Bar handle Allen keys made doing up the screws quicker and tighter easier.

My recommendation is not to rush the element assembly. While it probably can be completed in about 16 to 20 hours, it is much more pleasant and sensible to spread it over at least four or five days as I did. Tightening the Allen bolts and screws properly on each element section is vital to the success of the antenna.

When joining each element section to its neighbour, ensure both connecting

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Fig. 4: XR6 boom marked ready for adding elements. Fig. 5: XR6 boom with element mounting plates in place.

surfaces are clean and free of any oxidisation using wire-wool. Next, spread a thin layer of aluminium electrical jointing compound (such as Burndy Penetrox A) on the surface of the end of the element section, which is going to slide inside the other element section to make the join. The photo, **Fig. 3**, shows the element joints.

Once you have measured and set the element lengths, take your tape measure and re-check them, preferably after a few minutes break. In my experience a lot of HF Yagis perform poorly on initial testing because at least one of their elements was incorrectly measured/set up. All good mechanical engineers, technicians and assemblers check and recheck their measurements. The photos, **Figs. 4** and **5**, show the boom before and after attaching the mounting plates and before attaching the elements.

Installation

As suggested by Justin G0KSC, my XR6 was mounted near the top of my crank-over wind-up Hills tower 'upside down,' i.e. with all the element insulators and the antenna feedline connection facing the ground. This allows for some UV protection to be provided for the plastic antenna insulators by them often being in shadow, as well as an easy connection to the antenna feedpoint. The antenna was fed via an InnovAntennas 1:1 ferrite core balun.

Over the top of the XR6, at about one metre higher at 20m, I mounted an InnovAntennas C-140 rotary 40m dipole, so as to give me a rotatable antenna on all bands from 40 to 10 m, **Fig. 6**.

Adjusting the XR6

My principle interest is in CW DX chasing and contesting on the HF/LF bands, so the desire was to obtain a good match/Standing Wave Ratio (SWR) of less than 1.5:1 over the CW portions of 20/17/15/12/10/6m.

In all my times of building multi-element HF quad, delta loop or Yagi antennas, stretching over 45 years, I've never built one which didn't require adjustment after first putting it up. The XR6 was no exception, particularly because of my primary interest in the HF band CW sections.

To test out the XR6 it was initially raised to about seven metres – the height of my tower when fully cranked down – and a basic SWR check carried out, which revealed the SWR was around 2:1 or under somewhere in each of the various bands it covered.

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Confident on this basis that I had managed to at least assemble the XR6 correctly, the tower was then raised to its general operating height of around 20m and the SWR plotted on each band using my Austin QRP Club Vector Impedance Analyser (a super piece of test gear) and then checked using my IC-7610 at 20W output and an Autek WM-1 Computing SWR Meter.

This revealed that all the XR6 elements needed lengthening to lower the SWR so the minimum on each band was about 100kHz up from the lower edge of the band. In the case of the 12m and 20m bands, the minimum SWR point needed moving about 230kHz lower in frequency. On 17m and 15m it needed moving about 100kHz lower, on 10m about 430kHz lower and on 6m about 500kHz lower.

In order to work out exactly how much the antenna needed to be lengthened, some simple mathematics was used. The method I am about to explain can be used to adjust any homebrew or commercial Yagi.

Firstly, in the case of the XR6, which can be considered as a two-element Yagi on all bands, the same adjustment in length required needs to be carried out to both the driven element and the associated reflector/director, i.e. the antenna elements are basically scaled-up or scaled-down in size.

Secondly the antenna needs to be first adjusted on the lowest band it covers, followed by the next highest band, and so on (i.e. in the XR6, adjustment of the 20m elements is followed by the 17m elements, then the 15m elements).

On 20m, the minimum SWR point of my

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Fig. 6: XR6 on tower with C-140 dipole.

Frequency (MHz)	SWR	Frequency	SWR
14.00	1.1:1	24.89	1.18:1
14.05	1.0:1	24.94	1.3:1
14.10	1.0:1	24.99	1.4:1
14.15	1.0:1	28.0	1.4:1
14.20	1.1:1	28.1	1.3:1
14.25	1.2:1	28.2	1.18:1
14.30	1.3:1	28.3	1.0:1
14.35	1.4:1	28.4	1.1:1
18.068	1.1:1	28.5	1.32:1
18.118	1.2:1	50.00	1.2:1
18.168	1.3:1	50.05	1.1:1
21.0	1.2:1	50.1	1.2:1
21.05	1.3:1	50.10	1.3:1
21.1	1.4:1	50.15	1.35:1
21.2	1.4:1	---	---
21.3	1.42:1	---	---
21.4	1.5:1	---	---

Table 2: Final SWR curves of Innovantennas XR6 installed at VK6VZ.

XR6 was 1.1:1 at 14.332kHz, meaning this needed shifting approximately 230kHz lower. Using the time-honoured formula [2] for calculating the length of a half-wave dipole antenna in metres of 150/f(MHz), the length of one for 14.322MHz is 10.466m. Similarly, a half-wave dipole for 14.100MHz – my desired centre frequency – would be 10.638m.

Therefore, the XR6 20m elements need to each be lengthened by 10.638m minus 10.466m, which is 0.172m or 172mm. As a result, each tip section of the 20m elements was extended by half of this, i.e. 86mm.

A similar calculation process was then carried out for the other five bands covered by the XR6. After this, the tower was cranked down/tilted over to ground level and the antenna elements adjusted accordingly. When the XR6 was returned to its full height and the SWR rechecked, only the 10m elements needed further adjustment/lengthening. This additional adjustment was calculated in the same way as before.

The final XR6 SWR curves are shown in **Table 2**, which gives you an idea of the excellent broad bandwidth of the antenna.

XR6 Performance

The installation was completed at the end of November 2018, unfortunately just too late for a serious attempt at the annual CQ WW CW contest. However, extensive on-air testing took place during December 2018 and I was very impressed with the XR6's performance, noticing no discernible difference between it and the previous two-element delta loop on long distance paths.

The front-to-back ratio was excellent for a two-element antenna, showing around two to three 'S' points difference, depending on band conditions.

The XR6's front-to-side ratio was equally impressive, with signals being reduced in level off the sides of the antenna by up to four 'S' points. Europe and western North America were worked regularly on 20m and 15m with what seemed a similar ease to the XR6's predecessor.

In March 2019 I took my usual place in Team 1 of Australia's 'Commonwealth Contest' endeavours. This was going to be the real test for the XR6 – could it hold its own in terms of providing a similar score in comparison to my previous two-element delta loop beam? I was also using the InnovAntennas C-140 40m rotary dipole for the first time seriously in a contest.

In the Commonwealth Contest 2018, winds had hit 100km/hour during the first twelve hours of the contest, snapping half of the reflector of my capacitively-loaded Moxon 40m wire beam and throwing the HF delta loop wire beam around like a piece of broken fencing.

This experience had prompted my change to the XR6 and C-140, with their aluminium tubing elements. On the other hand, while the winds had been challenging, the conditions on 20m had been excellent for close to bottom of the solar cycle conditions, with both short and long path openings into the UK.

Commonwealth Contest 2019 proved to be a radically different experience, with the conditions on 20m next to non-existent on the long path to the UK. Signals on the short path were very weak and both **Kevin VK6LW** and I struggled to work many UK stations, leaving 40m to take up the slack.

Despite the poor conditions on 20, 15 and 10m, at the end of Commonwealth Contest 2019 I had a claimed score of 4,195 points for 304 QSOs, in contrast to 2018's 4,030 points from 321 QSOs.

In 2018 I had managed 128 QSOs on 20m but in 2019 the poor conditions had resulted in the QSO number dropping to 58. On the other hand, in 2019 my 15m QSO total had actually risen in comparison to 2018, with 28 QSOs compared to 11.

The nicest thing of all was that Australia Team 1 extended its hold on 1st place in the team competition in 2018 into 2019 – and with my experience of doing the Commonwealth Contest for over 20 years I was very happy with the performance of my InnovAntennas XR6 and C140. Over the last year or so, both antennas have been tested by winds approaching 100km/hour with no ill effects.

The XR6 MkII currently retails at £1,195, including VAT, from the InnovAntennas website. A compact version – the XR6C – is available, which uses capacitively-loaded 20m elements that are only 8.8m wide and costs £1,295. If you are interested in adding the 4m band, the XR7 is currently available on special offer at £1,195.

www.innovantennas.com

References

[1] Antenna Overview section of Innovantennas.com XR6-MkII 11 element 6 band Yagi Manual.

[2] Page 2 of Practical Wire Antennas by John D. Heys G3BDQ, published by the RSGB in 1989.

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The Magic of a Piece of Wire (Part II)

Joe Chester MW1MWD continues his theme from last month of using an end-fed wire antenna.

Of course, to pick up where I left off last month, there is still an impedance to match. **Steve G0KYA** has done a lot of work with a 19.8m length of wire [1]. I've put a vertical red line on Alan's graph (Fig. 1 from last month) to represent Steve's wire length. As you can see, this goes through the middle of the 80m gap, which is good, but is blocked on 40m, and just dodges by the end of 'no-go' sections on all other bands. Steve says that he got SWRs from 21:1 up to 400:1 on various bands for this length of wire using antenna modelling software. Now don't give up! There is a solution to matching these rather extreme impedances. And at least, these values are not infinite.

The solution is what is commonly called a 9:1 unun – a weird name for what is actually an impedance transformer. The name comes from its unbalanced-to-unbalanced action, where the ground is the common terminal (unlike in the balun, where the common terminal goes to the antenna). Some people, like **Jerry W2FMI**, want to call it a 'broadband transmission line matching network' – a real tongue twister! There are more details about this device in that same book, as well as details about how to make one yourself. In effect, this acts as a step-down transformer, which literally divides the impedance at the end of the wire by nine, to produce values easier to match at the transmitter. Steve gives examples of the impact of an unun on several bands, from actual measurements. For example, on 28MHz, without the unun the SWR was 409:1 but with the unun it becomes 1.2:1. Of course, this doesn't work well for the 40m band, because this length is so close to a half wave that the impedance is nearly impossible to match. He got an SWR of 13.6:1 on 7.1MHz with the unun. But this is not important for me because I have a dipole for the 7MHz band.

So, I now have your solution for you – a length of wire, hung up on a tree, or a pole, **Fig. 1**, or erected as an inverted-L, either Steve's 19.8m or Alan's 26.5m long. The shorter length will give you a multi-band antenna, usable from 80m to 10m, but not on 40m. The longer one will give you 160m to 12m, but not 10m. Get it up as high as you can. But beware the dreaded management meeting! A casual mention of wires at dinner one evening got a very nasty stare in return. *"You're not hanging*


1

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Fig. 1: A simple pole can support the distant end.
Fig. 2: Unun from M0CVO.

more wires outside my back window", I was told bluntly. Really? It's just a length of wire, isn't it? Apparently, the view through said window is a major visitor attraction in these parts, which means it is in effect a 'listed view' and can't be altered by as much as a single wire. That evening, I rang M for help. He's a man who has seen it all in his time. *"Tell her you'll take it down if she can see it"*, he told me. And that's what I did!

Taking the Plunge

I tried a sloper first – 19.8m of antenna wire running from the base of the shed up to a branch on the tree, with a couple of metres hanging straight down. This worked, but I realised that what I actually had was an inverted-L, mounted in a sense the wrong way around (its normal to feed the inverted-L at the base of the vertical). When it stopped raining, I decided, like Steve, to use a 10m fishing pole, but with the top two sections removed, mounted beside the garden shed, giving about 9m up and then 10.8m over to the tree. I then attached my unun (I got mine direct from **M0CVOantennas.com** – it's rated up to 400W, **Fig. 2**) and added a long counterpoise wire around the fence (or use a good ground stake if you prefer). Then I connected a suitable length of coax to the transceiver, and I was ready to get on the air. After that visual inspection, of course, which I'm pleased to say I passed with flying colours!

The Results

And the results? Outstanding! But it needed a bit of a tweak to get the best out of it. I measured the impedance at the radio end with my antenna analyser and got results comparable with those of Steve and others. The corresponding SWRs are, mostly, too high for my IC-7300's internal tuner, although the KX3 handled them easily. However, the small losses add up, and are rather too much at QRP levels, where every tenth of a dB is important. To get a better match, I switched off the internal tuner in the IC-7300 and connected my MFJ 945E manual tuner. With this, I was able to get the SWR as seen by the transmitter down to 1:1 on all bands (the tuner setting varies for each band, but a note in the log now has these settings). This means, of course, that the transmitter will work happily – it tells us nothing about the SWR at the antenna or losses in the feedline. However, it's time to get on the air.

2

I start with 80m, and the first thing I notice is the lack of noise! The display on the IC-7300 is really clear, and weak signals normally hidden in the grunge are now clearly visible. Its Churches and Chapels on the Air day, with lots of activity. I give **Tony GB4SRC** a quick call and get a 59 report. There are nets all over the place – 3727, 3754, 3772, 3793, 3743, 3700, 3609, 3763 and 3663kHz were all in use by the ragchewers, and the WAB guys were going strong on 3760kHz, as usual. My DIY vertical never displayed so many active QSOs all at one time. I would list the callsigns for you but as these operators all know each other, it was mostly first names every over. However, here's a few I did pick up: G4BIM, M0ILO, G4OAB, G6ZMX and, of course, the G2OT net. A day or so later, I caught GW0WPO/P on 3760kHz. He was 59 with me, but I was only 53 with him, using 100W. He was up Llangollen way at the time. But the key thing is my efforts paid off. It worked, even if not quite as well as a 3-element Yagi (but who could get an 80m one of those in a small garden?).

On 20m I get a good match with the tuner. I'm set up with an antenna switch to allow me to compare the EFA with the attic dipole. It's the weekend of the CQ WWW SSB contest and the bands are very crowded. This is an ideal chance to check the operation of my new antenna. To start with I limit myself to checking signal strengths. I honestly could not see any difference between the signals on the dipole and the EFA. It's time to make a few calls. I start on 20m, and in ten minutes work ten stations, mostly in Europe, first call every time. Best was RU1A in St Petersburg, RG5A in Moscow, and EW2W Belarus, all in CQ Zone 16. The rest of my contacts were all in Zone 15. Just for the record, I was using 100W. This continued for a while, and I could have worked many more, but then I remembered I promised you North America.

So, what about N1UR, in Vermont, zone 5, and both VE3EJ and VE3JM, in Ontario zone 4. Time to try another band? I tuned up 10m, and got HG5A, EA5DN, CR5T and ED7W. I then tried 15m and worked YU5R in Serbia. As evening approached, I thought I would have a look at 80m. First up was M6T, just to check I was getting out. I then worked OL4C on 3.761MHz and, unbelievably, UX2X on 3.744MHz. I didn't try 40m because the length of wire I am using is close to a half wave on 40m and as expected the end impedance is too high to match successfully.

In summary, I had QSOs with stations in CQ zones 4, 5, 14,15,16, and on 80, 20, 15 and 10m, which I would assess as a bit better performance than my set of attic dipoles, and with generally less background noise. I should also say that there were a couple of disappointments. Operationally, the antenna once tuned has a narrow bandwidth, which required retuning regularly as I moved around the wavebands. Using a manual tuner made this a bit tiring but even with this, the antenna was a good performer. I think I might look at replacing the unun with an ATU at some point (item added to worklist!). The other disappointments were failed QSOs – one of these was my usual contest contact with N1MM. I found Tom on 20m, and tried answering his calls, but he didn't hear me. The other frustration was that I heard PJ4K, Bonaire, clearly, and spent a bit of time trying to hook him. This would have been an all-time new one for me. But the QRM was dire, and eventually I had to admit defeat.

So, there you have it. A magic antenna, to catch the last few rays of that sleepy Sun? Perhaps not quite magic but a reasonable performer, nonetheless. And it's nearly invisible too. It's really easy to deploy, even in the smallest garden. Just be careful to pick a 'good' length of wire. Throw the wire over a tree, or into a tall hedge, as high as you can. Don't go mad with the length – really long wires, for example two or maybe even five or more times the operational wavelength, have different characteristics. Attach the unun matchbox, lay out a counterpoise wire just above the ground, plug in the radio and you're ready to get on the air. You'll get a bit more out of it as an inverted-L if you can mount it in this way. But really, it's just a length of wire. Try it and see if it works for you.

References

[1] *Stealth Antennas*, Steve Nichols G0KYA, page 114, published by RSGB, available from the PW Bookshop.

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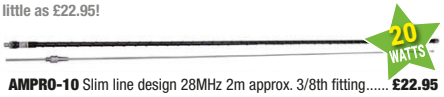

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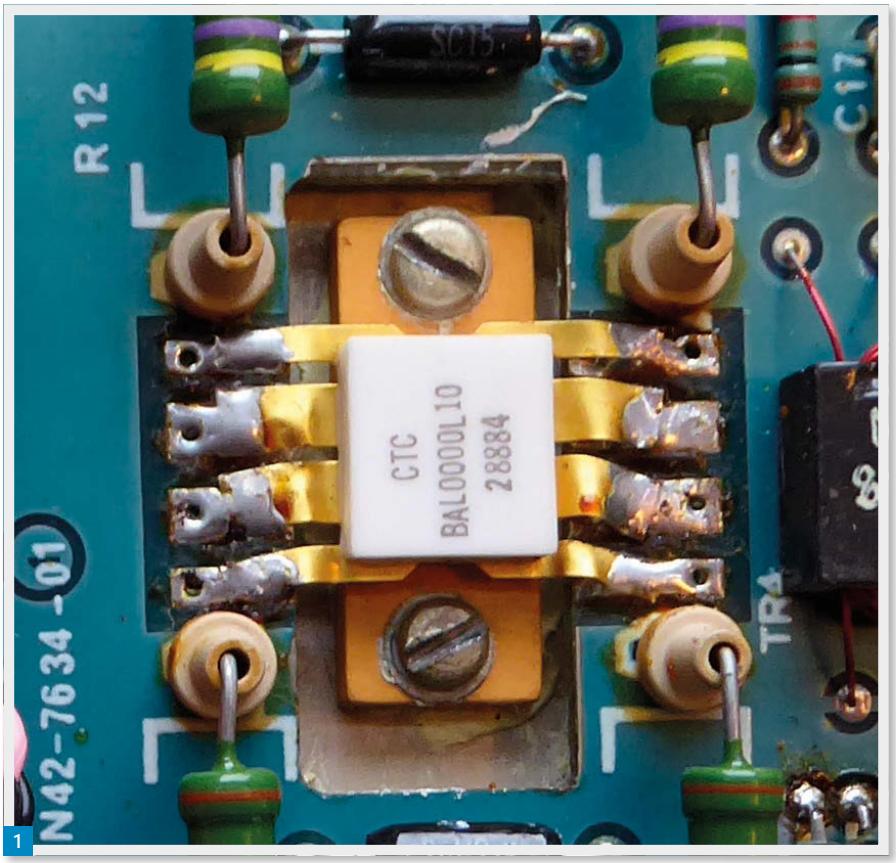
Marconi Challenger: End of an Era (Pt II)

Michael Jones GW7BBY
michael@gb2mop.org

Michael Jones GW7BBY continues his story of the Marconi Challenger and its restoration.



1

You may recall that I ended last month's piece by saying that Eimac had kindly offered a full set of replacement valves but that they would take two months to manufacture and ship.

Retest Driver Board: Properly!

While waiting, I re-tested the driver section and did some more research into the 4CX350 characteristics. Given that the Control Grid is biased at −27V DC and that the grid should not go positive, maximum power should be obtained with a voltage swing in the order of 54V pk-pk under load. Off load swing will be greater and, to allow for losses, say 65 to 70V pk-pk. ALC will come into play to keep the drive within acceptable limits. My re-test of the driver section showed that for 6V pk-pk input, the output varied from 8V pk-pk at the lower frequencies to 35V pk-pk at 28MHz. So, the driver output was low but greater than the input. I needed at least double the voltage swing. Using the QRZ forum in my search for information was very useful in confirming these conclusions.

The driver device was a CTC BAL0000L10 – a rare device made from unobtainium! It is two NPN transistors in a single 744a-01 package, **Fig. 1**. Testing this out of circuit revealed that only one half was working, hence the low output voltage. I was unable to find a datasheet for this transistor or find one listed for sale anywhere. Indeed, only two NPN transistors, MRF392 and MRF393, were available in this package. On an educated hunch, the original transistor looked like a 100W device and that seemed reasonable given that the driver probably operated in Class A for linearity, with a supply voltage of 24V DC. Either the MRF392 (125W) or the MRF393 (100W), both good for up to 500MHz, could be suitable. I decided that either could be used. Against this the price is about £90.00 so mistakes cannot be tolerated. I was a little uneasy about this transistor because it is only specified from 30 to 500MHz and I was going to use it below 30MHz, and it's the Museum's hard-earned money at stake.

Another option would be to use two more common RF transistors wired back to the driver PCB. Packages could be MT-72 or other RF package but would require some re-modelling of the mounting points. There is a cut-out in the PCB specifically for the 744a-01 device. The alternative transistors would have to be mounted on the heatsink and the PCB mounted on elevated stand-offs to clear the transistor packages and then the transistor leads extended to the PCB. Doable, not ideal, but kept in mind.

After discussing with **Paul**, we decided that the best solution was to order an MRF392 from Mouser. Fortunately, it all worked out. I was able to fit the replacement driver transistor on the bench at home and then test it, **Fig. 2**. Maximum output was improved and it was consistent from LF to HF, whereas the old transistor dropped off at the LF end. Also, with both of the transistors in the package now working, the power available will be greater, thus preventing the voltage swing from sagging under load.

In the meantime Eimac exceeded expectations and the four 4CX350s arrived about six weeks early but we were unable to fit them until the driver transistor issue was sorted out, which was very frustrating!

Other issues included damaged 'Doorknob' capacitors, **Fig. 3**. Fortunately, we were able to replace these from the Museum's stock.

Final Jitters!

Before fitting the new valves, it was essential to ensure that all the feed conditions for the valves were perfect: Bias, Screen voltage, HT and RF feed. After fitting the Driver transistor, I reassembled the valve box into the transmitter's RF unit still with the old valves in place. I was then able to set up the bias at −27V and the screen voltages for each valve at 400V. This is where my confidence was taking a battering. I didn't want to fit all four valves in one go and risk wiping out about £1000 worth of valves due to some unforeseen fault or oversight. I was sure that all the

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Fig. 1: Troublesome drive transistor, CTC BAL0000L10. Fig. 2: Driver test set-up.

operating conditions had been set up correctly, but still wanted to fit only one valve at a time as I reasoned that all four valves were in parallel so I should be able to run with only one valve in place but at reduced power. Technically this would be correct but I would have to block the unused valve chimneys to maintain airflow through the valve under test. I would also have to isolate or remove the unused anode clamps because it would be unwise to leave them hanging loose with 2.2kV on them! In the end I replaced one of the old valves with a new one and left the other three in place. As they were not contributing any output, any improvement would be due to the new valve. Finally, if anything did go wrong only one valve would be lost. Sure enough, power was much improved and the new valve seemed stable so I replaced a second old valve. Now the power output was very much improved and stable. If I transmitted USB into a dummy load, I could hear myself clearly on one of the Museum's receivers.

First Contact

Now, with four new valves installed we were ready to make some contacts. Practically, we were restricted to 80 or 160m, as the higher amateur bands are not covered by the marine bands. Also, being commercial equipment, only USB is available. (OK, there is CW, but I'm no good at it!). I took part in the Saturday morning AM VMARS net on 3.615MHz using the Oceanspan and asked if a few members would mind continuing to listen after the end of the net for my USB transmissions from the Challenger. This generally went very well, excellent audio being reported as well as good signal strength. Unfortunately, the RF drive started tripping out randomly, cutting me off in mid-over. To add to the woes the Museum power also tripped out!

More Drive Issues!

The drive tripping issue was at first perplexing. The RF drive trips, as stated earlier, if final valve air temperature exceeds 125°C, critical controls are moved after tune up, frequency data input is incomplete or the PLL drifts out of lock. If any of these last four faults occurs, the drive trip LED illuminates, but it doesn't tell you which of the faults have occurred. Another annoyance is that not all of the fault lines coming into the protection circuit are, for instance, low for no fault, high for fault. Some are high, some are low. Anyway, I made a simple table of the status of all four lines under no-fault conditions. Measuring them again under fault conditions gave the same readings on a meter. So, was it a transient fault or noise on one of the inputs, or even a fault in the protection circuit itself?

I decided to spend my next day in the Museum sorting it out. In the meantime, at home, I made a small board to fit onto

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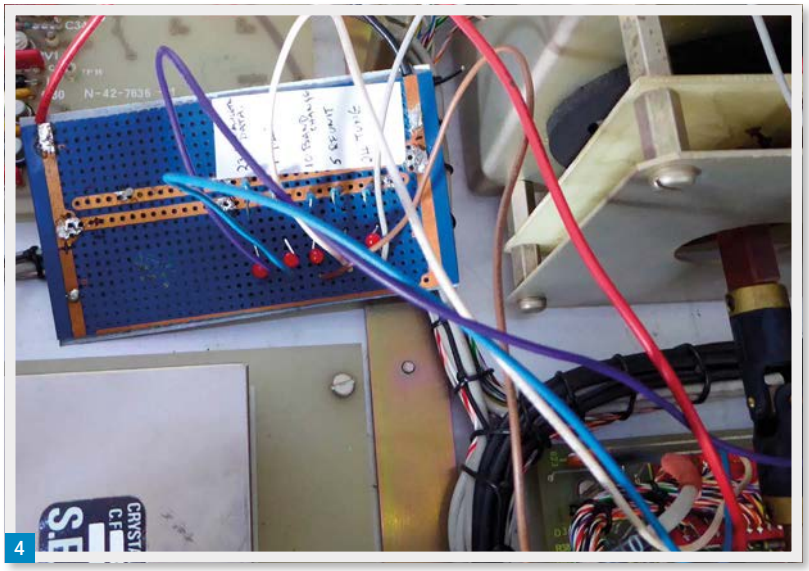

Fig. 3: Damaged antenna load capacitor. Fig. 4: Fault monitoring board.

the header for the drive protection circuit with four LEDs to monitor each of the fault lines, **Fig. 4**. I then powered up the transmitter, kept a scope at the ready, and the Challenger behaved perfectly for about two and a half hours. It did trip while I was probing after everything was well warmed up. I decided that it was time to apply the Mk1 test strategy and give it a good thumping! A healthy tap in the PLL area (see Fig. 5 last month) caused it to go reliably out of lock and trip the drive. The oscilloscope showed that the failure was only momentary, which explains why the fault did not appear to be present after the drive had tripped. Some gentler tapping with the plastic end of a screwdriver indicated something sensitive in the area of the divider chip. I gave it a push into its socket and the problem went away. To make sure, I removed and re-seated both the divider and the synthesiser chips. It was obvious from the condition of the pins that they had been removed before a few times. That seems to have fixed it. It behaved itself for about two hours after this fix.

VMARS run a USB net on 3.615MHz at 8.00pm Friday evenings to cater for military and commercial equipment that only runs USB. I joined this and received some very complimentary reports on both audio and signal strength. The Challenger behaved perfectly – a very satisfactory outcome with contacts in France and the Netherlands as a bonus.

Now seems a good time to apply to Ofcom for an NoV (Notice of Variation) to allow use of full power. As I write, it is October and the Museum is due to close for the winter months. This is when there are no visitors and all the hard work starts. Winter projects will include some modifications to add the higher amateur bands, also to add LSB. The January 2019 *PW* was very timely because it included construction details for a Spectral Inverter, i.e. swaps LSB to USB and vice versa at audio frequencies. The beauty of this device is that no internal modifications are required – it's magic! Many thanks to **Ron Taylor G4GXO** for his article – I shall be building two, one for the Challenger and another for the Kelvin Hughes, my next major project.

I must thank EIMAC (now part of CPI – Communications and Power Industries) for their kind donation of the four 4CX350s without which this rare transmitter would not have been restored to working order.

I would also like to thank **Ron Stringer** (ex-Marconi) for his insights into Challenger development.

The current Covid-19 outbreak means that the museum will not be opening, as planned, at Easter this year and will remain closed for April and May. A decision for June onwards will be made in May and published on the museum's websites www.gb2mop.org and www.internalfire.com

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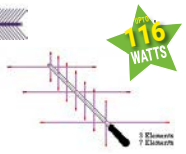

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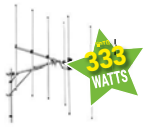

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Antennas Using Fibreglass Poles

Don Field G3XTT
practicalwireless@warnersgroup.co.uk

Don G3XTT explores the many ways in which fibreglass poles can be used to support a wide range of HF antennas.


1

Many years ago, when we lived near Cambridge over clay soil, I had great success with vertical antennas. Much less so for the 34 years or so we were in South Oxfordshire, where the ground was chalky and the water table was well down. But since moving to Somerset, I have once again turned to vertical antennas, which are working well for me.

There is nothing new about vertical antennas, of course. But the availability of sensibly-priced, good quality poles up to as much as 26m in length, or poles that will compact down small enough to fit into a suitcase, has encouraged lots of radio amateurs from SOTA-activators to large-scale DXpeditions, to forego their Yagis and try something different.

In this and perhaps one or two subsequent articles, I want to look at the care and feeding of the poles themselves (the downside is that, unfortunately, they can easily be damaged) to the sort of antennas we might wish to support and the various ways of matching them, along with some thoughts on earth systems.

I will start by being fairly anecdotal in the hope it will set your thought processes going as to what my work for your own operating circumstances. I'll dig a bit deeper into some of the technicalities in the subsequent articles.

Some Basics

For long-distance propagation, we need to launch our signals at as low an angle to the horizon as possible, so that they travel as far as possible on each 'bounce' off the ionosphere. Unless we live close to the sea, radiation below, say, 10° will be heavily attenuated by ground losses close to the antenna. But we are certainly looking for take-off angles of 30° or less. All antennas radiate across a wide range of angles but what we are looking for is an antenna where the majority of the radiation is at a lower angle to the horizon rather than upwards. This was well illustrated in some of the plots in **Ian Dilworth G3WRT's** article last month about the End-Fed Half Wave antenna.

Quarter-wave vertical antennas naturally offer a relatively low angle of signal take-off (I don't plan to go here into great detail about the performance of different lengths of verticals – maybe another time). To achieve similar low take-off angles with horizontal antennas requires them to be at least half a wavelength above ground, out of the question for most UK radio amateurs for the 160, 80 and maybe even the 40m bands.

What a vertical antenna does need, though, for effective performance, is a good ground system (more on this later) and also good conductive ground for many wavelengths out from the antenna. The first of these is in your hands. The second may be, but only if you can choose your home on the basis of ground conductivity! (The government has done exactly that with some its key LF, MF and HF sites.) Ideally, be located right next to the sea (see last month's article on seaside operating, for example).

Indeed, on the DXpeditions I have been involved with over the years, we have turned increasingly to using vertical antennas, even for the higher HF bands, with excellent results. But, yes, we do seek out operating

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Fig. 1: Don's 22m Spiderpole attached to a post at the end of the garden. Fig. 2: Configuring a 40/80m quarter-wave wire antenna. Fig. 3: Feedpoint of elevated 20m quarter-wave vertical. Fig. 4: Jubilee clip to stop telescoping.

locations next to the sea, wherever possible.

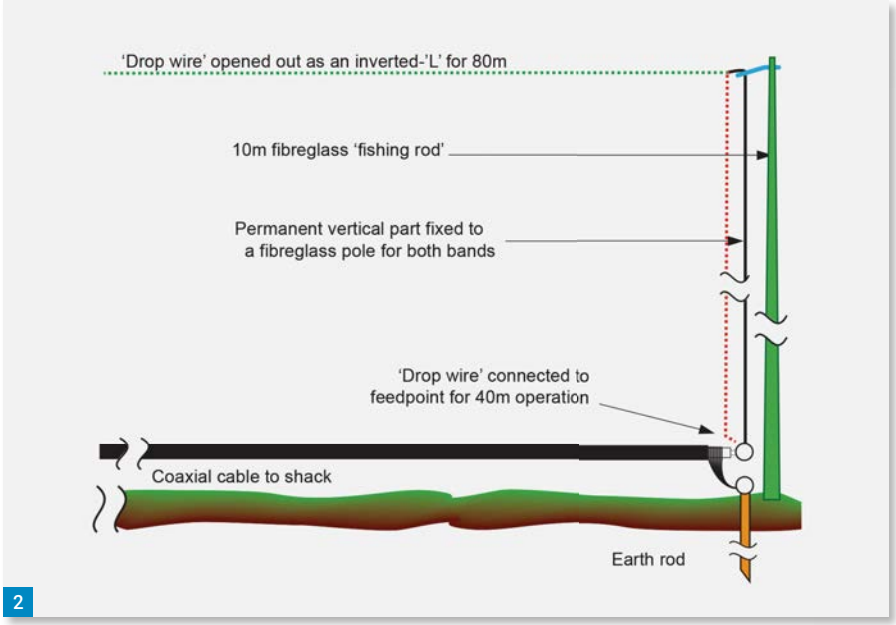
I should also note, in passing, that low horizontal antennas (and that includes inverted-vee dipoles) are excellent for close-in work such as a UK-based net or chasing Worked All Britain squares on 40m, say. A lightweight pole can be excellent for such activities too, provided the dipole isn't too heavy (so probably not a trapped dipole, for example).

Fibreglass Poles

One of the spurs to using vertical antennas for DXpeditions and other short-term (contest, special event, etc.) operations has the been the availability at sensible prices of good quality telescopic fibreglass poles. These offer good strength while being light in weight, ideal for back-packing, carrying on aircraft and so on. What's more, many of them are black, so they don't stand out too much against most backgrounds. And, for home use, it takes minutes to put one up or take it down, avoiding problems with planning permissions, worries about forthcoming gales or whatever. I currently have the lower sections of a 22m pole tied to a post, **Fig. 1**, and supporting a wire quarter-wave inverted-L antenna for 160m. I can raise it to about 17m (55ft) in less than ten minutes, and drop it in no more than five minutes if needed.

My first fibreglass antenna support, bought many years ago now, was a 10m pole (less than 1.2m when telescoped). I was amused when it arrived (from a well-known *PW* advertiser). It came with a mounting bracket and some radio-related accessories (guy rings, etc) but had clearly started life as a mass-produced roach pole – there was even the ring for the fishing line to go through! That pole served me well for many years, although it did cause some consternation on a trip to Iceland with my (then) teenage children. It turned out that Iceland is extremely protective of its pristine waters and fishing gear can only be brought into the country with a veterinarian's certificate to say it has been suitably sanitised! Needless to say, mine was dirty and well used. Eventually they were persuaded by the rest of my radio gear that I was using it for other purposes!

Anyway, nowadays Spiderbeam of Germany and others (see SOTABEAMS ads for smaller poles) sell fibreglass poles up to a remarkable 26m in length, more than enough for a quarter-wave vertical on the 80m band or as the basis for a very effective loaded vertical for 160m.



2

Practicalities

There are lots of advantages of using these poles as a basis for your HF antenna farm, particularly if you are unable to put up a permanent antenna installation. Most can be put up easily by one person, two perhaps for the longer ones. The shorter ones (a 10m pole as a quarter-wave on 40m, for example) don't need guying provided you can attach them to something reasonably substantial.

In Use

The ways in which such poles can be used in your HF installation are limited only by your imagination. But let me give you a few examples to start the grey cells working.

I mentioned in an earlier *Keylines* that my first efforts from the new QTH were on the 80m band, using an 18m pole (not a Spiderbeam one – ostensibly similar but more on that in a moment). 18m is just shy of the 20m needed for a full-size quarter-wave antenna on the 80m band but a wire the length of the pole and just a handful of turns on a suitable former (an empty Tesco one litre water bottle in my case – hi-tech not required!) gave me a resonance exactly where I wanted it, close to the bottom of the band (I was chasing a Pacific DXpedition on 80m CW). With just a handful of ground radials it performed very well and I went on to retune it to the top of the band for a modest effort in the CQWW Phone Contest at the end of October.

Raising a long fibreglass pole can be


3

something of a challenge and I opted out. Instead, I secured the pole to a substantial wooden gatepost and pushed it up one section at a time. Let me say at this point that I gather there are different ways of weaving the fibreglass into a tube and some methods make for a much more substantial product than others. My 18m pole was considerably cheaper than the Spiderbeam equivalent when I bought it but we had an identical one break in two when trying to raise it from ground level on the T32C DXpedition some years ago. I have never seen that happen with a Spiderbeam pole – I guess you get what you pay for.

Given my early success here with the that 18m vertical, I decided to be a little more ambitious and invested in a 22m (Spiderbeam) pole, with the intention of

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going 'large' for the CQ 160m CW Contest in January. I soon discovered that pushing up the last few sections is beyond the efforts of one man (this man, at least!) although I feel sure erecting it in the vertical position (rather than elevating it from the horizontal) would have been feasible if my son had been around to help. Incidentally, there are YouTube videos on the Spiderbeam site showing how to erect their larger poles (I don't intend this article to be a recommendation specifically for Spiderbeam – I just happen to be a satisfied user – but, as I said earlier, other suppliers are available or simply buy a cheap fishing pole if you only need a short pole).

Anyway, to cut a long story short, I ended up in the 160m contest with the pole about 17m high, supporting a quarter-wave inverted-L antenna. I had deliberately removed the top couple of sections of the mast, which always appear very flimsy and can easily break if you try to use them to attach, say, loading wires. On DXpeditions, for example, our typical 160m antenna is a T configuration (vertical plus two loading wires at the top). We use an 18m pole but with the top couple of sections removed. The third section down has always been adequate to take any tension from the (lightweight) top loading wire(s). Indeed, for home (more extended) use, I would tend to recommend always buying a longer pole than you need and 'discarding' the top section or two.

Anyway, cut to the following weekend, when I wanted to take part in a multiband contest. What could I put up quickly and easily that would do the trick? The inverted-L was still there and working well on 160m. I decided to use the lower 10m of an older 12m as a quarter-wave vertical for 40m (so I needed a 10m length), but with the wire brought back down and paralleled, so that for 80m I could take one half and draw it out horizontally (well, at an angle!) as shown in **Fig. 2**, as a quarter-wave for the 80m band. I'd have to run out to the garden each time I wanted to change bands but I felt that was a small price to pay. In practice, it worked well, with four 20m-long radials laid directly on the ground (radials on the ground don't have to be 'resonant. I'll have more to say about that later. They are simply coupling the return currents between ground and feedpoint). It turned out that the 40m configuration had a low VSWR on 15m too (third harmonic, so it was a three-quarter wave vertical on that band). For 20m, I used the elderly 10m pole that I mentioned earlier and created an elevated quarter wave with two quarter-wave radials dropping at about

4

45° (which gives a reasonably close match to 50Ω at the feedpoint). The photo, **Fig. 3**, shows the high-tech feedpoint! Incidentally, in this case the radials did need to be resonant because they were elevated and therefore not coupled to the ground (rule of thumb is that elevated radials need to be at least a tenth of a wavelength above ground to avoid too much coupling and detuning).

This 'antenna farm', covering all the contest bands other than 10m (which I didn't bother about because there really isn't much happening on there at the current state of the solar cycle) took me all of maybe a couple of hours to put up, check out and have ready for the contest weekend and worked very well (as a further aside, I actually started the contest with a commercial multiband vertical – no names, no pack drill – that I thought I could use on 20, 15 and 10m but some direct comparisons on the first day of the contest demonstrated very clearly that on 20m in particular, the elevated quarter-wave, costing me nothing but a few metres of wire, knocked spots off the commercial antenna with several S-points difference on both transmit and receive).

Given this run of successes, for the ARRL CW contest in mid-February, I decided to install a phased pair of quarter-wave verticals for a single-band effort. Phasing verticals isn't the most straightforward process but there's lots of literature on the subject and modern antenna analysers make it trivial to cut the required phasing lines. Again, I plan to come back to this later but suffice to say, a contest in which you only work North America means that a phased array pointing in just one direction (but with a reasonably wide cadioid pattern) is more than adequate and, in my case, seemed to work very well indeed with QSOs throughout the US and Canada.

Incidentally, when the VP8PJ (South Orkney) DXpedition was on, the only band on which I needed it was 17m, so I trimmed the driven element and elevated radials of the 20m antenna I mentioned earlier, and worked them with relative ease.

Points to Watch

As I said, in future articles I want to talk about the sort of antennas you might want to support with a fibreglass pole, including matching arrangements, earth systems and the like. I just want to finish off this time, though, some with general thoughts.

The larger Spiderbeam poles come with a set of jubilee clips to clamp each section, together with rubber strip to prevent the clips damaging the pole, and heatshrink tubing to tie the rubber strip and jubilee clips together, see the photo, **Fig. 4**. This is a wise approach for any telescopic fibreglass pole. Although the sections will lock together with twisting, I can recall several instances of the VSWR going high during a portable operation, only to see that the pole had partially collapsed. And I wouldn't recommend insulating tape either to hold the sections together or to tape the antenna wire to the pole. It tends to take the surface off the pole when you remove it. For holding the antenna wire, use cheap tie wraps and bin them after use.

By the way, I had always been told to avoid carbon fibre poles and stick to fibreglass because the former is slightly conductive and can therefore be lossy to RF. I see from the recent SOTABSEAMS advertisements that proprietor **Richard G3CWI** has actually made some measurements of his high-strength carbon fibre poles and believes the losses are acceptable, certainly when supporting dipole antennas. Personally, I would still be wary of using them for vertical antennas, where the wire is secured along the length of the mast.

I would also caution, especially near seawater, against using bare wire for the antenna. I have seen the effect this can have, with salt deposits the length of the pole, potentially, for example, shorting out the antenna feedpoint. I much prefer to use insulated wire. The length won't be exactly as calculated using the standard formulas, because the insulation will lead to the wire having a velocity factor below unity. The simple answer, though, is to cut the wire to the calculated length, check the resonant frequency and, if necessary, trim slightly (for example, if the resonant frequency is, say, 3% below where you want it, trim maybe 2% off the antenna and check again – better to trim more than once than to trim too much!).

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- QRP option: 100mW-2W output
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DJ-MD5
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- Gain: averages 11.24 dBi
- Wind survival: 105 mph

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XR-6.....11 el. **Standard** 20/17/15/12/10/6m..... **£1195**
XR6C.....11 element **Compact** version of XR6..... **£1296**
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- Controller w/preset

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- Vertical load 700 kg
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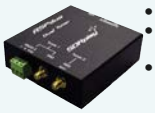
RSP DUO Dual Tuner SDR



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PRG-3000
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- 2m/70cms TX with FM radio RX
- Colour LCD display
- Fully featured
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- Colour LCD display
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Portable Vector Network Analyser

- Covers 100kHz-700MHz
- Touch screen Colour display
- Measures R, Z, X (sign), SWR, Phase, Return Loss, TDR, L, C
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- Frequency: 1-250MHz
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Complete with DTMF Microphone

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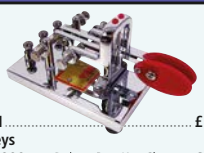

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Dual Band Handheld - IP67 rated

As reviewed in April Radcom

- Compact rugged body
- CTCSS, DCS, DTMF
- 5W VHF/4W UHF
- 200 memories
- RX Airband, FM Broadcast

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Communications receiver

- 150 kHz-34.99 MHz
- 600 memories
- IQ output for PC decode
- Removable Front Panel - (requires optional EDS17 remote kit)

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Alinco DX-10 New Model to UK!

Multi-Mode 28MHz Transceiver

- Power: 25W SSB, 12W AM/FM/CW
- Multi-colour display

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£1699

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- Interfaces with AT-04 Auto tuner/Antenna switch

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100W 'shack in a box'. X version covers HF=6m/2m/70cms & 23cms
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C/w box, handbook, microphone
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Comet

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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

~~£499.95~~ **£469.95**

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4 Band Dipole

- Power: 1kW
- Use as V or straight
- Vee: 7.4m
- Straight: 10.3m
- Covers 7/14/21/28MHz

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Worldwide Remote Shack Digital Modes

Daimon Tilley G4USI offers a comprehensive introduction to accessing your shack remotely for digital modes operation.

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

There are a number of reasons why you might want to operate your own shack while you are not actually there. In this article we will explore these reasons and how you might go about achieving it. The route I describe is not perfect but has given me good results with the digital modes. Other options are available but I hope this article will help you to consider whether this is something you may wish to explore, and give you some firm ideas about how you might go about it. I would also draw your attention to the introductory article on remote operating that appeared in the February 2016 issue of *PW*.

How I have used this Facility

I use this remote operating facility quite a bit, and for a variety of purposes – maybe you will come up with new uses for yourself.

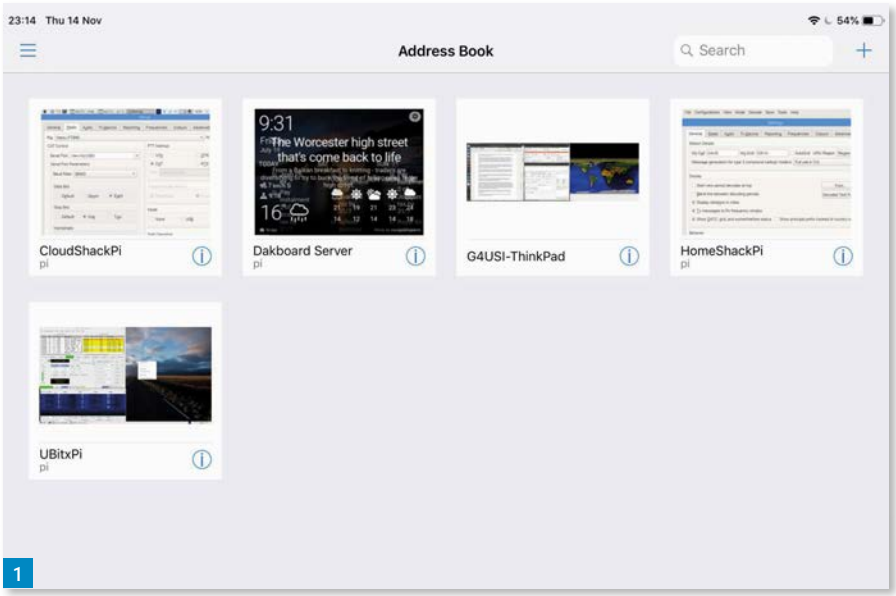
1. Remote digital modes. This falls into two camps, remote in the sense of out of the shack but in the curtilage of my home and garden, and remote as in away from home in another town, county or even country.

I have done both quite extensively. For example, at home I have used remote access from my study, at the other end of the house from the shack, to monitor FT8 while 3D printing or working on another non-radio project. I have also often used it to merely move my operating activity from the shack to the sofa, perhaps while the family are watching a film on TV. It is surprisingly satisfying to work DX from the sofa or armchair using your tablet – or perhaps I really am just sad!

In the summer mornings I enjoy sitting on the patio in the morning sunshine and operating FT8 in this way too.

Given that I have young children I am often pressed into service as Dad's Taxi. On many occasions, the distance travelled is such that I wait in the car while the kids undertake their activity. If there is time, I might take some portable QRP HF gear and set up, or use VHF, but on other, shorter occasions I leave the rig and computer on in the shack and connect by my phone or tablet for some digital HF work. Surprisingly, WSJT-X is useable on a smartphone screen with some care (and glasses!).

This facility also came in useful, when along with a friend, **Peter G0EYR**, I gave a demonstration to our local radio club in Taunton on digital modes, as the club does not have its own shack.



1

2. Accessing computers without screens or input devices. I really enjoy playing with Raspberry Pis and I have gathered a few now for different projects. Often these projects don't need the screen or keyboard and mouse connecting, and Real VNC provides a convenient way to access their desktop, virtual or otherwise, in order to control them. One example is a Raspberry Pi Zero that my youngest son and I built into an old computer monitor in our kitchen. We set up the Pi to automatically boot and to display a 'family dashboard' – a screen of family information, such as the family calendar, tasks and reminders, family pictures and a daily weather and BBC news feed. It was a glance at our respective day ahead, and such projects are often called 'Magic Mirrors'. From time to time we wanted to change the format of this without connecting up a mouse and keyboard, and Real VNC provided the solution. A similar method is planned for a Raspberry Pi Zero security camera project.

3. Controlling other devices. Until recently my only antenna was a G5RV, tuned with an LDG Z100 Plus auto-tuner on top of my Yaesu FT-891. When you change bands with this tuner, you need to physically press a tune button on the front panel, so remote operation was confined to one band that I had pre-tuned before leaving the house, which could be frustrating. Before installing other antennas, I had researched the possibility of using a Raspberry Pi, on which I ran my digital modes software, to activate a relay connected to this tune button. By doing a small amount of coding in Python, I would have placed a small icon on the desktop, which, when clicked remotely, would activate the tuner after changing bands in WSJT-X. Additional resonant antennas mitigated the need for me to do this and other projects got in the way, so I never completed it, but perhaps one day I will return to it. Of course, some auto-ATUs sense RF and automatically tune the antenna, removing this need altogether. The same principle could be used to switch your rig on and

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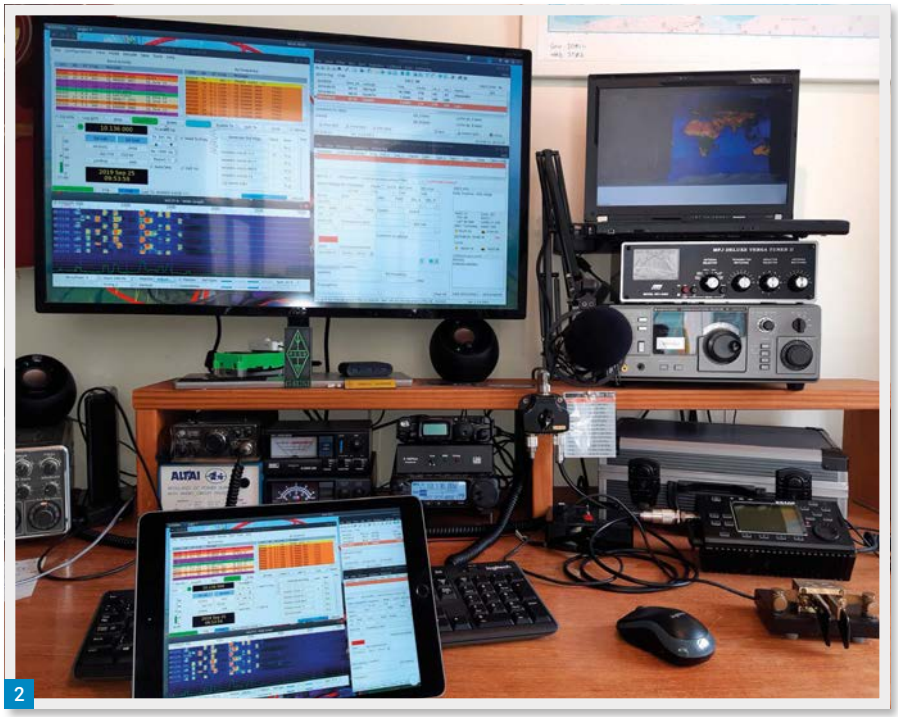
1. The 'Address Book' within VNC Connect, showing the devices I have access to remotely.
2. My two shack monitors in the background, with the iPad showing remote access to them. Note it is zoomed in at this point only showing a part of the main monitor. It is possible to scroll around both shack monitors.



off remotely, perhaps when operating remotely from abroad, activating antenna relay switches and other ancillaries. Many logging programs and other radio software open up further options such as remote rotator control, remote operation of a CW keyer and so on, all of which could be done remotely in the way I describe here.

4. A remote-access SDR receiver. I recently used the IF output from my Xiegu X5105 QRP transceiver to feed SDR software (Cubic SDR for Linux) and also used CAT control. This will now allow me to have access to my own SDR receiver from anywhere in the world at any time, without needing the radio with me. Yes, there are a number of very good Web SDR services out there but if you and your mates or your club want your own, this could be handy.

For this article, I intend to focus on digital modes such as those found in fldigi, WSJT-X or similar. This opens up everything from RTTY, PSK, SSTV, CW, FT8 and so on. It is possible to use some of the techniques I describe to operate by voice too, on SSB or other telephony modes, and I will touch on this later, but I haven't done so myself.

What you need to Operate Remotely

If you operate digital modes already, it is simply a matter of installing and using the correct software on both the shack computer and the device you wish to use to access it. That is just about it! This article is written on the assumption that you already have digital modes set up.

You will already have a computer that is connected to your rig and I will assume that like the majority of digital users, you will have CAT control of the rig, as well as a two-way audio connection of some type between your computer soundcard and your radio. This setup already gives your computer control of your radio, so all that we need to do is set up that equipment in the shack, switched on and running, and access and control it remotely.

The software we use to achieve this is often referred to as 'Remote Desktop' software. If you have worked in a large organisation with computers in the last decade or so, it will be familiar as the software used by your IT Help Desk, located elsewhere, to log in to your machine and take over its operation to fix a fault or problem. In our case we are using the same principles to take remote control of our own shack machine and have access to all of its functionality.

There are a number of propriety brands of Remote Desktop software that allow free use for personal, non-commercial purposes. Two of the most common are Team Viewer and Real VNC. I will focus on Real VNC. This is because it is what I use and it comes installed already on the Raspberry Pi operating system. It is also used by some of the world's biggest corporations. Real VNC have been operating for 17 years and have over one billion installations, so it is a well tried and tested product. If you would like to consider other options, these are nicely set out for you in an article here:

https://tinyurl.com/stk8xw9

Regular readers will recall that I used this process to access the Raspberry Pi in my uBitx Go-Box project in the August and September 2019 editions of this magazine, and in this article I will be expanding on that, showing how it is set up, so that you too can remotely operate.

The Real VNC software is available at this website:

www.realvnc.com/en

A further benefit of this software is that it is available on Windows, Mac, iOS, Linux, Raspberry Pi and Android. This is great because it means that if, like me, you have devices across a number of OS platforms (I have all of the above), you can still use the software seamlessly from any of your devices.

Security

If you are internet-aware, you will know that the internet comes with risks attached, and that it is possible for hackers to remotely access data and information from even large corporations. No one is going to ever guarantee the internet to be 100% secure, but if you have an internet connection already, you are probably managing those risks using firewalls and anti-virus software. In the case of Remote Desktop software, the distributors take security seriously and offer the latest security features, often similar to those that protect you when using internet banking, for example. Real VNC use a cloud-based service with strong security and it is also possible, at the setup stage, to require two-factor authentication as an extra layer of security. So, it is up to you and the level of risk-appetite you have as to whether or not this is for you.

Downloading and activating RealVNC

First of all, you need to create an account, so visit the Real VNC website (see above) and click 'sign-in.' At this screen you will be given the option to create a new account. Enter the e-mail address you wish to use and follow the instructions, selecting 'home' or 'personal use', which allows

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3. A close-up view of the tablet. Pinch and zoom and other touch-screen gestures work as normal.
4. The iPad zoomed-out, showing both main displays.
5. The bar allowing access to tablet keyboard and mouse functions in the bottom right.
6. Cubic SDR software in use as a Panadapter to my Xiegu X5105 and accessed remotely, giving me my own remote 'SDR'.

installation on up to five computers. Please note that at this stage you will be asked to specify an account password. Later, when you download the actual software, you will be asked to specify a server password, which must be different.

Having done that, you will receive a verification e-mail with instructions to get access to your account. By clicking the link, you are taken to a new web page. Scroll down to the 'Home' section and click the 'Activate' button. There is then an optional page where you can make a voluntary donation to help keep the service free.

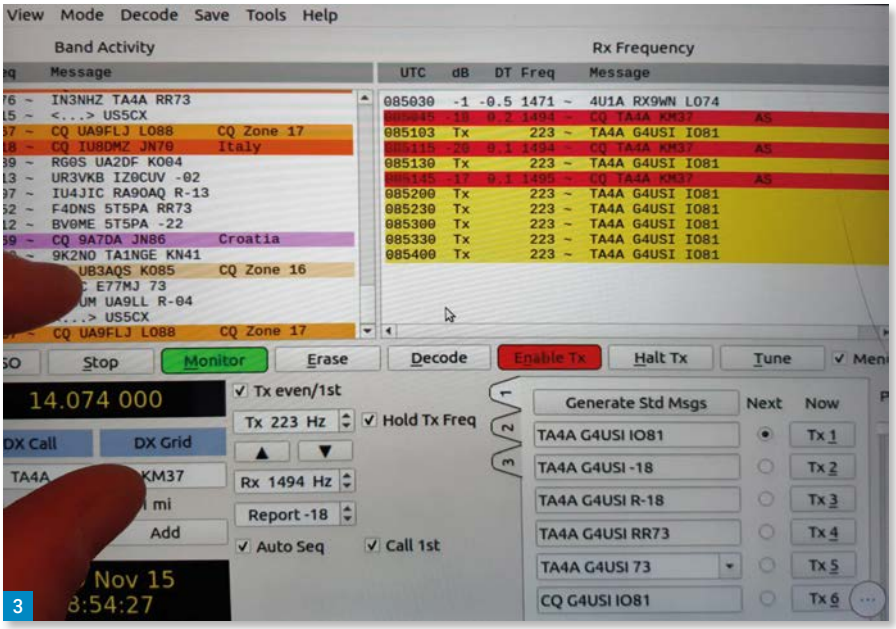
You then receive a further e-mail giving detailed instructions about how to proceed.

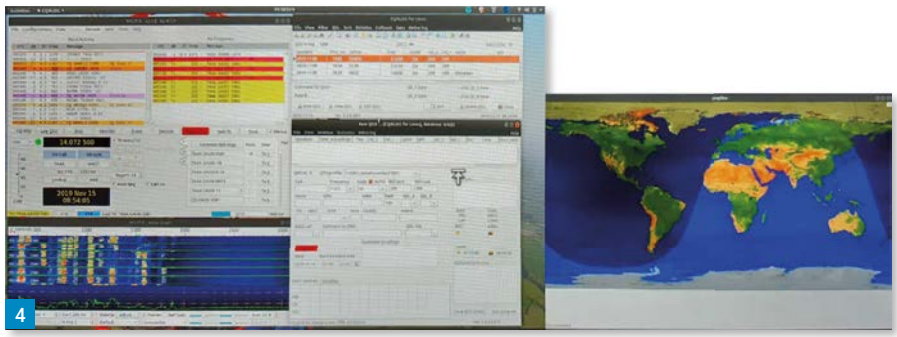
VNC Connect is the brand name for the Real VNC product. You need two separate pieces of software, or apps, to use the product. The first is VNC Server. This is installed on your shack computer, or any other computer that you may wish to control remotely. With a home subscription, at the time of writing, you can add five separate computers to control. The second app is VNC Viewer, which is installed on the device you wish to use to access your shack computer from. Note that it is possible to install both pieces of software on the same computer, giving you flexibility to access that computer remotely, as well as using that same computer to remotely access others.

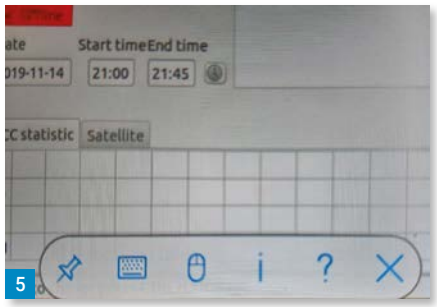
So, fire up your shack computer and visit: https://tinyurl.com/wjwjdsf

Then select your operating system from the list. You will see a big blue download button underneath your selection. Before you press it and download, be sure to take note of any options just below it. The Windows and Linux ones are the ones that currently have options. On Windows, use the default which, at the time of writing is 'EXE x86/x64'. This will run on both 32- and 64-bit machines.

On Linux, the default is 'Generic script x64' and I recommend this if you are using Ubuntu on a 64 bit machine, or use the 'Generic script x86' on a 32 bit machine running Ubuntu. Additional options are available for Debian and RPM Linux OS







users. You can often determine whether your machine is 32- or 64-bit in the 'Help' or 'About' sections of your operating system.

On Mac and Raspberry Pi, there are no options to choose from and, as mentioned earlier, the standard Raspberry Pi OS includes the software already.

In my case, for this article, I am going to be downloading VNC Server on my main shack computer, which runs on 64-bit Ubuntu 18.04 Linux OS, but the procedure should be the similar on other operating systems.

Having created an account and downloaded the software, you will receive an e-mail asking you to verify your address by clicking a button, and, once done, a further e-mail containing a 'get started' link. I won't go into too much detail about this because the instructions provided are very thorough, so it is pointless to replicate them here. The link provides a comprehensive video, as well as written instructions to get started depending on your operating system.

Downloading VNC Viewer your Devices

You then download VNC Viewer on the device(s) you wish to take control from. You can add this on any number of devices and I have it installed on an Apple Mac, an iPad, an Android phone and the two Ubuntu laptops I use for portable work from time to time. You can find the mobile versions in both the Android Play store and the Apple App store.

What is important to note during this process is that you will be asked to create two passwords. The first is for your account and the second is to authorise remote access. They are mutually exclusive and, until you get used to it, it is easy to forget this and use the incorrect password.

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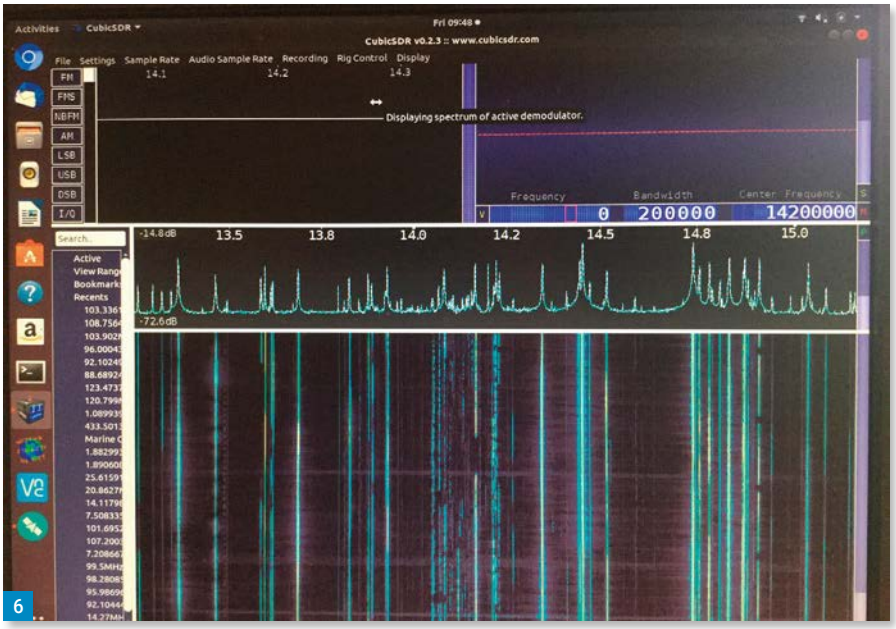

Once in the VNC Connect software, you can add other computers you may wish to control to your 'Team'. You should find that your main computer to which you downloaded the original software already appears. You can now add others, by following the instructions you were sent in the e-mail. In my case this includes my main shack computer, the shack Raspberry Pi, a Raspberry Pi I have built into my uBitx transceiver for digital modes (see my articles last August and September) and any other Raspberry Pis or Pi Zeros that I might want to access remotely or without connecting a separate screen and keyboard.

There is a slight rub here though. The Real VNC website points out that it is not possible to remotely control Apple iOS (phones and tablets) or Android devices from desktop computers – only the other way round. Neither is it possible to listen to audio (assuming the professional subscription) when using VNC Viewer on Android or iOS devices.

Other Users and Licensing Conditions

It is possible to invite other people to share your remote access. On a 'home' subscription, you can invite two other people (three in total) giving them access to use your machine(s) remotely.

On a professional subscription, there are an unlimited number of people who have access, and, additionally you also have the ability to stream HD audio from the remote device to the controlling device. Hopefully, one day soon you will be able to have two-way audio to open up the possibility of remote voice operation using this software. I believe some other remote desktop software already allows this but I am not interested in remote voice operation.

One potential application of the software on a professional subscription basis, might be for a club that has its own shack and equipment, to make this available for members use remotely at all times.

We should be aware of licence restrictions at this point. Other than for your own use, I would strongly encourage readers thinking of sharing access in any way to their shack, to have reference to their licence. I am not an amateur radio licence expert, but my reading of the licence leads me personally to identify the following particularly relevant sections (bold text is my own emphasis):

Section 3(1) Subject to Clauses 1(2), 3(2) and 3(3), the Licensee shall ensure that **the Radio Equipment shall only be operated by the Licensee personally and by no other persons.**

Section 3(2) The Licensee may permit the operation of the Radio Equipment by a person who holds a current United Kingdom Amateur Radio Licence **provided that any such operation of the Radio Equipment is carried out in the presence of and under the direct supervision of the Licensee** and that such persons are made aware of, and of the requirement to comply with, the terms, conditions and limitations of this Licence.

Section 3(5) Only where this Licence is a **Full (Club) Licence** issued to the Licensee for use on behalf of a Club, may the Licensee: (a) authorise any **Club member who holds their own separate Full Licence** to use and supervise the operation of the Radio Equipment on the Licensee's behalf under this Licence.

Section 10(1) **The Licensee may conduct Unattended Operation** of Radio Equipment provided that any such operation is consistent with the terms of this Licence. Additional restrictions which apply to the Unattended Operation of Beacons are specified in Schedule 2 to this Licence.

Section 10(3) This Clause 10 **does not permit the Licensee to install Radio Equipment capable of Remote Control Operation for general unsupervised use by other Amateurs.**

Section 10(4) **Any communication link**s used to control the Radio Equipment or to carry Messages to or from the Radio Equipment in accordance with Clause 10(2) **must be adequately secure** so as to ensure compliance with Clause 3 of this Licence. Any security measures must be consistent with Clause 11(2) of this Licence.

So, it appears that remote operation of your own station **is** allowed, but that use by other licensees **must** be under your own personal supervision. I take this to mean that a fellow licensee, of any class, could use my iPad or computer to access my station remotely as long as I was sat alongside them to supervise, but that I could not allow them to access my station remotely by themselves.

It also appears that a club, holding a full licence, could allow a club member remote access to their station, **but only if they too were a full licensee**, effectively ruling out a significant proportion of club members holding Foundation or Intermediate licenses from using such a remote access facility without direct, side-by-side supervision by a fully licensed member of the club.

Finally, the UK licence also seems to rule out the type of operations springing up in certain parts of the world, where amateurs are erecting 'super-stations' that can be hired by the hour by other amateurs and operated remotely for a fee.

As I said earlier, if you intend to allow others access to your remote station, I strongly advise to read the full text of the license for yourself, and, if necessary, take advice from Ofcom.

Taking control of your New Remote Station

If you are taking control from another computer with mouse and keyboard, it is

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very easy. Open up VNC Connect, choose the computer you wish to control, and enter any password required.

You will then shortly be presented with an exact image of the desktop screen on the computer you are controlling. Using your mouse and keyboard on the accessing computer, you have total control of the remote computer, exactly as if you were sitting in front of it.

This means that you can open and close software, access its storage, work on documents remotely, and of course, take control of your rig!

Taking control from a tablet or phone consists of exactly the same process, but it is likely in this event that, instead of using a mouse and keyboard, you will be using the touch screen. This is actually really straightforward but can seem a little daunting at first until you become familiar with it. You will also be viewing the remote desktop on a much smaller screen, but the software does a really good job of handling this and you can scroll around and resize remotely with no issues.

Indeed, on my shack computer, I have a 32in monitor, usually with two applications open side by side, and also the linked laptop screen. The VNC software allows me to explore and scroll across all that screen 'real-estate' easily, particularly on a touch screen such as my 10in iPad, and you use the usual touch-screen gestures, such as 'pinch' to zoom in.

I guess the biggest issue to get used to is how you replicate the mouse. Well, that is surprisingly easy, by just using your finger to move the pointer, but it is a little more involved to use the mouse buttons and takes a little getting used to. In the lower right-hand side of the control screen you will see a circle containing a line of three dots, **Fig. 5**. Touching or selecting this, reveals a small taskbar with six icons:

The first is a pin. Holding this pin for a moment keeps this little taskbar permanently open on your screen. You don't need to select this, but if you don't, the taskbar will disappear after a few seconds until you open it again.

The second icon is of a keyboard, and touching this brings up the standard tablet or phone touchscreen for use as normal. A small blue, downward-facing arrow in the top right of the keyboard removes the keyboard from the screen once more.

Next is the mouse icon. This gives access to mouse controls as well as any Function Keys on the remote machine. One use for this is in WSJT-X. When operating split and wishing to change your transmit frequency on the waterfall, WSJT-X requires you to press the shift key while left-clicking the mouse on the frequency you wish to use. On a phone or tablet, this is replicated by moving the mouse pointer with your finger, then clicking the up arrow under the mouse icon and tapping the screen where you want to transmit on the waterfall. A further useful feature in this taskbar display is a grey slider to scroll up and down documents. Another small arrow in the top right of this task bar, minimises the bar again.

The 'i' button allows information about screen size, connection speed and other criteria to be displayed and changed, while the '?' button provides more detailed help on mouse control and touch gestures.

Finally, the 'X' button asks whether you wish to disconnect from the remote computer, which is highly recommended at the end of each session.

Adding voice

Adding voice is entirely possible, it is just that I have not tried it (yet!). Perhaps the simplest method is to use Voice Over Internet Protocol (VOIP) software. Again, a lot of different software is available, but perhaps one of the best-known would be Skype. It is possible to install Skype on both the remote and accessing devices, setting it to auto-answer on the remote computer. By using either VOX or CAT PTT control, it is possible to operate on FM, SSB and so on. One issue to be aware of here would be internet connectivity speeds and the risk of lag, but it should be possible fairly easily and many amateurs do this now.

Another project added to my list perhaps. I recently heard that Windows software comes with a built-in remote option that allows for two-way audio. As I am not really a Windows user, I have not explored this, but for those of you who are, you may wish to research it further. It is called 'mstsc.exe'.

Conclusion

There can be many reasons for wanting remote access to your station, either from within your own home or from afar, and using existing proven technologies this is readily possible. Whether for your own pleasure, to share your shack's quiet RF location with friends, or to provide greater utilisation of a club shack, there are plenty of reasons to experiment, and plenty of internet resources. The possibilities are endless, why not give it a go yourself?

Radio Round-up

Yorkshire Floods

North Humber Raynet were activated during the recent widespread flooding in Snaith, East Yorkshire. The River Aire overtopped its flood defences late on the afternoon of February 24th and a multi-agency response team was set up to deal with it. The group received a call out from Humberside Police and British Red Cross staff at the Bronze Command that had been established at the Fire Station in the town.

A temporary control station was established at washlands near the village of East Cowick during the afternoon of February 26th with 13 members attending the developing situation, which eventually lasted over three days.

The call out led to members of the North Humber Raynet being positioned at VCPs (Vehicle Check Points), flooded roads and working alongside Yorkshire 4x4 Response vehicles as well as being located in the local Town Council emergency control centre and at Bronze Command.

Members were also involved in early stages of an evacuation of residents in East Cowick.

Tasks for the group were varied. Initially an informal VHF net was set up in the area around a flooded road, but this later developed into monitoring flood heights. By Saturday this had developed into strengthening the communications network for the local council and the Environment Agency as well as providing radio support to Yorkshire 4x4 Response vehicles. This used a VHF/UHF 'talk through' unit.

Group Controller Andy Russell G0VRM commented that: "The callout was a good example of integration between volunteer groups and other agencies. There were many groups involved. Police and control staff were delighted with our efforts. As a group we are lucky to have a sizeable membership and we had readied further shifts to staff the deployment over several days". The group were finally stood down late in the evening of February 29th as the flooding and the situation stabilised.

XE Mexico

2020 is the 60th anniversary of the founding of the Radio Amateur Association of the Republic of Mexico. ARARM has a special award available to amateurs and SWLs. For amateurs, contact ten special event stations using the 4A60 prefix, on 160 through 6m. The suffixes of the ten special stations are each of the letters of the nine zones of Mexico. The on-air activity, which has already started, will continue to July 26th at 0000UTC. The suffixes of the callsigns spell the word MEXICO, plus N for north, S for south, F for islands of Mexico, A for the official ARARM station, etc. Here are the callsigns: 4A60A, 4A60M, 4A60E, 4A60X, 4A60I, 4A60C, 4A60O, 4A60N, 4A60F and 4A60S.

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South Orkney and More

Steve Telenius-Lowe PJ4DX reports on a busy month on the HF bands.

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

The main DX activity this month was the VP8PJ operation by the Perseverance DX Group, **Fig. 1**. VP8PJ was active from Signy Island (IOTA AN-008, **Fig. 2**) in the South Orkney group, around 1000km south-east of the Falkland Islands, between February 22nd and March 6th. This was a fairly tough one to contact from the UK, though several of this column's contributors managed QSOs on CW, SSB, or FT8. From here in Bonaire, VP8PJ had strong signals on 20m SSB but the size of the pile-ups from both North America and Europe made QSOs on the other bands difficult, and propagation was such that VP8PJ remained unheard here on 10m and 12m. The team made over 83,700 QSOs and in the end I was lucky enough to work them on 10 band-mode slots on all bands from 15m to 80m (other than 60m).

DXpeditions Cancelled and Postponed

One of the difficulties associated with compiling this column around a month before the magazine is published is that of unexpected 'events'. Two of the three DXpeditions I mentioned in the March column, as well as one in the April column, came to nought. The German group planning activity from Djibouti, J2, came up against difficulties with the licensing authority and security agency and therefore cancelled their operation. Instead they are now operating as TO7DL from Reunion Island, FR, as this column is being compiled.

Meanwhile the proposed operation by **Alex 5B4ALX** from West Kiribati, T30ET, was cancelled due to the Covid-19 coronavirus outbreak. Finally, the planned operation from Swains Island, **Fig. 3**, in the Pacific has been postponed until later in the year, also due to restrictions imposed because of the coronavirus (the team would have had to spend 14 days in quarantine in Hawaii before being allowed to travel to American Samoa). The new dates for W8S are September 23rd to October 6th.

swains2020.lldxt.eu

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Friends Reunited

Way back in 1982 when I was living in Sweden I met **George Wagner K5KG**, who had been invited to take part in a DXpedition to Market Reef, OJ0. George needed transportation from Stockholm to the Åland Islands, OH0, and I was able to drive him the 90km to the port and then take the car ferry from Sweden to Åland, where we met the rest of the DXpedition team. I was pleased to help and, as a result of that meeting, **Karl-Erik 'Kee' Eriksson OH0NA/OJ0MA** invited me on the next Market Reef operation in 1983 – my first 'proper' DXpedition. Although I have since had many QSOs with George over the years, I had not met him again until he came to Bonaire to operate the PJ4G station in the ARRL DX Phone contest in March. He also operated as PJ4/K5KG before and after the contest. Thirty-eight years on, we're both a little greyer, **Fig. 4**, but it was great to meet up with George again after so many years!

Readers' News

Welcome to a new contributor to this column, **Tom Brady GW8HEB**, who wrote from Welshpool in Powys to say *"just thought I would drop you a quick message regarding my recent HF activity. I was in the shack on January 31st on 14MHz when I heard IU3BTY very loud and clear. I gave him a quick call with 5W from my Yaesu FT-817 and was really surprised when he came straight back. We exchanged 59 signal reports and I left him to continue calling. After only a few seconds he faded down into the noise, so I feel very lucky that I was in the right place at the right time. I use a very modest 20m half-wave dipole but do have a bit of a height advantage."* I feel Tom may be selling himself a little short. It should be possible to work Italy easily enough even with just 5W to a dipole so I look forward to hearing much more about Tom's contacts in the future.

I received a bumper submission from **Victor Brand G3JNB** this month. He was more than ordinarily active in February and early March and worked some great DX with his low power and verticals. He commented on the storms that battered most of the UK in February: *"Although gyrating wildly, my three verticals survived the horrendous gales and, to the exclusion of all others, I settled down to chase VP8PJ whom I could hear occasionally on 40, 30 and 17m."* Victor had no luck initially but later sent a follow-up: *"Following the tantalising glimpses of the VP8PJ South Orkney signals across 40 to 17m that had kept so many of us glued to our rigs for the past 11 days, at 1245UTC they heard my call on 17m, made just 0.87kHz up! Later that evening, they were a good signal on 10105kHz and I queued for ages but they were enjoying such a splendid 'pipeline' to JA that I decide to try again the following night. However, by mid-evening on the Tuesday, that same frequency was occupied by the new DXpedition TO7DL on Reunion Island who were running their own 'direct line' back to Germany and I almost missed my own call when the operator popped it in amongst the DLs. I worked them and waited. By 2200 they were still there, now very strong and deep into JAs, while the Cluster showed the VP8 and TO on the same channel. Judging by the pile-up and posts, I suspect that many stations had mistakenly logged the TO as their desperately-needed VP8PJ! All was not lost... just before their final closure on Thursday, I was hearing them at 'ESP' level for nearly an hour. At 2245 up came their signal and back came my call. Job done and a fabulous DXpedition passes into our hobby's history."* The VP8PJ team call themselves the 'Perseverance DX Group' and this shows how Victor's perseverance eventually paid off!

He concluded: *"The 9J2LA DXpedition to Zambia heard me on 17m and I looked immediately on QRZ.COM to find a live streaming link via Club Log complete with log check. My call confirmed in two minutes. The wonders of the Web!"* I have summarised Victor's other activity in the 'Around the Bands' section below.

Etienne Vrebos OS8D was also lucky enough to work VP8PJ in the South

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Orkneys. Unfortunately, Etienne was logged as OZ8D but eventually made good QSOs on 20m and 17m SSB. He now has a new Acom 1500 amplifier, which he is using with his Yaesu FTdx5000 and comments that *"it's right that 1kW makes life easier"*! Etienne made nearly 300 QSOs this month with the new setup, including some more great DX.

Reg Williams G0OOF wrote *"As at this time last year I turned to FT8 mode to fill the gap in the past months, with just the odd SSB QSOs along the way. Most exciting band for me on FT8 at this time of year is 10MHz, particularly in the early mornings as the band is beginning to open with JA, ZL, and east coast VK stations being heard and worked. In the evening 7MHz provides lots of east coast USA stations. The additional program which I have mentioned in a previous report is* GridTracker (**Fig. 5**) *which is constantly being updated with improvements and new features by the author. He has good communication with users of the software. This provides a nice visual mapping feature to FT8 etc.*

"Getting towards the end of the month my thoughts turned to the VP8PJ DXpedition to the South Orkney Islands. I was really keen to work them on SSB. Many hours spent with late nights, early mornings and daytime listening to all listed operating bands other than topband. Nothing heard except briefly on 18MHz, where they were very weak and barely audible. Attention turned to FT8 mode and I managed to work the team on 14MHz on the last day of the month in the evening. Looking forward to more contacts, hopefully on SSB during the rest of the time the team are on the island."

Tony Usher G4HZW wrote that *"Conditions on 28MHz show no permanent signs of improvements as yet but there have been some good short-skip openings. On February 11th I enjoyed 37 contacts out of a total of 51 for the whole of the period. Amongst the 51 there were 17 DXCC entities, all in Europe except for PP2RON in Brazil on February 24th. As usual 7MHz was open 24/7 and very crowded most of the time. It's often better during peak times to switch to FT4 where contacts seem to be easier, with a greater percentage of successful completions. 99 contacts during the current period in 32 DXCC entities; KH6M promised to be the highlight until I looked on QRZ.com and found he was in Florida!"*

Our other great 10m band aficionado, **Kevin Stock M0YRX**, sent in news from the '10 Metre UK Net' group prior to their summer challenge, which runs from April 1st to August 31st on 28MHz SSB. In February **Iain MM0TFU** noted 10m SSB openings on the 1st, 2nd and 11th of February and had 53 QSOs with 11 DXCC entities, including V51WH in Namibia, while Kevin himself recorded propagation on the 9th, 11th, 23rd and 25th (when he heard a PY) and worked nine DXCC, all from Europe. Kevin also went out portable in the Mendip Hills and worked stations up to 134 miles away, 'vertical to vertical'. The 2019 10 Metre UK Net summer challenge was won by **Tony M0IQD**, who worked 88 DXCC.

Owen Williams G0PHY says that he *"spent much more time this month in front of the rig listening for DX than in previous months and contacts were made with a number of non-European stations. Most contacts were on 14MHz but I managed a few contacts with US and Canadian stations on 7MHz. I managed to work both DXpeditions to Tanzania, the Italians on Zanzibar, 5I5TT, and 5H4WZ on Pemba Island. Conditions were good for the Caribbean with QSOs with PJ7TM on St Maarten and PJ2/AF4Z on Curacao. The ARRL DX phone contest provided contacts with western states, N7DD in Arizona,*


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K7RL in Washington, K0RF in Colorado and N9RV in Montana. In addition, I worked VE5MX in Saskatchewan and stations from New Mexico and California were also audible. One of the delights of the ARRL contest is turning the power right down and attempting to work the big contest stations and this year was no exception. I managed contacts using 10W with W2RE in Maine and CF3A in Ontario." Owen added that he had low expectations for VP8PJ given the current stage of the sunspot cycle and his low dipole: *"so I was pleasantly surprised that I actually heard them. The propagation was spotty at best and barely above 'ESP' levels but you could occasionally hear the odd word and their callsign and where they were listening. They were audible three days running from February 27th during*

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Fig. 1: The Perseverance DX Group operated as VP8PJ from the South Orkneys for two weeks in February-March. Fig. 2: Panorama of Signy Island, with the British Antarctic Survey base to the left (Photo credit: Ben Tullis from Cambridge, United Kingdom / CC BY https://creativecommons.org/licenses/by/2.0) Fig. 3: Swains Island, politically a part of American Samoa but a separate entity for DXCC. Fig. 4: Steve PJ4DX and George PJ4/K5KG in March, 38 years after their first meeting. Fig. 5: GridTracker screen shot showing stations, including G0OOF, trying to work VP8PJ on 7MHz. Fig. 6: Gordon MM0GOR, with helpers, operating as ZB2BU/P from the Rock of Gibraltar.

the afternoons, the first day they were on 14MHz and then on 18MHz... I was surprised that their signals were not louder as it was predominantly a sea path between here and the South Orkneys, although all the photos I've seen of that part of the world feature mountains. Such are the joys and frustrations of DX."

Kevin Hewitt ZB2GI wrote to say *"I went to the club yesterday to get a few contacts in the log dated February 29th. Two hours later I had made 150+ contacts initially into the UK with a few European stations, then into North and South America, Canada and a station in Barbados."* **Gordon Gray MM0GOR**, **Fig. 6**, joined Kevin and **John ZB2JK** to operate on 20m SSB as ZB2BU/P from the Top of the Rock. Using a Kenwood TS-440 at 50W to a 10m wire connected via a 9:1 balun they made over 50 contacts in one afternoon.

Around the Bands

Victor G3JNB worked some great DX in February and early March: **7MHz CW:** 9Z4Y, SO90PZKA, VY2TT. **10MHz CW:** 4U1A, JT1CO, TO7DL (Reunion), TU5PCT, TZ1CE, VP8PJ (South Orkneys). **14MHz CW:** E44CC, PJ2/NF9V, PJ4/K1TO, ZW8LABRE. **18MHz CW:** 9G2HO, 9J2LA, E44CC, VP8PJ.

Etienne OS8D offered **14MHz SSB:** 3DA0TM, 4L/G4ENL, 5H4WZ, 5I5TT, 6W1/EA4ATI, 9M2YDX, 9Z4Y, C5YK, E44CC, EP2HAM, ET3AA, FG4KH, FG5GP, FM4SA, FM8QR, FP5CJ, FR4QT, FY5KE, JH1GEX, JL2OES, JY5MM, HP9SAM, KL7HRN, VK2VRC, VK9NK, VP2MQX, VP8PJ, VU2XO, YB0AR, YB4FIK, ZD7FT. **18MHz SSB:** 5H4WZ, 9G5AF, E44CC, HH2AA, LU8EMM, VP8PJ. **21MHz SSB:** 5I5TT, PY2UD, ZS1SBW.

Reg G0OOF reports **7MHz FT8:** HI8JSG, KF4JEY. **10MHz FT8:** 9Y4DG, HI3CMM, HK3JHT, JR7AMZ, LU6HR, PY1SLP, TI2CC, R0WBG, RU0LL, VK3AWA, W4MRJ. **14MHz SSB:** 5H4WZ. **14MHz FT8:** TI3RCS, VP8PJ. **18MHz SSB:** 5H4WZ, CN8AM, N8QS. **21MHz SSB:** ZD7FT.

Tony G4HZW worked, on **7MHz FT4:** 4J3DJ, 4U1WB, 9K2OD, 9Y4DG, AA8CS, CO3LC, CU3ED, EA9QD, HF2020PZK, K4RUM, KC1MEY, KC2SZ, KK4ISJ, LW7HA, OL725PLZ, WA3SEE, ZB3M. **7MHz FT8:** CT3IQ, JR7VHZ, K2PS, KB1KR, LU3PI, VK2VAR, ZP/N3BNA, ZW86LABRE. **28MHz FT8:** PP2RON, SN2020PZK, SP90PZK and many other Europeans.

Owen G0PHY reported, on **7MHz SSB:** VY2TT, W3LPL, W3UA. **14MHz SSB:** 5H4WZ, 5I5TT, K7RL, K0RF, N7DD, N9RV, PJ2/AF4Z, PJ7TM, VY2ZM, ZS1OPB.

Kevin ZB2GI offers **5MHz FT8:** AG9S, K3SF, K4CN, K5DZY, N1ADM, N2OO, N8HMG, N9AKR, VE1VOX, VE3RUV, W7UT, W0IZ. **14MHz SSB:** 8P6MD, AA2AS, AB1RZ, AC6MW, AE7KI, CX8TC, KB3ZYB, KP4EYT, NC4MI, NP4L, PJ2BR, PR7AB, PY1LV, PY2COY, PY4AZ, PY5QW, PY8WW, VA2CZ, VE3BL, W8JMZ, WP3ZN, XE1CQ, YV5HNJ, YV5OIE.

Kevin ZB2GI, John ZB2JK and Gordon MM0GOR operated as **ZB2BU/P** to work: **14MHz SSB:** VA3HWC, VE1FA plus 50 Europeans.

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 July issue the deadline is May 11th. 73, Steve PJ4DX.

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Tom Morgan ZS1AFS
zt1tzs1afs@gmail.com

Soldering Coax Connectors (Part II)

Tom Morgan ZS1AFS explains how he puts connectors on 7mm coaxial cable, which wasn't around when Bill Orr (see last month) was writing.

In my early days of amateur radio I only used RG-58 cable. But, as I mentioned, the power limit here in South Africa was raised from 400W to a kilowatt. So, I re-cabled all of my antenna runs with RG-213. And that was a good move. With lower losses and good antenna systems all worked well at Station ZT1T.

Then I came across RG-8X, or Mini-8 coax. I was building a 40m vertical array (two elements). And cost was a consideration, especially as it required two Spiderbeam poles.

So, I thought I'd try Mini-8 – especially as there were rolls for sale at a reasonable price at the UK National Hamfest. **Sue G0EZN/ZS1AFR** questioned buying a reel. *"Are you going to carry that in your suitcase?"*

Of course, I had figured I'd do just that because we normally have two suitcases of 23kg each when flying. Even so, it was going to be logistically problematic.

Fortunately, I took the precaution of buying a couple of packets of coax plugs for 7mm coax. But the problem I discovered later is the internal diameter of the plug screw thread is too big. And the cable is a sloppy fit.

I obtained ferrite beads for the Mini-8 feedline. However, they were tricky to push onto the cable until I bevelled the outer insulation and twisted. Voila! They slid on easily.

However, a test run with a Mini-8 sample and a plug brought up two problems. The first was the cable slid too easily into the body of the plug. The second was with the outer braid folded back over the outer casing – screwing on the plug was quite difficult. And soldering the outer braid through the plug made a mess. And I didn't know what other amateurs do with this type of cable.

After erecting the array, the time to solder the plugs arrived. That's when I was unable to find a simple/standard method in my internet research or on the air. So, this is what I did, using soldering tools and a miniature pipe cutter for the circular cuts. A pipe cutter is a lot cheaper than cable strippers. Follow the steps below with the photos, which follow the same sequence.

1. First, place the outer ring on the cable with the thread nearest the end – in the correct attitude. We know what happens if we don't.
2. Cut away 30mm (or more) of the outer jacket. Do not nick the outer braid.

3. Mark 15mm from the outer jacket with a fine marker and tin quickly from the outer jacket edge.
4. Open up the inner insulation by gently unplaiting the outer braid. Fold this back over the tinned section.
5. Mark the inner insulation 2mm away from the fold in the braid. Remove the insulation from this point to the end of the cable to expose the centre conductor. Do not nick the inner conductor.
6. Tin the inner conductor.
7. Tin over the folded-back braid, which should be in contact with the lower layer. Quickly tin it to prevent melting the insulation. This will ensure a good contact with the body of the plug.
8. Gently screw the plug onto the cable ensuring the inner conductor slips through the hole in the plug. Hold the cable still while turning the plug slowly.
9. Trim the inner connector, if necessary, and solder to the plug tip.

10. Quickly tin the outer braid to the plug body. Beware: The 'holes' for some plugs are much too big to be filled without melting the cable insulation.
11. Finally, screw the outer ring of the plug in place.

Usually, I put insulating tape, or glass tape over the plug/cable point. That gives it more rigidity. I'll be interested in readers' comments.

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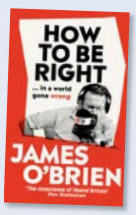

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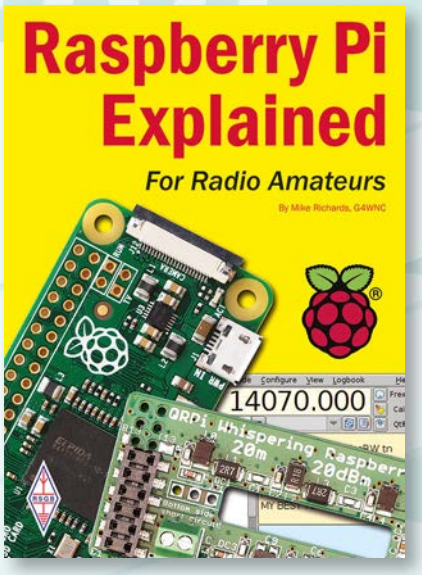
Raspberry Pi Explained *For Radio Amateurs*

By Mike Richards, G4WNC

The Raspberry Pi series of low-cost single-board computers were developed to promote teaching of basic computer science in schools. However, they have become extremely popular and are selling well outside the original target market including in Amateur Radio. Well known expert Mike Richards, G4WNC sets out in *Raspberry Pi Explained* to provide the basics of the Raspberry Pi, alongside making them work in an amateur radio context.



Raspberry Pi Explained guides you through step-by-step instructions to get the Pi working for you. Once you've learnt the basics, *Raspberry Pi Explained* is packed with comprehensive details of the Pi hardware and Linux operating system, including all those hard-learnt tips and tricks you need to make the most of the Pi. Mike also guides you through the installation of many of the popular radio related software packages. Readers will find detail of using WSPR, Dire Wolf, FLDIGI, WSJT-X on a PI alongside Software Defined Radio (SDR) applications such as GQRX, Linrad, Quisk to name just a few. Those without a working knowledge of the Raspberry Pi are not forgotten and they will still find *Raspberry Pi Explained* a vital reference that is packed with tips, advice, projects, programming and much more.

Raspberry Pi Explained is aimed at the beginner through to the experienced. So if you are considering using a Raspberry Pi for Amateur Radio but don't know where to start or perhaps you already have a Raspberry Pi and need help, then this is the book for you!

Size 174x240mm, 208 pages, ISBN: 9781 9101 9384 6
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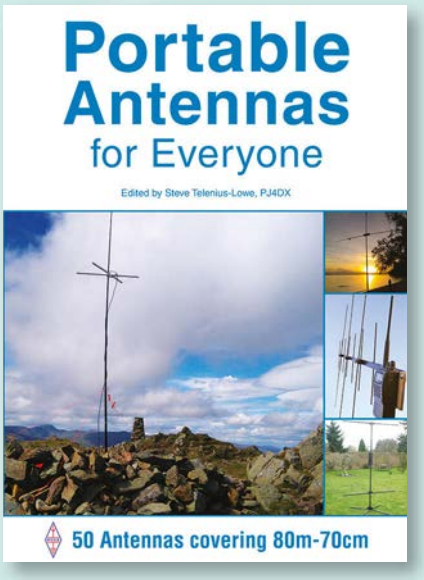
Portable antennas

Edited by Steve Telenius-Lowe, PJ4DX

Portable operating has never been as popular as it is today, thanks to modern, small and lightweight transceivers. But, indoors or outside, any station is only as good as its antenna, and that is where this book comes in.



Portable Antennas for Everyone is broken into sections. Specific designs from around the world are included, starting with a fibreglass pole and a simple 10m length of wire attached to make a quarter-wave vertical antenna for 7MHz. *Portable Antennas for Everyone* continues into verticals designed for use by the ocean and that provide a super-low angle of radiation of just 6 or 7 degrees above the horizon. How to make a vertical dipole array (VDA) is included, and there is advice on kite-supported verticals. There are also designs for HF dipoles, doublets and making your own lightweight HF beams. VHF and UHF antennas are not forgotten: the book includes a dual-band Yagi for satellite working, collapsible 2m and 6m beams, a roll-up J-pole, a 70cm Lindenblad antenna and a dual-band beam made from tape measures. You will also find reviews of commercially made antennas for portable operations. These include the Spiderbeam, the ultra-lightweight Hexbeam, the folding Hexbeam, and the all-band 'SuperStick', and much, much more.

If you are suffering from high domestic noise levels at home, operating portable from the countryside can be a real revelation. Often there is no local noise whatsoever and you find you can copy S1 signals with ease. *Portable Antennas for Everyone* allows everyone to get on the air while experiencing the great outdoors!

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An 80m AM Class E Transmitter

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

Eric Edwards GW8LJJ describes an 80m AM transmitter with two fixed frequencies and a VFO.

This is a transmitter with high efficiency for amplitude modulation (AM) transmissions. Before anyone reminds me that this is an old form of modulation and now been superseded by SSB it could argued that SSB (which is derived from AM) can be considered as superseded by digital modes. Amateur radio, however, is about communication and experimentation and all types of modulation, within legal limits, are allowed and indeed used. This is a project that can be built by anyone that has a reasonable amount of RF constructional skills and knowledge and is prepared to set it up with the use of a scope and a meter (preferably analogue types for both).

The transmitted output is derived from the VFO with no mixing or specialised filtering before any amplification stages as with SSB transmitters so the construction is relatively straightforward. The output power is determined by the PA voltage, and for low power, 12V will be suitable but by increasing the voltage to 24V the power output will be four times (twice voltage and twice current). I suggest using the PA at a maximum of 24 to 28V, which will be a good power out and not cause any problems of RF getting back into the oscillator section, so no special screening or similar measures will be needed other than making sure the earth is where it should be so as not to create earth loops. Doubling the power output will only be an increase of half an 'S' point anyway!

There is a large following of AM nationally and internationally and a group, VMARS (Vintage and Military Amateur Radio Society), along with others are currently transmitting AM on 80m and other bands along with many AM stations heard on the 160m band. Several are using homemade transmitters and many are using Class E designs.

This transmitter is complete and just needs suitable PA transformer wire and capacitors (mentioned in setting up). A modulator (a series type) is also needed and several are available in kits that can be seen on the non-commercial website (S9Plus, URL below) owned by **Dave GW4GTE**. The modulators shown there are designed for this type of PA and are connected in series with the PA HT supply. The transmitter to be described contains the local oscillator, PTT control, FET drivers and the power FETS along with the Class E type PA tuning for coupling to the antenna. This Class E design uses a VFO at the transmitting frequency so no doubling or mixing of the oscillator is needed. It has two fixed frequencies, 3.615MHz and 3.625MHz, along with a VFO that covers the 80m band. A 160m version can be made with two fixed frequencies, 1.977MHz and 1.908MHz along with a VFO that covers the 160m band

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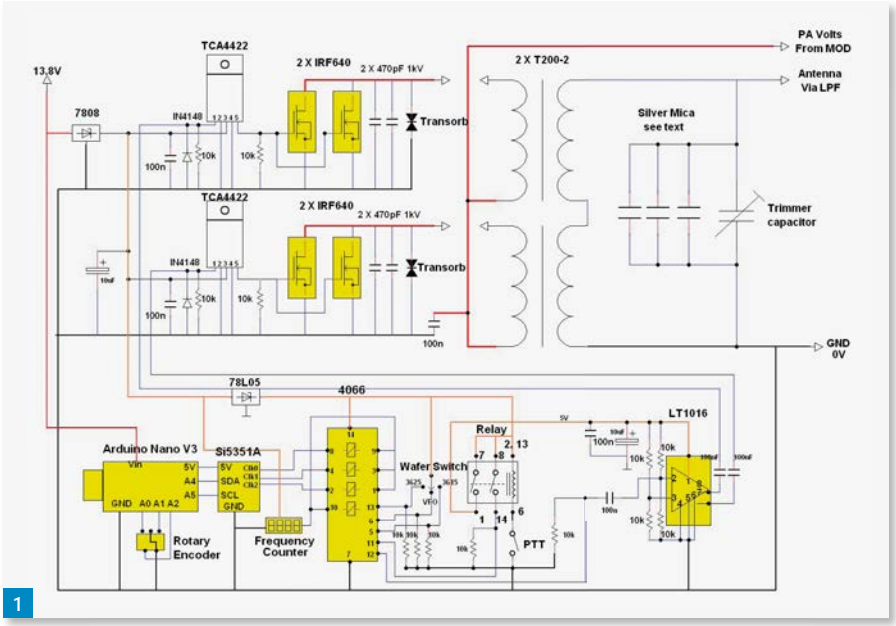

Fig. 1: Circuit diagram.

Class E

There many classes of emission types for PAs, and are given letters A, B, C, D, E, F and so on. They differ in the biasing arrangement of the devices and output tuning methods. Class A is biased mid-way so that it is always on and the input signal is allowed to cycle both positive and negative peaks without distortions or clipping, making it very linear but at the cost of efficiency. Many will recognise Class AB as that used in an SSB 'linear amplifier', which means the amplifier is biased between class A and class B. Both these types of amplifier are very inefficient when compared to a Class E amplifier, which is a switch and is either on or off so there are no heat losses because the devices in the amplifier are not working in the linear region of their characteristics.

Dave GW4GTE describes the Class E action (taken from his website) as follows: *"This type of amplifier achieves high efficiency due to the fact that when ideally tuned there is no appreciable time overlap between the above-zero voltage applied to the FET drain and the above-zero current flowing through it. Obviously, there must be volts for current to flow – the flywheel effect of the PA tuning produces this. The point is that when the FET changes state from on to off or vice versa, the source-drain voltage is almost zero, so no appreciable power is lost as heat as the FET switches. To achieve this, the PA is tuned for the required phase relationship between Voltage and Current. There must be a reactive element present to achieve this, so conventional resonance tuning resulting in a purely resistive impedance transformation won't work. The question then is how to establish the correct tuning point. The correct tuning point is reached when the circuit is working at its maximum efficiency for a given power level".*

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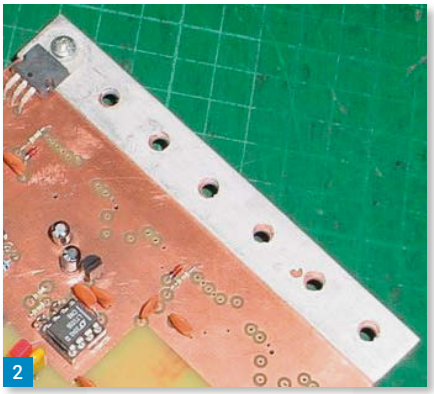

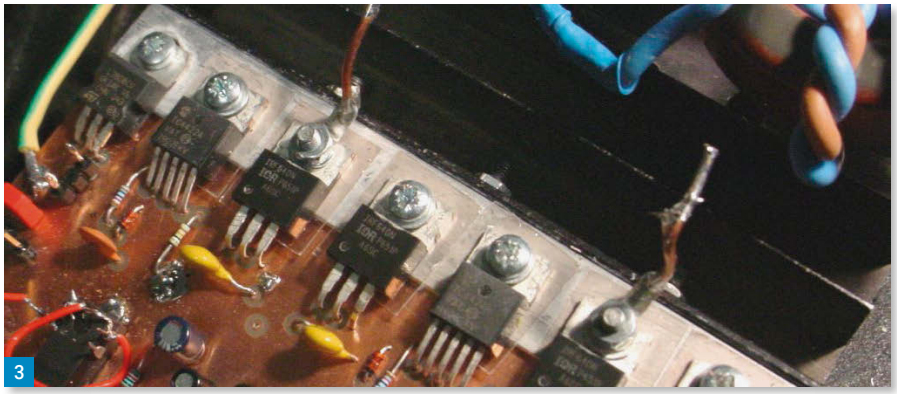

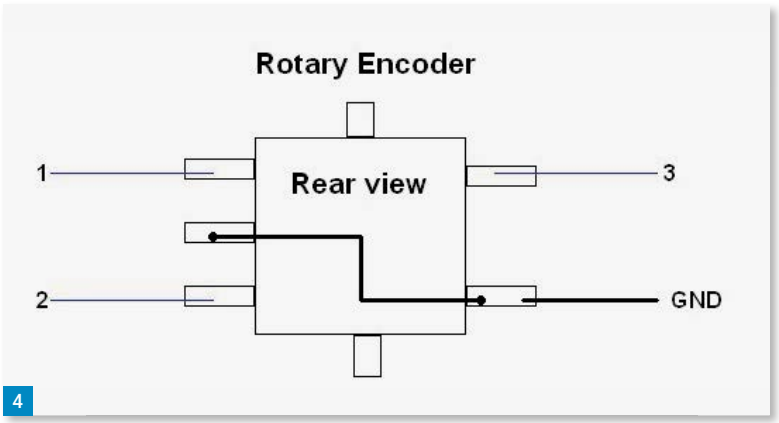

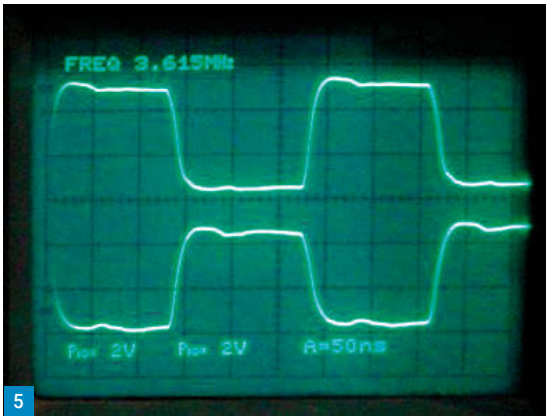

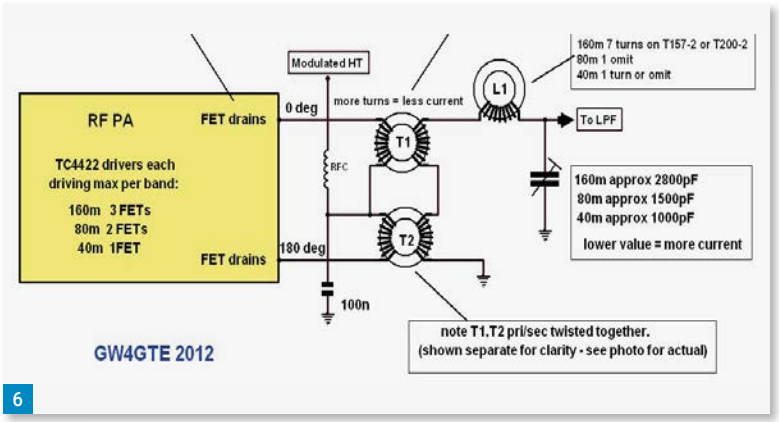

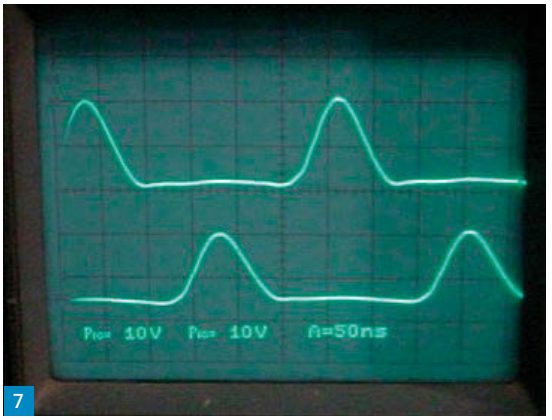

Fig. 2: Showing placement of 7808 regulator, etc.
Fig. 3: The output FETs in place.
Fig. 4: Connections for rotary encoder.
Fig. 5: Checking pre-transmit waveform.
Fig. 6: Toroid windings and suggested capacitor values.
Fig. 7: Waveform between FETs and toroids.

The Circuit

Fig. 1 shows the circuit in full and is a complete RF transmitter that only needs a suitable series-type modulator to make it a very efficient and quality AM transmitter. The output power to the antenna is controlled by the PA voltage and the drive remains the same whether it provides 4W or 400W of modulated RF power. The oscillator is a VFO but it also has two fixed frequency outputs so that a quick change from one dedicated AM portion of the band can be quickly selected and a provision is made for tuning anywhere in the band with the VFO position.

The oscillator is a programmed Arduino Nano module and it controls the three oscillators of the Si5351A module. Both these modules are programmed and calibrated before sending out as a kit or parts of the kit. Calibration is needed for each pair of modules so they will be sent as a pair. The outputs of the Si5351A module, clk0, clk1 and clk2 are connected to a quad bilateral switch (4066), which is used as the switching for the fixed frequency and VFO selections and as the PTT (Push-to-Talk) control. The frequency selection is carried out with a three-way rotary wafer switch and the selected output from pin 12 of the 4066 is taken to the comparator LT1016 where the input signal is converted into precision complementary outputs to drive the FET Drivers (TCA4422).

The square waves at the gates of the drivers need to be exactly 180° to each other otherwise the modulation sidebands will not be symmetrical and the modulation levels will be different on both sidebands.

These TCA4422 drivers present good switching waveforms to fully turn on and off the FETs. Other Class E designers use twice the VFO frequency and a divider (such as the 74HC74) to produce the complementary outputs at the transmitting frequency. This design uses the VFO at

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transmit frequency so no twice frequency is used. The output of the 4066 at pin 11 is connected to a 'reed' relay along with the 5V supply for the comparator LT1016. This is the PTT that is operated with an SPST (Single Pole Single Throw) toggle switch. The 5V to the comparator, along with the output from the 4066, is switched with the relay to ensure reliable switching with no floating signals appearing at the PA from the oscillators during standby.

PA Output Network

The PA output has a pair of IRF640s (branded IR types) in parallel on both sides and is operated in push-pull. Using this method of output provides a four-times increase in power over a single FET and greatly attenuates the even harmonics. The outputs of both pairs are connected to the toroid transformer. There are actually two transformers (two T200-2 toroids) and each of the primaries is driven by one pair of FETs (IRF640) in antiphase so the primary windings are in opposite phase to each other. The transformer secondaries are wired in series with one winding reversed for the outputs to combine in phase. This reads more complicated than it is in practice. The transformers also provide the conversion of low output impedance of the FETS (approximately 5Ω) up to 50Ω. It is important that the antenna is resonant at the transmitted frequency and is the correct impedance. This PA is different to the usual PA 'tank' circuits and the method of loading the PA into the antenna is not the normal 'tune for maximum smoke' but by adjusting the phase relationship of the voltage and current to achieve the maximum efficiency as explained by Dave earlier.

Transformer Connections

The 7808 regulator tab, FET tabs and driver tabs are connected to the PCB, which has aluminium 'angle' placed on the top of the PCB, **Fig. 2**. Holes (4mm) are drilled to align with the holes in the PCB (4mm holes have been drilled in the PCB) so that the aluminium is sandwiched between the Regulator, FETs and Drivers. The other part of the angle aluminium is to be attached to a suitable heatsink. Mica insulators are fitted between the tabs of the FETS and drivers and the aluminium to insulate it from the metal. The regulator can be fitted without a mica insulator because the tab is electrically connected to ground (0V). Two of the FETs are used for the connections to the coil (transformer), see **Fig. 3**. A solder tab is used for this and it has to be isolated from the PCB and angle aluminium. The plastic turrets, as supplied with the mica insulator pads are to be placed from the underside of the PCB for the two FETS the solder tabs of which will be used for the transformer connections. The plastic turret is entered from the underside of the PCB, feeding through the aluminium angle and the mica washer and finishing through the hole in the FET. A washer and nut secure the FET and after checking for no shorts between the FET tab and the ground, fit a solder tab and secure with a nut. The other turrets can be fitted from the top of the other two FETs going through the mica insulator, angle aluminium and passing through the PCB and the drivers. Again, see Fig. 3.

Modulation

This transmitter is designed to be used with a series modulator, which is a placed in series with the PA power supply. The usual valve type modulator employing plate modulation cannot be used with this transmitter because of the higher current drawn in the secondary of the modulation transformer compared with that used with valve transmitters. This solid-state PA can draw ten or more Amps with peak modulation but at a relatively low voltage compared to valve PAs where voltages used are in the hundreds but where the current drawn is usually in hundreds of milliamps. The modulation transformer's secondary windings will not be able to withstand many Amps as used with this transmitter. Typical modulators are audio-type power integrated circuits followed by a set of power transistors. The power transistors are acting like series resistors in a power supply and this is where the heat is dissipated. A better modulator is a digital type such as pulse width. This is more efficient and because it is using FETS switching on and off (like in the PA) less heat is dissipated as wasted energy. See **Ref. 2** for suitable modulators.

Low Pass Filter

A resonant antenna and antenna tuning unit (ATU) may be all that is required to suppress any harmonics radiating from the transmitter using this PA but having a low pass filter (LPF) is a sure way of greatly reducing any harmonics. This PA is in a push-pull arrangement, which means the even harmonics are greatly attenuated so the LPF only need to remove the third harmonics along with any odd harmonics.

Setting Up (preliminary)

With all the components fitted on the PCB, the oscillator fixed frequencies and the

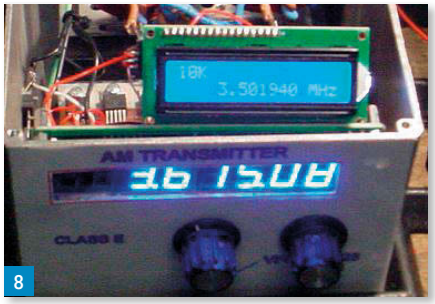

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Fig. 8: LCD or LED options for reading frequency.
Fig. 9: The completed transmitter, with modulator.

VFO can be tested before applying the PA voltage. Connect the frequency counter to the 'counter signal' pin 1 and pin 2 is the ground connection. Connect the rotary encoder switch to the connector marked 'rotary encoder' with the connections as in **Fig. 4**. Connect the frequency selector wafer switch to the PCB pins marked C0 for the VFO, C1 for 3615 and C2 for 3625. The common of the switch is connected to 5V. Connect the 12V (or shack 13.8V) to the connector labelled 12V with the positive to pin 1 and negative to pin 2 (ground). Apply the 12V and the selected frequency should be seen on the frequency counter.

Pre-Transmit

Remove the 12V and connect the scope probe to pin 1 of one of the TCA4422 ICs. If you have a dual-channel scope, connect the probes to pin 1 of each of theTCA4422 ICs. Set the scope probes to x10, the scope 'Y' setting to 2V and the 'X' timebase setting to 50nS. Apply the 12V and when the frequency has settled (looking at the counter) switch the PTT to transmit (but DO NOT apply the PA voltage). The waveform on the scope should be as **Fig. 5**. This has to be correct before proceeding any further because it provides the correct switching waveforms for the FETs.

Setting up the PA

Before applying the PA voltage make sure that there is no connection to ground from any of the FETs or the metal tabs of their drivers. These are insulated by the mica washers and plastic turrets that pass through the holes in the metal tabs of the

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devices. The metal tab of the 7808 regulator is the only one that is allowed to have a connection with the ground. If all is fine, connect a power meter and 50Ω dummy load to the antenna socket and place scope probes (set to x10) on the drains of each of the FETs with the solder tag connecting the output transformers. Connect a power supply with at least 10A current capability and a variable voltage control to the PA 'from modulator' terminals and set the output to 5V. This is a low voltage and is advisable for the initial test. An analogue voltmeter can be connected to the PA voltage terminal and if the power supply does not have a meter to monitor the current, then an analogue ammeter can be connected in series with the terminal and the power supply. Analogue meters are better here because they react faster than digital types in case of sudden increases in voltage or current. Digital meters can also suffer from RF getting into them and creating false readings. The RF can create rectification within the meter and produce voltages that are not otherwise there.

PA Toroids and Capacitors

The toroids used are two T200-2 types. These are red with a grey (or neutral) underside. For 80m there needs to be seven or nine bifilar turns on each one. The wire used is mains power cable type (15A). **Fig. 6** shows the windings on the toroid along with suggested value capacitors fitted across the output (antenna). L1 can be omitted for the 80m band and the variable capacitor can be a domestic broadcast valve radio type, either single, double or triple gang, or can be a 'postage stamp' type trimmer of about 100pF or greater. The voltage is low at this point as the impedance is 50Ω. The other fixed capacitors should be silvered mica types.

Winding the transformers is by placing a length (about 1.5m) of the blue and brown cables after stripping it from the grey outer sleeve and disposing of the bare earth wire, in a bench vice. The other ends can be pushed into the jaws of a power drill and turned on to provide a slow twisting of the cables. Twist until it is even and not too tight. You will need two lengths of this, one for each toroid. Take the first length and wind through the toroid nine turns remembering that one through wire is one turn. Leave enough wire at all four ends to be connected later. Repeat the operation with the other cable and toroid. Connect the primary and secondary windings as per Fig. 6.

Keep it Low to Start

The waveform seen on the scope when the two probes are connected on the tabs of the drains of the FETS that are connected to the toroids will look like **Fig. 7** when set up correctly. Note the slight fall off on the lagging edge.

To test the output stage it will be prudent to keep the PA voltage low and to start by using 5V. This will check if all is working correctly and at this voltage measured at the PA (modulator) voltage terminal it should be drawing about 1.5A. The power output on the meter will be approximately 5W. This is for a correctly tuned PA.

Increase the PA voltage to 10V and the current will increase to approximately 3A as expected, with the power now at 20W. You can see by doubling the voltage, the current will double and consequently the power output will be four times. Setting the voltage at 23V on my unit, the current drawn is 7.5A. This equates to an input power of 172.5W. The power output is reading 156.2W so the efficiency is 156.2/172.5 × 100 = 90.5%. Taking the voltage to near 30V, it will be drawing about 9A and the output power will be in excess of 225W.

When using this with a series modulator, the PA voltage will need to be set at half the PA voltage, which is quarter of the RF power. It will peak to the full output power (four times) when fully modulated at peaks.

The PCB

The PCB is double-sided and contains all the parts up to the T200-2 toroids. An A4 size print will be sent out with any parts ordered or just the PCB. As with standard RF procedures there are rivets pre-fitted to connect the top layer ground plane to the bottom tracks where required.

Other Bands

It is possible for this design to work on other bands up to 40m. This will involve a change in the programmed devices and a change to the output toroid windings. I can supply a programmed matched pair of Arduino Nano and Si5351 modules along with information about the PA transformer details for 160m.

LCD Option

An LCD can be used in place of the seven-segment display to read the VFO frequency, **Fig. 8**.

The seven-segment frequency meter reads the selected fixed or VFO frequencies but the LCD option only reads the VFO. This can be useful in that when the transmitter is used in any of the fixed frequencies, the VFO control can be rotated to select any frequency in the 80m band and the LCD shows this preselecting of the VFO frequency. The LCD uses a two-line display (1602) with the top line showing the rate of tuning step change, 100kHz, 10kHz, 100Hz or 10Hz, by depressing the rotary control switch. If this is used without the seven-segment frequency counter, LEDs can be fitted on the frequency change switch via suitable current limiting resistors (220Ω) to show which fixed frequency has been selected.

Is there a Kit?

A full kit is available with the PCB and all the parts to be fitted up to and including the toroids (except the aluminium angle) along with a picking list. This details the availability and cost of all the parts that are to be fitted on the PCB, which is also included in the list. This is appropriate if you have some of the parts in your 'junk box'. I am not supplying the output network wire for the toroids or the capacitors, neither fixed nor variable.

The author's completed unit, with modulator, is shown at **Fig. 9**.

References

1. Software for programming the Arduino Nano, Ray G7BHQ
2. Modulator and other related Class E information, Dave GW4GTE via the website
www.s9plus.com
3. Parts 'picking' list, Eric GW8LJJ (e-mail address at top of this article)

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Special Interest Societies

Colin Redwood G6MXL
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This month **Colin Redwood G6MXL** looks at societies that focus on a particular aspect of our wide-ranging hobby.

In addition to local amateur radio clubs and societies, which I looked at last month, there are numerous others that provide information and support to radio amateurs interested in a particular aspect of our wide-ranging hobby. Many of these groups provide specialist services to their members by organising conventions and contests. Some supply specialist components and other hardware to support their members build projects described in their journals.

Several of the groups have a 'Groups-IO' presence on the internet, enabling members to exchange information and views with fellow members.

In looking at a number of these specialist societies, I am aware that I am missing out several others, for which I apologise. Space doesn't exist to do justice to every special interest amateur radio society this month and, in the case of 'award-orientated' organisations such as Worked All Britain (WAB) and Summits on the Air (SOTA), I've already mentioned them in previous *What Next* columns. I will look at others on another occasion.

The membership subscriptions are correct according to the relevant organisations' websites at the time of preparing this article in late February 2020. These are subject to revision from time to time and may change as a result of the recent changes to UK postage rates.

G-QRP

As its name suggests, the G-QRP club is aimed at those who enjoy constructing and operating low power equipment. The club was founded in 1974 by former *PW* author **Reverend George Dobbs G3RJV** (now sadly silent key), and currently has a worldwide membership of around 4000. The G-QRP club publishes *SPRAT*, **Fig. 1**, a quarterly magazine that contains numerous construction projects and news from members. An archive disc is available covering the first 172 issues (over 40 years) of *SPRAT*. The G-QRP club organises a number of activity periods and offers a number of operating awards. The club also stocks a range of components, books and kits for sale to its members. Annual membership costs just £6 to those in the UK. Outside the UK, worldwide membership is available

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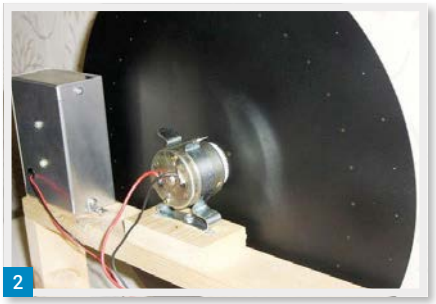
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Fig. 1: The front cover of a recent SPRAT from the G-QRP club.Fig. 2: A Nipkow Disc used for Narrow Band Television.Fig. 3: A Narrowband Television Test Card.Fig. 4: The front cover of a recent Six News from the UKSMG.Fig. 5: A typical cover of OT News from RAOTA. Fig. 6: Two members of BYLARA at an exhibition.

from several international representatives in local currency or direct from the UK at prices up to £13 per annum:
www.gqrp.com

In addition to *SPRAT*, the G-QRP club also offers members an internal QSL bureau and runs a number of QRP activity periods, on World QRP Day and over the Christmas/New Year period. These aren't contests, but the 'best' log wins a trophy. The club organises an annual Convention, which is currently hosted by the Telford Rally, usually held in September, and in 2020 there will be a second G-QRP Convention in Scotland. I should also mention that the Yeovil Amateur Radio Society also runs an annual QRP Convention, usually held in April each year. The convention features a number of lectures besides a range of exhibitors offering items likely to appeal to QRP enthusiasts.

BATC

The British Amateur Television Club (BATC) is another club whose name is self-explanatory. BATC covers all aspects of fast-scan television from video cameras to transmission and reception. The quarterly magazine *CQ-TV* has plenty of articles on ATV transmitters and receivers for the various microwave allocations and reduced bandwidth digital techniques for the UHF and VHF bands.

The BATC organises conventions known as CAT (Convention for Amateur Television) at locations around the UK. In 2020, CAT 20 will be held over the weekend of October 24/25th at the Midland Air Museum in Coventry. It will include lectures and discussion/fix-it time on Saturday afternoon and Sunday morning, followed by the BATC general meeting on Sunday afternoon:
www.midlandairmuseum.co.uk

Annual membership subscriptions are £8 for UK cyber-membership (where you download *CQ-TV*) and £20 for the hard-copy version. Some back issues are available to BATC members.
www.batc.org.uk

NBTVA

Keeping with the television theme, the Narrowband Television Association (NBTVA) is devoted to all aspects of early television. Its members' interests include the history of the origins of early television, restoration of original equipment, construction of replica mechanical television apparatus, **Fig. 2**, conventional electronic circuit design and construction. These days it also encompasses personal computers and software associated with the display and production of low definition television.

The NBTVA has a range of signal sources available for members including test cards, **Fig. 3,** on CD and programmed into

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EPROMS. NBTVA members receive a newsletter that lists other items for sale to members. UK membership is available for £10 (£10.50 via Paypal) per annum or £5.50 for those opting for a cyber subscription.

www.nbtv.org

BARTG

The British Amateur Radio Teledata Group (BARTG) is essentially a web-based organisation aimed at radio amateurs around the world interested in RTTY and other data modes. These days, there is no membership as such, so if you enjoy data modes such as RTTY and PSK31, feel free to participate in their contests. BARTG run four contests per annum. The Sprint is a 24-hour duration contest while the HF is BARTG's principal 48-hour contest of the year. There are two four-hour 75 Baud contests, one in April and one in September, which are growing in popularity each year.

BARTG has an extensive award scheme, including one for making contact using PSK31 with 40 different DXCC countries. There is a special award to mark the 60th anniversary of BARTG, for working GB60ATG using any of the popular data modes (RTTY, PSK31, FT8, FT4 and others). GB60ATG is active from various parts of the UK during 2019/2020 until June 29th 2020.

http://bartg.org.uk

6 Metres

The United Kingdom Six Metre Group (UKSMG) aims to encourage 6m activity in all countries throughout the world. The Group has assisted with the supply of beacons and equipment worldwide. Another important function of the group is to provide financial donations to 6m DXpeditions activating new countries. The group runs an annual Sporadic E contest, held in early June each year, and summer and winter marathons. *Six News*, **Fig. 4**, the Group's quarterly newsletter, has sections of members' radio contacts and reviews of new 6m equipment. Subscriptions for UK members are £15 for those wanting a hard-copy version of *Six News* or £10 for worldwide digital membership.

www.uksmg.org

Microwave

Founded in 1999, the UK Microwave Group (UKuG) has been the representative voice of UK amateur radio microwave enthusiasts since 2004 when the Radio Society of Great Britain (RSGB) disbanded its own Microwave Committee. As a result, the UKuG took over the former RSGB Microwave Newsletter and, from July 1st 2004, published it as Scatterpoint, which was the name of Group's own original quarterly newsletter up to 2003. Scatterpoint continues to be available to members via downloads over the internet.

The UKuG continues to celebrate its growth and success as the representative voice of amateur radio microwave enthusiasts in the UK. The Group is affiliated to the RSGB and, through the Group Committee, works closely with the RSGB Spectrum Forum. The Group is not dedicated to any one mode or band and is certainly interested in promoting satellite, wideband, ATV and data as well as weak signal operation. So, in some aspects the UKuG complements AMSAT-UK and the BATC.

The UKuG organises a series of regional 'round-tables' throughout the year, which enable microwave enthusiasts to get together. These events are a mix of talks about activities in the GHz frequencies and socialising. Usually some specialist test equipment is available, enabling visitors to make measurements of power, frequency, noise and so on at various frequencies above 1GHz, up to 10 or 24GHz and sometimes higher.

The UKuG also organises a series of contests throughout the year, designed to complement those organised by the RSGB VHF committee.

www.microwavers.org

AMSAT-UK

AMSAT-UK is the UK society that supports UK amateurs in making contacts through the various amateur satellites. While many members will see the quarterly magazine as their main membership benefit, the real benefit is the financial and practical work that AMSAT-UK provides to the building and launching of satellites for the Amateur Satellite Service. AMSAT-UK also sell a range of hardware to help members get started on satellites. Any money that is surplus to the production of its quarterly magazine is used to support the Amateur Satellite Service, including, for example, Funcube-1 (AO-73). AMSAT-UK organise an annual convention, which in recent years has taken place alongside the RSGB Convention in the autumn.

https://amsat-uk.org

RAIBC

Amateur radio can be a wonderful hobby for those with disabilities to make the most of their abilities. Established in 1954, the Radio Amateur Invalid and Blind Club

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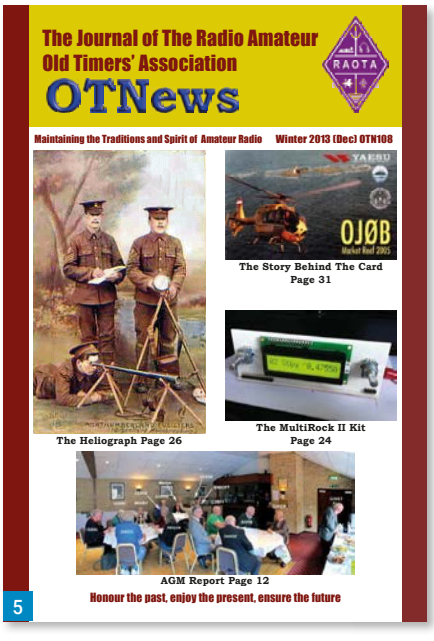

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(RAIBC) is a national society and charity, dedicated to supporting radio amateurs and shortwave listeners with disabilities. The club is a UK registered charity and is run and managed by an elected committee of members of the RAIBC, representing the wide range of abilities and talents found within its ranks. The RAIBC can provide audio versions of several publications, including Practical Wireless, RadioUser and RadCom, to members having low or no vision, or are text disabled or have a learning disability for which you may be required to provide proof of disability from a GP or consultant.

RAIBC has some equipment for loan to disabled members. In some cases, the equipment may have a voice synthesiser chip fitted for blind or partially-sighted members, or may have other modifications to facilitate use. Membership of RAIBC costs £10 per annum for disabled members, and £12 for supporters (non-disabled) members.

The RAIBC is reliant on donations of money and equipment. Details of how to donate or join the RAIBC can be found at: www.raibc.org.uk

RAYNET

RAYNET was formed in 1953 following the severe East Coast flooding, to provide a way of organising the valuable resource that amateur radio is able to provide to the community. Since then, it has grown into a very active organisation with around 2000 members, providing communication assistance to events such as sponsored walks every year. In addition, RAYNET provides support to both the statutory and volunteer emergency service organisations.
www.raynet-uk.net

RAOTA

The Radio Amateur Old Timers' Association (RAOTA) seeks to keep alive the pioneer spirit and traditions of the past in today's amateur radio world by means of personal and radio contact, while being mindful of any special needs. All members receive *OT News*, the association's quarterly magazine, **Fig. 5**. I find the antenna projects in *OT News* particularly interesting – many of which use balanced feeder. Those interested in the history of radio will usually find an article or two of interest in each issue of *OT News*. For those with limited eyesight *OT News* is also available on a variety of audio media. A sample copy of *OT News* is freely available for download from the RAOTA website.
www.raota.org

Two categories of membership are available. **Full Membership is o**pen to anyone who has been actively involved in amateur radio for over 25 years. You do *not* need to have held an amateur radio licence for the whole of that period of time, or even to have held one at all. Alternatively, Associate Membership is available for those who have been actively involved in amateur radio for a shorter period of time. An archive disc of issues 1 to 131 of *OT News* is available and can be thoroughly recommended. For those interested in antennas, RAOTA publishes a series of five books of *Proven Aerials and Related Subjects*.

BYLARA

The British Young Ladies Amateur Radio Association (BYLARA) was founded in April 1979 to further YL operating in Britain and so promote friendship, stimulate interest and, in particular, encourage good operating techniques and courtesy to all operators at all times. Like most of the organisations here it is affiliated to the RSGB. BYLARA organises get-togethers with fellow members at various rallies, **Fig. 6**. It produces a quarterly newsletter and has an award scheme. BYLARA also runs activity days on the 6th of each month.
http://bylara.org.uk

Radio Round-up

Dayton Hamvention Names 2020 Award Winners

Despite this year's cancellation, Dayton Hamvention has named five radio amateurs and one ham radio club as the recipients of its 2020 awards.

Yasuo 'Zorro' Miyazawa JH1AJT was named Amateur of the Year. Licensed in 1964 at age 15, Miyazawa became interested in DXing and, later in his life, international humanitarian activities. He was inducted into the CQ DX Hall of Fame in 2015. His many DXpeditions focus not just on handing out contacts but cooperating with the local population to implement needed humanitarian activities. In 2010 he established the Foundation for Global Children (FGC). "His efforts have helped revolutionize education in Japan by creating the learning systems for children who had difficulties in ordinary schools because of dyslexia, developmental disabilities, and other issues", the Hamvention Awards Committee said.

Jordan Sherer KN4CRD of Atlanta, Georgia, is the recipient of the Hamvention Special Achievement Award. A software engineer by day and digital amateur radio operator by night, Sherer started his journey into amateur radio in 2017, exploring PSK31, JT65, and, later, FT8. Fascinated by the ability to connect with others using low power, he set about developing a protocol for weak-signal mesh networking and communication. The result was JS8Call, a free, open-source platform inspired by WSJT-X and fldigi. It allows for keyboard-to-keyboard, store-and-forward, and network relay-based commwunication.

Hamvention bestowed its Technical Achievement Award on a group of three radio amateurs who have become well-known for their development of the WSJT-X digital software suite. The 2020 award recipients are Steve Franke K9AN; Bill Somerville G4WJS and Nobel Laureate Joe Taylor K1JT. Over the past seven years, the trio has collaborated on all aspects of WSJT-X and in particular the digital protocol FT8 and its contesting variant FT4. Introduced in July 2017, FT8 now accounts for a significant portion of all HF amateur radio activity.

WAB Charity Donations

WAB (Worked All Britain) is pleased to announce that they are able to make a further £3000 of donations this year as follows:

£500 to RAIBC; £500 to Methodist Homes for the Aged (auditor's choice); £500 to Cancer Research UK; £500 to Vasculitis UK; £500 to Fibromyalgia Action UK; £500 to Arthritis Action.

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Active Antenna Amplifier to the Rescue

Lee Aldridge G4EJB
leeG4EJB@outlook.com

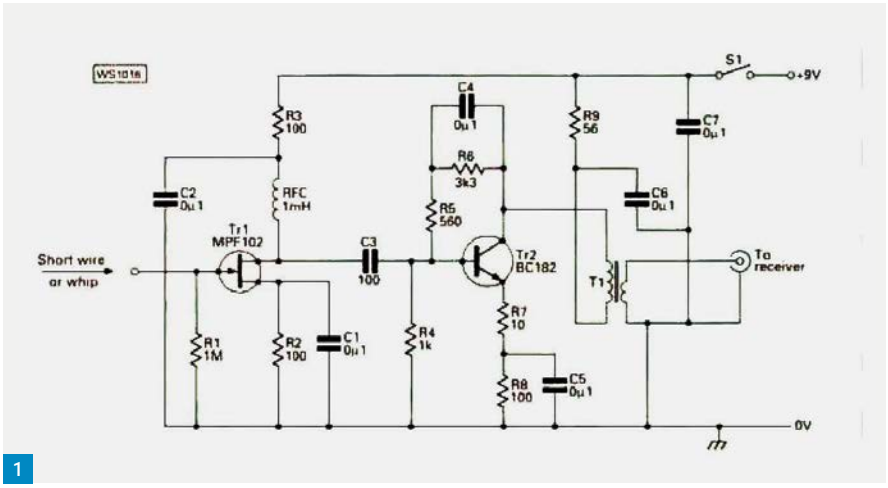
Lee Aldridge G4EJB finds a use for another of George Dobbs G3RJV's projects.

With Storm Ciara forecast, I decided the antenna masts in my garden needed to come down. One mast did require attention because the metal garden pole on the top had rotted and was only held up by the internal plastic pipe. I made a plan. While I repaired my antenna masts, I would build an active antenna amplifier so that I could at least listen to a few bands while in my shed. Where was the first place I looked for circuits and know-how? Yes, the *PW Carrying on the Practical Way* CD.

George Dobbs G3RJV had described a number of active amplifiers over the years. The articles that I referred to while constructing the amplifier can be found in *PW* November '98, March '08 and September '10.

George sets out the requirement in his November '98 article: "*It occurred to me that it might be useful to have a small general-purpose active antenna for times when I might have a receiver and be without an antenna. The requirements seemed to be for a small whip antenna, or similar, to feed a radio frequency amplifier capable of around 20 to 30dB of gain. Too much gain and local noise, or even internal amplifier noise, becomes a problem and too little gain and it will serve little purpose. The short antenna will offer a high input impedance and the output will probably need to be low impedance to suit most receiver inputs*".

Now even though I could have built a simpler amplifier, I liked the circuit presented in the November '98 article, **Fig. 1**, and decided to build it with what I have to hand.



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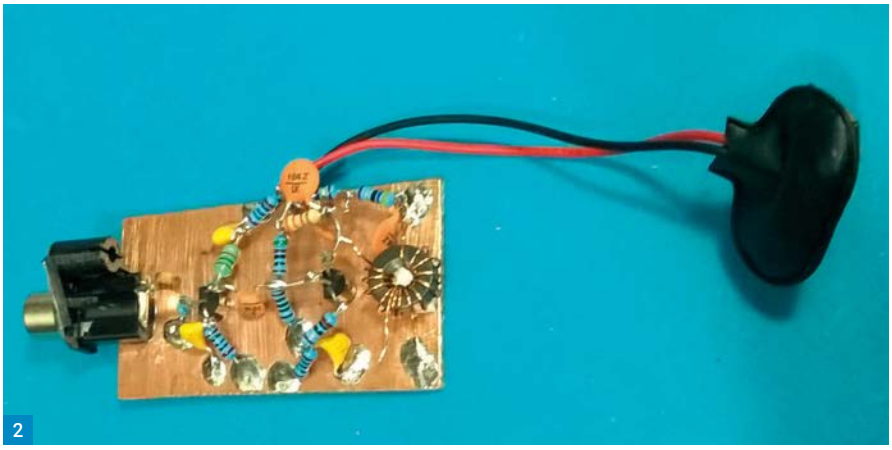
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Solving the Challenges

The first challenge was finding a suitable enclosure. Nothing gets thrown out at our household if it can find some use in the radio shed. Quite a while ago, a couple of nicely finished polished manicure set containers came my way. *"Ah, a metal case that splits nicely and with room for a 9V battery as well"*, I thought.

Next, to work out how to build the amplifier and fit it into the container. An old piece of copper-clad board was cut to fit and cleaned with a steel-wire pad. I decided on building the amplifier 'dead-bug' style, just as George had in his original article – something I hadn't tried to any great extent before. For those of you that haven't come across this method, it involves putting the active components with legs up in the air, hanging other components off them and using grounded components (such as decoupling capacitors) to keep all the circuitry rigidly held in place. Eventually I got the hang of the method and have to admit it is a quick way to build. I used a 2N3819 FET for Tr1 and a 2N3904 for Tr2. I decided to add a 470pF ceramic capacitor – as George had intimated in his other articles – to the input circuitry of Tr1, thinking it may help block potential LF and MF signals. One component that wasn't to hand was the 'pig-nose' or 'binocular' core, so I tried a FT37-43 ferrite core with the same number of turns, hoping it would do the same job of matching. The photo, **Fig. 2**, shows my completed board.

Testing Time

Having completed the board and checked my wiring, I connected my bench supply (set to 9V) and checked with my DVM for voltage drops on Tr1 drain and source resistors and Tr2 junctions, **Fig. 3**. All appeared to be sensible. Now to test whether the board would amplify a signal. My FET dip oscillator was on the bench

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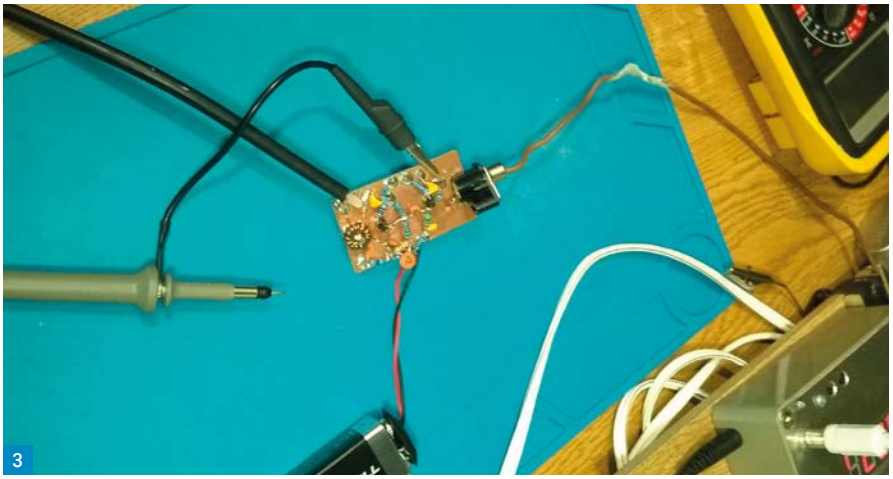

Fig. 1: Active amplifier circuit. Fig. 2: Completed active amplifier board - built 'dead-bug' style. Fig. 3: Active amplifier under test. Fig. 4: Completed active amplifier in action.

with the frequency counter connected, so I stuck a piece of wire into the amplifier input and put it close to the dip oscillator coil. I set the dip oscillator to 7MHz and connected my scope – on x10 input – to the input (very little discernible level on the scope, if any), then on Tr1 source. Yes, I could see a signal. I then connected to Tr2 collector – even more signal. Both stages were obviously amplifying. I checked the voltage on the output and as expected, there was considerably less (due to the transformer) but all appeared to be in order. It was also pleasing to see that the amplifier seemed stable.

Next to throw a piece of wire from the shed outside to avoid the EMC issues with my LED lighting. The 14ft (about 4m) wire antenna consisted of three pieces of wire connected with choc-bloc, most of it at a height of around 6ft (under 2m) – the other shed roof! The amplifier board was fitted into the screened can with a 9V battery. The output coax was connected to my new prized possession, a valved Star SR-550 HF receiver (from the 1960s).

The active amplifier was working, **Fig. 4**. I was really pleased with how well it worked on 80m, 20m and 15m yet initially it appeared a little less 'active' on 40m. I then confirmed my results on 80m, 40m and 20m using other receivers. To switch off, I just split the case and take the battery out. Yes, I could add a toggle switch but it can wait. After a couple of days with the amplifier in use, I heard a VE (Canadian) station on 40m – maybe not less 'active' after all. For that, the antenna wire was connected to a phono plug with screw terminals – no expense spared.

The masts did not go back up in a hurry due to the continual high winds so, having built this active amplifier 'dead-bug' style and regularly using it, the last words from George: "*This simple little circuit appears to be at home with a variety of receivers and is a useful extra item to have for casual listening without resort to a larger antenna. By following my success ... by getting busy with that soldering iron, you too could have your own 'Active Antenna'. Good listening!*"

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

Radio Round-up

SOTA G/SE Activity Weekend

A SOTA G/SE Activity Weekend is planned for August 22nd/23rd. There are 15 summits in the Southern England (G/SE) SOTA region to choose from. Summits are located in an area from Wiltshire in the west through to Kent in the east and south to the Isle of Wight and the South Downs. If you're thinking of operating from a summit, take a look at the SOTA region map and the info for the summit on:
www.sotadata.org.uk

This will give you previous activators blogs, really useful information on accessing the summit, suggested car parking and the recommended routes to the summit.

This event is for everyone – those who haven't activated a summit before as well as experienced SOTA operators. Bands and modes are up to the individual SOTA activator – it would be great to have a good 2m presence with as many Summit to Summit (S2S) opportunities as possible.

So, whether you fancy it for a half hour with a hand-held or for a longer time with a larger setup, maybe a VHF Yagi or an HF station, come and join in the fun! If you want more information closer to the date please contact Richard Perzyna G8ITB at g8itb@yahoo.co.uk

(Editor's note: Given the Coronavirus situation, readers should check with the organisers nearer the time to ensure that the activity is still going ahead).

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

Horizontal? Vertical? What to Choose?

Tim Kirby GW4VXE discusses antenna polarisation at VHF, reports on a fascinating moonbounce achievement and has all the latest operating news.

Tim Kirby
longworthtim@gmail.com


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It's been an exciting month here in West Wales for me. Although only a foolhardy person would say that the storm season has passed, I have been gradually getting some antennas up. Quite what to put up here was something I had a lot of fun thinking about over the last few weeks.

Regular readers will know that I have been an enthusiastic proponent of using whatever antenna you have on 2m FT8, be it a horizontal beam or a vertical. Where I was in Oxfordshire, I'd been using a vertical for a couple of years on 2m FT8 and had been absolutely delighted with the results.

I was conscious that in Oxfordshire I had a central location for UK activity, which meant I wasn't too far away from anyone, so I could get away with lesser gain. Another factor in my favour had been the large number of aircraft flying above me, allowing contacts to be made by aircraft scatter. The vertical had seemed to work well for these contacts.

When thinking about what I would like to put up here in Pembrokeshire, I knew that I would want at least a small Yagi – even a large one when the weather is settled! But I wanted to continue the vertical experiment. For one thing, it saves a lot of beam turning trying to optimise the signals.

As it happened, the first antenna to go up for 2m here was a small beam (a big thanks to **David M0GIW** and to **Andy GW0KZG** for his help getting the coax through a thick wall). To cope with the storms, I found a small pole and lashed it to a gate post. Although that doesn't sound terribly good, it's on a fairly high spot, so the antenna can 'see' well in most directions and in any case, it got me back on the band.

What was interesting was the stations I started to see. Although some of them were, of course, the same ones that I'd seen before, many of them were not. It was as though there is a subset of stations using vertical polarisation and another subset using horizontal polarisation and (almost) never the twain shall meet. When, just a few days ago, I got a vertical on the side of the house and started using that, a number of the stations that I'd worked often on the vertical from Oxfordshire suddenly started appearing again – albeit now at much greater distance.

I found that very interesting. One of the things that I had wondered about was whether, particularly for the aircraft scatter contacts, the reflected signals had their polarisation changed, so it would not matter hugely whether you used vertical or horizontal polarisation. I think that is probably true in some cases. However, it seems to me that the polarisation is preserved more often than it is not.

Yesterday, I was monitoring on the vertical and GM0HBK from IO77, almost 600km away, popped up. I quickly rushed outside, turned the beam and switched to it, but the signal was not improved! I am fairly sure that GM0HBK was using a horizontally polarised antenna, so something had happened to the signal for it to be more readable on the vertical.

You might be saying that this is all very interesting (at least I hope you are) but what point is he making?

My point is this. For many years it has been automatically assumed that to work DX on VHF/UHF (whatever DX is!) you will need a beam antenna. While it is unquestionably helpful to have a beam, you should not be put off trying 2m FT8 if you do not and 'only' have a vertical antenna. With perseverance you should be rewarded by some interesting contacts.

A couple of footnotes. If you have the ability to switch between vertical and horizontal polarisations, you should be

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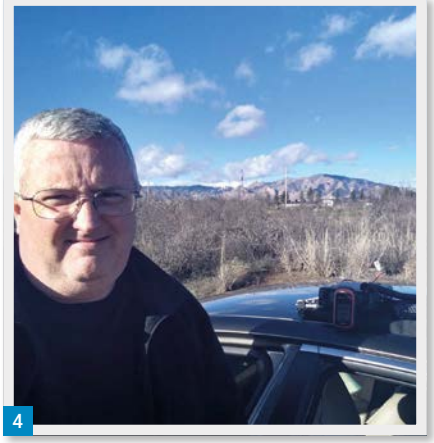

Photo 1: 2M0ETJ 70cm EME antenna.
Photo 2: QSL confirming 2M0ETJ's EME QSO.
Photo 3: Hazards of satellite operation!
Photo 4: WD9EWK at the DM51/52 boundary.

even better off. Finally, if you are reading this and thinking, 'OK, but I don't like FT8, I prefer SSB and I have a vertical antenna for 2m' – then try that too. You should make some contacts. I do not think they will be as wide ranging as if you were using FT8, but it is always worth trying. Last summer during some tropo, GW1JFV and I noted strong signals on FT8 and decided to switch to SSB. We made it, vertical to vertical, over a distance of 250km, which seemed pretty good going. What was an easy contact on FT8 was fairly marginal on SSB, but it made a fascinating comparison.

Making a start on 432MHz Moonbounce

Regular readers will know that I have sometimes included reports from **Tom M0ABA** who has made some excellent low power 432MHz moonbounce (EME) contacts as MX0CNS. On Twitter, I'd been watching with interest the progress of **Glyn Cartwright 2M0ETJ** who was also aiming to make a low power moonbounce contact. I asked Glyn if he'd be kind enough to write some notes of his experiences.

*"Ever since I started with an interest in radio as an SWL 45 years ago, I was always fascinated by signals from space. I remember reading about CW contacts using EME in the mid-80s and wondering "what if?" It was only when we moved back to southwest Scotland in 2013 that life finally started to settle down and allowed a bit more free time. I finally got around to getting a Foundation licence in 2017 and then the possibilities started increasing. I followed this in 2018 with the Intermediate (distance learning with **Ian GM3SEK** as my personal tutor!). Both my licences were done with the help of Wigtownshire Amateur Radio Club GM4RIV.*

*"My main interests are and have always been in VHF and up with satellites being a large part of things. Latterly, because of decreasing hearing, I've used digital modes. Over the last two years I have been researching EME more and getting bits put by, as and when available. During the searches I came across **Hartmut DG7YBN**'s website and his designs for the GTV series of antennas, which fitted perfectly with what I was looking for. Over the following months I came across **Tom M0ABA** on social media as being a regular builder of GTV's in various configurations for QRP EME use.*

*"One of my 2020 resolutions was to make an EME contact on 2m with QRP. Then totally out of the blue on January 12th, I had a message from Tom (we had not spoken before this) at lunchtime asking if I wanted to make an EME contact remotely! Well, I had a long hard think and in about half a millisecond I said yes! I quickly registered for HB9Q's logger to monitor what was going on and waited until around 8pm when the moon cleared obstructions at Tom's QTH. Tom had previously arranged a sked with **Bernd DL7APV** and at 1944UTC the QSO was completed! To say I was fizzing with emotions would be an understatement! It was something I had dreamed of for years and never thought I would do it, then within six hours the opportunity had arisen 'out of the blue' and been completed!*

"All this spurred me on and over the following few weeks I started putting my own station together. The azimuth control is a standard small rotator in a home-built cage, which mounts on a patio mount for convenience (this came with a 1.5m prime focus dish, which will be used for future EME projects). The elevation is taken

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care of with a small dish actuator on an aluminium hinged mount, which fits the standard rotator and is adjusted with a satellite dish positioner. The antenna is a DG7YGN designed GTV70-14, home-built and matched with an emi stub. The antenna is soon to be accompanied by another one on the frame, which is already built and just awaiting a combiner. My radio is a Kenwood TS2000 running 50W. My first contact was with ***Bernd DL7APV*** *using a preamp at the wrong end of the coax (the shack end) on March 5th".*

Congratulations Glyn. Please keep me posted on your future contacts – I am sure there will be plenty. Also, a big well done to Tom M0ABA for encouraging Glyn along the path!

Getting started on System Fusion

Thanks to **Don G3XTT** for passing on details of a manual for Wires-X-Fusion-C4FM created by WB7OEV, which you might find useful for setting up and using the system. You can find the document here:
https://tinyurl.com/rue2gjz

The 2m Band

Jef Van Raepenbusch ON8NT (Aalter) says February was a pretty quiet month with antennas down because of the various storms. However, he's put his V-2000 vertical back up and made a couple of interesting QSOs during the month, G3NJV (IO70) on FT8 and a very nice one on FM, MW7JLM/M (IO81). Jason was on top of a mountain in South Wales.

Simon Evans G6AHX (Twyning) gave a few points away during the RSGB 144/432MHz contest at the beginning of March. His best DX was G8HRS/P (JO01). Simon says that conditions were very poor!

Andy Adams GW0KZG (Letterston) has made some nice QSOs with UT1FG/MM on the *MV Goldeneye* from various squares. Andy lists the following squares worked on tropo using FT8 from February 16th to 21st: IN89, IN68, IN57 and HN70. On FSK441, Andy worked **Captain Yuri** using meteor scatter from IN44, IN33, IN22, IN02 and HN80.

Here at GW4VXE (Goodwick) highlights on FT8 have been G4LPP (JO02), EI4KP (IO52), M0AGJ (IO93), G0MBL (JO01), G4RUW (IO91), G4KUX (IO94), G7RAU (IN79), MW1CFN (IO73), GM0HBK (IO77) and EI4GGB (IO63).

The 70cm Band

The first 70cm FT8 QSO in the log here at GW4VXE was GW1JFV 15km away! I was also glad to work **Keith G8IXN** (IO70) with strong signals, around 200km across the water in Cornwall. Vertical antennas were used for all these contacts. I'll be looking out for more contacts on 70cm in due course.

Satellites

Peter 2M0SQL passes on that eQSL have introduced a new eSatellite award for confirmed eQSL contacts on satellites.

Jef ON8NT has pressed his V-2000 into service on both CAS-4A and CAS-4B satellites using 5W from his IC-9700, working EA7E (IN66), F1RRJ (JN09) and EA7Z (IM98).

Kevin ZB2GI has been busy on AO-91 and AO-92 using an FT-817 and a 2m/70cm log periodic. Stations in the log include EA5ITF (IM97), EA5GJ/P (IM96), G3PGA (IO71), DJ8MS (JO64) and EA5JN/P (IM97).

Simon G6AHX says that he is working with **Adrian G0VLG** to get a QO-100 system running. They have erected and pointed a Sky Zone 2 dish at the satellite. Discussions are proceeding, Simon says, on how to provide the uplink.

Peter Taylor G8BCG (Liskeard) says that his sole activity has been on QO-100 as his 6m and 2m antennas are firmly bolted down because of the gales. Peter worked 8Q7NC for DXCC entity 85 since last October. He says that the pileup for 8Q7NC, who was operating split, was nearly 50khz wide and seemed to be getting wider as news spread of the activation.

From Arizona, **Patrick Stoddard WD9EWK** writes, "*The COVID-19 (coronavirus) concerns caused the cancellation of one event I planned on attending, a two-day science fair in southern Arizona where I planned on doing satellite demonstrations. Even with the cancellation, I still made a road trip to a rarely-heard grid boundary in south-eastern Arizona, the DM51/DM52 grid boundary. This location is about 50 miles north of the USA/Mexico border, and about the same distance west of the Arizona/New Mexico state line. Not many live out in that area, and almost all satellite activity comes from those who are going to or through that area. This was a 400-mile road trip, and a nice way to spend a late winter day away from home.*

"The drive to the DM51/DM52 grid boundary took me about three hours. I left home an hour before sunrise, hoping to avoid the morning traffic around both of Arizona's largest cities, Phoenix and Tucson. Once I made it to the boundary, I started setting up my station, and taking the pictures to document my location. I was also showing my trip on APRS, and I know there were some who were watching my drive, so they could guess when I would start operating out there.

"Once I was set up, I worked an XW-2A pass that covered almost all of the continental USA. In a few minutes, I had logged 11 QSOs – a great count, especially since this wasn't an FM satellite. The FM satellites didn't disappoint, in terms of QSOs per pass. For the passes that covered most or all of the continental USA, I logged 12 QSOs on an SO-50 pass, and 14 on an AO-92 pass. AO-91 was crowded, and I only logged six QSOs on a coast-to-coast pass in the late morning. Fridays are one of the two days we normally have PO-101 active over the Americas. I logged eight QSOs on one of those coast-to-coast passes in the early afternoon.

"I spent about seven hours out at that spot and worked a total of 13 passes in that time – nine FM passes, and four SSB passes. I logged a total of 86 contacts with stations across the USA, Canada, and Mexico, while making both grids DM51 and DM52 a little less rare.

"The virus concerns haven't stopped others from going out and working satellites from many different locations. As I write this, a pair of operators are preparing to visit the most remote part of Big Bend National Park in Texas, where they will activate the very rare grid square DL88. And more are taking up this aspect of ham radio, going out and getting on the air away from home. Satellite operating makes this easier, with portable radios and smaller antennas that can be as competitive as some operating from home."

Peter Atkins G4DOL (Portland) always has some interesting QSOs to report and this month is no exception. On AO-7 Peter worked NM3B (FN01) on February 12th, C6AMA (FL15) and VE3CGA (EN92) on February 19th, UA0STM (OO21) on March 2nd and YV6IA (FJ78) on March 3rd. Peter says he is looking at the best way to get on QO-100.

Here at GW4VXE, I've enjoyed a few contacts on the FM satellites, SO-50, AO-91 and AO-92: M0GIW (IO93), EA2AWD (IN93), 2M0SQL (IO87), DL6AP (JO64), ON3ONX (JO20), F4DXV (JN04) and EA8BGO (IL28). All the contacts have been made using a 5W handheld and an Elk log periodic portable antenna.

That's it for this month. Please keep your news and reports coming. Keep healthy! See you next time.

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Making Pretty Panels

Dr Samuel Ritchie EI9FZB
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Dr Samuel Ritchie EI9FZB describes his approach to giving homebrew gear a professional finish.

1

2

The moment comes in each project when you have spent time and money to design and build a circuit or perhaps assemble an expensive kit and now you want to mount everything into some sort of enclosure that reflects the effort made.

You note the input and output connectors, the switches, the potentiometers, LEDs and displays and carefully design your front and back panels just the way you would like it. Then you look at the cost of an enclosure that will fit your PCB and has enough space on the front panels to fit everything. At this point you have asked one or more of the following questions:

- How do I mark where I want to drill holes in the front panel without damaging the factory finish that is already on the enclosure?
- How do I ensure everything is nicely aligned?
- I am not happy with Letraset, the output of label printers or sticky labels so how do I produce professional looking markings that I can be proud of?
- Do I need special tools and how do I make rectangular and square holes that do the job?

With this article I want to show how you can turn **Fig. 1** into **Fig. 2** – something you are pleased to announce as 'home-brewed'.

Selecting an Enclosure

I had already decided that I would use a 19in rack enclosure and the depth of the enclosure was determined by the size required to comfortably fit all the circuitry. Enclosures for 19in racks come in standard heights known as units and each unit is a height of 44.5mm. After looking at possible layouts using paper, ruler and compass (the drawing type, not the type with a needle fixated on pointing north) I selected a 2U enclosure (RS part number 584-227). This gave a usable front panel space of 440 x 88mm.

Using Microsoft® Office Visio® I set to work designing exactly where each item would go on the front panel, what size hole is required for each item, where the centre of each hole was to be located and once installed with cover or knob attached, how much space would each item take up. I first placed a 440 × 88mm rectangle on my worksheet because this defines the area into which I have to fit everything. The rectangle also helps to align the drilling template as will be seen shortly.

Drilling Templates

The top of **Fig. 3** shows the right-hand part of my drilling template. If you look at lots of equipment, you soon notice that symmetry seems to make the panel look neater and that everything is actually aligned with either the centre of the panel (the line marked as A), one third down from the top (the line marked as B) or one third up from the bottom of the panel (the line marked as C). I followed this approach. A plus (+) sign marks the centre of each hole that needs to be drilled, a blue circle the hole size required (also written in the circle) and a red circle or black markings showing the area that a knob or toggle switch would cover.

I printed out a few versions as I went along to make sure I was not trying to cramp up the potentiometers and whether there would be room for fingers once assembly was completed. As an A4 sheet of paper printed in landscape orientation is too short for this panel, you need to either use an A3 printer or print the completed template on two A4 sheets of paper, cut where appropriate, and use tape to join the two parts together.

The bandwidth switch needed six graduations at 30 degree spacing and **Fig. 5** shows a printout checking I had got the layout and graduations correct.

Decal Templates

From the drilling template I produced the decal template by removing all the construction lines, the border, the outer circles and any detail I didn't want to appear on my decal.

The bottom part of Fig. 3 shows my decal template matching the drilling template above it. I left the centre + signs as well as the hole size circles because these would help to align the decal when it came time to place it on the panel. I also made a scale to use around all the potentiometers showing increases or decreases in potentiometer function.

You will note that the decal can be in

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Fig. 1: The output of the design, fiddling and integration stage. Fig. 2: The final product. Fig. 3: Example of drilling template and decal template. Fig. 4: Ready to punch, pre-drill, drill and cut. Fig. 5: Checking my switch actually matches the template. Fig. 6: Tools for drilling holes. Fig. 7: Punch work. Fig. 8: Starting the drill holes.

colour, which I will make greater use of in my next project that needs a nice front panel.

Preparing to Punch, Drill and Cut

Having printed off my drilling template I now needed to fix it to the panel in such a way that I could work on the panel without the template moving at any stage. I used a Pritt Stick to coat the panel and then carefully aligned my paper drilling template, ensuring it was centred both horizontally and vertically before sticking it to the panel. The border established by the 440 × 88mm rectangle helped here. Using painter tape (also known as masking tape or frogtape), I stuck down the edges of the paper to make sure nothing moved while the glue dried. I also covered the back and edges of the panel and any part of the front panel not covered by paper to stop any metal filings or swarf from damaging the painted surfaces while I worked on it.

Fig. 4 shows the result. Once you have completed working on the panel you can peel off the paper and the tape. I used hot water and dishwashing liquid to remove any paper or tape (the Pritt glue and tape are water-based adhesives), oil and dirt that had stuck to the panel while working with it.

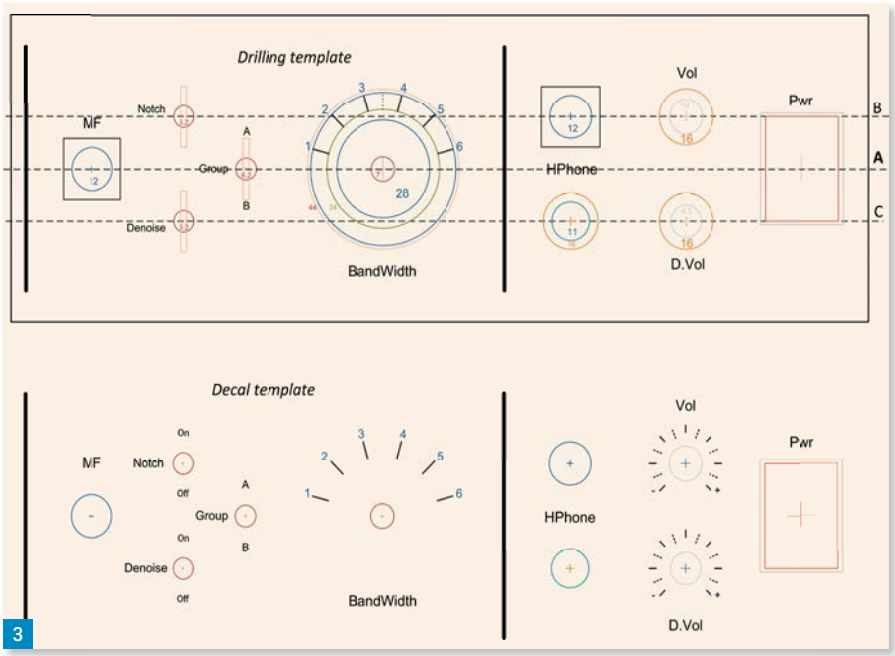
Making Round Holes

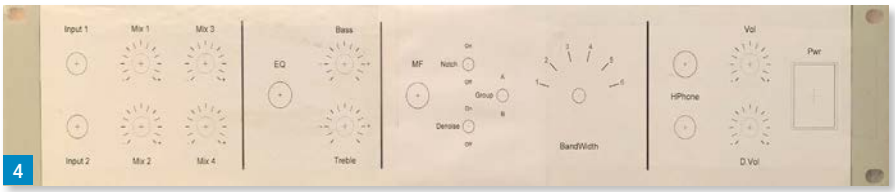
Some of the tools I mention in this section are shown in **Fig. 6**.

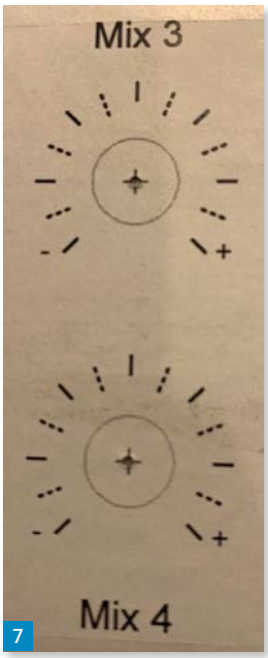
Using the hammer and centre-punch and making sure I am wearing safety glasses, I make a small indent at the point where the two bars that make up the + sign in the middle of each circle intersect. I place the panel flat on my bench under a decent light, carefully align the punch point with the + symbol and give the punch one firm hit with the hammer, **Fig. 7**.

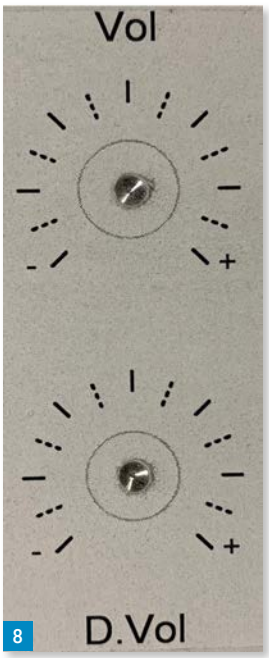
Having done all the punching, I take my Dremel© with a 2.5mm drill bit and using the punch indentations and wearing safety glasses, make the start of a hole, **Fig. 8**. This ensures that when I move to a handheld electric drill there is no wandering of the drill bit. When I get that bench pillar drill, which is on my wish list, I will be able to omit this step and go straight from punch to 4mm drill hole.

I use a high-quality drill bit in my handheld electric drill that has a speed control to make a hole through the panel. I clamp the panel to my bench with a piece of wood between the panel and the bench and thick cloth pads (the same used under chairs to stop them scratching or marking floors) on the part of the clamp touching the panel to ensure the clamp does not mark the panel in any way. Every hole is drilled to 4mm diameter because









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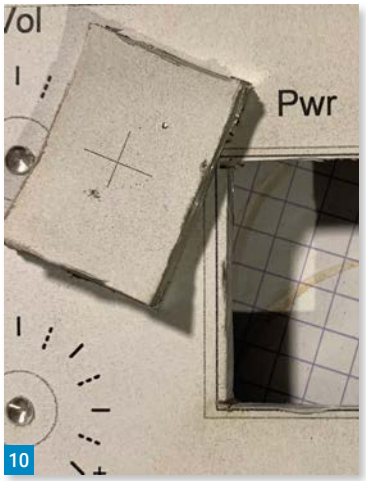

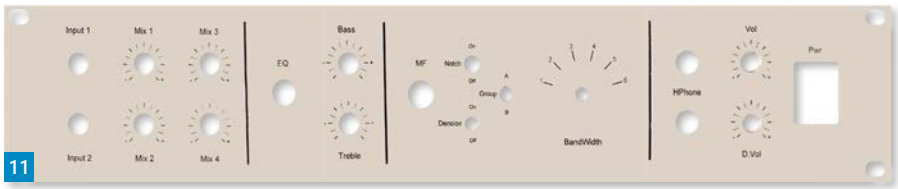

Fig. 9: Tools for cutting holes.
Fig. 10: Rectangular hole. Fig. 11: Drilled, cut and decalled panel ready for assembly.

this is the minimum size required by the stepped drill bit that I use to drill each hole to the right size. Here the circles on the template ensure I don't lose my mind and drill an oversized hole. Clamping is just as important but here I use two pieces of wood and two clamps making sure there is a gap for the stepped punch to fall between the two pieces of wood.

Each hole is deburred on both sides of the panel using a three-flute chamfering tool, which leaves a very nice looking hole. Do not be tempted to overuse the chamfering tool as you just want to deburr the hole and not countersink it.

Making Square and Rectangular Holes

The drilling template shows the size of the hole to be made for the power switch. The power switch snaps into the hole and has a surrounding ledge that covers up any small imperfections in your workmanship. **Fig. 9** shows the tools I use to make square and rectangular holes in panels.

I use a cutting disc in my Dremel© that is made for cutting along its edge – such as the no. 420 disc, which is recommended for cutting screws, sheet metal, thin wood and plastic. You cannot do curves with this disc, just straight lines, because flexing the disc snaps it. Always wear safety glasses and make sure you have clamped the panel firmly.

My technique is to work inside the line, to slowly lower the disc onto the metal and let the disc do the cutting work. It doesn't matter if you don't hold the disc perfectly perpendicular to the panel as the final touches and deburring are done with the fine metal file. Be careful once you have made a cut through the panel and then attempt to move the disc sideways to follow the line. When you move in the direction so that the disc is cutting down into the panel it is a lot smoother than trying to move in the direction where the disc is cutting upwards and trying to pry the panel out of the clamp.

It took three cutting discs to make the 30 × 20mm rectangular hole in my panel, which is 2.6mm thick. One disc was lost because I failed to clamp the panel tightly enough and it jumped and the disc snapped (wear those safety glasses) and a second disc wore down and needed to be replaced. Just be careful to take frequent rests so that the panel does not heat up too much so that the paint blisters. **Fig. 10** shows the result. Note that I left a little bit too much material on the left-hand side of the hole, which required some mind-numbing work with the file. I use a second-cut, double-cut, engineer's hand file, which is a good compromise for both deburring and taking off material.

Applying the Decal

I looked long and hard for a solution and was given advice by a number of companies that allow you to submit your own design, which they turned into a decal. I wasn't able to find a supplier who was confident that their process would produce the detail I was after with such fine lines and small fonts. Then I came across a South Korean company called Sonnyscopa and a product they produce called film-free laser decal paper.

From Amazon I acquired ten sheets, 50ml of their W1 glue and rubber squeegee, all for less than £25, and promptly warmed up my printer. The company has produced YouTube videos showing the steps to take but I followed the written instructions that came with the sheets of paper. You start by printing a mirror image of your decal on the shiny side of an A4 sheet of their paper. Again, I split my graphic into two to get the whole graphic onto one piece of A4 paper. I worked in four sections defined by the thick vertical lines you can see in Fig. 4. Having cut a section out I dipped the paper into lukewarm water for about 30 seconds during which time I coated that part of the panel with the supplied glue. You place the wet paper face down on the panel and you feel the backing paper come off leaving a clear film that has the decal printing on it. I found you need to be quick and align the section without delay because there is not a lot of time before the clear film starts adhering to the panel.

Then using the squeegee wipe the film so that all the air bubbles, wrinkles and moisture under the film are removed. I consider this to be the most important step to getting a good outcome. After I completed applying all four sections I ignored the YouTube video, which uses a hair dryer, and followed the written instructions, which require the panel to go into an oven for 15 minutes. Then the film can be gently pulled away leaving the printer toner on the panel. Another bake in the oven to make sure the transfer was well fixed and after cooling I sprayed the panel with clear matt varnish to protect the decals. **Fig. 11** shows the final result.

End Notes

While getting this result does need a commitment of time and effort, I am pleased with the final outcome. If it helps you to get started, I have made the Microsoft® Office Visio® files that I used available on my website at:
www.samuelritchie.com

I have no personal connection with or financial interests in Sunnyscopa, Radionics or Dremel©.

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Raspberry Pi Explained – Update

Mike Richards G4WNC
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Mike Richards G4WNC starts with his new book, but focuses this month on a cheap but cheerful APRS node.

Following-on from **Don's** generous review of my new book last month, I've set up a couple of online resources to provide support. One of the challenges of any book about the Pi is keeping pace with the developments. It is inevitable that some of the software and solutions presented in the book will change over time. To mitigate this, I've created a new page on my website where I'll keep a log of the changes and publish solutions where possible. You can find that page here: https://tinyurl.com/t6eloma

I have also created a new support group on Groups.io that I'll be using to deal with queries and announce updates and news items. The group is also available for readers to help each other. You'll find the group here: https://tinyurl.com/snnl59h

Generating Low Level Signals, Pt.2

Following last month's look at generating low level test signals, I've had a Siglent 3.2GHz spectrum analyser on loan. This gave me the opportunity to take a closer look at the signal quality from the Siglent SDG1062X AWG. I've shown a couple of plots in **Figs. 1** and **2**. Fig.1 shows the spectrum from 1-30MHz with the generator output set to 0dBm while Fig. 2 is a similar plot but with the generator and reference set to −20dBm. As you can see, the spectrum is cleaner at −20dBm, which is useful to know. I've also looked at the close-in spectrum to see how the phase noise looks. **Fig. 3** shows a 10kHz-wide spectrum plot with a 1Hz bandwidth where you can see that it's looking remarkably clean. I also took the opportunity to check out my much modified Feeltech 6600 to see how it fared. I was particularly impressed with the low phase noise of the modified Feeltech, **Fig. 4**. In its delivered state the FeelTech was terrible with a very messy output signal. Changing the PSU and the reference oscillator for high quality units has transformed the signal quality.

WSJT-X Icom Update

Joe Taylor K1JT's team have recently announced an important update for WSJT-X users that have Icom rigs. The previous WSJT-X (2.1.1) introduced some errors with the Hamlib package that's bundled with WSJT-X. This created problems with CAT control for some Icom rigs. The new release fixes those problems and installs seamlessly over the previous version, so the upgrade is simple. You can see more information on the WSJT-X website at **https://physics.princeton.edu/pulsar/K1JT/wsjtx.html**

Cheap and Cheerful APRS IGate Node

APRS (Amateur Packet Reporting System) is a well-developed system that is ideal for tracking movements or reporting telemetry type data such as weather reports, etc. Most APRS activity in Europe is focussed on 144.8MHz and there is excellent Google Maps based online tracking support available via several sites. A good place to start is: https://aprs.fi

Here you'll find a detailed map summarising all the activity. When you look at the map, you will soon notice that there are lots of areas with relatively few stations and this currently limits the usefulness of the system. As you well know, VHF propagation is essentially line of sight so there must be plenty of stations to provide reliable coverage. The best solution is to add full transceiver-capable internet-connected (digipeater) stations as these will repeat APRS transmissions in much the same way as a voice repeater and so extend the coverage. While it's good to add fully active stations with transceiver capabilities, we can also increase coverage using receive-only stations, provided they have an internet connection available. This is possible thanks to APRS-IS (Automatic Packet Reporting System - Internet Service). This is a worldwide network that live-streams APRS traffic. The receive-only stations with internet access are known as IGate (Internet Gateway) nodes and are remarkably easy to set up. All we need is a receiver for 144.8MHz and a computer running software that can decode and process the APRS data. Once the data has been received by the IGate, it is passed to the APRS-IS network using a standard internet connection.

A few years ago, setting-up an IGate node required several items of kit, including a dedicated packet modem. However, those days are long past and it's now easy to setup an IGate node with just an RTL-SDR dongle and a Pi Zero. This is possible because the entire operation can be handled in software and is a good example of the power and flexibility offered by software defined radio.

The setup I'll describe here comprises a standard RTL-SDR dongle and a Raspberry Pi SBC (Single Board Computer). You can use any of the common dongles, but if you don't already have one, it's worth spending a little extra and buying one of the RTL-SDR.COM V3 dongles. The RTL-SDR V3 dongles are a big improvement over the cheap TV units for several reasons. The most important is their much-improved reference clock that is particularly helpful for VHF operation. This provides better tuning accuracy and frequency stability. Although I'm planning this project around a Pi Zero, you can use any of the Pi models, including that old Pi that you have in the shack drawer!

Those of you who've used the Pi for other Data Modes projects will know that the first thing we normally need is an external USB soundcard. In this case it is not required because we are going to pipe the digital audio stream from the receiver directly to the software Packet TNC (Terminal Node Controller). I've shown a block diagram of the setup in **Fig. 5**.

I'm using two software packages, the first is rtl-sdr, which contains the universal drivers and utilities required to use the RTL-SDR dongle as an SDR receiver. One of the included utilities is rtl_fm, which is a neat, command-line, program that enables specific frequencies to be tuned and demodulated. The program was created with efficiency in mind, so it uses minimal resources, thus making it ideal

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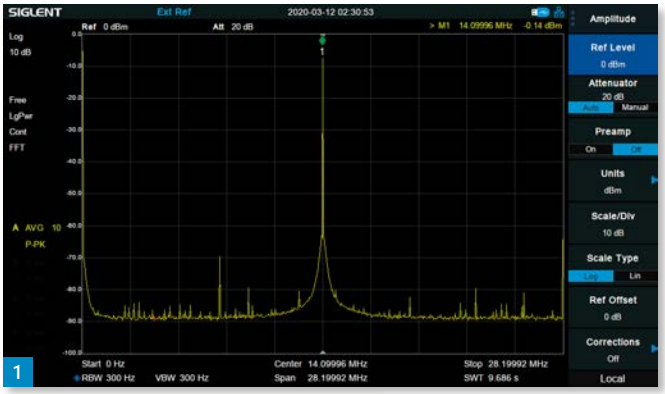

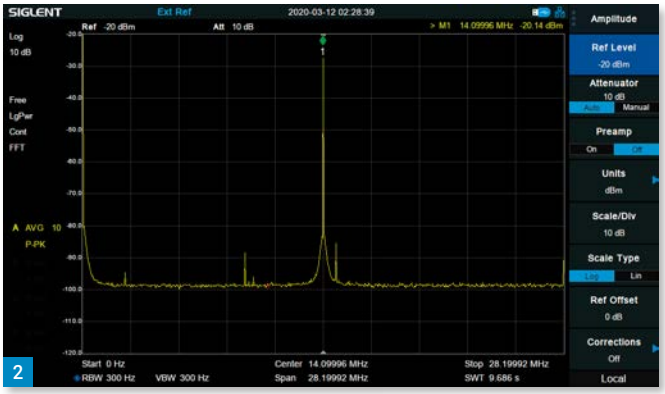

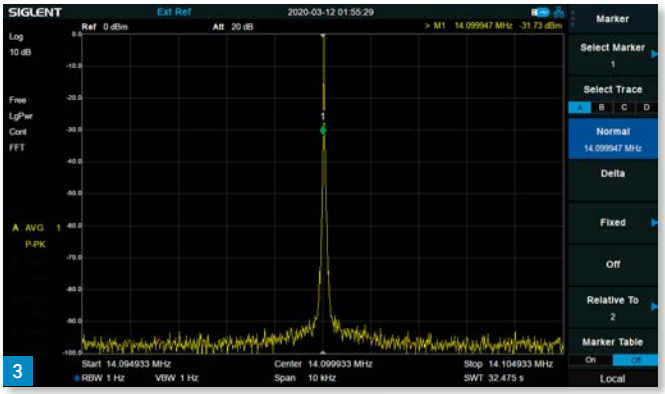

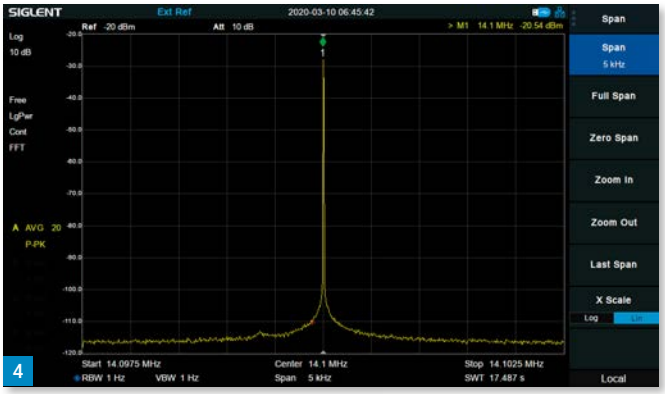

for low powered systems such as the Pi Zero. For the packet radio element, I'm using Dire Wolf, which has become the go-to packet software application. You can use any of the Pi models but it must be network connected, either through Ethernet, a Wi-Fi dongle or the built-in Wi-Fi. Once the project is complete, all you will need is the Pi, RTL-SDR dongle, 5V power supply, USB to microUSB cable and an antenna. However, for the setup stage, I suggest you connect a monitor, keyboard/mouse and a USB hub.

Assuming you have the hardware to hand, let's begin installing and configuring the software. Although this can be loaded on to an existing Raspbian card, it's better to start with a fresh Raspbian installation. I recommend downloading the new Raspbian Imager from:

www.raspberrypi.org/downloads

This is now the easiest way to install a new Pi image and is a customised version of the Etcher disk burner. The benefit of the New Pi imager is that it manages the image download, burns it to the SD card and verifies it. You'll need an 8GB microSD card or larger.

Here's a step-by-step guide:

1. Download and install the Raspberry Pi Imager from the Raspberry Pi download site. You can do this on a Linux, Windows or macOS machines.

2. Insert your blank microSD card (8GB or more) into your computer

3. Open Raspberry Pi Imager, select Choose OS and select the first Raspbian Pi Desktop

4. Move to the central box and navigate to your microSD card. Take care to make sure you've selected the correct one because other external drives will show up here.

5. Move to the right-hand box and click the write button.

The Imager will now burn the image and validate it. Next, you can connect your keyboard, mouse and monitor, insert the microSD card and power up your Pi. Follow the Pi start-up wizard to select your country, connect to your Wi-Fi system and check for updates.

At this point, you should have a fully updated Pi that's connected to your local Wi-Fi system. The next stage is to install the RTL-SDR and Packet software. If you're using a Pi 2, 3 or 4, this is particularly simple because we can use the versions that are stored in the Pi repository. These are not the latest software versions, but they are fine for our purpose and make installation a breeze. The following single command line will install both programs:

sudo apt install -y rtl-sdr direwolf

Assuming this completes successfully, you need to reboot the Pi. Once the Pi is up and running again, we can run the rtl_

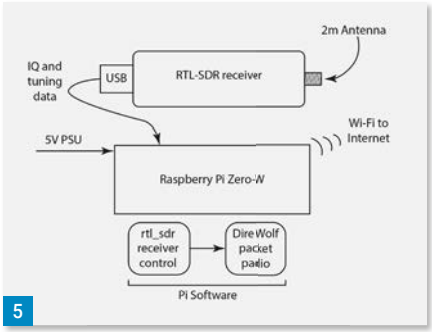

Fig. 1: Siglent SDG1062X – 14.1MHz sine wave at 0dBm. Fig. 2: Siglent SDG1062X – 14.1MHz sine wave at –20dBm. Fig. 3: Siglent SDG1062X – 14.1MHz sine wave –20dBm 10kHz span & 1Hz bandwidth. Fig. 4: FeelTech 6600 – 14.1MHz sine wave –20dBm 5kHz span & 1Hz bandwidth. Fig. 5: IGate node block diagram.

test command to test that the dongle is working correctly. Make sure the dongle is connected and run the following command:

rtl_test

This should produce an output similar to **Fig. 6**. You will probably see a single line saying lost at least nn bytes but that's nothing to worry about. If all is well, the terminal will show no further output, which means that it is receiving samples without error. To finish the test press Ctl-C.

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Installing Dire Wolf on Pi-1 or Pi-Zero-W

Unfortunately, the Dire Wolf version held in the Pi repository doesn't run properly on the early Pi's, so we need to build the software from source. Fortunately, the author has made this an easy task. Here are the steps.

1. Open a terminal session (Ctl-Alt-T) and enter: cd ~
2. Enter: git clone
https://www.github.com/wb2osz/direwolf
3. When the download completes, enter: cd direwolf
4. Enter: make
5. When that completes enter: sudo make install
6. Finally, enter: install-conf

That completes the Dire Wolf installation!

Our next step is to create a configuration file for the Dire Wolf Packet program. The normal way is to modify the existing config file. However, for our limited use as a receive only IGate node, it's easier to create a custom config file. Before you create the file, you will need the following information:

The station's lat/lon in degrees and decimal minutes and your IGate passcode. To get your passcode, visit:
https://apps.magicbug.co.uk/passcode

Enter your callsign and click Get Passcode.

Here are the steps to create the config file:

1. Open a terminal session (Ctl-Alt-T)
2. Enter: cd ~
3. Enter: nano aprs.conf
4. This will open a new file where you should enter the information from **Fig. 7**. Remember to use your own callsign, IGate password and lat/lon.
5. When you've created the file, press Ctl-X, followed by Y, then Enter to save and close the new file.

That's completed all the preparation and we can start the IGate node by entering the following command in a terminal session:

rtl_fm -f 144.80M - |direwolf -c aprs.conf -r 24000 -D 1 -

The first part of this command starts rtl_fm in FM mode with the frequency set to 144.8MHz. The pipe command | sends the output from rtl_fm to Direwolf, while the -c option forces Dire Wolf to use our custom configuration file. The -r option sets the audio sample rate and -D divides the sample rate by 1.

If you have problems, it is most likely to be a typo, so that's where you should start with your troubleshooting. When the system is running you should be able to see your station on one of the APRS maps where it will be indicated as a black triangle with R in the centre.

Next month I'll finish off with a method of automatically starting the IGate at power-up.

```
File  Edit  Tabs  Help
pi@raspberrypi:~ $ rtl_test
Found 1 device(s):
  0:  Realtek, RTL2838UHIDIR, SN: 00000001

Using device 0: Generic RTL2832U OEM
Detached kernel driver
Found Rafael Micro R820T tuner
Supported gain values (29): 0.0 0.9 1.4 2.7 3.7 7.7 8.7 12.5 14.4 15.7 16.6 19.7
 20.7 22.9 25.4 28.0 29.7 32.8 33.8 36.4 37.2 38.6 40.2 42.1 43.4 43.9 44.5 48.0
 49.6
[R82XX] PLL not locked!
Sampling at 2048000 S/s.

Info: This tool will continuously read from the device, and report if
samples get lost. If you observe no further output, everything is fine.

Reading samples in async mode...
Allocating 15 zero-copy buffers
lost at least 200 bytes
```

6

```
ADEVICE stdin null
CHANNEL 0
MYCALL G4WNC-10
MODEM 1200
IGSERVER euro.aprs2.net
IGLOGIN G4WNC-10 xxxx
PBEACON sendto=IG delay=0:30 every=60:00 symbol="igate" overlay=R lat=xx^xx.xxN long=xxx^xx.xxW
```

Add your call

Enter your Lat & Lon

7

Fig. 6: Typical output from rtl_test.
Fig. 7: Details of the Dire Wolf configuration file.

Rallies & Events

Plan your visits with our list of forthcoming events. Warners (Practical Wireless & RadioUser) will be attending events marked with an asterisk (*). Club secretaries/ event organisers: Please send full and accurate details of your events, affiliations and clubs as early as possible if you would like to be mentioned here: **wiessala@hotmail.com**

N.B.: Due to the Coronavirus situation, the Rallies calendar is dynamic at the moment, and there will be more cancellations and postponements. The information given here reflects the situation up to and including 27th March 2020. Readers are advised to check carefully with the organisers of any rally or event, before setting out. The Radio Enthusiast website will have updates, please check here regularly: **www.radioenthusiast.co.uk**

Postponed Rallies

11th April
MFARS SURPLUS SALE & RADIO MEET
mfars.secretary@gmail.com
www.mfars.club

12th April
RIPON RADIO RALLY
d.cutter@ntlworld.com
www.g4sjm.co.uk

19th April
WEST LONDON RADIO & ELECTRONICS SHOW (Kempton Rally)
New date: 15th November 2020
info@radiofairs.co.uk
www.radiofairs.co.uk

7th June
LOUGH ERNE RALLY
www.learc.eu
www.nadars.org.uk

Cancelled Rallies

26th April
ANDOVER RADIO CLUB RADIO & COMPUTER BOOT SALE
arac@arac.org.uk
www.arac.org.uk

2nd May
CDXC CONVENTION, AGM & DINNER
Chris@G3SVL.com
www.cdxc.org.uk

8th May
DARTMOOR RADIO CLUB RALLY
2e0rph@gmail.com

15th to 17th May
DAYTON HAMVENTION 2020
https://hamvention.org

28th June
33RD NEWBURY RADIO RALLY
www.nadars.org.uk/rally.asp
NewburyRally@nadars.org.uk

Unchanged
at the time of writing

April 26th (Sunday)
CAMBRIDGE REPEATER GROUP RALLY: The event takes place at Foxton Village Hall, Hardman Road, Foxton, Cambridge CB22 6RN. Car parking is free. Doors open 9.30 am for public entry and 7.30 am for traders. Entry is £3. There will be a talk-in station. You will see traders a Bring-and-Buy and an RSGB bookstall. There will be a car boot sale area. Catering is available on site (burger van has been booked).
Lawrence M0LCM

April 26th (Sunday)
NARSA – NORTHERN AMATEUR RADIO SOCIETIES ASSOCIATION EXHIBITION (BLACKPOOL RALLY): The NARSA (Blackpool) Rally will take place at its usual venue, The Norbreck Castle Exhibition Centre, Queens Promenade, Blackpool FY2 9AA. Doors open 10:30 am (10:15 for disabled visitors). Free on-site parking. Admission £5 (under 14's free). Food and beverages available. Usual traders, club- and special-interest groups, and an RSGB book stand. There is also a construction-competition and a club stand competition.
01270 761 608
dwilson@btinternet.com
www.narsa.org.uk

May 3rd (Sunday)
THORPE CAMP HAMFEST: The Hamfest is at the Thorpe Camp Visitor Centre, Tattershall Thorpe, LN4 4PL. Open for traders from 6.30 am and to the public from 9 am. Entry is £4, with children under 12 going free. Car parking is available within the grounds.
0795 665 4481

May 16th (Saturday)
READING DX MEETING: The Reading International Radio Group meets from 2.30 to 5 pm in Room 3 at Reading International Solidarity Centre (RISC), 35-39 London Street, Reading RG1 4PS. Meetings are an opportunity to get together for anyone interested in listening to broadcast stations from around the world on the short wave, medium wave and FM bands. All meetings include a well-researched talk and tea break.
barraclough.mike@gmail.com
www.bdxc.org.uk/diary.html

May 17th (Sunday)
DUNSTABLE DOWNS NATIONAL AMATEUR RADIO CAR BOOT SALE: Stockwood Park, Luton LU1 4BQ: Due to the Coronavirus issue, this year's event is contingent on the ongoing approval of the local council and Government guidance.
www.ddrcbootsale.org

May 31st (Sunday)
DURHAM AND DISTRICT ARS RADIO RALLY: The show is at the Bowburn Community Association, Durham Road, Bowburn, Co. Durham DH6 5AT Doors open 10.10 am to 2.30 am with disabled visitors gaining access at 10 am. Admittance is £2. There will be traders, a Bring-and-Buy, as well as an RSGB bookstall and Special Interest Groups. Catering and a licensed bar are on site.
07826 924 1192
dadars@gmx.com.

June 6th (Saturday)
ROCHDALE & DISTRICT ARS SUMMER RALLY: The rally is at St Vincent de Paul's, Caldershaw Road, off Edenfield Road, Norden, Rochdale, OL12 7QR. Doors open to the public at 10.15 am, with disabled visitors gaining access 15 minutes earlier. Admission is £2.50, under 12s go free. Pitches are £5 if you have your own table or £10 with a table provided. Refreshments are available.
0777 811 3333
m0nvq@outlook.com

June 7th (Sunday)
SPALDING DARS ANNUAL RALLY: The rally will take place at the Holbeach Community Sports Academy, Pennyhill Lane, Holbeach PE12 7PR. Doors are open at 9.30 am, and admittance is £3. The venue offers easy access from the A17, large area for boot traders, and a modern hall for indoor traders. Please note this is the same venue as last year. There will be a Car Boot Sale, RSGB Book Stall, Special Interest Groups and trade stands. Catering is available on site and there will be a prize draw/raffle.
07754 619 701
rallysecretary@sdars.org.uk

June 14th (Sunday)
ASRA SCOTTISH RADIO AND ELECTRONICS CONVENTION: The convention is at GTG Glasgow, 1330 South Street, Glasgow G14 0BJ. Doors open from 10 am to 4 pm. There will be traders, an RSGB bookstall and talks on the day. Catering is available on site.
www.asrarally.com

June 14th (Sunday)
EAST SUFFOLK WIRELESS RALLY (IPSWICH RADIO RALLY): The 2020 FDARS rally is at the Kirton Recreation Ground, Back Road, Kirton IP10 0PW (just off the A14). Doors open at 9.30 am, and the entry fee for visitors is £2. The venue has free car parking. Trade tables cost from £10. There will be trade stands, a car boot sale, a bring-and-buy, special-interest groups, GB4SWR HF station, and an RSGB bookstall. Catering is available on site.
07710 046 846
www.eswr.org.uk

June 14th (Sunday)
JUNCTION 28 RADIO RALLY : The event is at the Alfreton Leisure Centre Bowls Hall, Church Street, Alfreton DE55 7BD. Promoted by South Normanton Alfreton and District Amateur Radio Club. NB: This is not at club QTH. Doors are open 10.15 am (Traders 8 am). Tables are £12.00. Admission is £3.00. There will be around 100 tables, all indoors. Bar/ refreshments in hall and full café in the main sports centre. Dealers & private traders, RSGB stall, local and national clubs. New and used rigs, vintage, antennas, components, spares, books and magazines. Full disabled access, free parking and a meeting area.
snadarcsec@gmail.com
www.snadarc.com

20 JUNE 2020
BANGOR & DISTRICT ARS RALLY: The rally is at the Ballygilbert Presbyterian Church Hall, Ballyrobert, Co Down BT19 1UM. The doors are open from 11 am to 3.30 pm. Entrance fee is £3. More from Norman Newell by email to:
normannewellgi3ymy@hotmail.com

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Prosigns and Abbreviations used in Amateur Radiotelegraphy

Tony Smith G4FAI
g4fai@btinternet.com

Tony Smith G4FAI describes the origins of many of the prosigns and abbreviations we use in Morse today.

Many of the prosigns and abbreviations used in amateur radio communication originated in the formative years of the electric telegraph, long before the advent of wireless. Some of them have their origins in the landline codes while others, over the years, have been copied or amended from professional radiotelegraphy practice or specially devised for the hobby.

Back to 1844!

Several familiar abbreviations come from American Morse of 1844, **Samuel F.B. Morse's** original professional code, **Fig. 1**, for example:

'End of transmission' $\overline{AR}$ (- — - — -) equates to the American Morse letters FN of 1844 (- — - / — -) run together to signify 'finish'.

'End of work' $\overline{SK}$ (- - - — - —) comes from the American Morse numerals 30 (- - - — - / — —) meaning half past the hour, the end of a telegrapher's shift.

'And' $\overline{ES}$ (- - - -) is the American Morse symbol for ampersand, & (- / - - -) and a long dash for zero is also the American Morse symbol for zero.

Other codes/abbreviations surviving from early American telegraphy include GM, 'Good morning'; GN 'Good night'; 73, 'Accept my compliments'; OK, 'Alright'.

Other codes in present-day use also date back a long way:

Interrogation (?) - - — — - - and Dash (-) — — - - - — come from Austro-German Morse, 1852, an early attempt by the Austro-German Telegraph Union to create an international version of the Morse code.

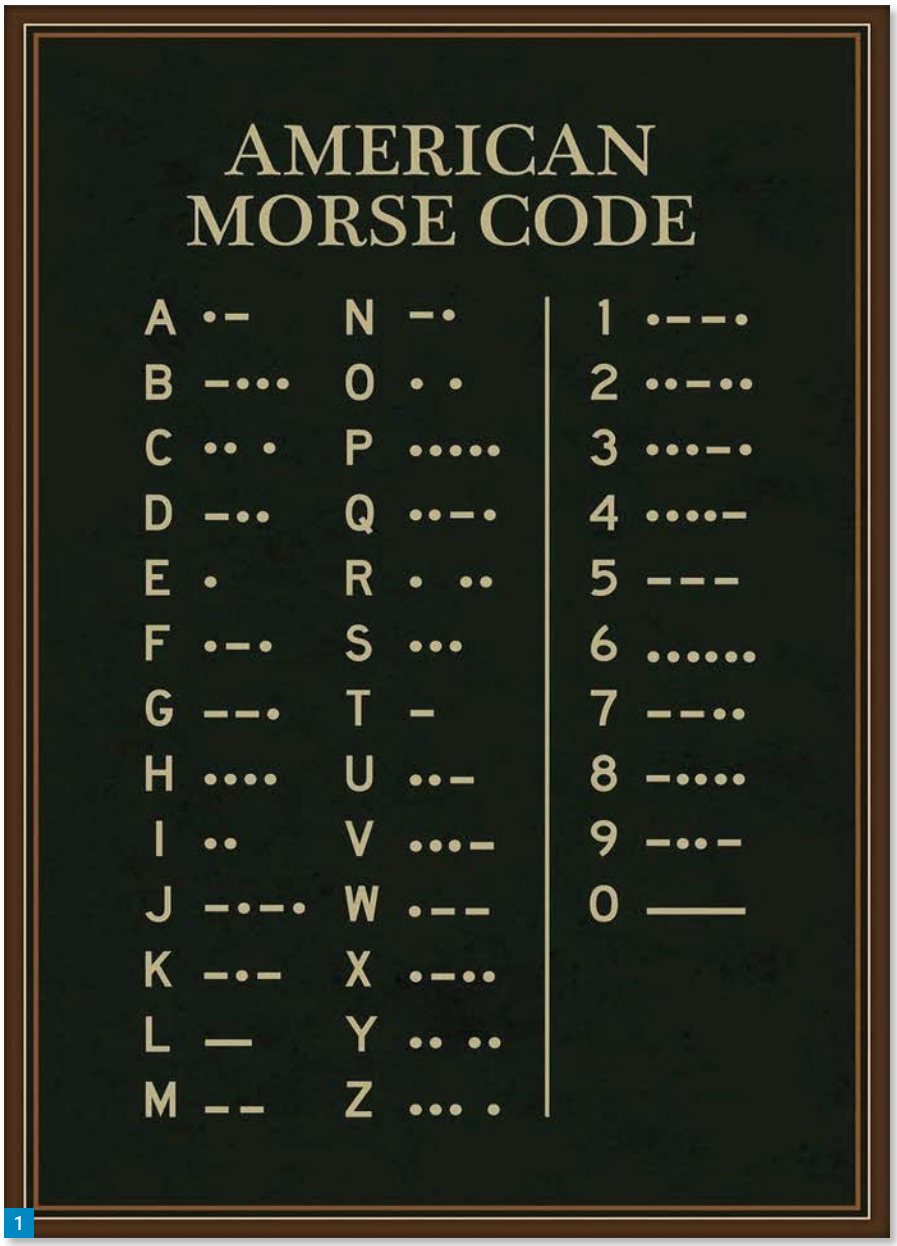
$\overline{CT}$ (commencing signal) — - — - —, $\overline{AR}$ - — - — - and 'Wait' - — - - - were officially adopted for the original ITU International Morse Code of 1866.

K (invitation to transmit) — - — was adopted by the International Wireless Telegraph Convention 1906, effective 1908.

Fraction — - - — - Error - - - - - - - - and R (Received) - — - come from the International Radiotelegraph Convention 1912, effective 1913.

Comma — — - - - — and Full stop - — - — - come from the International Radio Communications Regulations (Cairo revision 1938), effective 1939.

@ (commat) - — — - — - comes from ITU Recommendation ITU-RM (Morse), which specified International Morse code character set and transmitting procedures, effective May 3rd 2004.



1

Earliest Code Book

The earliest code book for Morse telegraphy was *The Secret Corresponding*

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Fig. 1: The original American Morse code.
Fig. 2: The earliest codebook for Morse telegraphy,1845.
Fig. 3: Post Office Morse Learner's Card 1899.
Fig. 4: The first Q-Code, 1912.

Vocabulary Adapted for use to Morse's Electro-magnetic Telegraph, published by one of Samuel Morse's partners, **F.O.J. Smith**, in 1845, **Fig. 2**. This was a dictionary of several thousand words allocated numbers within lettered groups, together with a short list of numbered phrases intended mainly for messages between telegraphists, such as:

20 — Write (ie. send) *more slowly, 21 — Write more rapidly, 22 — Separate your letters more, 23 — Separate your words more, 51 — Your letters are not accurately made.* There are Q-code equivalents of 20 and 21 still in use today, namely, QRS and QRQ, and there are occasions when equivalents of 22, 23 and 51 would also be quite useful!

International Codes

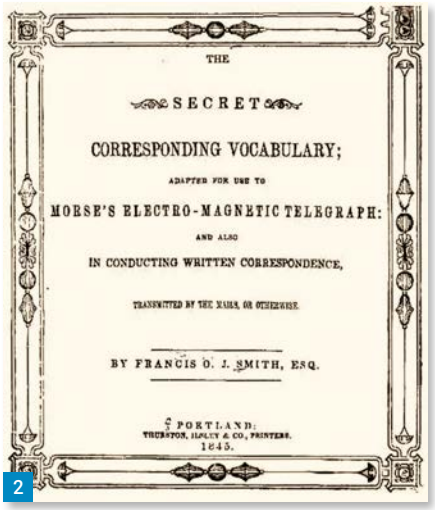
Following the invention of wireless telegraphy, international conferences were held to decide on codes and practices for maritime use, including the safety of life at sea. A preliminary Wireless Telegraph Conference in Berlin in 1903 recommended that, as far as possible, the provisions of the existing International Telegraph Regulations, dating from 1875 should be applicable to transmissions by wireless, including the use of International Morse code in both land-based and wireless international telegraphy.

The subsequent Wireless Telegraph Convention of 1906, also in Berlin, ratified this recommendation and created its own Convention and Annexed Regulations, including the adoption of the SOS distress signal, effective internationally from July 1st 1908. Other signals recommended for maritime use were:

Do you wish to use the International Signal Code? (PRB)*
Invitation to transmit (K) — - —
Begin transmission (CT) — - — - —
End of transmission (AR) - — - — -
Interrogation (?) - - — — - -
End of work (VA) - - - — - —

Most of which had earlier origins as explained above.

RA-RZ and SA-SE codes, with English and French equivalent meanings, were used for communication between British and French ships and coastal stations before 1912 but were superseded by the Q-code. Two of the codes had superficial links with the Q-codes, namely, RA – What station is


THE
SECRET
CORRESPONDING VOCABULARY;
ADAPTED FOR USE TO
MORSE'S ELECTRO-MAGNETIC TELEGRAPH:
AND ALSO
IN CONDUCTING WRITTEN CORRESPONDENCE,
TRANSMITTED BY THE MAILS, OR OTHERWISE.
BY FRANCIS O. J. SMITH, ESQ.
PORTLAND:
THURSTON, HALEY & CO., PRINTERS.
1845.
2

corresponding? (QRA – What is the name of your station?) And RB – At what distance are you from my station? (QRB – How far are you from my station?) but there was no other similarity.

(*The *International Code of Signals for Mariners* containing 70,000 signals was published by the British Board of Trade in 1857, with each signal related to a particular phrase or message. It was published in nine languages, in each of which the meaning of a particular code was the same to facilitate communication between ships of different nationalities. A much later version, in 1969, brought together in a single volume all signals suitable for all types of maritime and aviation communication, by sound, visual signals, radiotelephony and radiotelegraphy.)

Contradictions

Although the new Convention came into effect on July 1st 1908, each government participating was required to ratify it before it was applicable to its own country. Due to bureaucratic or other delays, not all countries did this before the effective date. Consequently, in some the official implementation date was later than that specified by the Convention. Additionally, old practices continued for several years as was evidenced when the *Titanic* sent both CQD (the old distress signal) and the new SOS in 1912.

By way of contradiction, some countries used particular signals well before they were agreed internationally as shown on the British Post Office Telegraphs instruction card of 1899, illustrated, **Fig. 3**. For example, a fraction bar is shown as — - — - and Error (Rub out) is shown as - - - - - - - - both of which were not agreed internationally until 1912.

A full stop is shown as - — - — - — but this wasn't agreed internationally until 1929, and, even stranger, 'Wait' is shown as — — — — - — even though it was previously agreed internationally as - — - - - in 1866!

SOS

Radio amateurs know that SOS is the international distress signal and over the years a number have heard it sent by vessels in distress and have reported it to the appropriate authorities to help initiate rescue operations.

Before SOS was adopted internationally, from February 1st 1904, all ships with Marconi wireless equipment used CQD as a distress signal, meaning *"CQ all Stations, Distress"*. At the 1903 W/T Conference Italy recommended SSSDDD as D had previously been used internationally as a distress signal, but this recommendation was not adopted.

At the 1906 Convention, the American distress signal NC, *"I am in distress and require immediate assistance"*, was also considered but not adopted, although it was (and still is) retained as a distress signal in the International Code of Signals. From April 1st 1905 German ships had been using SOS (known as Notzeichen), and this version was finally adopted as the international distress signal.

Q-Code

The Q-codes were ratified by the International Radiotelegraph Convention, London, 1912, effective July 1st 1913 and were intended for international communication between ships at sea and coastal stations. The original list contained 49 Q-codes, together with four extra signals, namely, CQ, TR, ! (exclamation) and PRB, the intended meanings of which can be seen in the table, **Fig. 4**.

The list was expanded and/or modified by later Conventions and divided into sections; QRA-QVZ was applicable to all services, QAA-QNZ was reserved for the aeronautical services and QOA-QQZ for the maritime services.

Of all the Q-codes, only a handful are in regular amateur use, including QRL, QRM, QRN, QRO, QRP, QRS, QRT, QRU, QRX, QRZ, QSB, QSK, QSL, QSO, QSY and QTH, most of which are also used (incorrectly!) in amateur radiotelephony.

A number of them have been modified or simplified for the amateur service, e.g. QRL – "Are you busy" has been changed to "Is this frequency in use?"; QRT – "Shall I stop sending?" = "I am closing down"; QRX – "When will you call me again?" = "Stand by"; and QSO – "Can you communicate with

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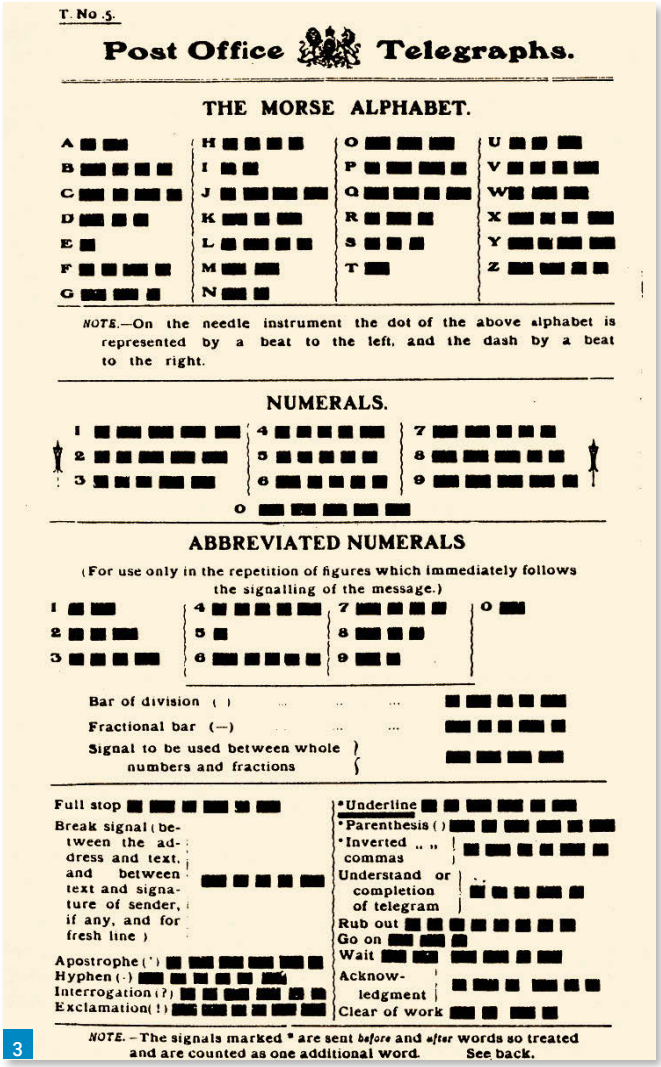


T. No. 5.

Post Office Telegraphs.

THE MORSE ALPHABET.

A ·–	H ····	O –––	U ··–
B –···	I ··	P ·––·	V ···–
C –·–·	J ·–––	Q ––·–	W ·––
D –··	K –·–	R ·–·	X –··–
E ·	L ·–··	S ···	Y –·––
F ··–·	M ––	T –	Z ––··
G ––·	N –·		

NOTE.—On the needle instrument the dot of the above alphabet is represented by a beat to the left, and the dash by a beat to the right.

NUMERALS.

1 ·––––	4 ····–	7 ––···
2 ··–––	5 ·····	8 –––··
3 ···––	6 –····	9 ––––·
	0 –––––	

ABBREVIATED NUMERALS

(For use only in the repetition of figures which immediately follows the signalling of the message.)

1 ·–	4 ····–	7 ––···
2 ··–––	5 ·····	8 –––··
3 ···––	6 –····	9 ––––·
		0 –––––

Bar of division ( ) ... ... ·––––·

Fractional bar (—) ... ... ·––––·

Signal to be used between whole numbers and fractions } ·––––·

Full stop ·–·–·–

Break signal (between the address and text, and between text and signature of sender, if any, and for fresh line) ·–·–·

Apostrophe (') ·––––·

Hyphen (-) –····–

Interrogation (?) ··––··

Exclamation (!) –·–·––

*Underline ··––·–

*Parenthesis ( ) –·––·–

*Inverted „ „ commas ·–··–·

Understand or completion of telegram ···–·

Rub out ––––––––

Go on –·–·–

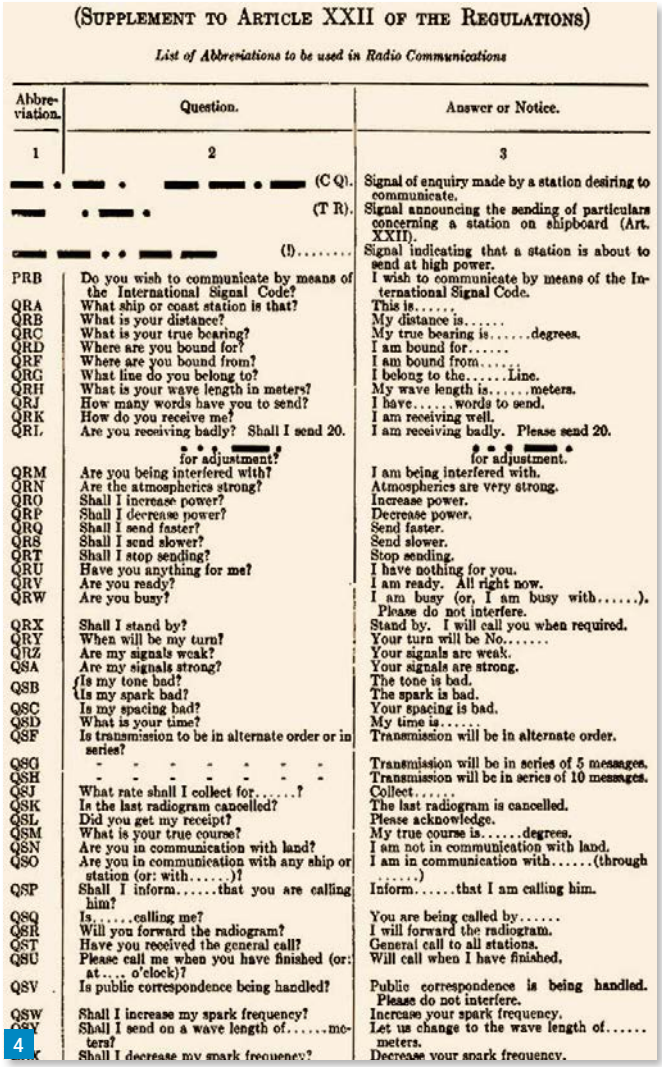
Wait ·–···

Acknowledgment ···–·

Clear of work ···–·–

NOTE.—The signals marked * are sent *before* and *after* words so treated and are counted as one additional word. See back.

3



(SUPPLEMENT TO ARTICLE XXII OF THE REGULATIONS)

List of Abbreviations to be used in Radio Communications

Abbreviation.	Question.	Answer or Notice.
1	2	3
––·–· ·–· ––· ––·–	(C Q).	Signal of enquiry made by a station desiring to communicate.
––· ·–·	(T R).	Signal announcing the sending of particulars concerning a station on shipboard (Art. XXII).
––– ––· ·– ––· –––	(I).....	Signal indicating that a station is about to send at high power.
PRB	Do you wish to communicate by means of the International Signal Code?	I wish to communicate by means of the International Signal Code.
QRA	What ship or coast station is that?	This is.....
QRB	What is your distance?	My distance is.....
QRC	What is your true bearing?	My true bearing is.....degrees.
QRD	Where are you bound for?	I am bound for.....
QRF	Where are you bound from?	I am bound from.....
QRG	What line do you belong to?	I belong to the.....Line.
QRH	What is your wave length in meters?	My wave length is.....meters.
QRJ	How many words have you to send?	I have.....words to send.
QRK	How do you receive me?	I am receiving well.
QRL	Are you receiving badly? Shall I send 20. ·–·–·– for adjustment?	I am receiving badly. Please send 20. ·–·–·– for adjustment.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are the atmospherics strong?	Atmospherics are very strong.
QRO	Shall I increase power?	Increase power.
QRP	Shall I decrease power?	Decrease power.
QRQ	Shall I send faster?	Send faster.
QRS	Shall I send slower?	Send slower.
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Are you ready?	I am ready. All right now.
QRW	Are you busy?	I am busy (or, I am busy with.....). Please do not interfere.
QRX	Shall I stand by?	Stand by. I will call you when required.
QRY	What will be my turn?	Your turn will be No.....
QTZ	Are my signals weak?	Your signals are weak.
QSA	Are my signals strong?	Your signals are strong.
QSB	Is my tone bad?	The tone is bad.
	Is my spark bad?	The spark is bad.
QSC	Is my spacing bad?	Your spacing is bad.
QSD	What is your time?	My time is.....
QSF	Is transmission to be in alternate order or in series?	Transmission will be in alternate order.
QSG	- - - - - - - - - -	Transmission will be in series of 5 messages.
QSH	- - - - - - - - - -	Transmission will be in series of 10 messages.
QSJ	What rate shall I collect for.....?	Collect.....
QSK	Is the last radiogram cancelled?	The last radiogram is cancelled.
QSL	Did you get my receipt?	Please acknowledge.
QSM	What is your true course?	My true course is.....degrees.
QSN	Are you in communication with land?	I am not in communication with land.
QSO	Are you in communication with any ship or station (or: with.....)?	I am in communication with.....(through .....)
QSP	Shall I inform.....that you are calling him?	Inform.....that I am calling him.
QSQ	Is.....calling me?	You are being called by.....
QSR	Will you forward the radiogram?	I will forward the radiogram.
QST	Have you received the general call?	General call to all stations.
QSU	Please call me when you have finished (or: at.... o'clock)?	Will call when I have finished.
QSV	Is public correspondence being handled?	Public correspondence is being handled. Please do not interfere.
QSW	Shall I increase my spark frequency?	Increase your spark frequency.
QSY	Shall I send on a wave length of.....meters?	Let us change to the wave length of..... meters.
QSX	Shall I decrease my spark frequency?	Decrease your spark frequency.

4

... direct (or by relay)?" = "Amateur radio contact".

Amateur QN code

A variation of the Q-code, the QN signals, running from QNA to QNZ, were created by the American Amateur Radio Relay League (ARRL) in 1939 for exclusive use on amateur CW third party traffic nets. Although used by amateur operators these codes are not intended for use in casual amateur conversations. Examples are: QNC – "All net stations copy"; QNJ – "Can you copy me?"; QNU – "The net has traffic for you. Stand by."

These are within the Aeronautical code range QAA-QNZ but, after consultation with the Federal Communications Commission (FCC) at the time, it was agreed that no difficulty could be foreseen as long as the codes continued to be used only in amateur nets.

Informal Abbreviations

Apart from those previously mentioned, the origins of informal abbreviations used by amateurs are less easily identified. Many have been copied or adapted from professional use. Others have been created by amateurs themselves. There are long lists in amateur handbooks and instruction manuals, and equivalents have been produced in many countries, making them potentially a useful international language.

Doubtless there are some amateurs who have an extensive knowledge of them, maybe more so in the past, but many amateurs today probably only use a handful of them. This results in 'rubber stamp' QSOs with a very limited exchange of information, e.g. RST 599, NAME JOHN, QTH LONDON, RIG FT817ND, PWR 5 WATTS, ANT W3EDP, and maybe WX RAIN, TEMP 15C. Sometimes much less. Two overs if you are lucky and then, TKS QSO OM (or DR YL), 73 (or 88), GL, HPE CUAGN, AR, VA. And it's all over. Two to five minutes, depending on content and the speed of the operators.

This is fine for beginners and it does facilitate limited communication with other amateurs who don't speak English very well. However, the potential is there for longer and more enjoyable exchanges, particularly in present conditions when contacts using manually sent Morse are becoming less frequent.

Still Flying the Flag

Amateur radio is the last bastion of radiotelegraphy and it has a rich heritage of historical abbreviations, codes and prosigns to facilitate useful communication between national and international stations. Professional radiotelegraphy is long gone. The military no longer use it as a regular means of communication, maritime operations officially ceased in 1999, but amateur radio is still flying the flag for Morse. It is an amazing fact that within today's high-tech amateur radio operations there are still surviving communication codes and abbreviations that were first used 175 years ago!

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RG174 (10m) BNC fitted one end	**£13.45**
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Balun kit 1:1 w/enclosure 125W	£14.95
4:1 matching xfmr kit 125W	**£14.95**
Stealth antenna cord (50m)	£8.50
O/wire line insulators x5 600Ω	**£4.50**
Adapter SMA(F)-SO239	£3.50
Adapter BNC(M)-PL259	**£3.50**
Lead SMA(M-M) 80cm RG174	£9.95
Lead PL259-PL259 80cm RG174	**£7.95**
Variable DSP filter module	£44.95
Bungee/shock cord 3mm per metre	**£0.55**

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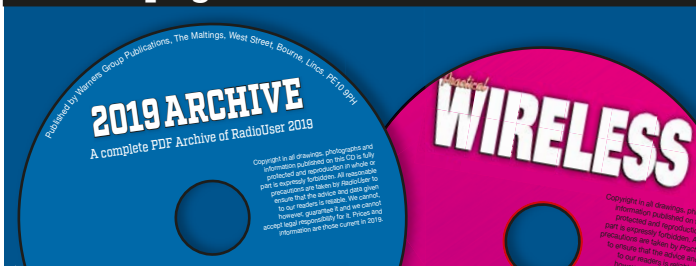

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Ionosondes

Steve White G3ZVW looks at how professional HF radio users study and measure the ionosphere.

The basic 'tool' that professionals and researchers use to study the ionosphere is known as the Ionosonde. It was invented almost 100 years ago, so needless to say the equipment has changed over the course of time.

The Basics

Layers of ionised gases from about 80km to over 500km above Earth's surface – collectively called the Ionosphere – can refract High Frequency radio waves back to Earth. The reason these gases are ionised, i.e have an electric charge, is because of action by radiation from the Sun. The level of ionisation is not uniform across the height of the ionosphere, across the globe or constant in nature. This means High Frequency radio propagation is constantly changing, which makes it an extremely interesting subject for scientists to study.

One of the basic terms used when looking at the ionosphere is Critical Frequency, which is the frequency above which the ionosphere does not return a signal. This is one of the important things ionosondes look at.

An ionosonde works by transmitting a signal and listening for it, to find out if it is returned by the ionosphere above it. The longer it takes for a signal to return, assuming any signal at all is returned, the further away (i.e. higher up) the ionosphere must have been that returned it.

The speed of light – and of radio waves – is 300,000km per second. This equates to 300km per millisecond, so if a transmitted signal takes one millisecond to return, it means that it was returned from a height of 150km. The total path length was 300km, 150km up and 150km back down.

The Basic System

Basically, there are six components to an ionosonde:

The transmitter

Designed to work over a wide range of HF frequencies, with no need to be re-tuned when it changes frequency.

The transmit antenna

Designed to work across a wide range of frequencies and radiate a lot of its signal straight upwards, so it certainly wouldn't be the kind of antenna that would be used for long distance working.

1

The receiver

Linked to the transmitter, so that it is always listening to the frequency that the transmitter is operating on.

The receive antenna

Broadband, so useful on a wide range of frequencies. A typical ionosonde receive antenna is shown in **Fig. 1**.

Control

A timed control system, to simultaneously control the transmit and receive frequencies, switch them on/off, etc.

Data gathering

A means of recording what the ionosonde's receiver hears. These days it will also be linked to the internet in some way, so able to send records to maybe a scientific institute.

How Ionosondes Work

Ionosondes do not transmit on fixed frequencies. Instead, each ionosonde – and there are lots of them around the world running all the time – constantly changes frequency. They transmit a plain carrier wave and by convention start low in frequency and move steadily higher, in a continuous sweep. Ionosondes are often called Chirp Transmitters or Chirp Sounders (the word 'sounder' being because the equipment is taking 'soundings'). That said, if you are listening on SSB and an Ionosonde sweeps past the frequency you are listening to, it does sound like a chirp.

Not all ionosondes make the same sweep of frequencies. Some start below 1MHz, while others start above it. Some stop at maybe 10MHz, while others will go higher in frequency, especially at times of high solar activity.

The start of a sweep is accurately timed, these days by GPS. The data that is gathered during a sweep (which takes a couple of minutes) is used to produce an Ionogram – a pictorial representation of the ionosphere. There are two ionosondes in England, but in the paragraphs that follow I will show some cropped ionograms from the Dourbes ionosonde in Belgium. They were taken at different times of the day and show clearly how propagation changed. If you look at the online ionograms you will see they have data appended, but I want to keep this as simple as possible.

Interpreting the Data

In the illustrations that follow, which were all captured on the same day, please just concentrate on the red reflections. These are the 'normal' reflections. The green reflections are extraordinary reflections and the black wavy lines are the computed electron density, both of which are beyond the scope of this feature.

The plot of **Fig. 2** was captured at 1325UTC. The Sun is just past its highest at this time, so it is roughly the time of day when the ionosphere will be at its strongest. The blue oval shows reflections from the E Layer and at this time of day they are good and strong. The black oval shows reflections from the F1 Layer, its base height at this time being 170km. The highest layer is the F2 Layer. It is shown in the red oval. In this figure the Critical Frequency of the F2 Layer (where the red trace sweeps sud-

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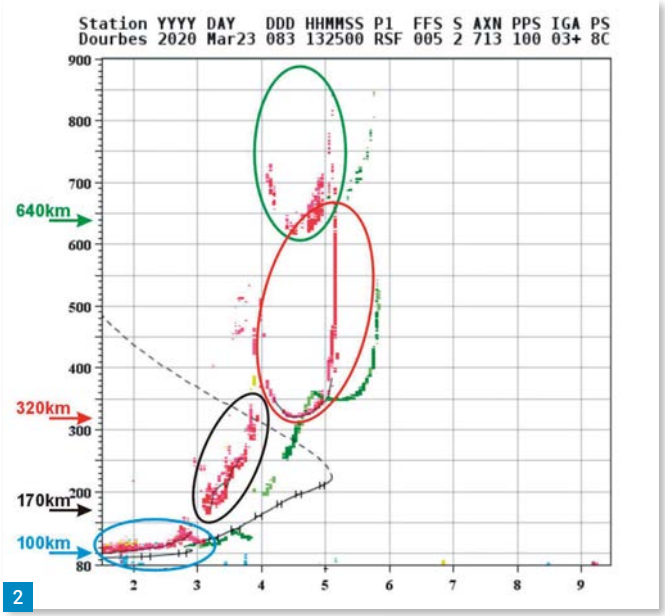

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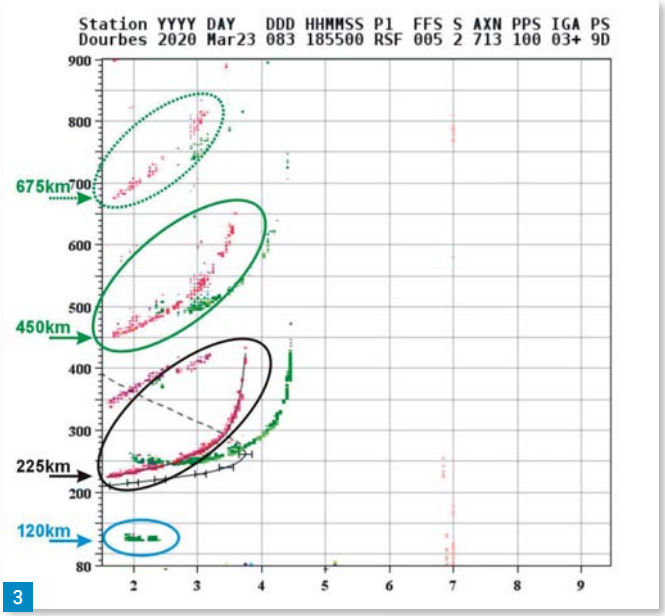

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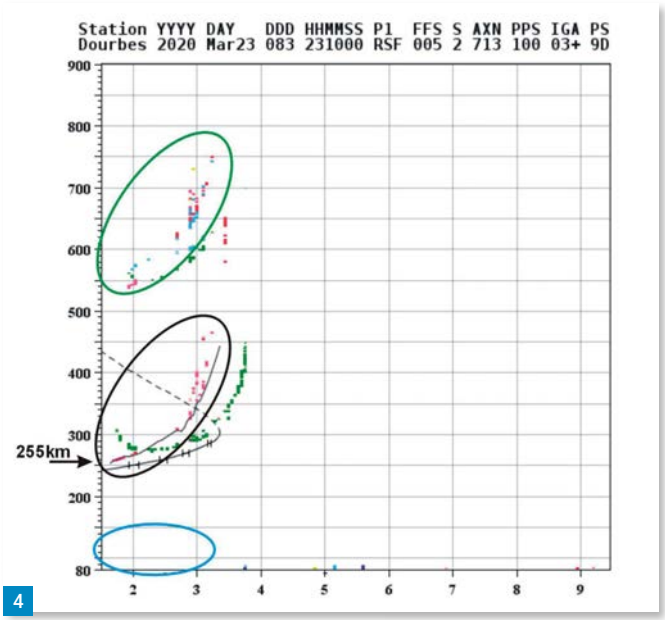

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Fig. 1: A typical ionosonde receive antenna, crossed magnetic loops. There is usually an array of them.
Fig. 2: Early afternoon ionogram.
Fig. 3: Evening ionogram.
Fig. 4: Late night ionogram.

denly upwards) is 5.1MHz, with the lowest reflections coming from 320km. Above the F Layer, and shown in the green oval, are 'ghost reflections'. These are caused by signals from the ionosonde's transmitter bouncing back from the ionosphere, hitting the ground, going back up and being reflected back to ground a second time. As Fig. 2 shows, the ghost reflections appear to be coming from a height of 640km, double the height of the real F2 Layer.

Fig. 3 was captured at 1855UTC. By twilight the ionosphere has weakened and conditions have changed dramatically. Compare the blue oval to the corresponding one in Fig. 2 and you will see that reflections from the E Layer are now much weaker. The E Layer has also moved higher, from 100km to 120km. By twilight the F1 and F2 layers have combined into one, which they always do at night. The bottom of the F Layer is at 225km, i.e. between the heights of the F1 and F2 Layers in Fig. 2. The Critical Frequency has dropped to 3.75MHz. In Fig. 3 you can easily see not only a double bounce 'ghost' in the green oval, but a treble bounce 'ghost' in the dotted green oval. Naturally they appear at double and treble the heights of the real F Layer.

Fig. 4 was captured at 2310UTC. By night the ionosphere has weakened still more. The blue oval that shows E Layer reflections is now completely empty. Gases at the height of the E Layer are no longer sufficiently ionised to return any signals at all. Essentially, the E Layer has gone for the night. It'll be back at sunrise. The F Layer shown in the black oval has moved to 255km, a bit higher than it was at twilight. It has also significantly weakened. Even so there is still a double bounce ghost reflection, although much weaker than it was in Fig. 3. The Critical Frequency has dropped further, to a little over 3MHz.

During times of high solar activity reflections from the ionosphere would go higher in frequency, i.e. they would be stretched out to the right in the ionograms. At the current point in the Solar Cycle the Critical Frequencies – the frequencies at which the various layers of the ionosphere cease to return a signal – are very low.

Modern Ionosondes

Solid-state equipment, of course, with some of them being able to give an indication of the ionosphere not just above but also in various directions. So-called Digisondes are complex and beyond the scope of a series such as this, which is aimed squarely at people who know little about propagation, rather than those who know almost everything.

Summing Up

In times gone by, not many hobby radio enthusiasts would have seen an ionogram and few of us would have known how to interpret one if we did. The internet has changed all that. Not only are there near real-time ionograms that we can view freely, they have information appended which gives us facts and figures.
Also, there are web pages devoted to understanding them. Lucky us!

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Science Museum

Dear Don,
I read with interest the letter (April) from **Geoff Voller G3JUL** – now I know who to blame for my lifelong interest in amateur radio and my career in electronics!

When I was a young teenager (early 1960s) I haunted the Science Museum in London throughout my school holidays. Easy to take a train from my home to South Kensington and there I was in the heart of museum land. The major attraction for me was GB2SM – I was there watching and listening whenever it was on the air. All I ever wanted was to become licensed and communicate with the world. All that lovely equipment with the curved console and the Labgear (?) rack-mounted transmitter was the stuff of teenage dreams (well almost).

The loss of the amateur radio station was, to my mind, a very short-sighted action by the museum authorities. I visited recently and the only real sign of the old days of amateur radio was the Morse key (very badly adjusted until somebody I know tweaked it) on a display of why clock time was made universal over the railways.

Oh, the memories of youth – but I will always be grateful to those who operated that station – it led to my degree and a lifelong interest in amateur radio.

Thank you G3JUL and all the others who operated there.

Barry Horning GM4TOE
Banff, Aberdeenshire

Prefix Confusion

Dear Don,
Regarding letter in the April 2020 edition about Prefix Confusion.

I understand that new issues of the M5 (+) 2 Full Licence callsign is reserved for former Marine Radio Officers who held the advanced Professional Licence either PMG1 or replacement MRGC, which required fault-free Morse at 20WPM and technical and telecommunications knowledge to a much higher level than the current Full Licence exam.

Greg White,
Birmingham

*(**Editor's comment**: Thanks Greg, I wasn't aware of that but see also this month's News pages regarding the issue of callsigns with two-letter suffixes.)*

Electronics Books

Dear Don,
Referring to **Barrie Eggleton's** letter in the latest (April) *PW*, I share his concern that messing about with electronics these days is not really served by books, particularly catering for the younger reader. However, I believe that all is not lost. I have a number of old radio books by **Gilbert Davey** and others, and these can still be found by trawling second-hand book websites. Also, and for electronics generally, how about the excellent range of books by Bernard Babani Publishers? Although many are probably out of print, there are loads listed in second-hand booksellers websites. Many of the components required will be old fashioned but can still be obtained. A lot of fun could be had in actually finding the books and the components, and the establishment of a 'junk box', as a result! Happy days!

Guy Howard M0ISK
Kettering, Northants

*(**Editor's comment**: Thanks for your Letter Guy. You're right of course although his point is well-made – nothing obvious currently in print.)*

Bruneval et al

Dear Don,
On reading your piece in the April issue of *PW* I was surprised to learn that you had not come across the story of the Bruneval raid.

If you would like to read more about Bruneval, Peenemunde and many more actions, naming the people involved, the process of organising these raids from the start to the finish of the war, and the constant need for new technology I suggest you get a hold of the book:

Most Secret War by RV Jones, ISBN 0 241 89746 7.

It covers radio, radar and the beams used by the enemy to drop bombs on Britain. I have read many books on the subject but this one outshines them all. I bought a second-hand copy from eBay for £4 just a few weeks ago. There are lots available.

Alex Blyth GM4TAL
Longniddry, E. Lothian

Roger Bip

Dear Don,
I agree with **Jorge EA4EO** that the use of End of Transmission (EOT) tones in general amateur radio communications is both undesirable and a poor substitute for observing correct voice procedure, something that sadly we amateurs are generally not very good at.

Having operated military and marine radio systems from HF to UHF, the importance of using correct voice procedure, which included using callsigns, standard NATO phonetics and announcing end of transmission, was paramount to ensuring that information was passed accurately and efficiently and that nets remained orderly – and with not an EOT 'beep' to be heard!

I listen regularly to 80m and 40m while working on bench projects and although most traffic is generally well structured it is evident that there is no standard voice procedure in place and being taught for amateur radio. Guidelines are published, notably by bodies such as the RSGB, but these fall short of defining the key words and templates that could form a standard 'wrapper' for voice communications. Such a construct need not be complicated or cumbersome to use and would certainly not detract from the enjoyment of that rare contact or the camaraderie of a local net. However, it would improve communications flow, particularly under difficult circumstances, and most importantly to anyone listening to our bands, present us as the highly skilled and capable band of enthusiasts that we are. With a few possible exceptions, such as weak signal VHF/UHF operation and

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1960s Apollo spacesuit VOX systems, my view is that EOT tones belong firmly in the world of CB alongside echo microphones and self-illuminating helical whips. Come on, we're better than this!
Ron Taylor G4GXO
Penrith

Starter Books

Dear Don,
The request for help finding books on basic electronics (**Barrie Eggleton**, April *Letters*) seems to leave a 'black hole' for such an important subject. I recommend *Electronics for Dummies* as a starter. It sounds belittling but it got a six-year old neighbour on the right track to university. Beware: I think I influenced this lad when he was only three years old. I built him a 'meep – maap' siren for his Christmas police car. That's another book to look for: How to upset a housing estate!

On another subject, oops! **Jorge Dorvier EA4EO** has raised the 'Bip' subject. I added a 'bip' to my TR9000 on SSB only. The year they came on the market – too many blown fuses ago to remember! There were several comments about its value under poor conditions. Perhaps I was the first 'bipper'. Sorry – I would now consider it detrimental to sanity. Imagine a 14MHz pile-up!
Mike Cooper ex. G8JOJ

Tuners

Dear Don,
I am considering resurrecting my interest in amateur radio. However, due to the limitations of my high rise flat, I would need to use a loop antenna probably hanging situated on my balcony. These I can make myself. My problem is the tuner. Some tuner manufacturers make tuners specifically for loop antennas, but an article from the RSGB caught my interest. It referred to stealth antennas and it would seem that all I need to make a tuner is two, possibly three, variable capacitors.

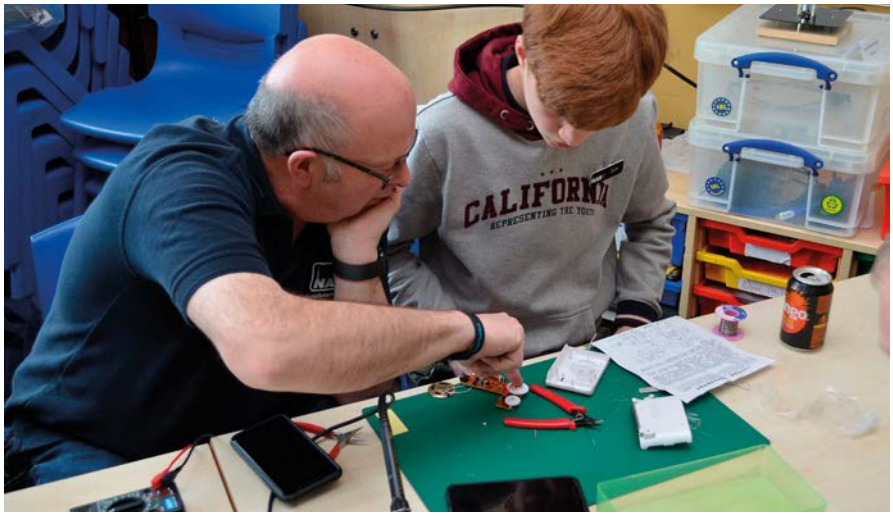
This leads me to believe that a normal tuner would suffice, unless I made my own, and that the tuners advertised for loops are just there to extract more cash than necessary from my wallet.
Gareth Drinkwater 2E0NCP
Swindon

*(**Editor's comment**: Thanks Gareth and, yes, tuners need not be complex. Most consist of maybe a couple of variable capacitors and a coil, depending on what it is being matched. There are many designs available on the internet and in the books. The only issue with small loops is that they are generally hi-Q and voltages can be high, especially if running higher power levels. I feel an article coming on ….)*

Radio Round-up

Amateur Radio Clubs as Hubs in a Rural Setting

Amateur Radio Clubs in the Somerset Area are being invited by MidSomerset Amateur Radio Club to take part in a local day conference later this year to find ways of supporting each other, connecting better with others in a rural setting, and growing the hobby.
Richard G4JJP, one of the organisers, said: "Increasing age, declining membership, and apparent irrelevance don't have to define amateur radio. But we do need to change the way we connect with each other and with interested groups if we are to halt the decline."
The Chairmen of 17 amateur radio clubs in the Somerset area have been invited to discuss the proposal with their members. Richard said: "We've already had great support from Clubs as far apart as Glastonbury and Exeter, and the local RSGB reps have offered some exciting new thinking. The idea of Clubs as 'Hubs' in a wider network is one idea that we will be exploring".
For more information, go to the website below, where you can download the proposal letters and other conference information:
www.wessexham.co.uk



National Science Week Demonstrations

Norfolk Amateur Radio Club (NARC) took part in National Science Week this year with a display and radio demonstrations at Norwich CNS School, where NARC meets every Wednesday. The school's Super Science Saturday featured a whole host of different events and NARC was only too happy to assist. CNS was one of the schools that made an ISS contact with astronaut Tim Peake.
Sonny M0SYW and Steve G0KYA put on a demonstration HF station using the club call G4ARN (Amateur Radio Norfolk), while James M0UKS and James G7PQF put on a display of 2m APRS and its applications.
NARC also demonstrated a Flex Maestro, which was connected via the internet to Malcolm G3PDH's home HF station, showing how amateur radio has moved with the times.
John Goldsmith M6JAU, who runs NARC's Bright Sparks activities for youngsters, also showed a wide range of interactive electronic projects, including a radio-controlled digger and a line-following robot, one of the projects the Bright Sparks had built.
David G7URP and Tammy showed electronic construction, while Sam (one of the club's new Bright Sparks) built a medium wave/FM radio from a kit – complete with instructions in Chinese!
Contact was also made with Norwich's twin City of Koblenz in Germany on 40m in a regular monthly net. Other HF contacts were made with Canada, Malta, Switzerland and Norway using SSB and CW.

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VU/PPM/S-Meter Module

Geoff Theasby G8BMI
geofftheasby@gmail.com

Geoff Theasby G8BMI draws our attention to a cheap VU meter that can be used for monitoring amplitude-modulated audio.

This is a stereo VU (Volume Unit) or Peak Programme Meter (PPM) drive module, which can also be used for receiver S-meters, as they are fairly similarly scaled although not so precisely defined (currently showing on eBay for £6.33, labelled 'Dual Stereo VU Meter Driver Board Amplifier DB Audio Level AC 12V'). VU and PPM meters were introduced just before WWII, in America and Britain respectively. PPM relied upon the ballistics of the meter, and VU could be used with almost any moving coil meter.

For an in-depth look at both, see the excellent Elliot Sound Products pages on the matter, from the viewpoint of an audio recording engineer. See also the Don-Audio site (search for 'Vintage Meters').
https://sound-au.com
www.don-audio.com

The driver module uses a BA 6138 IC, which incorporates a compression circuit and a Mute pin, Pin 1. If required, connect a switch between pins 1 and 9. The IC will also drive LED displays. My example, with the PCB marked KD-7319, works well, with a delay/hold of about half a second and good fidelity, **Fig. 1**.

Modulation Depth

The BBC modulation depth on AM (Amplitude Modulation) is normally about to 30%, (100% for a maximum of ten minutes, continuous 80%) for English male speech. Commercial radio is more often modulated to 40%. Radio amateurs generally strive (on AM) for close to 100% because this aids reception in weak signal conditions. These meters help to avoid exceeding the studio or transmitter technical limits. Positive-going signals can be over-modulated to 20% but negative going is not possible, says my source. Well, in fact, it is possible, but it generates huge interference because the carrier is cut, then reinstated, every cycle. (Pinch off) BBC calibration is performed at 440Hz with 70% modulation, and the 'pips' are also 70% modulated.

Possible Uses

Why should we use a stereo module? Well, if you are using diversity reception (two receivers on different frequencies, or with different antennas), then you can compare results more easily. Likewise, if you are working a station crossband, it could be informative. Or, readers could just use one channel, and luxuriate in the knowledge that there is a spare. My PPM by Ernest Turner, marked Model 325 1%, has a wirewound shunt within, or it looks like one, but not a rectifier, as some have, **Fig. 2**.

I have also encountered loudness meters, less relevant for amateurs, but that's a matter for another day.
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https://tinyurl.com/rqe7hcn

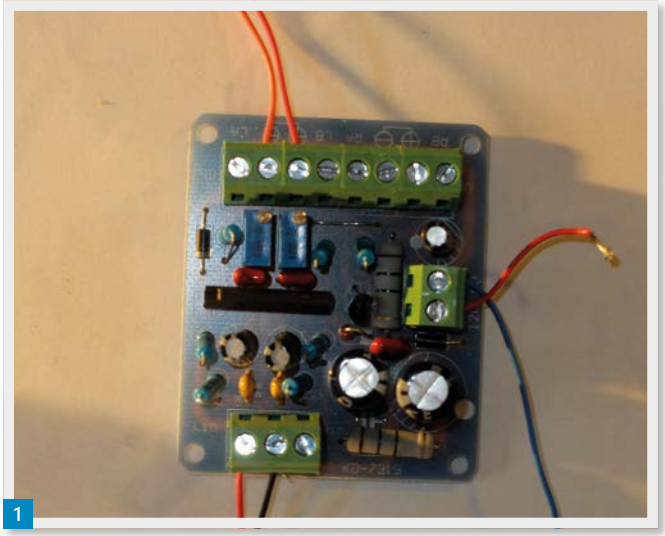
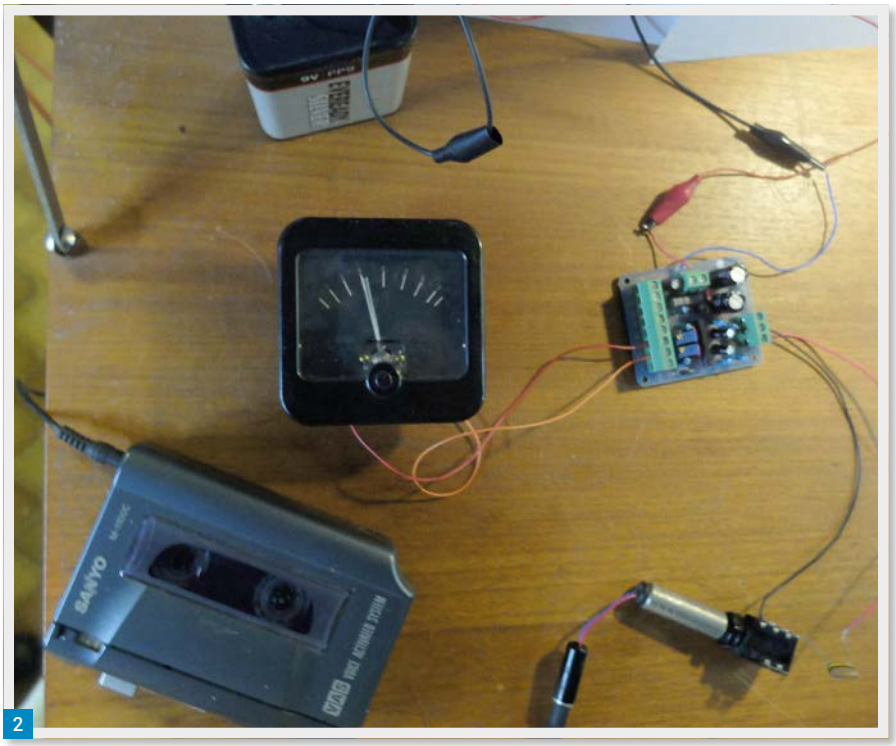


Fig. 1: The module.
Fig. 2: House of the Rising Sun on a PPM (Shades of Monty Python).



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Continued from Page 5

to operate your station from another room or another continent, or to operate a remote station from your home, for example to get round problems of local noise.

In the US, it's taken to another level completely, with commercially-run superstations being available for rental, operated from the comfort of your home. The HH2AA station, regularly active in contests, is usually operated from mainland USA, while the return of 4U1UN (UN HQ in New York) to the airwaves has only been made possible by allowing the station to be controlled from a site remote from the UN building, given security concerns about access to the UN building itself. There are plenty of other examples too. Just recently, in the Russian DX contest, I worked a station in Cyprus and recognised the voice as that of a friend. It turned out he was in Salisbury but enjoying operating his remote station. Does it matter? Perhaps not. What matters to us is presumably about where our RF goes, not where the operator is located. But if you decide to do some remote operation yourself, just be sure that you follow both the relevant licensing regulations and, if in a contest or making yourself available for awards chasers, the relevant rules applicable to those.

Revitalising the Hobby

In a News item on page 75 you will see that the MidSomerset Amateur Radio Club are taking the initiative to explore the decline in numbers within our hobby and how it might be halted. I'm not sure when their meeting will actually take place, given the current lockdown, but I applaud what they are trying to do and, as I now live in Somerset, I have offered to take part in their conference as and when it happens.

Funnily enough, as you will see in another News item, interest in amateur radio has increased in the US since the arrival of coronavirus. Maybe folk are perhaps realising that our hobby is a good one when we are confined to the home.

It certainly is worthwhile to try to explore how we can bring more people into the hobby. That said, it's been tried time and again and, sadly, largely without success. A lot of effort has been expended on bringing youth into amateur radio, but with relatively small returns. Maybe young people just aren't interested, don't have time to pursue our hobby, think it's full of old men, or whatever. I certainly recall some feedback a few years ago from a young German amateur who felt that the hobby as it was pursued by the majority just didn't suit him. Radio clubs were full of old timers, there was little interest by the majority in the sort of things that appeal to the young (satellite communications, digital modes, etc) and setting up stations from home didn't sit with those who probably couldn't even afford a home of their own.

This is a far cry from my own early days, when the average age of amateurs was much lower and most of us gained our licences when in our teens (in my case I was just 16 when I got my callsign). But, then, the hobby largely appealed to would-be scientists and engineers, whereas nowadays that demomgraphic are more likely to be pursuing something in the IT arena.

Maybe other clubs could emulate MidSomerset and set themselves the challenge of how to bring in new blood. But maybe that new blood doesn't have to be from the young. The hobby can and does appeal to an older age group, perhaps those coming uo to retirement and wanting an avocation that they can follow even when confined to the home through bad weather, ill health or, yes, a viral lockdown. Something to think about during these dark days, perhaps.

Meanwhile, keep safe and enjoy having time to pursue your radio!

Don Field
Editor, *Practical Wireless* Magazine

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

THE MFJ-1234 RIGPI REVIEWED: Don Field G3XTT takes a look at a handy controller for your amateur radio station.
VALVE & VINTAGE: Bernard Nock G4BXD adds an Eddystone ECR to the museum's collection.
BASE LOADED VERTICALS: Steve Telenius-Lowe PJ4DX describes how to base load a vertical antenna for the LF bands.
THE QRPGUYS DSB DIGITAL TRANSCEIVER KIT: Martin Peters G4EFE takes a look at a neat kit from US supplier The QRP Guys.
PEDESTRIAN MOBILE: Ken Churms G4VZV describes his pedestrian mobile operations from Spain.
There are all your other regular columns too, including Carrying on the G3RJV Way, HF Highlights, World of VHF, Notes from a Small Station, In the Shop, The Morse Mode, Making Waves, What Next and Data Modes.

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