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MSO5102	100MHz	8GSa/s	*200Mpts	500,000 wfms/s	*16	2 Channels
MSO5104	100MHz	8GSa/s	*200Mpts	500,000 wfms/s	*16	4 Channels
MSO5204	200MHz	8GSa/s	*200Mpts	500,000 wfms/s	*16	4 Channels
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PRACTICAL WIRELESS

April 2021 Vol. 97 No 4
On sale: 11 March 2021
Next issue on sale: 8th April 2021

ISSN 0141-0857

Practical Wireless
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Bourne, Lincs PE10 9PH
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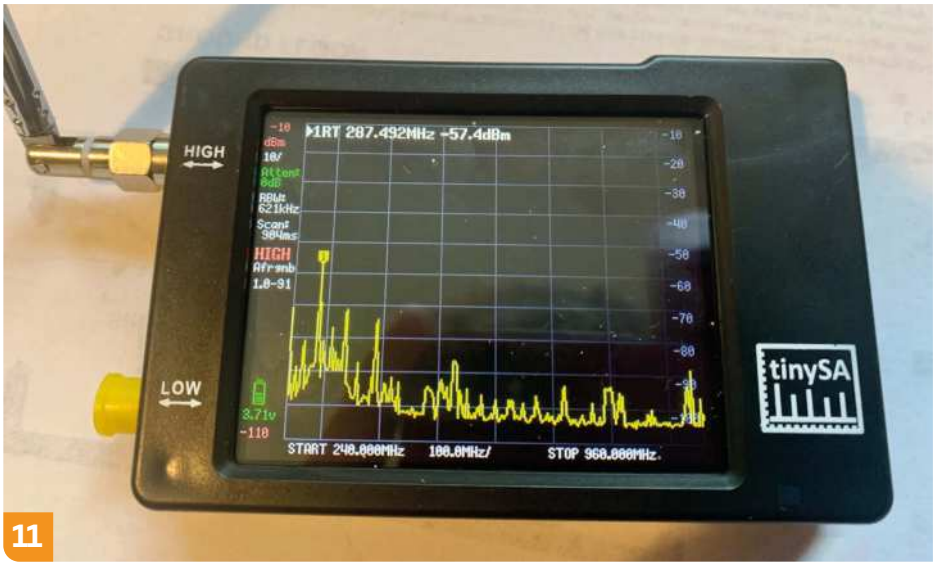
We regret that due to Editorial timescales, replies to technical queries cannot be given over the telephone. Any technical queries are unlikely to receive immediate attention so, if you require help with problems relating to topics covered in PW, please either contact the author of the article directly or write or send an email to the Editor and we'll do our best to reply as soon as we can.

This publication is printed by Warners 01778 395111



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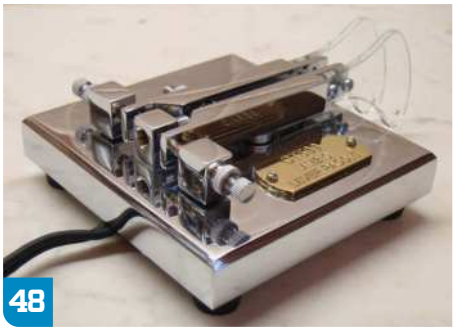

I was privileged this month to be one of the presenters for the Orlando Hamcation. Not in Orlando, of course, but online as is the way nowadays. The benefit (or downside?) was not having to travel to the USA and also that participants could join from anywhere in the world. My session, on 'A New QTH with Antenna Restrictions – how to make HF contesting work when temporary antennas are the only option' attracted 300 participants and generated some great questions at the end. The organisers asked me because they had seen my interview on TX Factor. The presentation is available on YouTube, or I am happy to share the Powerpoint slides that formed the basis of it, for any readers who may be interested – drop me an e-mail.

Temporary Antennas

And while on the subject of temporary antennas, it's a subject that **Colin Redwood G6MXL** tackles this month in his *What Next* column. I noted with some amusement Colin's comment about the length of antenna or pole that can be carried on a roofrack. It reminded me of an incident at the end of HF Field Day on one occasion with the Reading club. I had loaned my TH5 triband Yagi for the occasion, to go on one of the trailer towers we used to take to the Field Day site. To transport it, I had simply split the elements in half, so each section was about 16ft long (a quarter wave on the lowest band, 20m), which I could easily transport on top of the car. But after the contest some of the VHFers in the club set to to help dismantle it, and were busily reducing it to its individual parts of a just a few feet. Fortunately, I caught them in time! I really didn't want to be rebuilding it from scratch once I got it home again.

Complex Numbers and Exams

In last month's *Letters* pages, **Michael Jones GW7BBY** asked for help in understanding complex numbers. This request really seems to have struck a chord with a number of replies coming both to me and direct to Michael, including two or three people who have offered to write articles on this subject and other technical matters in what we hope will be a jargon-free, understandable way. It's great to see such a response from *PW* readers and Michael and I are very grateful. I look forward to running these articles in the near future because it seems clear that there is a real thirst for knowledge on some of these subjects.

Which actually ties in nicely with this month's Star Letter in which **Daniel Keely M7EAU** argues for a modular-based exam such that people can follow their particular interests rather than being constrained to what appears to be an increasingly out-of-touch syllabus. I believe there is a worthwhile debate to be entered into on what is clearly a matter of concern to many of those who are thinking about upgrading from Intermediate to Full. Certainly, the numbers making that transition are much lower than we might hope for, many being happy (or simply frustrated?) to stay at Intermediate.

Out of Lockdown?

We have a few rally items in this month's *News* pages but have yet to reactivate our *Rallies* page. The good news is that most Covid restrictions should be removed by late June although it's not at this stage clear how this change applies to large gatherings, whether indoors or outdoors (though I see that Nightclubs will be able to open again so we can all go out and party!). But the changes should at least allow us to go out and about with our radios, whether for SOTA, contests or whatever.

Don Field
Editor, *Practical Wireless Magazine*

Newsdesk

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

Mini 1300 Handheld Antenna Analyser

Moonraker are now stocking this standalone antenna analyser. It features: Panoramic scan • Generator • Time Domain • Multi SWR • Setup • Find Frequency • Tune SWR/Sound • View Pictures • USB HS card reader • SWR Measurement Range: 1.0-1999(Single Point Mode), 1.0-20.0 (Scan Mode) • Display Modes: Numerical display, curve display, Smith chart • Connector Type: UHF N-type • SMA OPEN-SHORT-LOAD Calibration Kit x 1 • LCD size: 480 x 272 4.3in TFT LCD display • Contact Screen Type: Capacitive • All capacitive touchscreen on the display – no buttons are needed • Power Source: USB or Internal Li-ion • Built-in Li-ion charging circuitry and DC-DC booster • Maximum charging current: 5V/1.5A • External Storage Method: TF card • Weight: 550g It is in stock at £199.99 inclusive of VAT.

www.moonraker.eu

DIRECT ENTRY TO FULL LICENCE: The RSGB's Examination Standards Committee (ESC) has launched a consultation to ask for the views of the amateur radio community on a new, Direct to Full licence exam, which would run in parallel with the existing three-tier system.

The background to this consultation and a link to the proposed syllabus can be found on the RSGB website:

www.rsgb.org/direct-to-full

There is also a link to a short survey, which asks specific questions but also gives you an opportunity to add additional comments or questions.

The consultation will run until Sunday March 14th 2021 after which they will gather the results and announce them in due course.

Tony Kent G8PBH, Examination Standards Committee Chair, says "We would encourage everyone to take part in this consultation".

SIGNAL IDENTIFICATION GUIDE: Ed N4II reports the availability of the Signal Identification Guide site *"with many samples of the various signals you may hear on the bands"*. This site has samples of audio along with *"what they are and where they come from"*.

www.sigidwiki.com/wiki/HF

New from Nevada

Nevada Radio have announced the release of the Alinco DM5X-GE Analogue/DMR digital handheld transceiver.

This is an upgrade on their earlier DJ-MD5 handheld and now this Xtreme version includes both GPS with APRS support and Automatic Repeater roaming facility.

The radio is full of features, including a broadcast FM receiver with 100 memory channels, four selectable output powers from 0.2W to 5W, 4000 channels, built-in VOX, a digital recorder and a large clear display.

It's easy to import/export DMR contact databases and set parameters with CSV files from a computer. The built in GPS sets date and time automatically.

The radio will sell for £179.95 and is available from Alinco Exclusive UK distributors Nevada:

www.nevadaradio.co.uk

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

RAOTA NEWS: The spring 2021 of the Radio Amateur Old Timers' Association (RAOTA) quarterly magazine (*OTNews*) will be arriving on members' doorsteps in the near future. As usual the content covers a wide range of subjects and time periods. Early empire wireless telephony experiments in 1927, together with radio repairs during WW2, serve as reminders of our past. Making your own capacitors is as relevant today in certain circumstances as it ever was, and the latest developments in propagation forecasting outlined by K9LA make for fascinating reading about what the future holds in that area.
RAOTA aims to maintain the traditions and spirit of amateur radio. Although passionately interested in the history and traditions of amateur radio, and fortunate that they can get a lot of this first-hand from members, they are equally passionate about the future of our hobby. One of the magazine covers demonstrates this quite succinctly, showing a picture of communications in WW1 next to one of a DDS synthesiser kit. An article about each is contained in that issue.
One of the enduring myths about RAOTA is that you need to have been licensed for 25 years to become a member, but you don't. Anyone with an active interest in amateur radio is welcome to join. There is no need to hold (or be qualified to hold) an amateur radio licence.
To find out more please go to the website (below) to find the e-mail address, or write to: RAOTA Membership Secretary, 65 Montgomery Street, Hove, East Sussex, BN3 5BE
www.raota.org

OFCOM UPDATE: on VP8 amateur radio licences in British Antarctic Territory, South Georgia and South Sandwich Islands.
Chris G3WOS/VP8WOS and Alan G4EEL/VK6CQ/VP8PJ report: *"You may be aware that there have recently been some amateur radio licensing difficulties experienced in the Falkland Islands due to new communications legislation being implemented. This involved all previous and existing VP8 licences issued under the old Falkland Islands Wireless Telegraphy Act being revoked en masse in early 2020. This included all existing VP8 Antarctic and South Georgia licences, resulting in no legal amateur radio operation in these Overseas Territories being permitted using a VP8 callsign. Licences were then revalidated and re-issued under the new Falkland Islands Communications Ordinance on a case-by-case basis for use in the Falkland Islands only.*
"We now have some good news from the UK's regulatory body, OFCOM concerning this situation.
"For full details, please read our post on Open-Falklands:
https://tinyurl.com/y7d6u7vm
If you have any questions please contact us:
chris@openfalklands.org.fk
alancheshire@yahoo.com

RALLIES: The rally situation remains fluid and we don't have enough information to bring back our Rallies page for the time being.
We do, though, have three recent notifications:
The Hack Green Radio Surplus Hangar Sale/ Hack Green Bunker Rally is scheduled for April 18th 2021, Government Covid regulations permitting. Any last minute cancellation will appear on the Facebook Page:
www.facebook.com/HGsecretbunker
Location: Hack Green Secret Nuclear Bunker, Nantwich, Cheshire CW5 8AL. Sale of electronic equipment, amateur gear, components, military radio items and vehicle spares. Doors open 10am
Contact 01270 623 353
coldwar@hackgreen.co.uk
www.hackgreen.co.uk
The Wiltshire Radio and Car Boot Sale will take place (all being well) on Sunday August 1st 2021. Start time 09:00 and finishing at 13:00, It will take place at Kington Langley Village Hall and Playing Field, Kington Langley, Wiltshire SN15 5NJ, traders welcome. for further information please contact:
Chairman@Chippenhamradio.club
However, the 2021 Callington (Cornwall) ARS Rally has had to be cancelled.
And further afield, the organisers of the Friedrichshafen International Amateur Radio Exhibition are optimistic that this year's event will take place over the weekend of June 25th to 27th, albeit on a reduced scale to what has been the norm in recent years.
Given the continuing lack of clarity over large gatherings, readers are recommended to double-check before heading to any rally.

SILENT KEYS: While we don't normally report on Silent Keys (sadly, there are too many of them), we mention two this month as being particularly worthy of note.
The first is Handel Bluer G3UUZ also known as 'Andy the light' who passed away in February aged 92. *Practical Wireless* featured a three-page article on him in the March 2000 issue. He was best known for his enviable antenna setups from various lighthouses around the UK and his own WAB square while stationed on Bishop Rock lighthouse near the Isles of Scilly.
And Carlos S. Menem LU1SM passed away on February 14th. Born in 1930, he served as the 44th president of Argentina from 1989 to 1999.

IWM ASKS RADIO AMATEURS TO LEAVE:
The Imperial War Museum (IWM) has asked the amateur radio group on *HMS Belfast* to remove all equipment not directly related to the history of the ship.
The group has had a presence on *HMS Belfast* for 45 years (and see our *In Focus* report in the November 2017 issue of *PW*).
We understand that the amateur radio group at RAF Duxford (another IWM site) have also received a similar notice.
Any questions, or further information please contact Gavin Keegan G6DGK
gavin.keegan@tiscali.co.uk

ARTIE MOORE: In this issue of *PW* you can read the story of Artie Moore. Coincidentally, South-Wales based filmmaker Ben Roberts will shortly be dramatising Artie's story into a short film.
He tells us, *"In preparation, I have made many contacts and learnt as much as I can about Artie and the night he received the Titanic's Distress Call. I'm good friends with* ***Cess Davies****, who actually met Artie in the 1930s, and remembers it well. He has some fantastic insights into the life around Gelligroes Mill, and the sort of man Artie was. I'm also in contact with the Blackwood Radio Club, who own Artie's original transmitter!"*
To help cover the £6000 cost of making the film, the film makers are running a Crowdfunding Campaign.
Details can be found at:
igg.me/at/artiemoore

Visit our Book Store at www.radioenthusiast.co.uk

RADIO ENTHUSIAST BOOKSHOP

The Magic Bands

Written by the editor of Practical Wireless, Don G3XTT and published by the RSGB. It runs to 224 pages and aims to appeal to all six and four-metre enthusiasts whether they are newcomers or 'old-hands'. The book is a rework of Don's 'Six Metre Handbook' which was first published 12 years ago.

This is an extensive revision, and incorporates useful information on 'digital operating techniques' as well as more traditional operating.

Words by: Tim Kirby GW4VXE

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The Radio Geeks 144/430MHz Dual-Band Inflatable Antenna

Tim Kirby GW4VXE tries out an intriguing antenna for 2m and 70cm.

Tim Kirby GW4VXE
longworthtim@gmail.com

Radio Geeks is the new name for Air Antennas. You may remember that we carried a review of the Air Antennas innovative, inflatable antennas some months ago and they created a lot of interest.

Tom Morris GM3HNN, the man behind Radio Geeks, has been hard at work on a number of projects, but one of them was a revised version of the inflatable antenna for 2m/70cm.

This is what Tom has to say about the antenna: *The next generation of the Dual-Band antenna. The V2 ham dual-band base & portable 2m/70cm Tx & Rx antenna, 144-148MHz & 430-440 MHz (440-450 MHz USA), 125W, & now with extended Rx, 118-160MHz, 380-450MHz for AirBand & PMR listening, VSWR 1:3:1, now with gain 5dBd, waterproof, 450 grams, 1.66m, 6m cable to PL259.*

Trying it Out

Tom kindly sent me an antenna to try. One of the great things about the antenna, which is evident as soon as it arrives, is its size. It collapses down into a pouch (roughly A4 sized) that can easily be stowed in a rucksack for a SOTA expedition. If you're on a camping trip, it might even make an emergency pillow! The antenna seems quite durable and Tom says that it is made from the same type of material as lifejackets, so although I would avoid prickly bushes and trees to suspend it from, you should be fairly safe. Unlike the earlier 'Air Antennas', which were fluorescent yellow, this version is black, making operation a little more discreet.

Tom says the centre frequencies for the antenna are 145.500MHz and 438.500MHz. My initial reaction was that the 70cm centre frequency was a bit high for European use, where activity is between 430 and 440MHz. However, I imagine this enables Tom to cover the 440-450MHz part of the band, which is used in North America, with a single design. We'll have a look at how this affects 70cm performance in a moment.

Deployment of the antenna is simple. Open up the pouch, unfold it and give a couple of puffs into the valve. Make sure there's plenty of air in it to help it keep its shape. The antenna is terminated by a PL-259 connector at the end of 6m of RG-174 coax. There's a flap at the top of the antenna, which allows you to hang it from a convenient tree, stick or pole. There are two Velcro bands at the bottom of the antenna, which would allow you to strap it to some sort of support, but Tom tells me that the antenna works better if it's hung from something.

Within ten minutes of unpacking the antenna, I was outside in the field, with my Yaesu FT-2D, the inflatable antenna and an SMA to SO-239 adapter. It was a bit of a windy day, as it often is during the winter here, so I decided to support the antenna myself rather than risk it being blown into the next county. With the FT-2D tuned to the APRS frequency, 144.800MHz, I transmitted an APRS beacon, which was immediately received and digipeated by the Mount Leinster digipeater in Southern Ireland, some 85 miles away from me. Instantly, I disconnected the inflatable antenna and tried to send a beacon again, this time using the FT-2D with its rubber duck antenna. This time, Mount Leinster did not hear my beacon. I tried several times, without success (which I should say is normal). It was clear, then, that the inflatable antenna was providing some extra gain over the rubber duck antenna – very useful for portable activity.

Changing bands to 70cm, I tuned to EI7MLR, the analogue repeater on Mount Leinster on the same mast as the APRS digipeater just mentioned. With the rubber duck antenna on the FT-2D I was able to open the repeater up, as I was with the inflatable antenna, which was providing around 1½ s-points improvement over the rubber duck. Although not as dramatic as the improvement in the 2m band, this is still worth having.

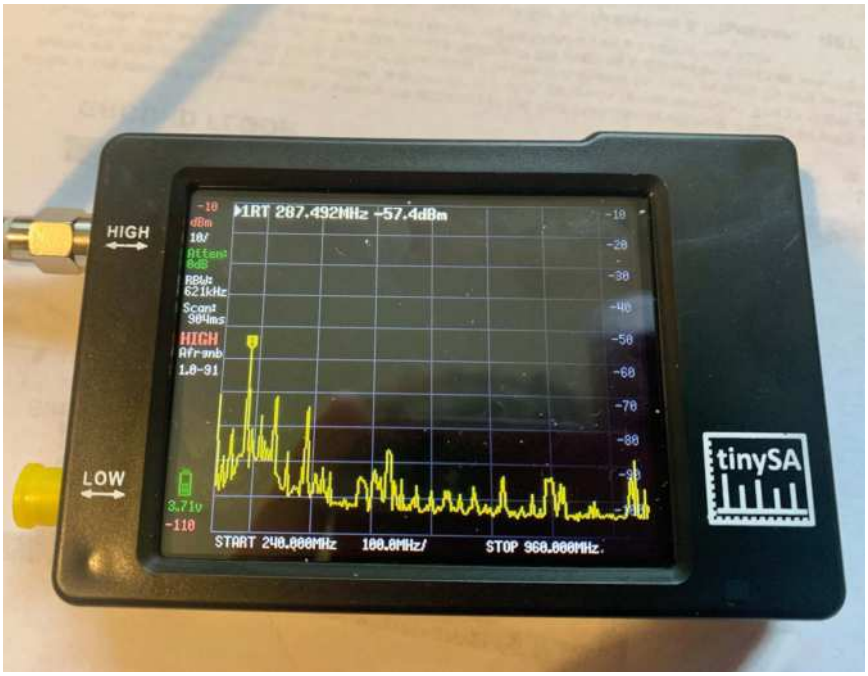
Deflation of the antenna is straightforward too. Just pop a finger in the valve and push gently, while pressing the antenna's sleeve to get the air out of it and fold it back up, ready to place back in the pouch. It takes just a few seconds.

Further Reflections

Although we are talking about the inflatable as a hilltop type antenna, it is worth pointing out that it also makes a very good 'temporary' antenna. Its predecessor was the first VHF antenna I put up here, a day or two after we moved in – you can easily dangle the antenna from some guttering and bring the coax in through a window. I've also used it propped up inside a window or loft hatch and had good results.

This new version of the antenna is designed to take up to 125W (previously

Tim Kirby GW4VXE
longworthtim@gmail.com



The Tiny SA Spectrum Analyser & Signal Generator

Tim Kirby GW4VXE plays with and recommends a handy and inexpensive piece of test equipment.

A few weeks ago, I was on Twitter and noticed a tweet from **Ian MW0IAN** that he had a 'new toy'. I was suitably intrigued and having made some brief investigations placed an order for my own!

The TinySA is a spectrum analyser and a signal generator in a small form factor, very reminiscent of the NanoVNA, which **Don G3XTT** reviewed a few months back.

The TinySA website (below) introduces the TinySA as follows:

- The tinySA is a small spectrum analyser, primarily intended for 0.1MHz to 350MHz input but it has some nice other capabilities:
- Spectrum Analyser with two inputs, high quality MF/HF/VHF input for 0.1MHz-350MHz, lesser quality UHF input for 240MHz-960MHz.
- Switchable resolution bandpass filters for both ranges between 2.6kHz and 640kHz.
- Colour display showing 290 scan points covering up to the full low or high frequency range.
- Input Step attenuator from 0dB to 31dB for the MF/HF/VHF input.
- When not used as Spectrum Analyser it can be used as Signal Generator, MF/HF/VHF sinewave output between 0.1MHz-350MHz, UHF square wave output between 240MHz-960MHz.
- A built-in calibration signal generator that is used for automatic self-test and low input calibration.
- Connected to a PC via USB it becomes a PC controlled Spectrum Analyser.
- Rechargeable battery allowing a minimum of at least two hours portable use.

www.tinysa.org

I was interested in the TinySA for a couple of reasons. The first is that people often ask me what the spectral purity of some of the transceivers I review is like. Although the upper frequency limit of the TinySA would not allow me to look at the third harmonic of a 432MHz transceiver, it would allow me to get an idea of how clean or otherwise the transmission is and, of course, it's possible to get a reasonable look at the third harmonic of a 144MHz transceiver. Although the TinySA would not give me high-quality laboratory results, it could give me an indication of how clean or otherwise a transmitter would be.

A second attraction for me was the signal generator capability. I was keen to

Continued on next page

the limit was 60W), which gives plenty of possibilities for use with a rig such as the IC-9700 in a temporary location on either FM, CW/SSB or FT8.

Slightly concerned about the 70cm centre frequency up at 438.500MHz, I put the antenna on my NanoVNA to look at the VSWR curve through the 70cm band, particularly in the parts of the band that are in regular use in the UK. I needn't have worried. At 430MHz, the VSWR is around 1.8:1 and falling rapidly as you go up in frequency. At 433MHz, where the majority of simplex activity would be along with some repeaters, the VSWR is around 1.6:1 and by the time you get to 438MHz, the VSWR is 1.4:1.

So, there we have it. The Dual-Band inflatable antenna works particularly well on 2m and is significantly better than a rubber duck. On 70cm, the improvement is there but is less pronounced. If you operate away from home often, be it out on the hills or from 'alternative' locations, then you may find this antenna very useful. It is extremely compact and will fit in a rucksack along with all your other 'stuff'. As a receive antenna it will work well for air, marine and PMR segments.

You can order a dual-band inflatable from the Radio Geeks website (below) at a price of £79.00.

www.radiogeeks.co.uk

Very many thanks to Tom Morris for his kind co-operation in the production of this review. ■

see if I could make some measurements to establish how well receivers were working, both at VHF/UHF and I'd also been playing with some vintage CB radio equipment and I thought it would be useful to have a means of peaking up the receive side of these transceivers.

Couple both of those with a healthy dose of interest and a price tag of around £55-65 depending on your vendor – I was convinced.

On Arrival

The TinySA arrived quickly. I'd been able to place an order through Amazon. The first impression was very positive, as the unit arrived extremely well presented in a gift-style box.

Contained in the box is the TinySA unit itself, a small antenna terminated in an SMA male connector, two patch leads both terminated in SMA male connectors, an SMA-F to SMA-F barrel, which can be used as a gender changer, and a USB lead to connect the TinySA to a PC, or for charging the battery.

Testing, Testing

The first thing to do on receiving the unit is to run the self-calibration tests. This process and indeed, many other use cases are described on YouTube on the TinySA YouTube channel:

https://tinyurl.com/y6zxl7mq

However, if you prefer written documentation, there is a useful document here:

https://tinyurl.com/y32lyk7e

The self-calibration tests went through quickly and happily the unit passed them all. I have read that some 'counterfeit' TinySAs have appeared on the market and that these may fail some of the self-tests.

My first test with the TinySA was to connect up the telescopic antenna to the 'high input' and select 'High in' using the Mode menu. This allowed me to see the spectrum between 240 and 969MHz. A quick blip with a 70cm handheld suggested that things were working and then a very large peak on the spectrum around 890MHz (from my mobile phone) popped up. This was all quite interesting. Indeed, **Justin G4TSH**, who also has one of the units, very quickly used it in this mode to diagnose the source of some interference around the house.

If you use the unit in 'DF mode' like this, then you might find the attenuator capability handy as you get closer to the source of the signal.

On the YouTube channel, there are plenty

of examples of how you might go about using the TinySA. 'IMSAY Guy' also has a number of videos about the TinySA on his YouTube channel that you may find interesting.

I was able to use the TinySA to compare harmonic levels of various 144MHz transmitters, which was indeed illuminating and showed that not all transmitters are created equal! Using the signal generator (and all the attenuators I could find!) I was able to use the TinySA to compare the sensitivity of various radios in the shack, both at VHF/UHF and in the CB/10m bands. Something else that was interesting was the ability to look at Adjacent Channel Rejection figures.

The USB cable that comes with the TinySA can be used for charging the battery (which seems to have a good life) but you can also use it to connect to your PC and run some PC software. There is a choice of both Windows and Linux software. I used the Windows variant. It is reasonably rudimentary, but provides the ability to take screenshots and, of course, to look at a rather larger display than on the TinySA itself. You can read more here:

https://tinyurl.com/ohd1assl

Unlike the NanoVNA, where I found that I needed the PC software to get the best out of the unit, I would say the same is not yet true of the TinySA and the PC software does not yet include all the capabilities of the unit.

The USB connection from the PC also allows the upgrade of the TinySA's firmware, which I have not yet attempted although it looks relatively straightforward.

Overall

I've been really pleased with the TinySA. If you have a shack full of test equipment, you probably don't need one. However, if you do not, it's a very useful tool to have to hand and I have got a great deal of interest and fun from mine.

The TinySA is available online as well as from Mirfield Electronics here in the UK. Prices vary, depending on the supplier from around £55 to £70.

Radio Round-up

RSGB'S 'GET ON THE AIR TO CARE' CONSTRUCTION COMPETITION WINNERS: The RSGB's Get on the air to care construction competition was for projects made during the Autumn 2020 lockdown, the Christmas and New Year holiday period or the early 2021 lockdown.

The Society was delighted to receive 27 entries from 15 entrants and the standard was very high. To reflect this, the judges awarded four prizes rather than choose one winner as originally planned. These were:

Gordon Lean G3WJG (1st prize: £125)
Paul Graham M0PGX (Runner up prize: £75)
Laurence Fletcher G4SXH (3rd prize: £50)
Robert Lynch M0NVQ (Highly commended and receives the RSGB Handbook)

You can find out more about their projects in the April *RadCom* and on the RSGB website:

https://tinyurl.com/788wrrwm

CAPE-3 CUBESAT: The University of Louisiana (UL) student-built CAPE-3 satellite was launched on January 17th. A 1-U CubeSat, CAPE-3 includes a digipeater and experimental UHF adaptive radio. An AX-25 telemetry downlink has been coordinated on 145.825MHz and a 1k2 frequency-shift keying (FSK) downlink has been coordinated on 435.325MHz.

CAPE-3 is the third cube satellite in the CAPE series. The primary educational mission is to allow grade-school classrooms to access the Smartphone CubeSat Classroom, and run interactive experiments through an experimental smartphone ground-station grid.

The secondary mission is to perform scientific experiments involving radiation detection and to take pictures of Earth.

The solar-powered spacecraft, created by UL Lafayette's CAPE Satellite Team, was launched with nine other CubeSats as part of NASA's Educational Launch of Nanosatellites (ELaNa) program.

A Virgin Orbit LauncherOne rocket attached beneath a wing of a customized Boeing 747 was dropped high above the Pacific Ocean. It climbed about 225 miles above Earth and then ejected the satellite.

The CAPE satellites are named for the university's Cajun Advanced Picosatellite Experiment program, designed to prepare students for careers in science, technology, engineering, and mathematics (STEM) fields.

https://tinyurl.com/y7qgg2b6

Metal Oxide Varistors and their Uses

Colyn Baillie-Searle GD4EIP explains the ins and outs of a useful but oft-overlooked device.

Colyn Baillie-Searle GD4EIP
practicalwireless@warnersgroup.co.uk

The majority of people have not heard of Metal Oxide Varistors (often abbreviated to MOVs), but may have purchased extension leads incorporating surge suppression. It is good practice to attach modern equipment to sockets that incorporate surge suppression because they protect equipment from sudden very short duration high voltages. These are known as transient voltages and can damage TVs, amateur equipment and any other modern digital equipment. Here I intend to explain where and how surges are generated, how we can protect against them and how you can make your own protection device. In addition, I will include Metal Oxide Varistors, which were not originally designed for this purpose but have now become widely used in industry.

Transients

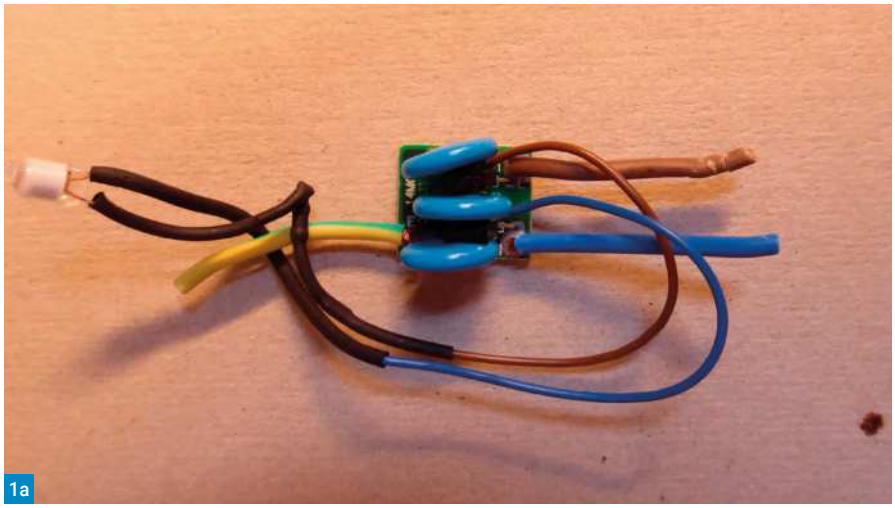
Transients are a sudden very short duration, very high voltage that can occur on top of the normal supply voltage. With our mains supply in the UK of 220/240V a transient could easily be three times that voltage or more for a duration of a few milli-seconds, perhaps around 1000V for 0.005 seconds. During this time it could cause damage within equipment such as switch mode power supplies, which are commonly used today in almost all modern digital equipment such as TVs, transmitters and the like.

These transients can be repeatable or just a single pulse. They can be produced during a thunderstorm, switching off a florescent light or any electrical equipment that incorporates inductance, capacitance or both.

A number of years ago there was a major power cut on the Isle of Man when a building company cut through a major power cable from the power station. All of the stored energy from consumers had to go somewhere, so it propagated down the mains to all the electrical equipment connected to the mains supply.

The equipment then received a large transient voltage causing damage. The power company stated that they were not liable for any damage to equipment as it was up to the consumer to have their equipment protected against surges, with a surge protection device.

So how can an inductor or capacitor produce a transient when the device is switched off?



1a

Energy is measured in Joules and the energy stored in an inductor (simple coil such as a transformer or choke) is given by:

W (energy) = $\frac{1}{2}LI^2$ Joules

The energy stored in a capacitor is given by

W (energy) = $\frac{1}{2}CV^2$ Joules

where:

L is the inductor size in Henrys,

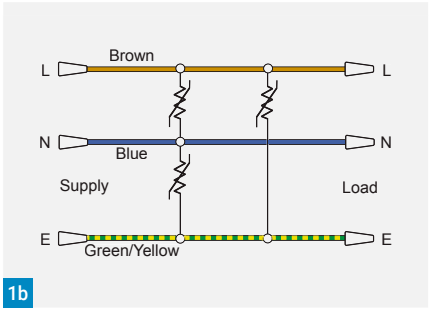
I is current in amperes,

C is capacitance in Farads

V the voltage in volts

A transient can be repeatable or non-repeatable. A non-repeatable transient could be generated by switching off a fluorescent light for example, which incorporates a large inductor. Sometimes you might have noticed when switching off a fluorescent light that a little flash or spark is observed in the switch. This is the energy that was stored and is now being released as the high voltage across the opening switch contacts as they move apart causing a transient. This might not happen every time so is non-repeatable.

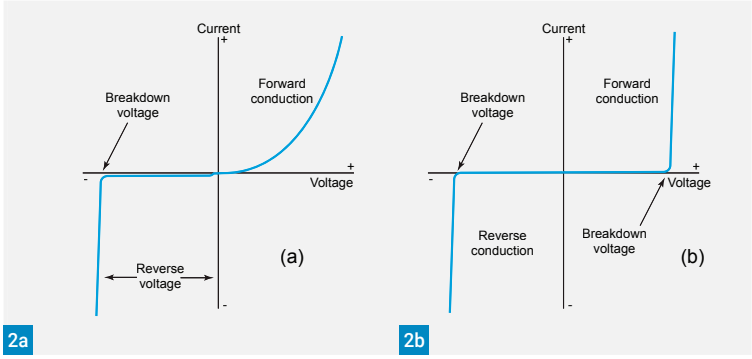
Repeatable transients are caused by equipment such as commutation voltages from motors or generators, arc welders and any equipment incorporating inductive loads being repeatedly switched on and off, similar to the old electric bell continuously being pressed for a little while.



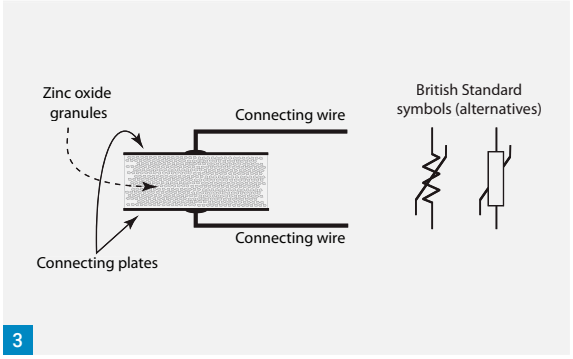
1b

Random transients cannot be predicted by their very nature, which is elusive and therefore more difficult to suppress. For all these types of transients it is good practice to have all equipment connected to a surge suppression socket and so protect them from being damaged.

The photo, **Fig. 1a,** along with the equivalent circuit, **Fig. 1b,** shows a typical surge suppression circuit incorporated in an extension socket. It shows three metal oxide varistors connected between live (the brown one) and neutral (blue), brown wire and earth (green/yellow) and finally the blue one and earth on the incoming wires.



2a 2b



3

Figs. 1a and 1b: Using MOVs for mains protection purposes. Figs. 2a and 2b: Typical characteristics of a Zener diode and an MOV. Fig. 3: Internal structure of an MOV. Fig. 4: Equivalent circuit of an MOV. Fig. 5: Low power devices. Fig. 6: High power device. Fig. 7: MOV crowbar circuit.

Metal Oxide Characteristic

A metal oxide varistor is a voltage dependent non-linear resistor, which means its resistance is not constant throughout its voltage/current range. With linear the current is proportional to voltage whereas with non-linear the current is not proportional to voltage. Metal Oxide Varistors have a defined forward and reverse breakdown voltage characteristic. This means, at a defined voltage, the Metal Oxide Varistor will conduct in the positive area as well as the negative area.

Fig. 2(a) shows the characteristic of a typical Zener diode where in the forward direction it acts like a normal diode and readily conducts beyond 0.6V, but under reverse bias it works differently to a normal diode. It starts to conduct in a controlled manner at a particular voltage, known as the Zener voltage.

Fig. 2(b) shows the typical characteristic of an MOV. It can be seen that the MOV has two well defined breakdown voltages, one in the reverse and one in the forward direction, so it's almost like two Zener diodes operating in different directions. This is not really true but the characteristics look like that and it's an easy way to think about it.

MOVs are formed by a sintering process, where zinc oxide powders are pressed into a ceramic disc producing conductive zinc oxide to which wires are attached.

Sintering is the process where granulated materials are pressed and heated to combine into a new material or into layers of the materials. It is commonly used in engineering to produce everything from oil-lite bearings (bearings that need no oiling because the oil is soaked into the material), to the heat shield on the space shuttle.

In the zinc oxide the granules are compressed to form a solid block. The grain size of the zinc oxide is very important for uniform conduction and distribution of heat. The voltage rating of varistors is proportional to the thickness of the device and average zinc oxide grain size. **Fig. 3** shows the structure of an MOV while **Fig. 4** shows the equivalent circuit.

R_{off} is the resistance when the varistor is not conducting

R_{on} is the varistor's bulk resistance when the device is fully conducting.

C is the package capacitance

L is the inductance of the leads

The varistor characteristics follow the equation: I (current amps) = KV^{α}

Where K is a constant, just a number

α is a figure of merit derived from the following formula

$\alpha = [\log(I2/I1)] / [\log (V2/V1)]$

The current and voltages are taken from the voltage-current curve for the varistor from manufacturer's datasheets. The higher the value the better the device performs.

Varistors must be capable of operating under both steady state (i.e. no spikes/transients) and transient conditions. The process for selecting the correct device for an application when the environment is not fully defined is to make assumptions and approximate some values to select the best device for the job.

For most applications the following steps will help in choosing the correct device:

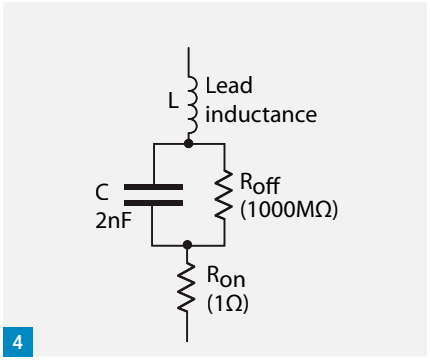
Determine the necessary steady-state voltage rating (e.g. 220/240V)

Establish the transient energy absorbed by the varistor

Calculate the peak transient current through the varistor

Determine any power dissipation requirements

Select a device that should do the job and therefore it will not go into conduction under these conditions. It is good practice



4

5

to choose a device 110% or greater than the nominal voltage.

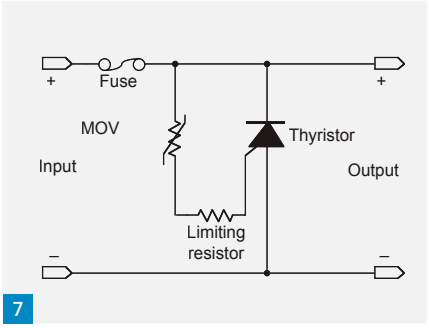
In Detail

Let's look at them one at a time, going through in detail.

1. Determine the voltage the equipment is being connected to and which therefore needs to be protected against.
2. The Energy of a device is stated in Joules (Watts-Seconds). All devices have a stated energy value that must not be exceeded otherwise the device will become damaged.
3. The peak current, amps, for the device is the maximum allowable current for a single pulse and this must also not be exceeded. If multiple pulses are expected, then this must be taken into account when choosing the current rating of the device otherwise it will get hot, melt, burn or generally just never work again.

4. Transients generate heat and the device must be chosen to withstand this heat. Power and energy are very similar but not the same. Power is Energy per second and measured in Joules. Simply the energy in Joules multiplied by the number of pulses per second, more pulses received then more heat will be generated.
5. Always allow an increase of at least 10 to 20% on all the above for safety.

6



7

Device Selection

There is the manufacturer's datasheet to assist us in the process of selecting the correct device for the application we are putting it to. High energy devices are mounted with tags to be attached to a heatsink with spade terminals to connect to the circuit. This gives a connection where we can have a heatsink to get rid of the energy/heat. The photos, **Figs. 5** and **6**, show low energy devices and a high energy one. Lower rated devices just have wires and look similar to capacitors.

Specifications for devices can be obtained from the internet or from suppliers such as General Electric [**2**, **3** and **4**]. A typical GE device will have marking as shown similar to 'V 130 LA 20 A' where:

V denotes the manufacturer; in this case it is a General Electric.

- 130 is the applied RMS voltage of the device
- LA Product series. HE High energy, PA Power varistor and LA Radial lead.
- 20 Pulse energy in Joules
- A is the selection
- Type A selection is the standard model with B and C selections providing progressively tighter clamping voltage.

In Use

We saw in Fig. 1 earlier the general protection circuit using MOVs. If a transient appears, it is quickly removed by being conducted to earth or across live and neutral and therefore protects the equipment plugged into the socket. Extension leads with built in transient surge protection usually have some sort of indicator to show it is protecting correctly. If this indicator extinguishes, then you know you have received a transient and hopefully the equipment has been protected. The extension lead will have been destroyed while protecting your electrical equipment and must now be replaced.

MOVs were designed for the purpose as described. However, one day while I was employed at AEI Semiconductors an unusual application was required. This was to protect from lightning strikes using large hockey puck thyristors in a high voltage, three-phase controlled bridge. Hockey puck devices are large circular diodes and thyristors in the shape of a hocky puck, with one face the anode and the other the cathode. They are connected to circuits by clamping bars to each side of the device [**6**]. This assembly consisted of six arms with seven large thyristors in series in each arm.

The protection circuit was to force the thyristors into conduction once a stated voltage of 9700V appeared across the assembly. I thought up the idea of using a crowbar circuit, which is used to protect DC circuits from overvoltage [**5**].

A fuse is placed in series with the positive lead from the power supply to the circuit and a thyristor then goes between the positive and the negative lead, with a Zener diode with a limiting resistor between the anode and the gate of the thyristor. Once the voltage to the circuit exceeds the Zener voltage, the thyristor conducts, blowing the fuse and protecting the circuit.

Investigating the characteristics of MOVs, I felt that they could be used in a similar manner because once the voltage has been exceeded they conduct in a similar manner to the Zener diode with its well defined conduction voltage. MOVs are manufactured in a wide range of voltages and I chose three 430V devices and connected them in series to make a total of 1290V.

This was the required protection voltage for the individual thyristors. Seven of these were constructed and connected in series across each thyristor in each arm, 42 devices in total for the three-phase controlled bridge. Once a voltage in excess of 9700V appeared across the assembly the thyristors triggered in sequence and the excess voltage was connected to the load. This in turn allowed the dissipation of the energy out of the circuit and thereby protected the thyristors. The thyristors used in this type of circuit are very expensive thus the company was very anxious to protect them.

Fig. 7 shows the crowbar circuit using the MOV. It consists of an MOV connected with a limiting resistor to the gate of the thyristor. Once the MOV's voltage has been exceeded the thyristor will conduct and blow the fuse thus protecting the circuit.

With this type of application the thyristor only requires a few milliamps for conduction so low energy rating MOVs are used. The voltage range of varistors varies 14V to over 800V. Therefore, this type of circuit can be used to protect circuits against excessive high voltage, such as in the power supplies in linear or other circuits requiring protection that is out of range of Zener diodes.

MOVs are also more robust than Zener diodes, so they can be used to replace Zener diodes in voltage regulated power supplies. They are indeed more versatile than they originally had been designed for.

Summary

The intention of this article was to explain what MOVs are and their usual commercial application. Also, to investigate and explain another application where they can be used, which they were not manufactured for; this being their use in a circuit to achieve high over-voltage protection. They are a cheap component and are more robust than Zener diodes. There is no reason why MOVs cannot be used as high voltage regulation in a similar manner to Zener diodes, which operate at lower voltages. This is an area I am working on, using varistors in high voltage regulators.

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1. Over voltage protection, by Dr C Baillie-Searle. *New Electronics* 1977.
2. Transient voltage suppression manual by General Electric.
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5. https://tinyurl.com/ip8gh8bq
6. https://tinyurl.com/3tcutu7a

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HKITM-S Mini hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted..... **£32.95**



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AMPRO-60 Slim line design 5MHz 2m approx. 3/8th fitting..... **£24.95**
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450-20 Ribbon feeder 450 ohm high quality slotted, 20m **£19.95**
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TK-12 wall bracket offers 12" clearance **£19.95**
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PTP-20 2" to 2" mast clamp **£5.95**

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Getting Started (Part IX)

Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk

This month **Colin Redwood G6MXL** looks at getting equipped to operate away from home.

As I write this in early February 2021, it looks likely that most of the UK will be subject to movement restrictions for some time to come as a result of the Covid-19 pandemic. With this in mind, I thought it would be useful to readers to consider how to prepare for operation away from home, once we are permitted to do so.

Location

Not all amateurs are fortunate to live in properties where antennas can be put up. If you are looking for a location from which to operate, you'll want to consider which bands you are planning to operate on. Generally speaking, the VHF, UHF and SHF bands benefit from sites with clear take-off to the horizon. So ideally, you'll be looking at a hill or mountain.

While height can be an advantage at HF, just getting away from man-made noise sources can be a really big help. Many amateurs find the effects of a saltwater reflector from operating on a beach can help launch their HF signals with a nice low take-off angle.

Transportation

Your choice of bands, antennas, power source and other equipment is likely to be determined by how you plan on getting to your chosen operating location. What can be carried on foot up a mountain is vastly different to what you can transport in a vehicle to a hilltop or beach car park.

Equipment

Equipment can be as simple as a VHF/UHF FM handheld transceiver, **Fig. 1**. Even with a basic VHF/UHF handheld, you'll need to make sure that you have charged the battery, and depending on the period of operation you plan, you may wish to have an additional battery or two charged and ready to use. If you anticipate using repeaters, then make sure that your transceiver is programmed with the relevant repeater parameters such as input and output frequencies and the correct CTCSS tone frequency.

Power Source

Broadly speaking, the choice of power source will be between batteries or a generator. Generators are probably best suited to stations wanting to run higher power. Large, higher capacity, batteries are best suited for running 'medium power' for a number of hours. Smaller batteries are best suited to situations where you need to transport the equipment by foot to a summit.


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The various battery technologies have a big impact on weight. For example, a 12V 7Ah sealed lead acid battery weighs about 2.2kg, while a LiPo or LiFePo battery of similar capacity weighs about 530g and is much smaller, **Fig. 2**.

Whichever battery technology you decide to use, make sure that you don't short the output because batteries can produce dangerously high levels of current that can melt wires. Make sure that your chosen battery doesn't produce a voltage in excess of the maximum voltage your transceiver is specified for, and use an appropriate charger for the type of battery you are using.

If you are travelling by air, you'll need to check the regulations (often guided by IATA) with your carrier. In many cases the limit for carry-on luggage is a 100Wh battery. A 14.4V 5Ah battery is 14.4 x 5 = 72Wh. Carriers usually provide details on their website.

Supports–VHF/UHF

For supporting VHF/UHF verticals and Yagis, I like swaged aluminium poles, **Fig. 3**. These are available in various diameters, wall thickness and length. I find the 1¼in or 1½in diameter variety are ideal for small to medium length VHF and UHF Yagi antennas with booms up to about 2.5m in length. In use, you simply slot one into the next until you get to the desired height.

You'll need to consider transportation constraints. Most domestic vehicles can accommodate lengths of 1m or so, longer if you can fold seats down. With a roof-rack, you may be able to choose longer lengths. The only downside with swaged poles is that the antenna may sometimes rotate in a strong wind at one of the joints. A bit of tape wrapped around the joints is usually sufficient to prevent this.

Antennas–VHF/UHF

For the VHF and UHF bands, a Yagi antenna takes some beating. If you are looking for a new antenna, it is important to consider the boom length and how small it can be when dismantled. If you are going to put up an antenna without any assistance, then you need to consider weight and arrangements for getting it safely into the air, often on an exposed hilltop. If you are going to be attaching the elements to the boom on site, then consider some way of marking the elements so that you know which goes in which position. Coloured insulating tape can work well – I use a different colour for

Fig. 1: The author using a 2m/70cm FM hand-held transceiver near the summit of Snowdon. Fig. 2: A 5Ah LiPo battery is much smaller and lighter than a 7Ah sealed lead-acid battery. Fig. 3: A swaged aluminium pole. Fig. 4: Some lightweight telescopic masts can fit in a suitcase for travelling. They're ideal for supporting wire antennas. Fig. 5: A pair of home-made traps. Fig. 6: Connecting parts of a lightweight portable linked dipole using croc-clips. Fig. 7: A wing nut in use. Fig. 8: Operating from Swyre Head in Dorset.

each band, so that I don't end up with the elements for my 4m Yagi on my 6m boom!

Supports – LF/HF

The other type of support I use is a telescopic mast in the style of a fishing rod. These are available from several suppliers. Collapsed length and extended length are two parameters to give particular consideration to. The smaller the collapsed the length the easier it will be to transport. I took my portable mast with me when I last bought a luggage case, **Fig. 4**, as it was absolutely vital that I could transport the mast in my case for foreign travel. While extended height can be a consideration, really tall masts generally weigh more, and can flex a lot in strong winds. I find telescopic masts excellent as centre supports for inverted-V dipoles for the LF and HF bands. They can also be used to support a vertical wire antenna.

Antennas – LF/HF

On the LF and HF bands you can experiment with numerous designs without the constraint of a small garden or complaints from landlords or neighbours, although you'll need to keep the safety of the public in mind. Except for major contest groups and DXpeditions, most portable operators successfully use relatively lightweight antennas such as verticals or wires.

Dipoles

I like using resonant half-wave dipole antennas when portable because they can be used without an ATU. I usually use them in an inverted-V configuration with great success on bands from 10m to 80m. While I'm sometimes happy to stick to a single band at a time – perhaps 40m for Worked All Britain – there are occasions when it is handy to be able to switch to a different band. If you want to operate on more than one band, then you have a few options.

ATU

One option is to use an ATU. You'll need to make sure that it can correct a sufficient range of mismatches. Some transceivers with built-in ATUs can only handle a very limited range of mismatches (perhaps up to a 3:1 SWR). This is fine for correcting minor mismatches as you move from one part of a band to another part of the same band. It may not be sufficient for use with many antennas such as a half-size G5RV and some verticals.

Other built-in ATUs can cover a greater range of mismatches. For some portable operations (where you have to physically carry everything) the additional weight of an external ATU may be prohibitive, in which case you'll need to choose a resonant antenna.

Traps

Several main dealers stock traps for a range of bands (you'll need identical traps for each leg of a dipole). Traps will enable you to get a dipole resonant on more than one band, **Fig. 5**.

I've used traps at home with great success, but they add weight to wire antennas and may flex the top of telescopic antenna supports to an unacceptable extent. There are some designs of lightweight traps available from suppliers such as SOTAbeams, which can be used for low power portable setups.

Linked Dipoles

Another option is to use what is known as a linked dipole. This is essentially a dipole for the highest frequency band on which you wish to operate that is terminated in a connector or croc clips, **Fig. 6**. To operate on another band, you'll need to lower the wire enough to connect or disconnect a section of wire – more sections for lower frequencies (longer wavelengths), fewer sections for higher frequencies (shorter wavelengths).

SOTAbeams sell several ready-to-use linked dipoles. The models cover various combinations of the 80m, 40m, 30m and 20m bands. Linked dipoles can be easily constructed using readily-available parts (such as choc-block connectors for adding additional lengths of wire). SOTAbeams sell a kit of parts and suitable antenna wire, di-


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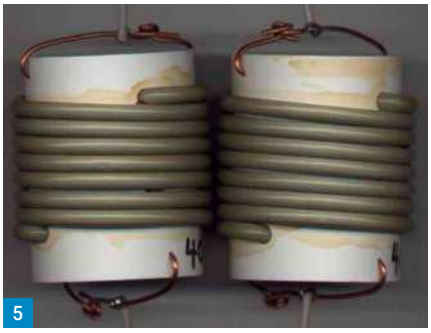
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Equipment	Supplier
Drive-On Mast Support	Sandpiper
Drive-On Mast Support	SOTAbeams
Drive-On Mast Support	Radioworld
Drive-On Mast Support	Tennamast
Lightweight Masts	SOTAbeams
Lightweight Masts	Sandpiper
Linked Dipoles	SOTAbeams
LiPo and LiFePo Batteries & Chargers	Hobbyking
Swaged Aluminium Poles	Moonraker
Traps	Spectrum Comms.
Traps	Nevada
Traps	Waters & Stanton
Traps	Moonraker
Traps	SOTAbeams

Table 1: A selection of suppliers of items referred to in the article.

pole centres, baluns and feeder. Their website also includes detailed instructions and a useful calculator to determine the correct lengths of the wires needed:
https://tinyurl.com/y9d55l8c

There are a number of sources of traps and materials to make linked dipoles and dipole centres. I've included a few in **Table 1**, although there are plenty of others.

Although I have focused on dipoles, don't forget that there are plenty of vertical antennas that can be used away from home, including, for example, the Bantenna design reviewed in the December 2020 issue of *PW*.

The RSGB book, *Portable Antennas for Everyone* by *PW* HF columnist **Steve Telnius-Lowe PJ4DX,** has numerous other antenna designs. Between them they cover the most popular amateur bands from 80m to 70cm.

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Supporting Poles

One challenge that any portable operation using an antenna support will encounter is to stop the support from falling over. Several techniques can be used, depending on circumstances.

If where you operate you are fortunate to have a fence, bench or table that is firmly fixed in the ground, then you can consider attaching your pole using bungy cords, cable ties or rope, etc. I use this technique at a couple of my favourite locations for portable operating. Some amateurs successfully use drive-on mast supports or tripods.

Another technique is to use guy ropes. Attaching ropes to poles can be done with either metal clamps or plastic shims with holes that slide down a telescoping mast. The plastic variety are much lighter and so are more suited to situations where you need to carry the station to your operating location.

Tools

I aim to minimise the tools I need to take with me when I operate away from home. I try to swap any conventional nuts with wing nuts, **Fig. 7**, so that I don't need to take a spanner and they are more visible if I drop them. If this isn't feasible, then an adjustable spanner can save carrying several spanners.

Connectors

Make sure that all feeder is terminated in the correct connector for the transceiver you'll be using. If not, consider either changing the connector in advance or make sure you remember to take a suitable adaptor.

Checklist

It is a good idea to prepare a checklist to make sure you don't forget anything. This can be broken into a number of sections:

Antenna system (poles, antennas, feeder, ATU, SWR meter, patch leads, adaptors)

Transceiver + Transverters (not forgetting power supply and associated leads, charged batteries or generator and fuel, microphone, headphones, CW key etc.),

Logging (paper, clip board and pen, or charged computing device),

Clothing and Domestics (tables, chairs and suitable clothing for the period of operation).

For your first operation away from home, I think it is a good idea to assemble the complete station in the garden, just to make sure you don't forget anything.

Conclusions

I hope I've given readers a few ideas for operating away from home. While it may still be some time before this is permitted, many of us will have time on our hands at present to buy, build and test equipment for when we are permitted to safely return to the great outdoors.

Daimon Tilley G4USI
practicalwireless@warnersgroup.co.uk

Amateur Radio on a Budget (Part II)

Daimon Tilley G4USI takes a look at budget options for getting started at VHF/UHF.

I don't intend to make this series into a 'buyer's guide' or review column, rather I am trying to give a flavour of what is available, both new and used, at reasonable prices. In some cases we will look at the equipment in the shack here, as well as what is more generally available in the market. In this particular article, I will divide the piece between handheld, mobile and base-station type radios, with a look at SSB and linear amplifiers too.

Handhelds

Starting with one of the cheapest first, a Baofeng GT3-TP, **Fig. 1**. This well-known Chinese rig was bought by me nearly four years ago when I first returned to the hobby after a long absence. It costs around £32 from Amazon, and comes complete with a battery, charger, in-car battery charger, earphone/mic, belt-clip and antenna. It provides full coverage of the 2m and 70cm amateur bands, with receive capability extending well outside that, and up to 8W out. Oh, and did I mention an 18 month warranty and 60 day no-quibble return?

There are very many different types of Baofeng, and mine has been around for some time, so it is well worth a look through the ads in this magazine and online for different versions.

Baofeng and other Chinese branded radios get a lot of press, some of it negative and undeserved. There is no cheaper way of getting a commercial, ready-made transceiver, brand new, at this kind of money. And it works! Sure, it's not perfect, but then what is? If you live in range of a repeater or internet gateway, then this could be an ideal first cheap rig. Plenty of amateurs use them for portable FM satellite work too. You could use this as a portable rig or, by connecting to an external antenna, there is no reason at all that it could not be your main VHF/UHF rig in the shack, although for practical reasons they are not ideal for this due to their size, shape and layout. If you decide on a handie as your main shack rig, I recommend investing in a separate handheld microphone so that you are not having to lift the radio, attached to coax, every time you want to talk.

Having passed my Baofeng onto **Josh**, when he got his Foundation licence, I was in the market for another handie. I decided to spend a bit more this time, because I had an interest in exploring some of the digital FM modes, such as D-STAR, Yaesu System Fusion, etc. I also wanted to use my radio with a hotspot in the shack, to add another dimension and to be able to receive civil and military aviation frequencies so that my youngest son, **Olly**, who dreams of being a pilot, could enjoy it too. In the end I purchased the Yaesu FT-70D, **Fig. 2**, a dual band VHF/UHF handie, with extended receive, and the Yaesu System Fusion mode (C4FM) as well as traditional FM. This radio is quite a lot more expensive, at nearly £170, but so far I have been quite pleased with it, and I regularly use it on FM satellites from the garden (see *PW* article) and on C4FM via a Raspberry Pi Zero hotspot. While there are more fully-featured handhelds out there with APRS, GPS and similar, this is probably the most I would personally spend on a handheld as it does all I need.

So, are there handheld options between this price range? Well yes, there are rather a lot actually. Don't forget, that as well as FM handies, and the proprietary digital modes such as System Fusion, D-STAR, etc, there are DMR (Digital Mobile Radios) available too. I don't intend to go into DMR here. **Tim Kirby GW4VXE** has explained that on a number of occasions in this magazine, but a piece like this deserves to mention them as another option and their price is usually pretty attractive, although they can require quite a bit of setting up, and they might not be a best start for a beginner.

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Here are a few examples from the adverts in this magazine to choose from:

- Midland CT-990 10W 2m/70cm – £99
- Yaesu FT-4XE 5W 2m/70cm FM – £65
- Yaesu FT-65E 5W 2m/70cm FM – £80 (slightly larger than the FT-4XE with improved display and keypad)
- TyT MD-UV380 2m/70cm DMR – £85

It is interesting to note that neither Kenwood nor Icom currently have a presence in the relatively cheap dual-band handheld market, at least not that I could discover, so they are not listed here. Also note that you need to spend in excess of £100 for a new handie that will do System Fusion, D-STAR, etc.

On the second-hand scene, in my experience, it tends to be the more expensive (when new) transceivers that come to mar-

Fig. 1: The Baofeng GT3-TP. Fig. 2: The Yaesu FT-70D. Fig. 3: Josh's 'shack'.Fig. 4: The CRT 279 UV.

ket. Perhaps we tend to hang on to ones we don't think are very valuable, but that does allow you to purchase a high-quality radio at a more budget price. For example, my (reasonably) local amateur radio dealer who specialises in used gear has a couple of Yaesu VX-7R transceivers for sale at just under £150. These give you 6m as well as 2m and 70cm, and are rugged and even submersible.

One recommendation I would make is whatever handheld you choose, if you plan to use it as intended, replace the stock 'rubber duck' antenna with something better. I use a telescopic half-wave antenna, which is almost a metre long but makes a massive difference. We are looking at VHF/UHF antennas in the next article in the series.

Mobile

Here at G4USI/M7JOT we have two FM mobile rigs. **Josh** has a Yaesu FT-1802M, **Fig. 3**, which I bought him as a present for passing his Foundation Exam. This rig, discontinued in 2009, is capable of up to 50W across the 2m band, although he is limited to 10W of course. It is small and compact and with it he can enjoy both simplex and repeater QSOs as well as access an internet gateway across the Bristol Channel in Wales. As Josh is only 15 years old, he is not yet using it mobile, but with a PSU it sits in pride of place in his bedroom shack. He gets a lot of pleasure from it and it only cost £80 used. I bought the PSU new, as there don't appear to be many on the used market. But, having said that, a good PSU is a great investment as it will probably outlive the operator. My advice would be to buy the biggest and best your budget can manage, to give you options for the future, such as running an HF mobile rig or adding a linear amplifier, for example.

For my own part, now being retired, I drive very little, but I do like keeping a rig in the car, so that if I am stuck somewhere on Dad's Taxi duties, I have the option of a QSO or two. I actually didn't own a suitable rig for this purpose until, in 2019, I attended the Newton Abbott rally in Devon. I reluctantly bought a raffle ticket at the door (I never win anything) and left my details as I departed for home. A day or so later an e-mail arrived to tell me that I had won first prize – a dual-band mobile rig.

I had no idea what it was or what to expect and a few days later it arrived. It was a CRT 279 UV dual-band 2m and 70cm rig, **Fig. 4**, capable of 20 to 25W output. CRT is

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a French brand but as far as I can tell they are rebranding Chinese-built budget rigs. It came with a CD-ROM containing programming software and a programming cable. I think they were about £80 to buy at the time. What can I say about it? Well, it works, but I don't really enjoy using it. While I have had a number of QSOs on it, there really isn't a decent user manual and that can be frustrating at times. In addition, the build quality is pretty rotten, with the rubber channel selector falling off in your hand repeatedly (it is just a push fit) and I am bound to lose it soon. But, on the positive side, it works, is easy to program using the supplied software, and it was certainly obtained on a budget at just £1 for the raffle ticket!

Don't be put off though, because there are better quality Chinese brand mobile radios available through the usual retailers.

From a used perspective there are often plenty of older mobile rigs for sale. There are a number of amateur radio Facebook 'For Sale' groups and I subscribe to many of them. On my screen in front of me as I write, I can see an Icom 2000, 25W 2m rig, with airband receive, for just £40 and £10 postage and a Yaesu FT2800m, giving up to 65W on 2m for £90.

Note to newcomers – most mobile rigs are designed to be run from a 13.8V supply, either a vehicle battery or from a regulated Power Supply Unit (PSU) so please bear that in mind if you see a bargain. Can you provide it with power if you want to use it at home?

Base Stations

Typically, base stations are physically larger rigs and usually have the ability to run straight from the mains without a PSU. There really is a complete lack of new VHF/UHF base stations at affordable prices, and options come down to two main types. First are the 'shack in the box' rigs, so-called because they cover HF, VHF and UHF, and then there are more vintage rigs. There is not much in the middle here, particularly if you want to explore SSB and CW on these higher bands. Unless you are buying a shack

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in the box covering HF through UHF, I don't know of any multimode VHF/UHF transceivers on the market for less than the price of the Icom IC-9700 at £1,800. If readers know of something that fills this gap, please write in!

I am not going to cover the 'shack in a box' in this article, but will do so in the HF article coming soon. So, what to do?

Well, there are options. You might use a mobile rig as your main base station unit. Or you might even use your handheld, either as it is, or through an external antenna. You might also choose to use it through a 'hotspot' in your shack, so that you can talk to the world through the power of linking the internet to radio. Neither of these (at least modern incarnations) will give you SSB and CW though.

This is where the vintage scene comes to the rescue.

My main VHF rig in the shack, until very recently, is a beauty. This is a vintage Kenwood TS-700, **Fig. 5**, a 1970's rig, designed for base station or mobile (!) use, and puts out 10W. It has a special place in my heart, as when I was first licensed as G6PRY in the early 1980s, my local club in Ibstock, Leicestershire, had a later model, the TS-700G, in its shack, and I have very fond memories of working all around Europe on 2m SSB with it.

I am fortunate enough to have a good second-hand amateur radio dealership about an hour away from me. When I walked into the store and saw the rig, my head raced back along memory lane and I knew that, for nostalgia alone, I had to have it. It cost me £80 and has given me faithful service ever since. It is always monitoring S20 when I am in the shack, as well as being used for local nets. A great positive about this rig, in my view, is the fact that there are no menus to navigate, everything you need is on the front panel. It does SSB and CW too. These modes were really popular on VHF 30 or more years ago, and while still in use now, it would be great to see more equipment covering these modes at affordable prices.

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In common with rigs of this vintage though, repeater access can be an issue. In days gone by, the way to 'access' a repeater was to sound a 1750Hz 'toneburst'. Typically, you either selected repeater shift on your rig and toneburst was automatic, or, you had to remember to select repeater shift and toneburst separately via separate controls. If you didn't have toneburst on your rig, not to worry, you could, quite literally, whistle the tone on the input frequency and get the access acknowledgement. Later years, and more repeaters, brought greater sophistication with CTCSS (Continuous Tone Coded Squelch System) and repeaters were often grouped by geography and allocated a common tone for that area. Here in Somerset/North Devon, 94.8Hz is the tone mostly used. I certainly can't whistle that low! This shift to CTCSS can bring problems with vintage gear. For almost a year, I could hear my local repeaters but not use them. A friend from the local Taunton Club came to the rescue with an old PMR rig that he had fitted a CTCSS board to years ago as a radio engineer. I removed the board and was fortunate enough to find the manual online and instructions to fit it to my rig, which involved locating a number of points on my PCB to solder to. The problem was that the circuit diagram for the version of my rig shown was different to mine, it was the North American version. I spent many hours examining the differences and with some detective and guesswork combined, managed to find what I believed to be the equivalent points on my version – success – I can now access the repeaters too.

Don't be too put off by this. Please do check if the rig you are interested in has CTCSS fitted but if not, then for some of the more common used rigs there are still readily available CTCSS boards that will be a much simpler fit than mine. You can search for these boards online in a well-known auction site, and in the back of magazines such as *PW*.

Recently advertised second-hand I have seen a Trio TS-780 multimode, 10W for £200, and the Trio TS-711, **Fig. 6**, is another good multimode rig at a similar price. The TS-811 is the sister rig of the 711 for 70cm, and sat together on your shack desk they would look really nice and provide great service.

Other Single Sideband (SSB) Options

In the days of vintage gear, there was another category of rig – portables. Too big to be handhelds, and considered on the small side/low powered for mobile use, they filled a size and capability gap at the time.

Fig. 5: The Kenwood TS-700. Fig. 6: The Kenwood TS-711. Fig. 7: The Yaesu FT-290R. Fig. 8: The author's transverter box. Fig. 9: An inside view showing the two transverter boards, switching, etc.

There were a large number of these rigs sold and they were very popular. The positive news is that there are still plenty around if you want that elusive SSB capability at V/UHF without having to spend a fortune.

Arguably, the most popular was the Yaesu FT-290R, **Fig. 7**. Introduced in 1981 for the princely sum of £220 (£862 in today's money), as a 15-year-old G6PRY in 1982, they were out of my humble reach. Capable of a mighty 2.5W at 13.8V, it could be powered from a PSU, a car battery or eight internal AA or Ni-Cad cells, allowing you to carry it, a bit like a bag or satchel. It also had company on 6m in the form of the FT-690 and 70cm with the FT-790.

If you want to work portable, from the car, or from home on SSB, say for the 2m competitions, then one of these could be just the ticket. Still quite popular today, expect to pay between £120 to £180 and don't forget about CTCSS for repeater work. Again, modules are readily available for these and are an easy fit in this case.

There is also another important option in this area – transverters. A transverter connected to an HF rig is a device that allows your HF rig to produce and modulate your signal in whatever mode that rig is capable of, and then convert (or transvert) it to another frequency – the frequency at which you desire to operate. I will spare readers the technical details of how a transverter works, but suffice to say that they can work very well.

Although I had the TS-700 in the shack, I had no base-station 70cm capability at the time, and also wanted to be able to have the benefits of my SDR waterfall, and easy access via the SDR to digital modes. I set about researching transverters. There are some available on the second-hand market, but they are not all that common. However, I came across a company called the Transverter Store on Ebay (website below). This is a company run by a Ukrainian amateur who produces quite a wide range of products at very reasonable prices and has very good reviews.

https://transverters-store.com

In my case I was interested in a 2m transverter and one for 70cm too. There are a number of options. You can buy the basic single-band transverter, along with the recommended attenuator board for £28.60. This gives you two fully built and tested PCBs for you to build into your own case. You can also buy them as ready assembled parts with the box and ancillaries as a kit, or as a fully assembled box ready to go for about £75.

In my case I wanted to have a transverter for both 2m and 70cm, so I opted for the single attenuator board, with a 2m board in the 2m kit with box and switches etc. I also ordered a single 70cm board without attenuator. Then with some careful examination of the schematics, I assembled all three boards in the one box and added additional switching to change between bands and an additional antenna socket for 70cm on the back. I ended up with a single neat box (see pictures, **Figs. 8** and **9**) containing an attenuator/RF sensing board, a 28MHz-to-144MHz transverter and a 28MHz-to-433MHz transverter, all for the cost of about £95 plus my assembly time.

On air, I was very pleased with it. I was getting 20W out for 10W input, and had the full abilities of my HF SDR transceiver across both bands. Audio reports were good and digital modes, SSB and setting CTCSS tones in the SDR software were all a doddle. If you have an HF rig but no V/UHF capability, or you desire to add SSB capability on these bands, then this is a fun and cost-effective route to go. One word of caution though. If using a conventional HF rig, you will need to convert frequencies in your head, or use a cheat-sheet, so that when the dial shows 28.5MHz, for example, you know what frequency you are transmitting on in the band you are transverting to. In my case, my SDR software could account for this, so the frequency displayed was the frequency I was operating on.

Linear Amplifiers

By modern standards, 10W from my TS-700 is not a lot of power on a VHF rig used at home, and 2.5W from a portable rig such as the FT-290 is less than any modern handie, so I went searching for a linear amplifier. Linear amplifiers for 2m and 70cm were very popular back in the day because most rigs on these bands put out between 1 and 10W, so now, many are surplus to requirements. You can often see them advertised second-hand, and you can almost always pick up one by a company such as Microwave Modules. Expect to pay anything between £0.50 to £2 per watt, depending on age, condition and power output. You can find them with various drive levels and power outputs.

I was lucky enough to come across one on Facebook, made by BNOS, which transforms my 10W input to 180W out (although

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with age, this is down to about 135W now). It works well on FM and SSB, and contains a helpful preamp too. It was being sold by an amateur in North Wales who promised it was working but couldn't vouch for the output level. I took a gamble at £80, including postage, and was very pleased with it indeed.

So, what have we learned here? Well, there is certainly a great deal of choice in the new and budget end of the market for VHF/UHF FM transceivers, but with the notable exception of DMR you need to pay a bit more to access the manufacturer's own digital modes. If you want to give older and vintage gear the use it deserves, then there are some real bargains to be had. Of course, if you go this route, please do so with your eyes open. Try to test the equipment first if you can (difficult with Coronavirus) or buy from someone you trust, but sometimes, with a little due diligence on the seller, and a healthy dose of common sense, many of these rigs are worth a place in your shack. Inevitably older rigs can have problems, but many of these may not be too difficult to deal with. There is often lots of space inside older gear to undertake repairs, lots of guidance online, and lots of fellow amateurs at your local club who will know these rigs intimately. As you can see, some of these rigs, such as Josh's FT-1802 and my TS-700, are well worth a try for such little money and such a lot of fun in return – and what better than to stop a beautiful old rig gathering dust, being broken for parts, or worst of all, ending up in landfill.

Until next time, when we will look at budget antennas for VHF/UHF, stay safe and find yourself a piece of history to play with!

Four Metre FM Mobile

Tim Kirby GW4VXE
longworthtim@gmail.com

Tim Kirby GW4VXE has all the usual VHF news but starts with a discussion of FM mobile operation on the 70MHz band.

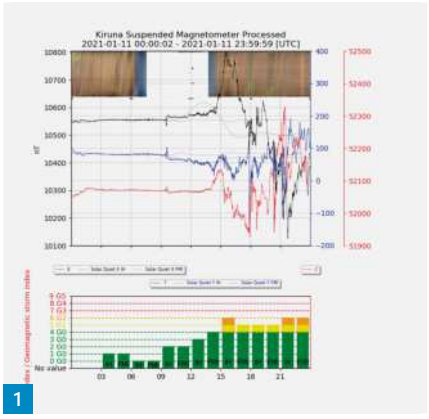
A few weeks ago, I was had the opportunity to try out one of the little Anytone AT-779 radios for 70MHz FM. It has about 15W output at full power. Not having a 70MHz antenna up at home currently, I found my quarter-wave magmount and put the AT-779 in the car. I don't think I have tried four metre mobile before. Well, that's not strictly true. I remember some years ago, in Oxfordshire having an ex PMR rig in the car for a week, not hearing anyone and taking it out again!

To my surprise, my first CQ from the car, situated in the yard was answered by **Luke 2W0LXT** in Letterston, a few miles away from me over some quite undulating terrain. Signals to and from Luke were excellent. I was then called by **Richard GW1JFV** some 15 miles away in Haverfordwest who was a little bit noisy, but we had an easy QSO.

However, what has really impressed me has been how well 70MHz FM mobile works in the very undulating Pembrokeshire countryside. I have had the opportunity to try a couple of QSOs with Richard, based at home, using a 'Ringo Ranger' type antenna at about 4m above ground level. Interestingly, Richard's path in my direction is not clear. We have found signals remarkably consistent over distances of 15 to 20 miles and more, particularly in areas where it was hard to imagine that signals would have reached on other VHF bands. For example, I was able to hear Richard, albeit weakly, on the seafront at Goodwick, where hills obstruct the path to the south in his direction. I managed a similar distance to the north east, working **David GW4OUU** in Cardigan.

The only downside I found was that the band was very noisy near shops, petrol stations or buses! It might not be an ideal mobile band if you are spending a lot of time in an urban environment. However, if you are able to spend time in quieter rural locations, then 4m FM might well be an interesting band/mode for you. Equipment for 4m FM is now readily available and smaller rigs such as the AT-779 will easily fit in most vehicles.

Chatting to **Peter GW4JQP**, he reminded me that motoring organisations such as the AA used to have repeaters just outside the 4m band and that he remembered breaking down in the West Country many years ago and being 'recovered' back to Newport



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in Pembrokeshire with the 76MHz repeater on the mountains above Swansea providing coverage all the way. I do remember that when I first came on 4m FM in the early 'noughties' I could hear various Fire Service repeaters just outside the band at some distance from where I was.

Wales is still in lockdown at the time of writing but I am looking forward to trying some more distant mobile tests on the band, once travelling is a little bit easier. It would be great to hear of readers' experiences with 4m FM activity. My impression is that quite a few people have equipment for the band (after all, the new Icom IC-7300 and the older IC-7100 cover it) but just need a little encouragement to come on and make some contacts.

DroidStar – DMR, D-STAR, YSF, NXDN, P25, IAX and M17 Modes on your Android Phone

Digital voice enthusiasts may well be interested in DroidStar, an app for Android mobile devices, which allows you to connect to radio networks on DMR, D-STAR, YSF, NXDN, P25, IAX and M17 modes from your phone, without an amateur radio transceiver. The application has been developed by **Doug McLain AD8DP**.

I installed DroidStar on my RFinder B-1 Android smartphone. In fact, I'd tried a release a month or so back and it had unceremoniously crashed, so I had abandoned the experiment. However, this later release installed successfully.

Once you've installed the app from the Google Play store, you'll need to launch it and go to the Settings tab. There you will need to enter your callsign and your DMR ID as well as a Brandmeister password. There are various other fields that can be entered, depending on which modes you plan to use.

Having done that, go back to the Main screen. Select DMR, for example, and then choose a master server. I used the Irish Brandmeister master (BM_Ireland_2721) and then selected a talkgroup. I used the Salop DMR Cluster 23575 and hit Connect.

At the bottom of the screen you should see a Host IP address displayed and a 'heartbeat' ping counter, which should keep incrementing as long as you are connected. As a station transmits on the talkgroup, you should hear them coming through. There's a big blue button at the bottom of the screen, which you can press and hold to transmit.

So far so good! The problem that I found was that both receive and transmit audio were quite juddery. Receive audio is intelligible although not particularly nice to listen to. I have heard varying reports on transmitted audio ranging from unreadable to adequate. Transmit on D-STAR has been disabled because of this problem.

As I understand it, the poor audio quality issues result from the software codec that is used to process the data into speech and is an issue that other developers have encountered. It may be that future releases of the software can improve on the current performance, so it's definitely an app to keep an eye on. In any case, I find it quite useful to monitor some of the talkgroups, perhaps for something to listen to in the car, even if I don't transmit using the program. And for a quick 'I'm on my way' type QSO, the audio quality is probably good enough, even if you wouldn't want to inflict it on someone for a more lengthy contact.

I also had some problems with DroidStar not wanting to change talkgroups and resolutely keeping hold of a talkgroup I'd previously used on DMR. I got around that by using the Brandmeister dashboard and dropping the talkgroups connected to DroidStar, which is seen as a hotspot.

So, DroidStar is certainly something to take a look at and will, I'm sure, be of great interest to those of you interested in Digital Voice, but it's not something that feels as though it's ready for widespread usage just yet. As we went to press a new version of the software has just been released, so it will be interesting to see what improvements there are.

Love the ICQ Podcast?

Martin Butler M1MRB, Presenter and Technical Editor of the popular ICQ Podcast, contacted me to tell me that the podcast now has its own talkgroup on the Brandmeister DMR network, talkgroup 9480. The idea behind getting the talkgroup set up was to allow podcast subscribers to have a means of giving feedback to the presenters using amateur radio technology. Significantly too, Martin wanted to be able to provide a means of 'Elmering' for people who might want to ask questions about something they heard about on the podcast, or raise questions generally. Martin gratefully acknowledged the help of **Adrian Craig M0GLJ** and **Andy Taylor MW0MWZ** in getting the talkgroup set up. It's hoped, very shortly, that talkgroup 9480 will have links to other digital networks such as Fusion and NXDN.

The 6m Band

John Rowlands MW1CFN (Anglesey) wrote with regards to the January 12th opening that I mentioned last month and says, *"As it happens, while there are often unusual and difficult-to-explain winter Es events, this one seems quite easy to explain in terms of Es induced following a pretty strong geomagnetic disturbance. I attach a shot of magnetometry from the 11th, which went on into the 12th and, as is usually the case, gave rise to Es"*. See **Fig. 1**.

Brian Williams GW0GHF (Penarth), **Fig. 2**, has recently got back onto the band using an IC-756 and a delta loop. He is particularly interested in SSB tropo contacts and calls and listens on 50.150MHz. He is also interested in PSK31.

The 4m Band

Simon Evans G6AHX (Twyning) now has a ¾-wave vertical at the top of his mast for the 4m band. He is using an ex-PMR Storno rig, producing 15W of FM (Simon also has his IC-7300, which will run up to 60W on FM). Simon says there is an interesting group of 70MHz users in the Worcester area as well as other more local users. On February 2nd, Simon worked **George G8AOJ** in Coleford in the Forest of Dean who had just completed

Fig. 1: MW1CFN sent the solar data for January 11th, preceding the major Es event on January 12th. Fig. 2: Brian GW0GHF in his shack in Penarth, South Wales. Fig. 3: G0BVD's award for receiving SSTV from the International Space Station. Fig. 4: The insides of G4BXD's new 23cm system. Fig. 5: G4BXD's dish, used for 10GHz.

an amplifier for the band. The path between them passed over Ruardean Hill, so as Simon says, 4m signals do seem to be able to go around corners and over hills (rather confirming what I said earlier in this piece).

Brian GW0GHF is active on 4m with a transverter, an A200 linear and a Sirio vertical antenna.

The 2m Band

Tony Collett G4NBS (Cambridge) says that prior to the 2m SSB Activity Contest on February 2nd he was surprised to work G4RRA (IO80) on FM, the only station heard apart from a local. Tony took part in the 2m FT8 Activity session on February 3rd, making 50 QSOs in 18 different locator squares. QSOs of note include DG1KDD (JO31), DL2PL (JO31), DL6YBF (JO31), DL5EBS (JO31), DC220GERKE (JO40?), EI3KD, (IO51), MM0OKG (IO86), GW6TEO (IO71) and GI6ATZ (IO74).

Simon G6AHX made some repairs to his 8-element OWL Yagi, which got damaged last year but is now working very well once again. During the UK Activity period on February 2nd, Simon had 25 contacts with the best DX being GM3SEK (IO74) at a distance of 339km although another nice contact was with F1BHL/P on the Cherbourg peninsula.

The 70cm Band

Tony G4NBS was on for the AFS contest on February 7th and says there was good activity from the UK. He had to get the Morse key out to work G7RAU (IN79) but in the end it was an easy QSO. Other nice QSOs were F1MKG (JN08), F4CHA (JN08), F6DZQ (JN09), F4HRD (KO00), GI6ATZ (IO74), GD8EXI (IO74), MM0GPZ (IO75), GM4AFF (IO86), GW4MBS (IO71) and EI8KN (IO62). In the UK Activity contest on February 9th, Tony says there was good activity although not many planes around, hampering QSOs into Scotland. However, Tony worked GM4BYF (IO85) and then the Morse key got a second airing this month to work GW0MDQ (IO83). Other nice QSOs were GD8EXI, GD1MIP, GI6ATZ and GM3SEK then turning the beam back to France to work F1MKG (JN08), F1CBC (JN09) and F4HRD (JO00). During the FT8 Activity session on February 10th, Tony worked 49 QSOs in 19 different locators. He was particularly pleased to work M0AFJ (IO70).


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Satellites

Jef Van Raepenbusch ON8NT (Aalter) received the SSTV from the Russian cosmonauts on the ISS on January 28/29th using his IC-9700 and V-2000 vertical.

Kevin Hewitt ZB2GI operated through AO-92 on January 2nd, from outside the Gibraltar Amateur Radio Society club, working EA4M (IM89), G0ABI (IO80), EA1PA (IN71) and EA2CDY (IN82). Kev also walked up the Rock on January 28th and 29th to receive the SSTV images from the ISS. Kev says that he received six full images with two duplicates during four passes. He used a Yaesu FT-817, data interface, Win 7 notebook running the MMSSTV software and a Diamond white stick dual-band collinear.

Phil Oakley G0BVD (Great Torrington) also enjoyed the ISS SSTV event on January 28/29th. Phil used an IC-9700, a collinear at 26ft and the MMSSTV software. Phil was excited to receive the Indonesian Space Explorer SSTV Diploma, having received the pictures from the ISS, **Fig. 3**.

Patrick Stoddard WD9EWK (Phoenix) has some interesting news: *"In the past couple of weeks, **Endaf N6UTC/MW1BQO** and I have been making some QSOs using the AO-27 satellite using D-STAR instead of analogue FM. This isn't the first time D-STAR has been used via satellite, but we were wanting to see if AO-27 still supported this form of digital voice communications.*

*"Back in 2007, the control operator for AO-27, **Mike N3UC**, tried D-STAR through AO-27 with **Robin AA4RC**, developer of D-STAR soft-*

ware and related hardware (DV Dongle, DV Access Point dongle). Using two radios on each end, N3UC reported that both operators were surprised at the just how well the digital link was received. Along with the digital voice, the D-STAR signals carried each station's callsign through AO-27, and those callsigns showed up on the downlink radios at each station.

"AO-27 was originally designed to relay data, 1200 to 19200bps GMSK. The uplink receiver on the satellite lacks the filtering normally seen on FM receivers, which blocks the low end of the audio passband from being heard.

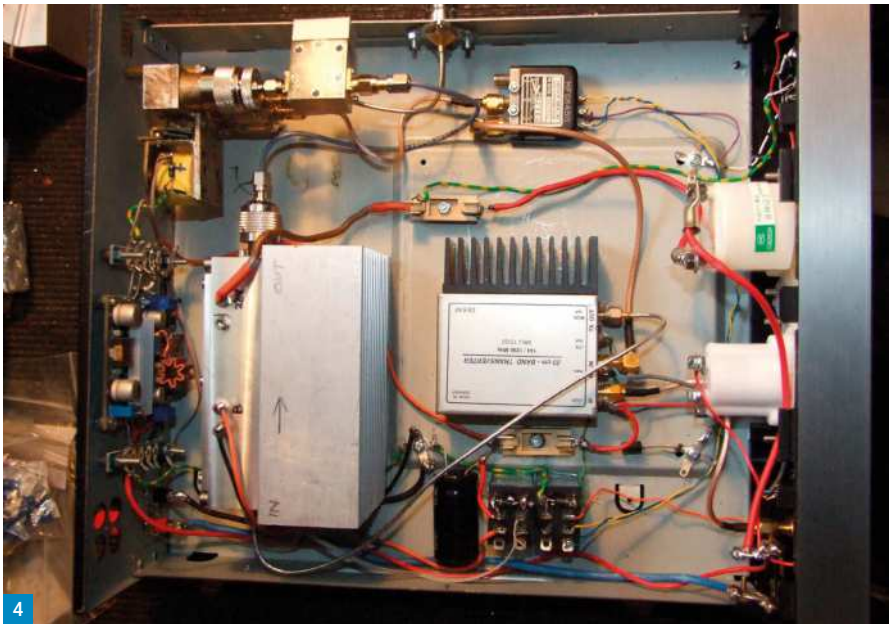
"After reading the writeup about this 2007 AO-27 D-STAR test in the Wayback Machine from the old ao27.org website, and after talking about this, N6UTC and I decided to give it a try. Like in 2007, we used two radios on each end. N6UTC transmitted at 15W using an Icom ID-880H mobile radio and received the downlink with an Icom IC-80AD handheld radio. I used two Kenwood TH-D74s on my end, transmitting at 5W.

"On January 25th 2021, I tried AO-27 to see if I could hear myself using D-STAR. Late in the pass, I was able to hear myself as I said my callsign, and started to give my grid locator, as AO-27's repeater switched off. I heard for myself that D-STAR audio was pretty good through AO-27. I shared my audio recording with N6UTC, and began looking for good passes to make a two-way contact.

"The evening of January 27th 2021 was a better pass for a D-STAR experiment. AO-27 was up to just over 30° elevation at N6UTC in California, and up to 17° maximum elevation for me in Arizona. Once the repeater switched on, we began making our calls. It took us about two minutes to complete a QSO. N6UTC reported that my audio was breaking up, but he heard me well enough to give me a 'QSL' to signal a good contact. We followed the QSO up with a phone call to discuss what we saw and heard. The 5kHz tuning steps on the Icom and Kenwood radios complicate the use of D-STAR via satellite. With the Doppler effect, there were points in the pass where the AO-27 downlink signal fell between the 5kHz tuning steps on our radios. When the downlink was on, or close to, a tuning step we found the audio was good. Just as reported by N3UC in 2007.

"It was a lot of fun to recreate the 2007 D-STAR experiment, using newer radios. I have not been able to determine how much power was used by N3UC and AA4RC when they were transmitting D-STAR through AO-27. It appears that 5W can work on passes where AO-27's elevation is up to at least 20°. Of course, D-STAR won't work if others are transmitting in FM at the same time, or if the FM signals are stronger and capture AO-27's uplink receiver.

"N6UTC and I hope to work other stations through AO-27 using D-STAR. In addition to Icom's handheld and mobile radios with D-STAR, and the Kenwood TH-D74, Icom's satellite-ready IC-9700 could be used to work AO-27 using D-STAR."



4

SSTV

Jef ON8NT writes, *"We have a weekly SSTV net now on 144.500 FM on Sunday mornings from 0900 to 1100UTC, with participants from Belgium and the North of France, so with some good conditions the UK could be in range. I am able to use MULTIPSK for this on my Linux PC using Wine, although it is a Windows program. I have also used MULTIPSK for receiving APRS and Packet. MULTIPSK is an unbelievable program with what you can do in decoding and sending different, even exotic modes.... although the interface looks a little old-fashioned".*

http://f6cte.free.fr/index_anglais.htm

Jef has also been experimenting with sending SMS messages from both APRS and JS8CALL using the SMS Gateway services at:

http://smsgte.org

Microwaves

Bernard Nock G4BXD, located in IO82UJ or Kidderminster, Worcestershire is looking forward to this year's microwave operations and is replacing his quite successful 25W SGLabs 23cm system with a new setup, **Fig. 4**, comprising a Kuhne transverter and a 140W PE1RKI amplifier feeding into the newly acquired 28-element Yagi. In addition, his 13cm station will be complemented with a 160W Nokia amplifier while the 3cm station increases from 2W to 9W with the addition of a new DL2AM amplifier with the possibility of feeding into a 1.4m prime focus dish, **Fig. 5**. The 9cm station continues for the time being with the SGLabs transverter and Stealth 20W amplifier feeding a 20dB flat panel array. Bernard would welcome operators to look out for him and skeds can be arranged direct, military1944@sol.com, or during contest events on ON4KST.

5

That's it for this month. Thanks to everyone who's written in. I should mention that I had an e-mail from one reader who said, *"you hardly ever cover any FM or DV"*. Purely by chance, I had plenty on both those subjects this month! But, if you'd like to see more FM or Digital news covered, please drop me an e-mail with any news you have. I'm always happy to include items on any aspect of VHF/UHF operation in the column.

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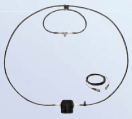

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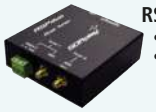

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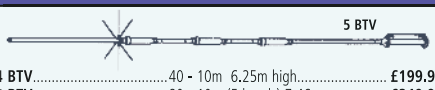

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A Lot of Nonsense

Steve White G3ZVW
practicalwireless@warnersgroup.co.uk

This month **Steve White G3ZVW** will be Making Waves in a rather different way, by talking a lot of nonsense. This is because the claims made by some advertisers for signal coverage and antenna gain are nonsense.

Before I start to debunk some myths and expose some advertising claims as ridiculous I would like to explain something technical, the decibel (dB). I am not going to explain it in detail to those who don't understand the subject, I just want readers to know that a gain of 1dB is a gain of 20%, a gain of 3dB is double and a gain of 10dB is ten times. Those who understand decibels will already know more about the subject than is needed to understand what follows.

The gain of a directional antenna is measured in dB, but here we encounter the first problem because there are two different decibels that can be used. This can lead to confusion, especially if the advertiser of an antenna doesn't specify which kind of decibel is being used!

dBi. Decibels with respect to an isotropic radiator – a theoretical antenna that radiates equally in all directions. No such thing exists in the real world.

dBd. Decibels with respect to a dipole, an everyday real-world antenna.

The difference between the two is just over 2dB, so for practical purposes an antenna that has a gain of 10dBd has a gain of 12dBi. 12dB looks better in an advert than 10dB, so unscrupulous advertisers sometimes quote antenna gain in dBi without specifying.

When it comes to amplifiers, dBi and dBd are both meaningless, so beware of any advert which quotes the gain of an amplifier in either way. For amplifiers, straightforward dB is the correct term to use.

Local Area Networks

Lots of wireless routers have one or more antenna sockets. The plug-in antennas supplied are, guess what, little bits of wire. The ideal length of a resonant antenna for WiFi is about 3cm, so the main reason I can think they make them as long as they do is that they look more impressive. A longer bit of wire is likely to have some gain, but in which direction? It cannot possibly be in every direction and on a router it would be hard to predict in which direction(s) the gain might be. By virtue of the fact that it is high up and in the clear, a plug-in omnidirectional WiFi antenna that you mount on your roof is going to give you greater range than something indoors. These antennas come in various shapes, sizes and colours. See **Fig. 1** for an example. It will get your WiFi signals further, but if you want your wireless router to have much greater range you need to plug in an antenna like one of the ones shown in **Figs. 2** or **3**. Bear in mind though that in each case the gain from one of these will be in one direction, not all around. It's a fact of life that you can't get something for nothing, so a stronger signal in one direction will always be made up for by a weaker signal in other directions.

1

Television

In **Fig. 4** you will see some outlandish claims. Adverts for very similar TV antennas that claim to allow you to receive TV from 200, 1,000, 5,500 or 9,900 miles away.

Considering the fact that almost all TV in Europe is broadcast at UHF (these antennas are not suitable for VHF TV), the curvature of the Earth will see to it that under normal conditions signals do not carry for more than tens of miles. Under enhanced conditions terrestrial TV signals may be received from greater distances, but this is the domain of the enthusiast – and an enthusiast wouldn't buy any of these! For interest, if you would like to know somewhere that is 9,900 miles from London, Fiji is.

Even if it was possible to receive terrestrial TV at such distances, there's a second problem with these claims. For technical reasons associated with how a digital terrestrial TV signal is put together for transmission, the signal suffers from a breakup if you try to receive it too far away from the transmitter. In the real world the Freeview TV signal simply doesn't work over distances of more than about 35 miles (60km), even if the signal is strong enough. Each of the people who came up with these ads must have an extremely vivid imagination… or scant knowledge of the subject.

Some indoor TV antennas are fitted with a preamp. Typically, the preamp will be USB powered, such as two of those shown in Fig. 4 – the ones with two plugs. First of all, what will any of these four antennas contain? In each case the answer is the same – a bit of wire. Nothing more, nothing less. It is likely to be a loop or a dipole that has been folded around to fit in the box. The preamp – for those which have one – is in the cable, where it splits.

The antenna in **Fig. 5** is intended to stick on a caravan roof. Inside will be a metal rod or a bit of wire a few inches long. The words of this ad quoted VHF and UHF coverage, with a gain of 25dBi. Considering it has a preamp, the preamp could have a gain of about 20dB, but the antenna itself will have some loss compared to a resonant dipole, so the overall figure at UHF might be more like 20dB. Essentially, the preamp is there to overcome the inefficiency of the antenna. Overall, the antenna will have some gain, but not as much as claimed. At VHF the gain will be a minus figure, because the antenna is far too small. The size of the minus figure will depend upon the frequency being received. The lower the frequency, the worse the figure will be.

Fig. 1: Omnidirectional outdoor antenna for WiFi.
Fig. 2: Yagi beam antenna for WiFi.
Fig. 3: Dish antenna for WiFi.
Fig. 4: Collage of outlandish adverts for cheap indoor TV antennas. Fig. 5: A tiny TV antenna for a caravan. Fig. 6: LTE (Long term Evolution) router that uses 4G mobile signals instead of a phone line for broadband internet.
Fig. 7: Antenna sockets on the back of an LTE router. Fig. 8: A Yagi beam antenna claimed to work from 700-2700MHz. Really? Fig. 9: A log periodic antenna that actually will work from 700-2700MHz.

The preamps in any antennas like these will amplify any signals, so they amplify TV and everything else. Place such an antenna too close to something that is emitting radio frequency interference – which lots of things do – and the preamp might be blocked or overloaded. As for the claim that such an antenna will enable you to receive NBC or ABC, well that depends on whether those stations are being transmitted in the first place. Also, in the UK there is no 4K (Ultra High Definition) terrestrial TV.

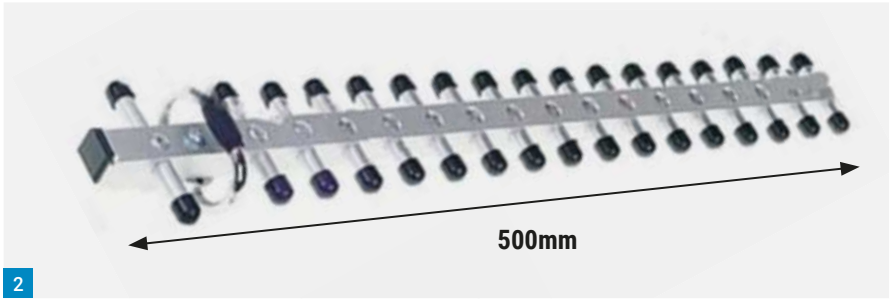
MiFi

Some people are turning their backs on using a twisted pair of copper wires at home for their telephone and broadband Internet. People who live in areas where fibre optic cables have been run to their homes are lucky, but there is a third way. Some mobile phone networks actively promote switching to the mobile phone network for broadband.

You can turn on the mobile hotspot of a smartphone for those nearby to access the internet. Depending on the mobile network's signal level, the download speed can rival some so-called fibre broadband connections (which isn't fully fibre, because the fibre ends at the street corner cabinet).

Although so-called MiFi through a smartphone works well for some, others miss being able to plug network cables for peripherals such as printers into a router. To overcome this you can buy routers with a SIM socket. Essentially, a MiFi or Long Term Evolution (LTE) router (**Fig. 6**) is a mobile phone and a router in one box. From personal experience I can vouch that they work. Although they have an internal antenna for the mobile phone network, just as smartphones do, some have sockets for external antennas as well (see **Fig. 7**). If your mobile phone signal is weak, an external antenna should make things better, but the claims made for some of these antennas are utter rubbish. Here are some examples.

Fig. 8 shows an advert for a Yagi antenna that is said to work from 700MHz



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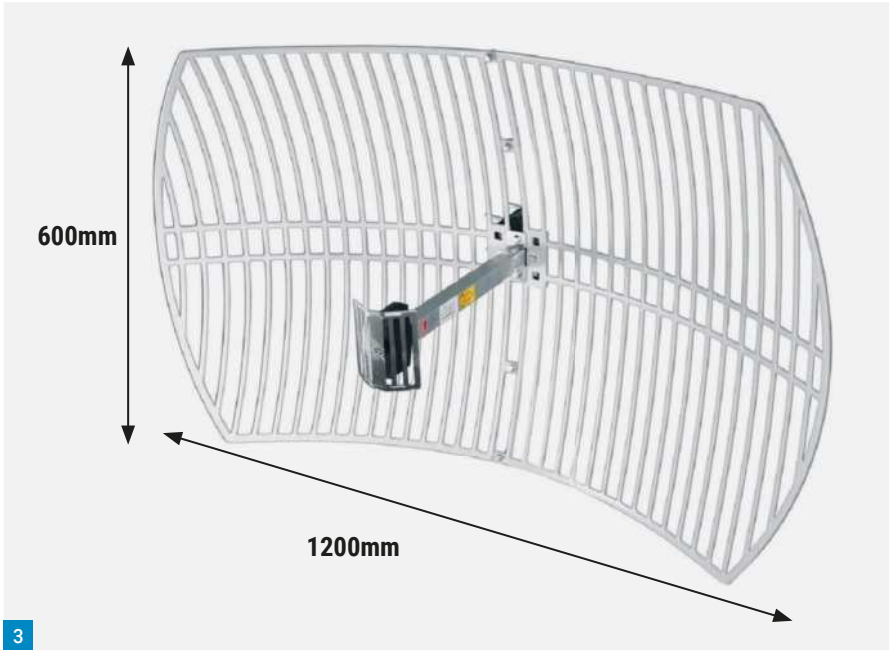

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to 2700MHz, which encompasses all the frequency bands used for 4G. I'd like to see that! Unless something is done to make a Yagi broadband, it will work only over a fairly small range of frequencies. With beam antennas there's a trade-off between size, gain and bandwidth, so while a beam antenna can be designed to work over a broad band of frequencies (wideband) it won't have anything like as much gain as a narrowband beam. The antenna in Fig. 8 should work (with varying efficiency) from about 700MHz to 900MHz and also on some of the higher frequency bands used by mobile phone operators, but not all the way from 700MHz to 2700MHz. Also, the gain will not be the same across all the frequencies it does work on.

A wideband beam antenna for all mobile phone bands should look a bit like this (**Fig. 9**), broad at one end and about a quarter of the width at the other. It is called a log periodic, not a Yagi. Size for size it will not have as much gain as a narrowband Yagi


7

antenna, which has been optimised for one frequency. Short versions of the log periodic antenna often come encased in plastic that has a characteristic wedge shape. Be cautious about buying short ones that aren't encased, because short log periodics for TV sometimes get advertised as being suitable for 4G. These might work at about 800MHz, but they won't work on the higher mobile phone frequencies.

Conclusion

Two well-known phrases spring to mind, *Caveat Emptor* (Latin for 'Let the buyer beware'), and 'if it seems too good to be true, it probably is'. Spend your money wisely, people.

8


9

The Case for 75Ω Twin Feeder

Rob Dancy G3JRD advocates the use of 75Ω feeder.

Rob Dancy G3JRD
practicalwireless@warnersgroup.co.uk

One of our biggest problems nowadays is that high noise levels swamp the signals we are trying to receive. Some things can be done about it, and it is useful to go back to basics to look at how the situation can be improved.

For many people with limited space, an antenna such as the G5RV is a good choice if they wish to operate on several different frequencies. But the excellent article in the September 2020 issue of *PW* by **Vince Lear G3TKN** shows that the best SWR on all bands is worse than 1.5:1, which is not really acceptable. It is suspected that many rigs with an SWR meter indicating a good ratio, connected via an ATU to the feeder, have in fact pretty awful conditions in the feeder and the antenna, masked by the ATU.

Wire dipoles are very easy and cheap to make, unobtrusive, and can be trimmed accurately to resonate to give an SWR close to 1.1 to 1 over most of a band, and a near perfect one in the most-used part, provided it is fed properly. Dipoles are balanced, so it makes sense to keep the balance, and use a balanced feeder.

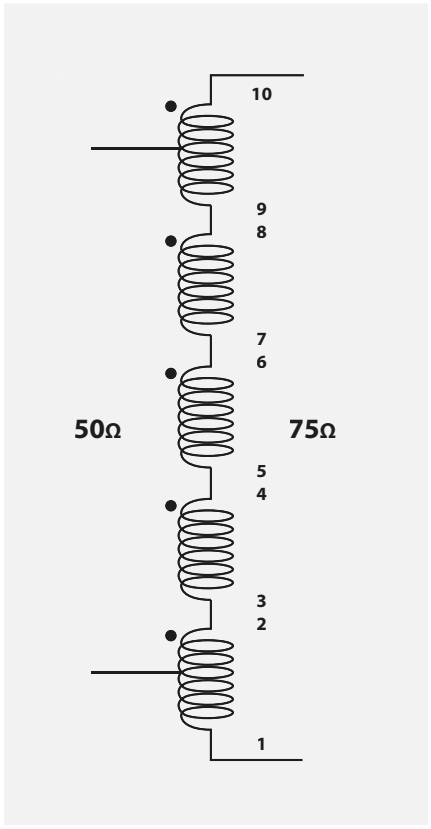
The texbooks say that the input impedance of a dipole is 73 + j42.5Ω. Ignoring the j42.5Ω as a figment of the imagination leaves a resistive 73Ω, so a 75Ω twin feeder really is very much better than 50Ω coax, and also avoids the use of a balun up top. One advantage of a twin feeder is that any local noise signals impinging on it cancel out.

My experience in 1953 at the high-power HF transmitting hall at the Rugby radio station showed that everything can be matched properly. With tens of kilowatts of RF kicking around, it had to be just right. The space at Rugby was admittedly a little more than a suburban garden (hundreds of acres) and there were lots of shortwave antennas there, each for a specific frequency, all with twin feeders, and no ATUs of course.

There are many advantages in accurately matching the transmitter-feeder-antenna combination for a good SWR. It will increase the received signal strength, and reduce noise pickup. A properly resonant dipole is effectively a tuned circuit, making the required signal stronger while reducing the pickup of signals outside the resonant frequency. Also, as the line is 'flat' (i.e. with a very low SWR) the length of feeder is completely unimportant.

Another advantage is that when transmitting there is maximum power transfer, lower losses and a suppression of harmonics. There is less likelihood of RF feedback into the shack because the feeder, which is closer to the shack than the

Continued on page 43



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Another Redesign

Joe Chester M1MWD ponders possible improvements to his station and antennas.

Joe Chester M1MWD
m1mwd@gmx.com

So, six months or more or research, and a few experiments later, I'm stuck again. But this is a real meta-level problem. During my less than exotic career, one of the things I learned was that change management by design usually delivered a better result than change by random add-on. To get to what I want will require a significant spend on what are essentially system components, black boxes if you like, to build the system I need. Now the exact sum involved, while heading up to substantial, is not really the issue. The question is how to know for certain that my design, including all those component black boxes, will work as imagined after that expenditure. So, bear with me while I explain what I'm contemplating, and the alternatives. Maybe you can help.

All that research suggested that the right way to progress the performance of my small station is to put up a low-noise receive antenna, connected to my KX3, a transceiver with a very good receiver on board (check the Sherwood tables for more information on this). I've looked at both passive and active receive solutions. I've studied receive antennas such as the BOG and the EWE, and considered receive loops, such as the Wellbrook. I've acquired and tested an E-field probe from **Roelof PA0RTD**. This worked well as a receive system as I reported in the January *PW*. So, the theory is to set up this little system as my receive antenna, and continue to transmit on my inverted-L with my IC-7300. Of course, you will see the problem straight away. If I transmit at 100W and the E-field probe picks this up, it might destroy its sensitive circuitry (I discussed this in the E-field piece). Of course, it's easier with a passive antenna; all I need to do then is to ground the receive antenna when I press the PTT.

This problem is not helped by the fact that the IC-7300 has only one antenna socket. There are ways around this problem such as the DX Engineering RTR-2, or the RX7300, which requires


1

intercepting the IF frequency to create a second antenna socket. Then there is the MiniKits receive antenna switch, and even DIY solutions, like that of G0HWW (URL below). All of these solutions should work. However, using these would mean that I can't use the KX3 as my receiver. And there is a cost attached to them.

https://tinyurl.com/yazaoc9y

But all of this is really only half the problem. I think the system needs to be connected to at least one computer in order to activate digital modes. My preference would be to use my Mac but the software for this is limited. I also have a cheap Windows 10 laptop, which I could use. This doesn't have a line-in port, so an external soundcard will be needed. Drawing diagrams of the planned station improvements shows a spider's web of cables – USB and coax, coax switches, and all the assorted black boxes – not to mention steelwork for a mast (ahem, 'antenna support'!). So, a thought occurs, is there in fact a simpler solution? An old friend once told me to spend ten times as much on antennas as on transceivers and other assorted devices. So why not start there?

The Antenna Farm

For my antennas, I need to erect a mast on the deck of the boat. The current antenna is shown at **Fig. 1**. I'm very conscious of the centre of gravity issue (thanks **Brian G4BIP** for this tip) – I can't put too much mass on deck, and risk raising the CoG and toppling the boat. I need help with this, but I know where I can go for it. Given a mast, I can put my inverted-L back up, and maybe a full-sized dipole for 40m too. A small three-element beam for 2m might sit on top, or a J-pole. It might even support a 6m vertical. Because this will be hinged at the base, the antennas I want to use can be mounted as required, and the whole lot lowered as required. And finally, I can add a low noise antenna, be it an EWE or an E-field probe (why not both?). Some of this is captured in **Fig. 2**.

Fig. 1: The existing antenna installation.
Fig. 2: A possible solution for the antennas?
Fig. 3: One possible station configuration.

The Transmission Lines

So that's the antenna farm done. Now the transmission lines. I would like an auto-ATU at the base of the mast for either the inverted-L or the doublet (probably the latter). So, I end up with coax feeder cables, six of them, down to the shack. The Inverted-L, the doublet, the EWE, the 2m and 6m cables, and a spare! So, what to do in the shack with all these cables. I really don't have room for a set of different transceivers. I would prefer just one, especially if it can handle all the T/R switching between these antennas. But let's just say that the mast, antennas and feeders are a given.

The Transceiver

Now the transceiver setup. The draft plan is to acquire that DX Engineering RTR2 and plug two antennas into this, one for receive and one for transmission. But then there are the other antennas. I've seen a really nice matrix antenna switch, from Elad. This would allow me to switch any antenna into the system as required. I've drawn a diagram of all this, for your approval, **Fig. 3**. Complicated, isn't it? And expensive too. I estimate I'm looking at something north of a couple of grand. So here comes the dilemma. It should work, shouldn't it? But what if it doesn't deliver the lift in performance I want? Is there a more effective way to spend that kind of money? In fact, is there is a simpler solution?

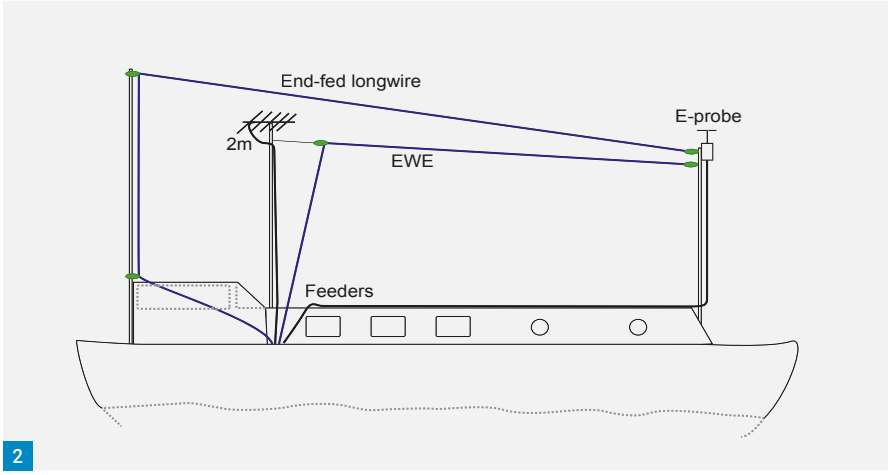
The answer is yes, there is, but it may cost a little bit more. The expenditure on the antennas can't be avoided. Clearly, I can eliminate some of the complexity with a different transceiver – one which has provision for the different antennas I want to use! I can write you a specification, if that helps. Principally, it means antenna sockets! It should also be an SDR transceiver, as I believe that this is the route to the best performance. And a receiver up in the top models in Sherwood's tables is also a must. So, in a sense, I've now come full circle.

I recall when I was first licensed in the last century, the transistor radio was the size of a trolley bag, and amateur radio equipment was just beginning to enter the IC age. My FT-290 gave great service with a 'white stick' screwed onto the side of the shed, a cut down coat hanger on the roof of the car, and a small HB9CV for portable outings on 2m. With this, I spoke with operators all over the place, even into the UK and Europe. I knew I wanted to get on HF, but my VHF training was very useful in helping me understand how amateur radio QSOs worked. I used the club radio a couple of times a week, a venerable FT-101, attached to ladder line up to a doublet. Later years saw me acquire an IC-706Mk2G, and several Hamsticks to mount on the car and to the shed roof. After I retired from 'active service', I knew I wanted to progress by building a proper, if necessarily small radio station. I was still doing portable work, and the IC-706 wasn't really the best for this. So, a KX3 arrived, and became my goto choice. With this I discovered QRP working, which has been very rewarding.

Needing more power, I acquired an IC-7300, the main workhorse here today, and associated bits of kit. The station now works very well. One of my principal joys during the lockdown days was discovering a way to get on 80m. In a sense, there is nothing wrong with my station, it's just that I believe that with a bit of effort it can do more.

Like what? Well, the sunspot count is on the rise, so it would be nice to be able to work more exotic stuff – Australia, for example. I've already worked an Indonesian station during a recent contest. I know of stations in the UK doing this regularly, some using beam antennas, from quiet rural locations, but at least two are using G5RVs. I'm sure I can do this with my wire antennas, if I can fix the curse of the local noise level. I too live in a semi-rural spot, on the banks of the River Avon in Gloucestershire, but there are houses nearby, which are producing S5+ noise levels, particularly on the low bands. Working this problem has led me to a very complicated solution, and also a very simple one. All those additional components will also bring losses into the system that I need to avoid. So, the one box does all solution has jumped to the top of the list.

Right then – which one?



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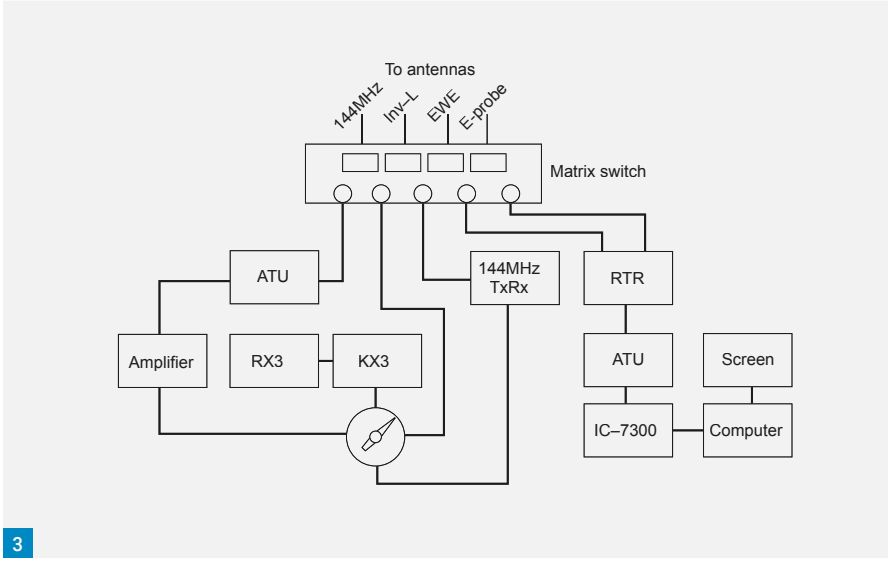

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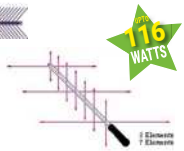

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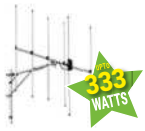

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Electronic Circuits Fruit Machine

Geoff Theasby G8BMI
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Geoff Theasby G8BMI takes a simple circuit and shows how it can be developed for multiple uses.

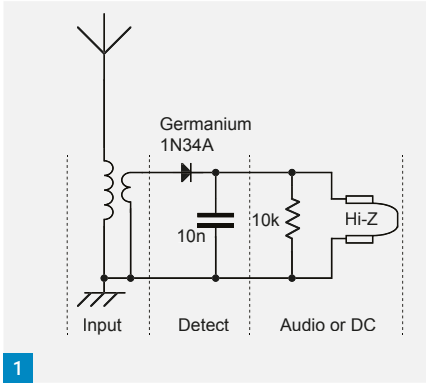
A conversation on social media with a novice-licensed amateur led me to think that there are many simple receiver circuits, RF probes and field strength meters about, all using the same basic circuit, but never acknowledging their commonality. That person wanted to use computers in radio, but did not know of the simple RF projects that can enhance a beginners' practical experience. A limited number of logic gates, AND, OR can be formed with diodes, but that is not really relevant here.

Let's begin with the crystal set with which (I hope) we are all familiar, **Fig. 1**. It consists of a tuned circuit, a diode, a capacitor and an earphone. The diode removes the RF, and the capacitor any that is left, leaving a varying audio signal. The output is sent to a high impedance earphone, a crystal type, not smartphone earplugs. A tuned circuit as shown will also protect the diode from static electricity by allowing a DC path to earth. Values are relatively arbitrary, say 10nF and 10kΩ. Any diode will work, after a fashion, even rectifiers of the 1N4001 series, or LEDs. The input voltage needs to exceed 0.6V for a silicon diode such as the 1N4148, but a germanium OA81 or Schottky 1N5711 or the BAT series will have a lower voltage threshold, typically 0.2V, and the unit will be more sensitive. A voltage doubler D2, should also increase the output. Try it! This circuit may be split into three sections, the tuned circuit, the detector and the output. If we imagine each section wrapped around the drums of a fruit machine, so that any combination of the three may be selected, then, pull the handle, figuratively speaking, and build what shows up.

The antenna can be any length, of any size wire, limited only by practicality and the ability to survive the weather, if outdoors. A series capacitor, of any value, which may be variable, but let's say 50pF, will serve to electrically alter the length of the antenna, and make it seem more efficient.

Replacing the earpiece with a meter gives us an absorption wavemeter. Tuned to the approximate frequency, it can help us to roughly determine the frequency of an oscillator, **Fig. 2**.

If we remove the tuned circuit, and take the antenna straight to the diode, we have an aperiodic (untuned) field strength meter. Placed in the vicinity of a transmitter, it will indicate the relative levels of the strongest transmission, and thus form a modulation indicator, **Fig. 3**.



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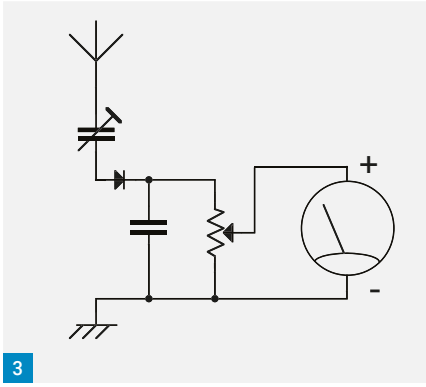

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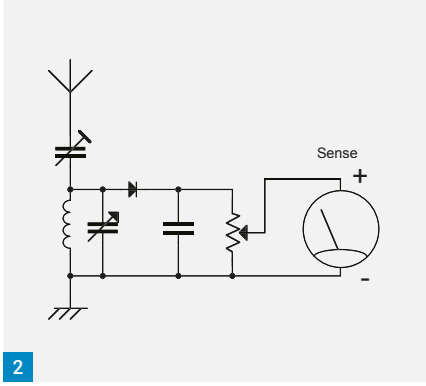

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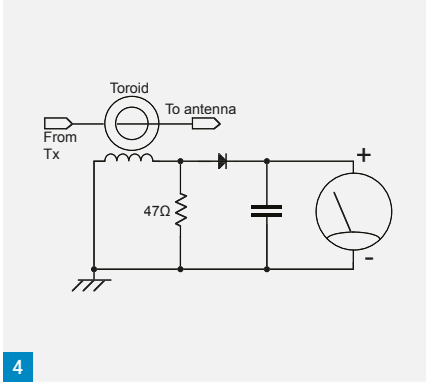

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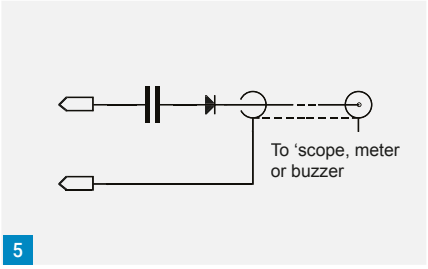
If we pass the signal wire from the transmitter to the antenna through a ferrite ring or toroid such as Amidon FT 50-43, on which is also wound about 20 turns of 22SWG wire, the output from this, developed across 47Ω will produce about 30μA in a 50μA meter with a transmitter of 10W output. This is a useful tool: tune the ATU for maximum on the RF ammeter and no SWR meter is needed. In previous years, thermocouple meters were used, but these are now rare. The thermocouples often burned out and the meter scale was non-linear as well. This, then, is an RF current meter, which can be calibrated, but tuning for maximum will be as good as using an SWR meter, **Fig. 4**.

A passive RF probe, for use with a multimeter or oscilloscope, will detect the presence of RF in a piece of equipment being tested, **Fig. 5**.

The same circuit is used for a simple receiver audio 'S' meter, where the output is across a resistor, maybe variable, such as 10kΩ, to set the readings to a reasonable level, and a meter, the more sensitive the better, from 50μA or more. The meter is not calibrated, but provides a relative indication, **Fig. 6**.

Replace the meter with an LED and suitable resistor, found by measuring the output voltage when connected to the RF output of a transmitter, and isolated by a small capacitor. Or just wire in an LED and see if it lights up. The variable can be adjusted so the LED flashes only on



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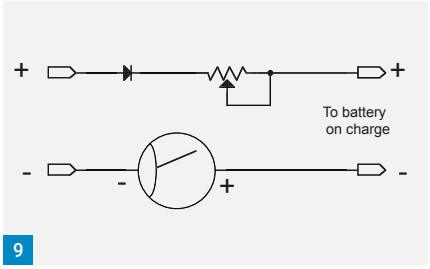

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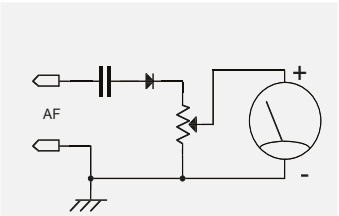

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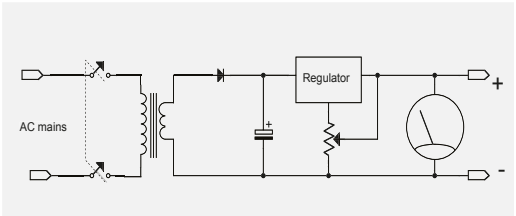

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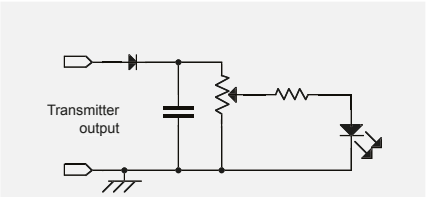

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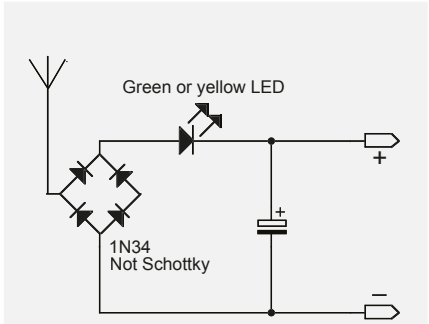

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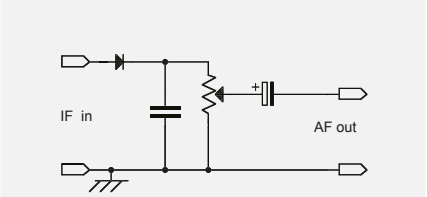

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speech peaks, or 'key down' conditions of a transmitter, thus indicating that it is working, **Fig. 7**.

This basic idea is used in simple AM receivers, to detect modulation and separate it from the RF or IF component, which is discarded. It is also known as an 'envelope detector', **Fig. 8**.

A simple lead acid (including sealed) battery charger is shown, with the essential mains isolating transformer, **Fig. 9**.

This can also be used as a bench power supply, with the addition of a variable voltage regulator, LM317T, and refinements such as a large smoothing capacitor, bridge rectifier, etc, **Fig. 10**.

Free Power?

Take the antenna to a bridge rectifier as in Fig. 9, again using Ge diodes, OA81, etc. Not Schottky diodes, which despite a low 'turn-on' voltage, are leaky when reverse biased.

Fig. 1: Basic crystal set circuit.
Fig. 2: Absorption wavemeter.
Fig. 3: Aperiodic field strength meter.
Fig. 4: RF Ammeter. Fig. 5: Passive RF probe.
Fig. 6: Audio 'S' meter. Fig. 7: Transmitter speech peaks/modulation indicator.
Fig. 8: Receiver envelope detector.
Fig. 9: A simple lead-acid battery charger.
Fig. 10: Basic DC power supply.
Fig. 11: Free power?

A very low leakage is exhibited by the b/e junction of 2N3904, a 1N3595, or even a yellow LED, but they are silicon or other materials with a high turn-on voltage, so a germanium diode it is then, **Fig. 11**. It will develop about 1V at 100µA, if you can find a use for this. I got 10mV with a random wire, 1N34A and 470µF, though it drained away quite quickly when a 20k/V meter on its 250mV range was connected. A large 1MΩ resistor in the output will reduce this tendency and measured with a digital or FET voltmeter. If you are discovered laying out wire loops below electricity pylons, it's nothing to do with me! Perhaps for an amplified crystal set? I think this is where we began...

Continued from page 34

antenna, is not radiating, whereas coax might well be. Coax has the advantage of being unaffected by nearby objects, particularly metal ones, but in practice twin feeder is not affected either if normal care is taken.

All the transceivers on the market seem to have a 50Ω input/output impedance, which is a rather odd, when TV sets have always used 75Ω. For our rigs a 75Ω balanced one would be better, still allowing the use of an RF earth for an antenna setup that needs it. So, when using 75Ω twin feeder, a 50Ω to 75Ω impedance transformation is necessary, and for completeness, a design is included here that is found to be easy to make and efficient in use. It is important to use a ferrite ring with the correct characteristics, and the Fair-Rite HG-FT24031 is suitable, obtainable from Ham Goodies, and no doubt other suppliers. The Scientific Wire Company is a good source for the enamelled wire.

50Ω to 75Ω Impedance Transformer

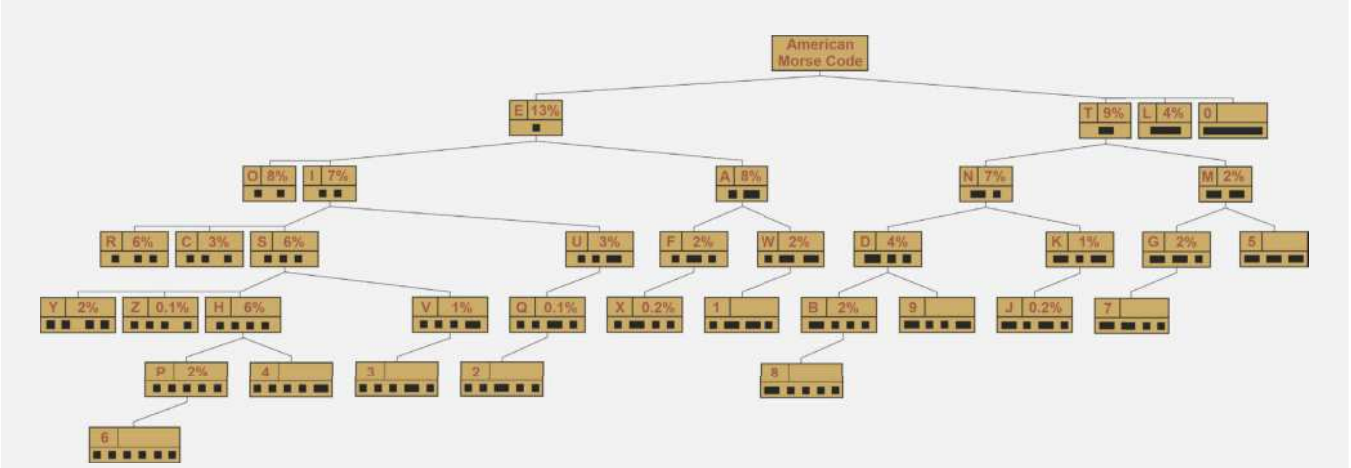
Take five lengths of 18SWG enamelled copper wire about 46cm (18in) long, clean about one cm of the enamel off the ends and tin them. It is probably easiest to use a small Swiss file to remove the enamel. Put small labels near the ends of each wire; light-coloured insulation tape is suitable. Number them 1 and 2 for the first wire, 3 and 4 for the next and so on, the first and last wires having centre taps. Clean a small area off the middle of them, connect short pieces of wire and wrap with a little insulation tape. Then with all the odd numbers at one end, (evens will find themselves at the other end!), twist the wires together a little to get them all in close proximity, not worrying too much about keeping them all in the same relative position. Insulation tape can be wrapped around the bundle to keep the wires close to each other. Pass the bundle through the ferrite ring six times, starting at the centre and working both ways, all in the same spiral direction, and with the tap wires on the outside. Space the bundle evenly but keep all the individual wires as close as possible to each other.

Connect them up as shown in the diagram, using sleeving or other insulation over the joints. The length of the wires from the ferrite is not very important. You now have a very closely wound symmetrical impedance-changing auto-transformer, with a ratio of 5:4. There is a square law around here somewhere:

$(4\pi N^2\mu A/10^9 L$ in cgs units, where N is the number of turns, comes to mind from studies 70 years ago).

$5^2/4^2 = 25/16$ which equals 1.5625 to 1, near to 1.5 to 1, (or 75 to 50) and close enough for all practical purposes.

Disadvantage of 75Ω twin feeder? Often very tough insulation, and hard to strip. But much stronger than coax, easy to join and terminate, and much less likely to give any mechanical failures.



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Mike Bedford G4AEE
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A Surprising Code: Morse Revealed (Part II)

Mike Bedford G4AEE continues his quest to reveal some of the lesser-known facts about Morse Code.

Given that it was developed over 175 years ago, the uninitiated might be tempted to think that Morse Code is by no means sophisticated, and that it might be appropriate to think of it as a 'coarse mode' of communication, if you'll excuse our unashamed and gratuitous use of that spoonerism. The fact it was never even formally acknowledged as an international telegraph alphabet might appear to reinforce that view. The first code to be give that honour was Baudot Code, ITA1, the 5-bit teleprinter code that was a derivative of Baudot. Murray Codes became ITA2 and ASCII, the code that is a subset of Unicode, as used for today's Web traffic, is ITA3. So how does Morse compare to ASCII in terms of bits per character, which is inversely proportional to transmission speed, so could be thought of as a measure of efficiency? ASCII is easy. Although there are 8-bit extensions, it was originally a 7-bit code. For asynchronous transmission, each code has to be preceded by a start bit and followed by a stop bit, so that gives a total of 9 bits. Morse is more difficult because characters differ in their length. If we just consider letters and the inter-word space, the average is pretty much the same as ASCII's 11 bit, but if we add in numbers, that figure rises dramatically to 12.6 bits. When we further bear in mind that 7-bit ASCII has codes for upper and lower case letters, figures, punctuations and more, it's starting to appear that our unflattering spoonerism might not be too far short of the mark, after all. But things aren't quite as they appear.

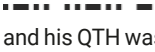
Developed in 1952, Huffman Code is an algorithm for compressing data. It works well with textual data like ASCII and operates by assigning variable length codes to characters depending on how frequently they appear in the data. For English text, it would generally be found that space would be the most common, followed by "E", then "T", "A" and "O", through to "J" and "Z", which are the least common. So, "E" and "T" would be assigned the shortest codes, while "J" and "Z" would be assigned the longest. Perhaps that's ringing a bell. OK, so there are odd exceptions – "O" for example – but this characteristic is true of Morse Code, "E" being a single dit and "T" a single "dah", while the likes of "Q" and "J" have much longer codes. The upshot of all this is that International Morse Code fares a lot better if we consider typical English text, instead of simply averaging all the letters. In particular, for a message containing just letters and spaces, the weighted average is 8.6 bits. OK, so we're not really comparing like with like, because ASCII's 11 bits includes a lot more than just letters and spaces, but it's still an impressive example of how it makes use of a principle that came into being over a century later. And there's more. If we turn our attention to American Morse, **Fig. 1**, that figure for letters and spaces drops right down to 7.3 bits. At that sort of level, we can surely afford a smattering of figures and still come in below that 11 bit figure for ASCII. Perhaps Victorian technology has something to teach us after all.

But even that isn't the end of the story. Like ITA1 and ITA2, ASCII is a binary code; Morse isn't. 7-bit ASCII, therefore, contains all the binary codes from 0000000 to 1111111. This means that there are codes with 0, 1, 2, 3, 4, 5, 6 and 7 successive zeros and the same number of successive ones. Now, I'm going out on a limb here, but I'd be surprised that anyone listening to ASCII at a reasonable speed – in other words, without using a stopwatch – could differentiate between a 6 unit mark and a 7 unit mark, or between a 5 unit space and a 6 unit space. Putting that another way, it rather seems that it would be virtually impossible to read ASCII by ear. By contrast, recognising the difference between Morse's 1 unit and 3 unit mark, or between its 1, 3 or 7 unit space is surely child's play.

The Many Faces of Morse

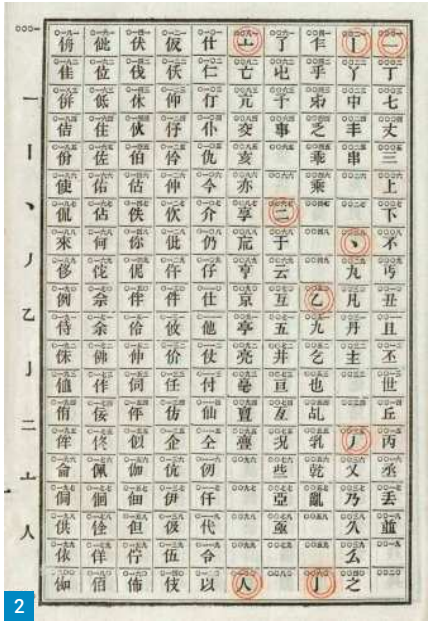
Last month, we discovered three variants of Morse Code, namely International Code, American Code and Cable Code. Here we're going to concentrate on International Code but, even so, it comes in several flavours that those of us living In English speaking countries might not be aware of.

If you were to hear a French operator indicating that his name was:



and his QTH was:

Fig. 1: The original American Morse followed letter frequencies (shown here not including space) better than International Morse code, leading to a higher level of efficiency.
Fig. 2: Just as with this historic code book, today's Chinese Morse Code involves looking up and sending a 4-digit code for each character. (Public domain, from Wikimedia Commons)
Fig. 3: However good your dual paddle keyer, according to some operators you're not using it at its best unless you embrace Ultimatic instead of iambic mode. (thanks Pietro Begali, Begali keys). Fig. 4: Jeremiah Denton altered the world to his plight as a POW in Vietnam in 1966 by blinking the word *"Torture"* in Morse Code. (US National Archives)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you shouldn't just assume that you'd misheard. In fact, those unfamiliar Morse characters represent "É" and "È" respectively, so his name and QTH would be Léo and Sèvres. Identical codes can represent different letters depending on the language, so:

▬ ▬ ▬ ·

could also be the German "Ö", the Norwegian or Danish "Ø", or the Polish "Ó". Their actual interpretation depends on the language, therefore, and in that sense, there are versions of Morse Code for several European languages that are written using the Latin script. The chances are that, as an English speaker, if you were in contact with an operator in France or Germany, they'd assume you didn't know these codes so they wouldn't use them. After all, there's rarely any ambiguity if the nearest English letter was used – for example "E" instead of "É" or "È" – and in German, "Ö" and "Ü" can quite legitimately be replaced by "OE" or "UE" respectively, and "SS" can be used instead of "ß". However, German and French operators have told me that these codes genuinely are used on the amateur bands, and they also spoke of Brazilian operators regularly using the Portuguese code and the Scandinavian countries also using their national variants of International Morse Code.

Even in Europe, though, there are languages that don't use the Latin script. Most notably are Greek, which uses the script of that name, and the languages of several Balkan and former Soviet countries that use the Cyrillic script. It probably comes as no surprise that, in the Morse Codes for these types of script, the codes for the closest Latin letters are used so, for example, the Morse for the Greek letter delta, "Δ", or the Cyrillic letter "Д" is the same as for the Latin letter "D". In fact this also holds true for Middle Eastern scripts so exactly the same Morse symbol that we used for "D" is also used for "د" in Arabic or "ד" in Hebrew, even though efficiency will surely decrease as languages diverge from English in the frequency at which letters occur. However, as we continue our journey east, things get even more interesting.

Where it gets especially interesting is with some Asian languages where the number of letters in the alphabet increases well beyond the number used in English Morse Code, sometimes dramatically so. A classic example is Wabun Morse, which is used for sending messages in Japanese or, to be more accurate, it's used for sending messages in Japanese katakana characters. To westerners it might sound strange, but katakana isn't the only Japanese form of script, and we'll touch on an alternative later. Back to katakana, though, and a major stumbling block is that there are no fewer than 48 characters. Yes, we've seen that some European codes have more than 26 letters and, therefore, need Morse Codes that are unfamiliar to English speakers, but extending the code to 48 characters has a serious implication. In International Morse Code, the longest letters contain four dits and/or dahs (B, C, F, H, J, L, P, Q and V) and, if we count all possible codes with 1, 2, 3 or 4 dits or dahs, 30 characters are catered for. In some of the European codes this results in a few of the extra characters having to be represented by codes containing 5 dits or dahs, for example "É" and "È" in French. In katakana, however, 18 characters, that's 37% of the alphabet, can't be represented by 1, 2, 3 or 4 dits or dahs. The upshot of all those longer characters, of course, is that Wabun Morse Code is more difficult to learn, especially when we bear in mind that Japanese operators are nearly all familiar with International Morse Code too, and will switch between the two with a:

$\overline{\text{DO}}$ (▬ · ▬ · ▬ ▬)

to prefix Wabun content and an:

$\overline{\text{SK}}$ (· · · ▬ · ▬)

to terminate Wabun and continue with International Code. At first sight it might seem that it's less efficient in terms of transmission speed. However, an admittedly superficial review of Japanese katakana words rather suggests that they tend to be shorter than English words so the negative aspect of the longer Morse symbols might be cancelled out.

One of the other Japanese forms of script, which is generally intermixed with kana when writing Japanese, is called kanji. To say that it's different from katakana, or from most forms of western writing for that matter, would be an understatement with significant consequences to Morse Code. Katakana is an alphabet in the sense that each character represents a phonetic sound; kanji isn't. Specifically, kanji characters are so-called logographs, which means that they don't represent sounds but meanings. So simple words are represented by a single kanji character, while more compli-

cated words might be represented by a pair of characters. The upshot of this, of course, is that there are lots of them. It's been estimated that there are up to 50,000 kanji characters, 2,136 are considered necessary for literacy, and most people probably know about four times this number. In Japanese, we can largely ignore this issue when thinking about Morse Code because it's possible – although by no means recommended when writing the language – to represent everything in katakana and therefore send it as Wabon Code. But much the same kanji characters are also used in Chinese, and here there's no katakana to fall back on.

It's not hard to work out how long some Morse symbols would need to be to encode Chinese. There are two symbols with a single dit or dah, four with a combination of two dits and/or dahs, eight for three, and so on. Doing the sums, therefore, we come to the conclusion that to represent 8,000 characters, most of the Morse symbols would comprise a combination of 13 dits and dahs. I think we can probably all agree that would be totally impractical. After all, would you fancy having to remember that the Morse for 键 – the Chinese character for key – is:

-.-.-.--.--.--

plus the codes another several thousand characters? Needless to say, that Morse code is purely fictitious, but it helps drive the point home. We can imagine that Chinese could have been sent by spelling out each character phonetically and sending it using the Morse Code that most of the rest of the world are familiar with. But it would be problematic because the various Chinese languages use essentially the same written characters but words are often pronounced quite differently. The solution actually adopted remained faithful to Chinese culture, in encoding characters directly, but at a cost. Developed in 1872, the method used a code book, **Fig. 2**, in which the telegrapher looked up each character to derive a four decimal digit code that was then transmitted using the International Morse Code for the digits. Given that each page of the code book contained just 20 characters, we can but imagine how long it would take to look up an unfamiliar character.

Dual-Paddle Keyers

Much of what we've delved into so far isn't universally appreciated, even though it's quite fascinating if you like that sort of thing, as we hope you do. It has to be admitted, though, that most of it isn't of any practical value unless, perhaps, you want to give French or German operators a nice surprise by being able to respond using the unique Morse Codes in their languages. However, our last topic, while still containing information that will be new to some of you, does contain a practical element. In particular, you might discover new and better ways of using a dual paddle key, especially if you fancy hacking a bit of code on a Raspberry Pi or Arduino to implement your own keyer. After all, if you only ever use a commercial keyer, you're stuck with the options provided.

Chances are, if you use a dual-paddle key, such as that shown in **Fig. 3**, you use it in conjunction with an iambic keyer. Apparently the word iambic is a poetic term, relating to a rhythm of alternately stressed and unstressed syllables, a clear reference to the alternating dits and dahs that are generated when the two paddles are squeezed together. What you might not know is that there are two flavours of iambic keying, imaginatively known as iambic mode A and iambic mode B. Reputedly, the differentiation came about because of the vagaries of the circuit design in some early keyers. Your keyer probably allows you to switch between the two, but your initial choice might have been largely random and, whatever you chose, you'll no doubt have got used to it. To put the record straight, though, in mode A, when you release both paddles from a squeeze it stops after the dit or dah currently being sent, while in mode B it also adds an extra dit if it was sending a dah, or a dah if it was sending a dit.

Your dual-paddle key doesn't have to be used in iambic mode, though. There is an alternative, which dates back to the early days of electronic keyers. And many operators, on discovering it, report that they prefer it to iambic keying. That alternative is Ultimatic

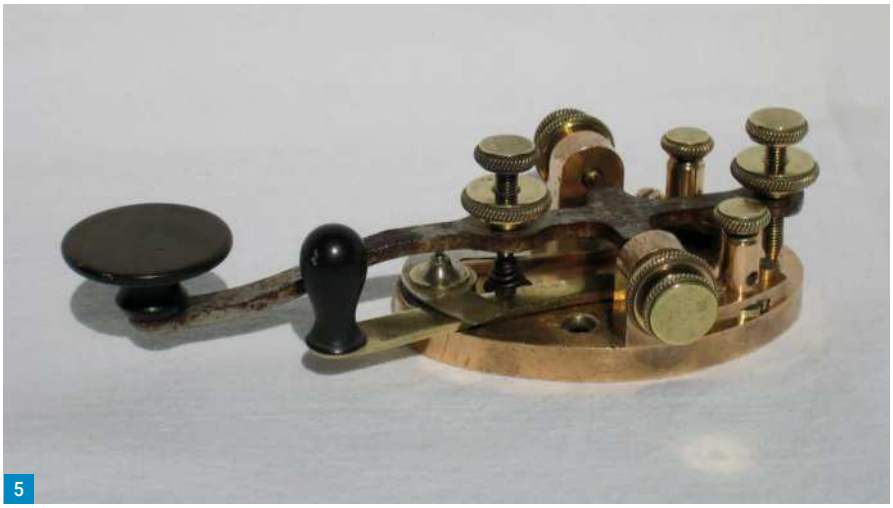
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Fig. 5: In early telegraph networks, unless all keys expect the one transmitting were closed, communication was impossible, hence the lever. (thanks Mark Brundit M6BRN)
Fig. 6: Ever since it was completed in 1956, the Capitol Records Building in Hollywood has transmitted the Morse Code for "Hollywood" from a light on top of its tower each night. (Downtowngal, Wikimedia Commons)

Morse Steganography

As a kid, fascinated with secret messages and codes, I invented a way of sending a message by encoding it as Morse Code and hiding it in a pencil sketch. My first attempt was a drawing of a country scene with, all importantly, a row of stalks of grass in the foreground. And yes, you've probably guessed it, those grass stalks differed in their length to represent dits and dahs. I didn't know it at the time, but this was an example of steganography, hiding a message in another message, image, audio file or the like. It seems I wasn't the only one to have such ideas.

Famously, in 1966, American prisoner of war **Jeremiah A Denton, Jr.** was forced by his Vietnamese captors to take part in a TV interview. On the pretence of being dazzled by the lights, he repeatedly blinked a single word in Morse Code. That word was *"Torture"* and confirmed to US intelligence the plight of their POWs, **Fig. 4**.

In their long running civil war with the FARC militia, in 2010 the Columbian Army started to prepare for the rescue from captivity, of 16 kidnapped soldiers. The plan required a message to be delivered to those soldiers, without the knowledge of their captors. Listening to the radio was one of the few luxuries afforded to the captives and this formed the basis of the plan. A pop song was recorded and secured regular airtime on a Columbian radio station. It contained a cunningly disguised message in Morse Code, telling the captives to be prepared for a rescue attempt, and resulting in all 16 being freed unharmed.

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mode, named after the keyer on which it was introduced, and which has also been called dit/dah insertion mode or similar. The left and right paddles operate in the same way as an iambic keyer, if they're operated alone, but the result of a squeeze is quite different. If you're sending dahs and close the dit paddle, it will send a string of dits for as long as both paddles are closed, reverting to dahs when the dit paddle is released. The converse is also true. At first sight this might not seem to be much different from the operation of a single paddle keyer, but the statistics tell a different story. To send A-Z and 0-9 takes 132 key movements with a straight key, 90 with a semi-automatic bug, 73 with a single paddle automatic key, and 65 with an iambic keyer. In Ultimatic mode, that figure drops to one less than iambic but, according to its advocates, it's so much more intuitive.

So, there are some thing you could try out if you want to turn your hand to a bit of programming, and you can also experiment with options such as auto inter-character, and auto inter-word spacing, which prevent you from leaving illegal gaps such as two or four dit lengths. But if you really fancy something a bit different, how about giving some thought to how to implement American Morse Code – as we discussed in Part 1 of this article – with an electronic keyer. The main difficulty is handling the long and extra-long dahs, unless you want to add a third paddle, that is. There are probably other options but how about abandoning iambic or Ultimatic keying and use a squeeze, while already sending a dah, to increase the length of that dah to four or eight time units, depending on how long you squeeze it for. And don't forget, you'd also need to change the ordinary dah length from the usual three time units to two, as used in this archaic form of Morse Code.

We've already concluded that the moniker 'a Coarse Mode' isn't all appropriate, whatever Morse Code's detractors might believe. Indeed, rather than indicating that it's surely well past its best, our study of efficiency rather indicates that Morse was well ahead of its time when it appeared back in the first half of the 19th century. Indeed, if you need some additional evidence that it's still alive and well, here's something you might not have encountered. As recently as 2009 the world's communications regulatory authority, the ITU, added a new character to Morse Code, the first since the Second World War. That character, as used in e-mail addresses, is the commercial at sign, "@", and its Morse representation is:

▬▬▪▬▪

And with that encouraging bit of news, we'll sign off from our exposé of a surprising code. Here's to the next 176 years then.

Morse Meets SMS

The Morse Code ringtone on old Nokia phones to indicate an incoming SMS (text message) is well known. Less well appreciated is that Android allows you to use Morse Code to enter text. If you want to try it out, this is an option provided by the Gboard keyboard app, but it won't let you select the Morse keyboard unless you select American English as the language. It works like cable code in the sense that it doesn't rely on how long you press the screen for but, instead, the keyboard contains just two large dit and dah areas. Apparently this method of text input is suitable for people with disabilities that would make using a normal keyboard difficult if not impossible.

That Strange Lever

Ever wondered why early Morse keys often had a lever that allowed them to be locked in the closed position, **Fig. 5**? I'd long assumed it was to make it easier to transmit a continuous carrier while tuning a transmitter but reality is more interesting. Those keys were created before the days of radio so were intended for use on a landline, and herein lies the answer. The circuit of a telegraph network involved the keys and sounders of all the stations being connected in series. Only one station could transmit at once and, to allow that, the keys at all the other stations had to be closed. Suddenly that strange lever makes a lot more sense.

The 'No Key' Key

Given the amount of engineering effort that goes into designing and building top-end Morse keys, and the prices they attract, it seems reasonable to believe that if you're a speed merchant, the design of the key is paramount. You might be interested to learn, therefore, that researchers at the Auckland University of Technology in New Zealand have eliminated the finer points of mechanical design by developing the 'no key' Morse Key. Instead of a key, their technique involves analysing a CCTV data stream to determine the textual relating to the finger movements of using a non-existent key. As of 2017, though, accuracy was only 84%. Perhaps better not bin that key just yet then.

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

Normal Life

Roger Cooke G3LDI has his usual selection of Morse-related topics.

Roger Cooke G3LDI
roger@g3ldi.co.uk

Same heading as in the February column, but I have now had my first jab! It was the AstraZeneca one (you don't get a choice!) and I must admit that I did suffer slightly with this one. You know the sort of thing, man-flu symptoms, aches and pains, but the worst one was feeling sick for about 3-4 hours. It all passed and I am still here to tell the tale, so hey-ho, looking forward to the second one in April. Normal life has still not returned, however, but then again Lockdown is normal to me.

I rarely go out, I am not a pub person, and living alone, I would not even consider going out for a meal, to the cinema or any other place. Our local club, the Norfolk ARC does not meet, but we do have NARC live each week and as programme secretary I have arranged for some very nice talks on a Wednesday evening. Our club chairman does a very professional job with presentation, so take a look and see what you think. It's on Facebook and also streamed on the BATC site, which is where I watch it.

Learning Morse in Lockdown

One thing about being in Lockdown is that few people can complain about a lack of time to do any practice! I have been teaching Morse since I was licensed, in 1956, and believe me, I have heard all the excuses you can come up with for not doing the practice, except possibly the dog ate my Morse key!

Here in Norfolk, we have six classes per week, different methods, different speeds and five different tutors. We have done well over the years in encouraging CW operators and also getting more interested in taking part in contests, activity periods, and so on. One tutor you may know of is the TV Weatherman, **Jim Bacon G3YLA**, who has also produced a very useful website called Propquest:

www.propquest.co.uk

This is very useful for looking at the FoF2 before the RSGB CC contest. Jim is known as the Good Cop as he is like your friendly Psychologist in his approach to his students. I am known as the Bad Cop, not taking excuses lightly and not too liberal with praise, just enough to be tolerated! It's all a bit of fun really but it does help to produce results.

Practice

There are various ways of practising. This applies to Morse Code just as well as learning piano or any musical instrument. There is no substitute for practice, so live with it and get on with it! How much time you devote to practising is up to you, the person who has to practise. If you really want the end result and you crave that ability, you will devote as much time as you can each day.

Sure, you can find an excuse for whatever time of day:

Applies to morning (too early), afternoon (I need a nap), and evening (too late).

Then there is *"I practised for 20 minutes one day last week"*. Wow! You really do want it then!

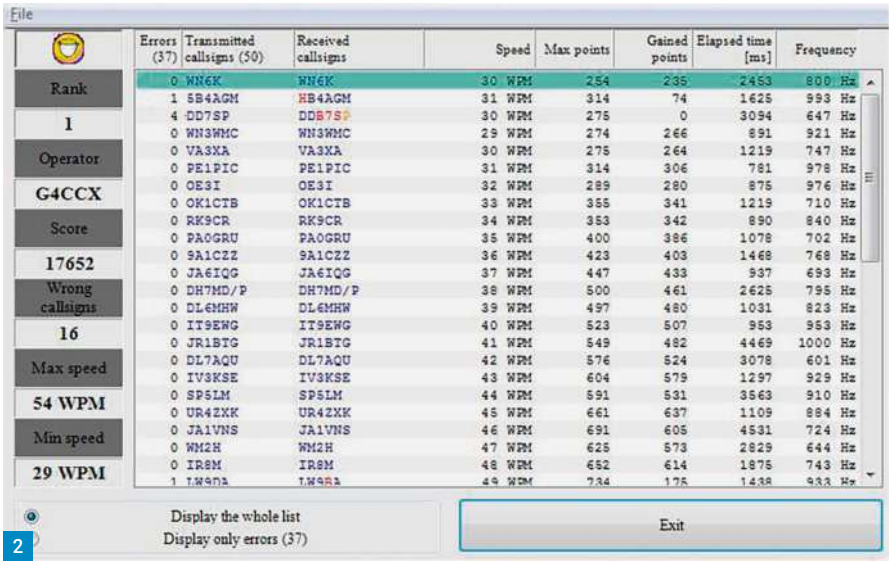
"I had to do some work last week". For 12 hours every day?

"The kids were playing up". All week?

"I was ill on Tuesday". Did it take the rest of the week to recover?

"I just couldn't bring myself to settle into

1



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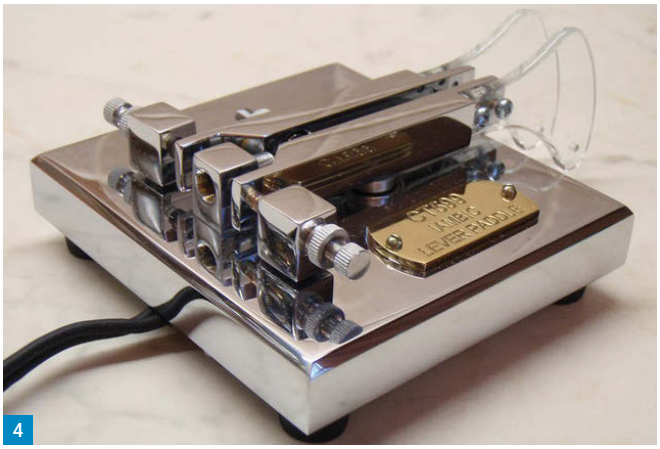

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Fig. 1: G4LPP achieves 54wpm with the RufzXP software. Fig. 2: And G4CCX achieves the same. Fig. 3: The 'Christmas' paddle from RA1AOM. Fig. 4: W4PM's key from UR5CDX.

practice". Grow up!

"It just doesn't sink in". It won't! That's the idea of doing the practice every day for at least 30 minutes every day!

You get the idea. No matter what excuse is used it means you probably should not bother at all.

We do run friendly competition with RufzXP (website below). **Phil G4LPP** has set the standard for this program so far and I hope to run a table in our Newsletter so others can take part. Phil sent me a screenshot of his latest success, **Fig. 1**. **Chris G4CCX** also had an attempt and his screenshot is in **Fig. 2**. Interestingly enough both Phil and Chris were students of mine only three years ago. Just shows what can be achieved with practice!

www.rufzxp.net

Paddles Online

You may remember me featuring keys made by **Valery RA1AOM** in my column last year. Valery makes extremely nice paddles, featuring stone bases and paddles with no springs, but neodymium magnets. Well Valery sent me a picture of one he made for Christmas with a small addition on the top. I thought that was neat so have a look in **Fig. 3**.

Meanwhile, **Puck W4PM** found a nice key from **Yuri UR5CDX**. He also has an interesting range of keys available. As you know a dedicated CW operator never has enough keys so Puck ordered the CT599MX. Puck says: *"The order was placed on January 13th, key was shipped on January 15th and received on February 2nd! The packing was outstanding. I believe an elephant could sit on it and not damage the key inside. The key is very nice looking as well as very good performing. It holds its own against my Begali, Mercury, Vibroplex and Bencher iambic keys. It is also very reasonably priced."* It is shown in **Fig. 4**. And here is a link to Yuri's website:

https://tinyurl.com/2s3exu77

There are a surprising number of reasonably priced keys for sale on there.

I saw a quote regarding Morse keys which I thought quite funny. Morse keys to amateurs are like shoes to **Imelda Marcos**.

I am not sure how Brexit will affect purchasing from abroad but I guess there is only one way for prices to go anyway when governments are involved.

Norfolk ARC CW Net

Every Monday evening, contest nights excepted, Norfolk ARC hold a CW net on 3545 +/- occupancy. We normally have around nine, sometimes ten stations in the net, so overs have to be short.

Are there other nets of this size running at all? I have heard nothing so can only assume there are none or if there are, the participants don't read this column! The other thing I would like to know is what procedures do you adopt? We don't use net procedures. I see some groups in the USA are using procedural codes such as QNI, QNN, and such. I am just wondering if we should both learn and adopt those Q codes into our nets. I can see the advantages and appreciate the reasons for doing so, but I have never heard those being used in the UK. Mind you I have not heard that many nets in the UK either.

It's all part of being a good CW operator after all, and far better than concentrating on sending 5nn 73 to all and sundry. I did expect to hear from **Gerald G3MCK** regarding the procedural signals, knowing how particular he is!

We also run a straight key night on the last Monday of the month. So, if you want do some straight key practice, feel free to join us, propagation allowing.

Morse Code Could Save Your Marriage!

Mina Miller, **Thomas Edison's** wife, was no stranger to technology and inventions. Her father was actually a millionaire inventor himself. After meeting through a mutual connection's home, Edison taught Mina Morse code, a relatively new technology at the time. The reason? Mina was one of 11 children. Conversing in Morse code gave the couple an easy way to communicate in secret – even in plain sight!

Edison claimed Morse code was how he actually proposed to Mina and lucky for him, she said −•−− • ••• The happy twosome tied the knot on February 24th, 1886 and were together until Edison's death in 1931.

73 and May the Morse be with you.
Roger G3LDI.

The Story from Bonaire

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

Steve Telenius-Lowe PJ4DX reports from his island QTH, but with plenty of HF news from readers around the world.

In last month's *HF Highlights* I commented that as we are at the start of a new solar cycle, it would be a good time to start making contacts on 10m in order to qualify for the IARU Region 1 28MHz Award. This RSGB certificate requires confirmed contacts using only the 28MHz band with amateurs in 40, 60 or all 99 countries of IARU Region 1. RSGB Awards Manager **Lindsay Pennell G8PMA** has now sent in an example of this award, **Fig. 1**, and full details of the RSGB HF awards programme can be found at: tinyurl.com/vuxe3r5

Unfortunately, propagation on 28MHz (and 24MHz) remained generally poor in January and February, although some of our correspondents reported making a few contacts on both of those bands. The current poor conditions are reflected by the continued low sunspot numbers and solar flux. The sunspot number has often been at 0 while the solar flux has stubbornly remained in the low 70s for more than a month at the time of writing in mid-February. I think we all became a little over-excited (myself included) at the prospect of a quick improvement in propagation when the solar flux peaked at 116 at the end of November last year, but it was not to be. Nevertheless, the trend shown in **Table 1** should be upwards over the medium to long term, the only question being when that process will resume.

News from Bonaire

My wife, **Eva Telenius-Lowe PJ4EVA**, has qualified for DXCC on digital modes just over two months after starting to operate on FT8 and FT4, with 102 entities (and counting) confirmed on Logbook of The World (LoTW). Her QSL cards, **Fig. 2**, have now been printed and will be available from our QSL manager, **Tim Beaumont M0URX**. Eva has been very active on 7 and 14MHz, and I thought it would be interesting for readers to see (in 'Around the Bands', below) what is being worked from this side of the Atlantic on FT8/FT4. Eva uses an Icom IC-7300 to a Spiderbeam with three elements on 20m and a 40m inverted-V dipole.

After a period of inactivity, **Peter de Graaf PJ4NX** is back on the air with a new IC-7300. He is also mainly active on FT8 and FT4, using the DX Commander multiband vertical that was reviewed in the August 2020 issue of *PW*. After being back on the air for less than a month, Peter had already made over 2000 digimode contacts.

	Feb '21	Jan '21	Dec '20	Nov '20	Oct '20	Difference
SFI:	72	73	81	86	73	(–1)
SN:	0	0	11	27	26	(±0)

Table 1: Solar Flux Index and Sunspot Number on February 11th compared with previous months.

Those wanting a phone contact with Bonaire should look out for **Bert van Oort PJ4KY**, **Fig. 3**, who is active on SSB and I am planning activity in the CQ WPX SSB contest on March 27/28th.

Readers' News

First on parade this month is our man on the Rock, **Kevin Hewitt ZB2GI**, who wrote to say that *"Gibraltar went into lockdown on January 2nd. Exercise is still allowed and walking up the Rock is the best place to avoid people although operating portable up the Rock is not possible... 10m FT8 was open on January 12th and 26th and 12m FT8 was open on the 31st."*

The New Year celebrations of **Victor Brand G3JNB** were marred when the output of his Yaesu FT-818 dropped to a solitary watt. *"I tested it thoroughly but to no avail. However, having the rig checked professionally served to thwart 'Murphy's' dastardly plot. Absolutely nothing was wrong with it! Very relieved, but did I hear the faint echo of his vicious chuckle? During the Yaesu's short absence, my venerable Heathkit HW8* (**Fig. 4**) *allowed me to just potter around working EU. Running just one watt to my 10m vertical on 40m E73AA reported 'You are blasting in Victor!' On the 11th, I reinstalled the FT-818 and tested successfully on 20m with EW8O. Conditions deteriorated mid-month due to a CME but I still heard **Tony ZL2AGY** for the first time since 2017. Special calls worked on 40m CW included SQ0MORSE, OZ2HOPE, SN0LEWIN and 7X3WPL of the Sahara DX Club (also on 20m). Mali's TZ4AM on 30m and NY2PO on both 40 and17m were reasonable DX QSOs but the best contact, despite vicious QSB, was with **Sal C31CT** in Andorra on topband!*

*"Meanwhile, I realised that I had rather overdone my move to 'QRP only' with respect to my fishing rod 17m and 30m verticals. Lengthy, 30-year old coax is buried beneath the lawn, now with substantial losses, and I may have a problem working DX with the remaining watts. To gain an extra S-point on these bands, a small amplifier and matching control system, based on the popular QRP Labs kit, has been expertly built for me by my good friend **Ken Maxted GM4JMU**. This provides me with from 1 to 18 watts depending on drive applied. However, my multiband, 10m SOTA pole vertical remains dedicated to pure QRP... for now.*

"That FT-818 power loss problem? Actually, I had popped the rectifier diode of the test meter itself. You just can't win 'em all!"

John Rowlands MW1CFN reports that *"2021 began with quite modest activity on 12m and 15m, out as far as the Middle East and central Russia. But 12m activity subsided significantly until January 12th, which saw a very busy day across Europe and out to the US following a day-long geomagnetic disturbance to G2 levels the preceding day. With the sun then tending towards laziness, a 12m hiatus followed from January 14th onwards, where 15m picked up the slack, with SNR of FT8 in positive territory, out into mid-west US and South America on most days. Another moderate geomagnetic disturbance to G1 levels on January 24th created good propagation on 12m the following day, out to the west coast US and South America. 9J2BS (Zambia) made regular appearances on 12m during the period. February 1st saw excellent 12m conditions, with 4S6RSP (Sri Lanka) being logged by a very early 0834UTC. Another excellent period followed over the next two days, with strong 12m propagation out across the whole US. There were no significant geomagnetic disturbances preceding these events."*

Tony Usher G4HZW had *"little in the way of operating during the current period,*

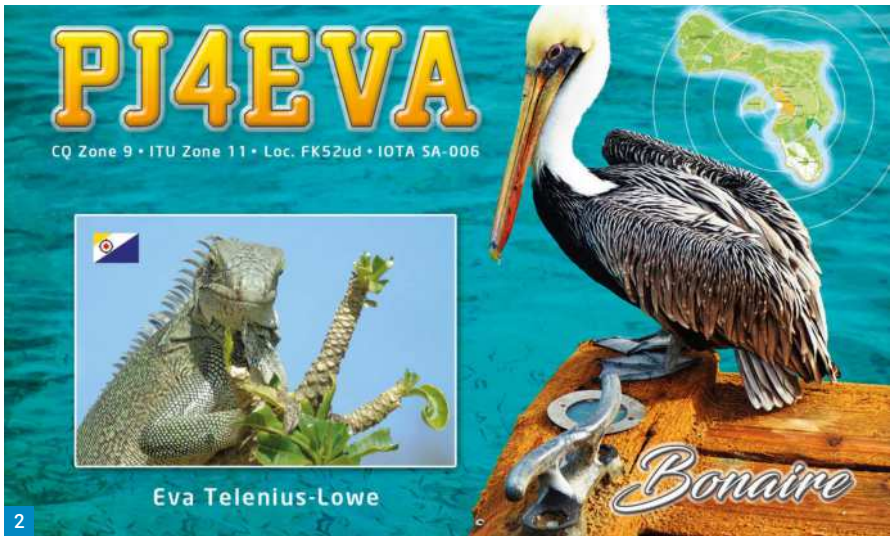

Fig. 1: The IARU Region 1 28MHz certificate awarded by the RSGB.
Fig. 2: The new QSL card of Eva PJ4EVA.
Fig. 3: The station of Bert PJ4KY is inspected by some of the local inhabitants.

although JAs and ZL on 7MHz were encouraging. On 28MHz plenty of winter Es and a little DX: two ZS stations on Friday 5th... The Facebook group '10 Metre UK Net' has organised a weekly activity period, every Sunday 10.00am to noon with 28.400 to 28.450 the recommended spot on the dial. So, I fired up the Kenwood TS-830 and enjoyed a few SSB QSOs. It was my first time on during one of these periods and although I had four QSOs the general consensus was that conditions were flat and had been better the previous week."
On FT8 and FT4 Tony uses a Yaesu FT-450 running 50W into a 4-element Sirio Yagi at 40ft on 28MHz and the same rig and power into a ground-mounted, helically-wound vertical plus 16 buried radials on 7MHz.

My *World of VHF PW* colleague **Tim Kirby GW4VXE** surprised me with an HF report! He wrote, *"Having a bit more space to play with here* [since moving from England – *Ed*] *I have been spending a little time on the HF bands, as something a little different to VHF. I recently renovated my 35-year old Butternut HF6V vertical, with the help of some spare parts from DX Engineering in the USA. I have put it up on the edge of the field and have been gradually adding radials. It seems to be working well on 3.5, 7, 10 and 14MHz. I've a little work to do on some of the other bands, but I'm sure it will get there. Predominantly I have been operating on FT8, although I take part in the CWops CWT activity periods each Wednesday, which are good fun if you like CW. Two very interesting callsigns seen on 7MHz FT8 but not yet worked are PJ4DX and PJ4EVA! I think I've seen you on 10MHz too, in the evening here. To my delight, the 3.5MHz FT8 signal has reached ZL for the last couple of mornings and on 7 and 10MHz in the evening I'm always pleased to be heard at DP0GVN in Antarctica."* Tim added that he's *"not terribly into DX chasing these days – just happy to make QSOs wherever and whenever"*, but anyway sent a list of some of his highlights.

Owen Williams G0PHY sent in a report *"from a cold Biggleswade. There was not much activity here this month. The last RSGB Hope QSO Party saw a lot of European QSOs on 7MHz; apart from that there was some DX activity on 14MHz and a solitary contact on 18MHz. At the end of last year we had a tree surgeon carry out some pruning on an ash tree in our garden and I have been trying to find ways of getting a couple of lines into the tree to significantly raise the height of my dipoles and improve the performance of the vertical."*

Carl Gorse 2E0HPI wrote that January had been *"one of those months with the pandemic, with most portable activities on hold but with my Yaesu FT-817 and the Elecraft AX1 antenna mounted on to the BNC socket of the radio and a nice spot on the beach with no-one around* (**Fig. 5**) *I did manage to get out once... I have been making a loft antenna with quarter-wave lengths of wire for 40/30/20/17m and running a little more power of 30W from home with the Yaesu FT-450D, mainly FT4/FT8 modes and some PSK. Managed to get G3XTT on FT8! I'm quite happy operating from home at the moment and it's much safer. We have currently suspended all GxFF/WWFF at the moment until it's safe to proceed within current government guidelines."*

Etienne Vrebos OS8D wrote from Belgium to say that he now mainly uses his original callsign, ON8DN, only on VHF *"as people on VHF are not used to understand*

Fig. 4: Heathkit's 1970s HW8 is still a delight to operate, says Victor G3JNB.
Fig. 5: The Elecraft AX1 antenna on the North Sea coast at 2E0HPI/P.
Fig. 6: In you look carefully you can just see the Hexbeam of Etienne OS8D camouflaged among the trees in a snowy Brussels.

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short callsigns such as OS8D, even not in Belgium." He made 250 SSB QSOs during the month using a Hexbeam on HF, **Fig. 6**, and HyEndFed antennas for 40m and 80m. *"The last weeks I called CQ a lot on 40m and was pleased to work and talk to many new operators, especially from G, GW, GM and GI. I'm sure they could call CQ themselves but are too shy, and they answered with their 5W or 10W and sometimes indoor antennas. I'm really happy and honoured, it sometimes was their first contact outside the UK. It gives me a good feeling, and they always are surprised I want to talk a lot with them, not only a 59. I ask them what they use and so on... We have to do that more often, they made the effort to get a licence and they deserve some respect and talking to them is good for our future of all of us.*

"Regarding DX, only a little activity as you can see, but my activity is actually here in Europe with Germany and UK on 40m, it allows me to keep a good level of knowledge of my German and English."

Around the Bands

Eva PJ4EVA: 7MHz FT8: 3A2DS, 7Z1IS, 9G5FI, 9J2BS, 9M2TO, A65DR, FM4RU, HH2MK, J3/WA2DE, J73ESL, P41E, PJ7FM, T6AA, UN9GA, YF8ABL, ZF2BL, ZL1BD, ZS6RHL. **7MHz FT4**: ZA/IW2JDP. **14MHz FT8:** EK3GM, HB0WR, HI3AA, S79KW, TI5GAX, V51WH, VK4ABW, VP2ETE. **14MHz FT4:** J69DS.

Kevin ZB2GI: 5MHz FT8: 4Z1DZ, 5B4AIF, A45XR, C31LK, TA1L. **7MHz FT8:** BG2AUE, W3RVD. **14MHz SSB:** 5B4AIX, EA6PT, VE6CQ. **18MHz FT8:** 5P1KZX, HF7X. **21MHz FT8:** AD8FD, AK3V, KK9V, N1JP, N2QLT, N4TZ, N5OK, PP5EI, PU5KGB, RV9CX, UA9XL, VE3JWH. **24MHz FT8:** 5B4AAB, OD5KU, TF1OL. **28MHz FT8:** 5B4ALJ, CQ0ODX, EA8AE, PY6HD, RA2FL, TM21HNY, ZS6NJ.

Tony G4HZW: 7MHz FT8: JE1GAP, JH5RPL, N1UL, WM0L, ZL3IO. **7MHz FT4:** PS8CW, W2CG. **28MHz FT8:** 9K2HS, 9Y4D, KG4ERR, LU7IAC, TF1EIN, VE1ZA, W4HG, ZS6HBE, ZS6LKF.

Tim GW4VXE: 3.5MHz FT8: 5B4AMM, C31MF, NP4G, OY1R, V31MA. **7MHz FT8:** CU3AT, EA8AT, EA9QD, ZA/IN3PPH, ZB2GI. **10MHz FT8:** 4K1AZI, A45XR, CN8AM, CX2AQ, HI8JSG, J73WA, JF8QNF, LU2VH, NP3DM, PY2GG, PY4WL, T77C, TF2MSN, TF5B, YB1HK, YV5ZV, ZA/IN3PPH, ZB2CM.

Owen G0PHY: 14MHz SSB: C4W, NS1DX, RO98AE, VE9FI. **18MHz SSB:** CN8ZG.

Carl 2E0HPI/P: 7MHz FT8: GB75ISWL, GD0TEP, OE100GTU. **10MHz FT8:** TF5B. **14MHz SSB:** ES3/LY3X (ESFF-0144), SV2RUJ/P (SV/TL-085), EA8RM, TK4TH. **18MHz FT8:** RN5AA.

Etienne OS8D: 14MHz SSB: 4L6DL, 9Z4FE, EP3SMH, FM8QR, FP5CJ, HP1DSD, JL1MWY, JY5MM, LU3MO, V31MA, VK5KI, VP9IN, VP9IV, VP9KD, YC9BHJ, YN7ZTR, ZA1E, Z81B. **18MHz SSB:** 4L1WW, CO8LY, PY2JY, TI2CC, VK2BY. **21MHz SSB:** CE6CGX, YC9MX.

Signing Off

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

RX888 Update and More

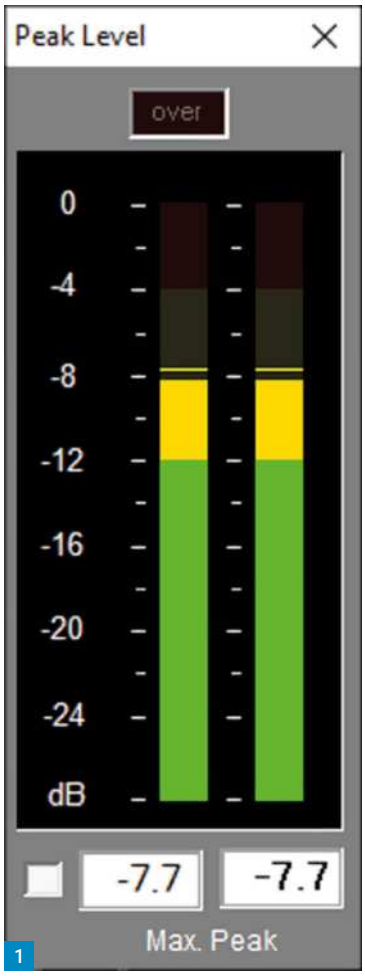
Mike Richards G4WNC has updates on the RX888, WSJT and the Raspberry Pi.

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk

I mentioned the new RX888 receiver a few months ago and it has attracted lots of interest from the SDR community. The RX888 is the first ready-built receiver that delivers raw 16-bit data samples from the ADC (Analogue-to-Digital Converter) directly to the PC. Most of the previous generation of SDR designs employed an FPGA (Field Programmable Gate Array) to down-sample the raw data from the ADC and provide a more easily manageable data stream to the PC. However, the widespread provision of USB3 connections on modern computers gives us PCs that can handle the raw ADC data. The immediate benefit is a simplification of the SDR hardware and removal of the expensive FPGA. By providing a raw data stream to the PC, all subsequent processing is under software control so is easy to update and add new features.

The commercially available receivers in this range began with the RX666 which was followed up with the RX888. These designs use LTC-2208 ADCs that are capable of sampling a 64MHz bandwidth with a 16-bit samples. In addition to providing a direct sampling ability to 64MHz, the RX888 included an R820T tuner to extend the coverage to 1.7GHz but with a limited bandwidth of around 10MHz.

Following the success of the RX888, a Mark II version is now available. This follows the same basic design but has been refined following feedback from users. The new model has a more flexible HF front-end with a 0-31.5dB adjustable attenuator. The fixed gain buffer amplifier for the ADC has also been replaced with a variable gain amplifier with a range of −10dB to +33dB. The combination of these new devices provides an RF adjustment range of −41.5dB to +33dB for HF and 0dB to 55dB for VHF/UHF. This should be sufficient for just about any use. Other changes in the MkII include replacing the R820T tuner with the newer R828D, an enhanced 64MHz lowpass filter to improve image rejection. There is also the facility to use an external reference clock, but you would need to add your own socket. The new receiver is well supported by software, including HDSDR and SDR-Console. At the time of writing the receiver is available on eBay and AliExpress at around £175. I should have mine by the next issue, and be able to provide a performance report.



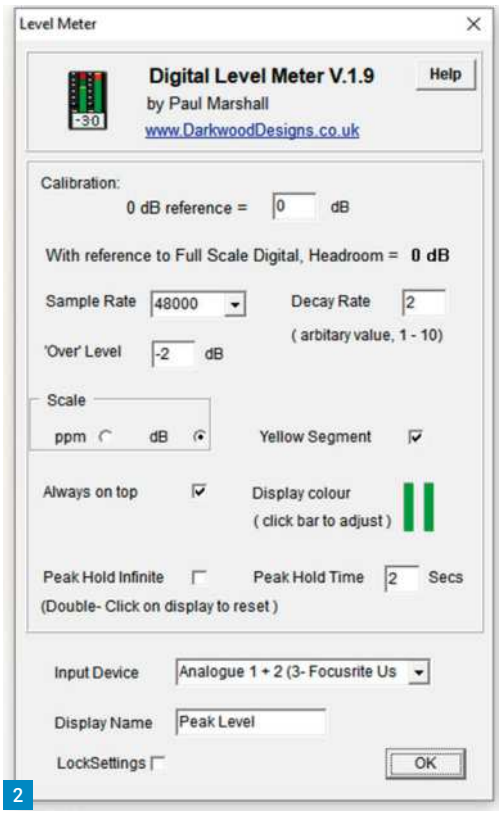


Fig. 1: Digital VU meter for monitoring audio levels. Fig. 2: Config panel for the Digital VU meter. Fig. 3: Linux PulseAudio VU Meter for the Raspberry Pi and other Linux based systems. Fig. 4: The new Raspberry Pi Pico microcontroller board. Fig. 5: Pimoroni's versatile Pico Explorer board with a Pico installed.

Audio Levels

Having dealt with many queries from new Data Modes users, a common problem area is getting the audio levels right and particularly avoiding overload. Let's look at an audio tool that can be used to check the system. The main requirement is an independent level meter that can show you what level is being applied to an input. For example, if you have an analogue rig that's connected to your computer soundcard, you need to know that it's not being overloaded. You could use a digital multimeter with an AC millivolt scale to make a measurement. However, you probably won't know what level the soundcard can handle, so that could be a blind alley. A far better solution is to measure the digitised levels that the soundcard is generating from the input signal. That way we're measuring inside the PC and should be able to clearly see if the signal is limiting. This solution also works well for rigs that have built-in soundcards or are full-blown SDRs. There are many level meter programs out there, but one that I recommend is the Digital Level Meter by **Paul Marshall**. You can find it here: https://tinyurl.com/mw4e49ea

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

This is a straightforward level meter that's very light on computer resources but works extremely well. The meter is completely free but, if you like it, I recommend donating to encourage the author. As you can see from **Fig. 1**, the meter uses a simple barograph display where 0dB represents the maximum or full-scale output from the soundcard. To access the meter's configuration, you right-click on the meter to reveal the panel shown in **Fig. 2**. Towards the bottom of this panel you will see the Input Device selection where you can use the drop-down menu to select the appropriate soundcard. Immediately below this is a box where you can set a custom name for the meter. In the main part of the configuration panel, the default settings are usually about right, but there are a few things you may want to trim. It's useful to have the meter on top of any other open windows and you do that by ticking the 'Always on top' option. In normal use, the meter shows a peak-signal line that has a hold time of two seconds. By ticking 'Peak Hold infinite' the peak indicator will always show the highest peak. This can be reset by double-clicking on the display. Another especially useful indicator is the peak indicator levels at the bottom of the display. These normally show the live peak signal levels. However, if you click the small button to the left of the indicators, it will switch to maximum peak and will store and hold the highest peak level.

If, like many, you have a Raspberry Pi based Data Modes terminal, the simplest solution is to install the PulseAudio VU Meter, **Fig. 3**. This is a free, lightweight application that provides a simple level meter for the Pi. To install it, open a terminal session (Ctl-Alt-T) and enter:

sudo apt install -y pavumeter

This installs two audio meters, one for capture and the other for playback. You access the meters via the Pi menu then Sound & Video - PulseAudio Volume Meter (Capture). I've tried this meter with the popular data modes software and a level of between ⅓ and ½ scale is about optimum. The PulseAudio VU meter is configured to monitor whichever sound device is set as the default.

WSJT-X 2.3

This month sees a bumper release from the **Joe Taylor K1JT's** WSJT-X team. The first is the public release of WSJT-X 2.3. This has been in development for a while and represents the release of the final version, so this is a good time to upgrade. The headline news with v2.3 is the introduction of two new modes, FST4 and FST4W. These have been designed specifically for use on the LF and MF bands where they can take advantage of the lower doppler spreads. The sensitivities of these modes are better than previous WSJT-X modes with similar sequence lengths and achieve close to the theoretical limits. Of the two new modes, FST4 is a two-way QSO mode with a payload of 77 bits in the same format as FT8/4, so employs highly structured messages. One significant operating difference is the sequence lengths that can range from 15 to 1800 seconds. The mode is indicated using the name plus sequence length so, for example, FST4-60 for a 60-second sequence length. The second new mode FST4W is similar to FST4 but has been designed to operate as a beacon mode that will replace WSPR in the LF and MF bands. FST4W uses sequence lengths of 120, 300, 900 or 1800 with a reduced payload of 50-bits to carry WSPR-like messages.

The WSJT-X team are recommending that FST4 should replace JT9 for two-way QSOs and FSTW4 should replace WSPR for propagation sounding on the LF and MF bands. The new modes have already been added to PSK Reporter and the WSPRnet site, so these are the best places to check for activity. Once you've upgraded to WSJT-X v2.3.0, you need to transfer the new operating frequencies to drop-down menu. Here's how to do that:

Open WSJT-X

Go to the File menu and choose Settings - Frequency

Right-click on the Working Frequencies table and click Reset

That will update all the working frequencies and add frequencies for the new modes.

WSJT-X 2.3 Raspberry Pi Upgrade

Previous WSJT-X releases have been easy to upgrade on the Pi, but the new version makes a change in the dependencies, so we need to install a few packages before upgrade. Here's a step-by-step process to complete the upgrade:

Open a terminal session (Ctl-Alt-T)

Begin by updating the operating system: sudo apt update && sudo apt upgrade -y

Next, we need to add a new locale as follows: sudo dpkg-reconfigure locals

In the window that opens scroll down to en_US.UTF-8 and press the spacebar to select it. You should see an asterisk appear.

Tab to OK and press Enter, then Enter again

When the locale installation finishes, enter the lines below to install the dependencies

sudo apt install libgfortran5

4

5

libqt5widgets5 libqt5network5 \
libqt5printsupport5 libqt5multimedia5-plugins libqt5serialport5 \
libqt5sql5-sqlite libfftw3-single3 libgomp1 libboost-all-dev \
libusb-1.0-0

Open a browser and navigate to the WSJT-X site and download: wsjtx_2.3.0_armhf.deb

The final step is to install the new version over your existing installation with the following:

sudo dpkg -i ~/Downloads/wsjtx_2.3.0_armhf.deb

That's it, you should have the new version installed and working.

WSJT-X v2.4.0 RC1

Although launched at the same time as WSJT-X v2.3, WSJT-X v2.4.0 RC1 is the first release candidate for testing that includes a new mode for fast fading signals such as tropospheric, rain and ionospheric scatter along with EME from VHF up. The user message format is the same as FT8/4, but it employs 65-tone FSK (Frequency Shift Keying) with a unique tone for time and frequency synchronisation. During testing, Q65 has proven to be remarkably effective for 6m ionospheric scatter, achieving regular communications over long distances when the band is 'dead'. The Q65 mode has a several permutations of transmit/receive period and tone spacing. These are indicated by a number and letter after the mode name, so that Q65-15A would be 15 second period with 6.67Hz spacing. I've shown the sub-mode options in **Table 1**.

Period (s)	Tone Spacing				
	A	B	C	D	E
15	6.67	13.33	26.67	n/a	n/a
30	3.33	6.67	13.33	26.67	n/a
60	1.567	3.33	6.67	13.3	26.67
120	0.75	1.5	3	6	12
300	0.29	0.58	1.16	2.31	4.63

Table 1 -WSJT-X Q65 sub-modes

Raspberry Pi Pico

Last, but not least, is the launch of the all-new Raspberry Pi Pico microcontroller board. As usual from the Pi Foundation, they have rocked the market with this new board. At the heart of the unit is their own, custom-designed, microcontroller chip, the RP2040. This is a dual-core ARM Cortex M0+ processor that can run at up to 133MHz. The Pico is the first of many boards that will feature the RP2040. The Pico model includes 264kB of SRAM and 2MB of on-board Flash memory along with 40-pins of inputs/outputs, including all the popular communications protocols. There are also three 12-bit ADC inputs to interface with the analogue world. For hobbyists, it's a great addition to the range and costs a mere £3.80! The simplest way to get programming with the Pi Pico is to use MicroPython and there are lots of examples and add-on boards appearing on the market.

I've shown the new Pico in **Fig. 4**. In **Fig. 5** you can see the versatile Pico Explorer board from Pimoroni. I'm currently working on a Pico version of my popular power meter and will release the details here when it's complete.

Afraid of SMDs, don't be!

Michael Jones GW7BBY has hints and tips on SMD construction.

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Surface Mount Devices (SMDs) have been around now for a few decades. They are gradually replacing leaded, wire-ended or through-hole components in many applications, **Fig. 1**.

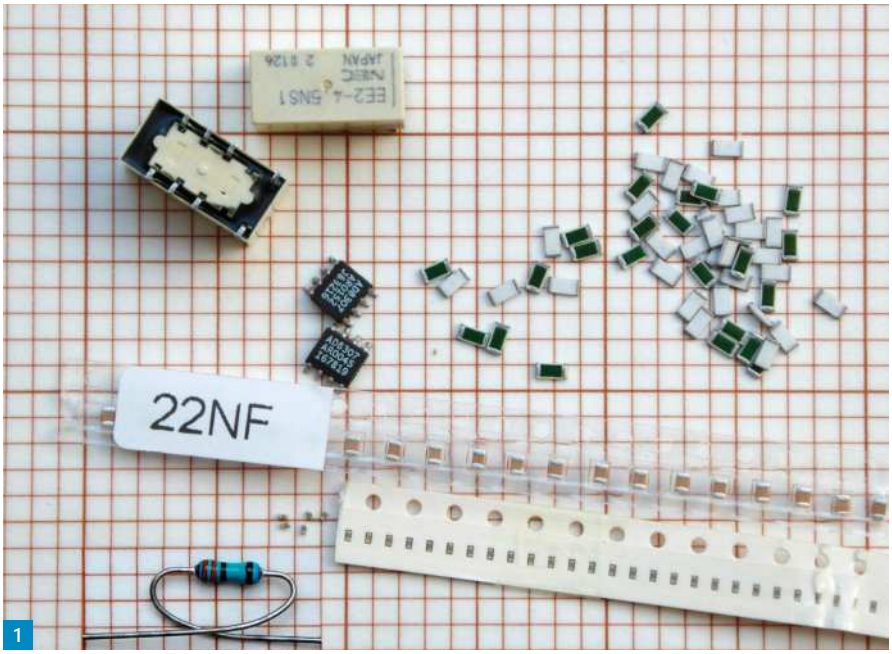
They have many benefits for manufacturers. They are smaller, allowing higher component density and therefore smaller circuit boards, they are better suited to automated component placement by machines, and finally they do not need holes drilling in the circuit board thus saving on tooling and simplifying assembly operations. They generally consume less power and therefore generate less heat and as a consequence, a board populated by SMDs can be more reliable.

For us, non-professionals, who do not have robots to place our components, or have huge production runs, the above benefits, while valid, are much less persuasive. I have to say that the part I dislike most in the PCB process is drilling the holes! The downside for hand-made boards is that SMDs are small and fiddly, they need a steady hand, perhaps a magnifying glass – one sneeze or a breeze through an open window and you've lost the lot! On the other hand, for RF applications, especially in the UHF regions and above, a well-designed board using SMDs can improve RF performance by minimising stray capacitances and inductances from both component leads and long tracks.

For the moment through-hole components are still readily available for home and amateur use although some integrated circuits (ICs) are only available as SMD packages, or are becoming hard to find in traditional DIL (Dual In Line) packages.

Embrace the Challenge

The chances are that you will have to deal with SMDs at some point, just embrace the challenge! You will need a magnifying glass (I wear glasses and find this flip up magnifier very useful, **Fig. 2**, fine pliers, tweezers, a fine tipped soldering iron and, as a minimum, some fine multicore solder (or solder paste and SMD flux is better).



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These SMD test probes from eBay (about £2.50) are also very useful, **Figs. 3** and **4**.

SMDs are generally supplied in strips. If not already marked with the component value, write the value on the strip. Keep the strips and original packing together to aid future identification, Fig. 1 again.

If you're completely new to SMDs find an old PC motherboard or any other scrap board with SMDs for practice. To hone your skills you can buy ten sacrificial surface mount LM358s for 99p from eBay, and a selection of SMD resistors for a similar price.

A Helpful Device

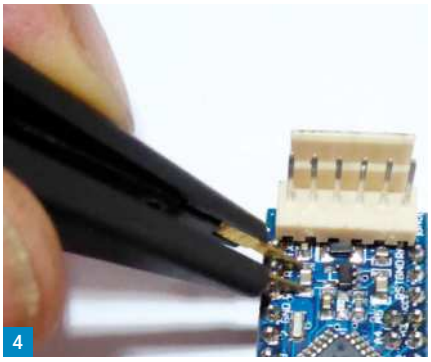
You may also find a device like the one I made, **Fig. 5**, helpful. I'm not giving full construction details here as you can see the general principle from the pictures and adapt construction to your own skills and available materials. Mine is made from 1mm steel sheet, joints are spot-welded. The brass rod for holding the SMD is about 2mm diameter from a model shop. The end is tapered, but cut off square to sit neatly on the SMD. The spring is from an old ballpoint pen. The hexagonal blocks are a couple of heavy brass spacers that I had. The lower one has a grub screw that can be slackened to allow the block to be moved on the brass rod to adjust the pressure


2

from the spring. In fact, the weight of the brass blocks is almost enough to hold the SMD in place, the spring just makes sure. The base is approximately 90mm^2, while the reach of the top arm is about 75mm. This will allow an SMD anywhere on a standard 100 x 160mm Euroboard to be pinned down.

You could make something similar in wood or Perspex/Acrylic sheet. If you are going to work in metal, parts can be joined with nuts and bolts or pop rivets. If you use brass or tin sheet, parts can be soldered together. Don't forget that model shops have suitable materials for this sort of project: brass rod, brass, aluminium or tin sheet, small bore tubing for bearing surfaces, etc.

Fig. 1: Selection of SMDs with normal 0.25W resistor for comparison (the grid is 1/10in squares). Fig. 2: Flip up magnifier for glasses wearers. Figs. 3 & 4: Tweezer probes for SMDs. Fig. 5: Home- made device for pinning down SMDs. Fig. 6: Fibre pen, abrasive block and brass wire brush. Fig. 7: Selection of fluxes. Fig. 8: Solder paste.



Soldering SMDs : Cleanliness

Cleanliness is essential for a successful result. Start with an abrasive method. Fibre pens are excellent for this purpose, **Fig. 6**. Abrasive blocks are also good, but cumbersome for fine work. A brass wire brush is also a useful tool, but care needs to taken not to damage fine tracks or adjacent components. There is also the risk of leaving brass strands or even conductive deposits on the circuit board.

I've tried a number of different methods of soldering SMDs. For occasional work you can solder SMDs by applying a little solder to each pad, place the device and hold it with a screwdriver or similar, then dab each end with your soldering iron. If you need a bit more solder, you can then re-work the joints without the screwdriver in place. However, a bit too long on the joint with the iron and both joints melt and the resistor or capacitor comes away stuck to the end of your iron – frustrating! I have heard that SMDs can be temporarily held in place with super glue or other adhesive, even Blue Tack. All this is fine for very occasional SMD work. If you are going to solder SMDs more frequently, there are better methods.

Improved Techniques

Whichever method of soldering you use, the device described earlier will hold the SMD in place while you solder, freeing up one hand and preventing the SMD sticking to your iron.

Flux and Solder

Fluxes range in consistency from liquids to pastes, **Fig. 7**. I find the pastes more useful. Apply some flux to the solder pads on the board. Using tweezers, place the component on the pads and hold it in place. Apply a small amount of solder to the fine tip of your soldering iron and use it to carry the solder to the junction of the SMD and the pad on the board. There should be no need to hold the iron on the joint, the solder should flow almost immediately into the joint.

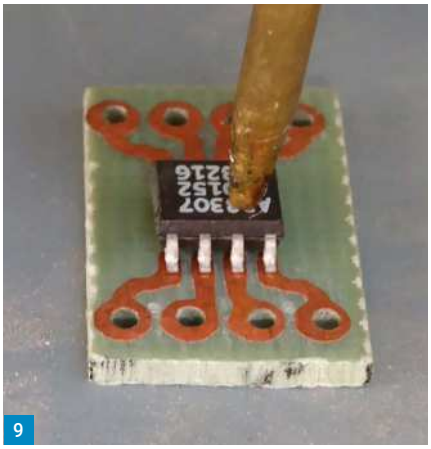
Solder Paste

If you are doing a lot of SMD work, it is advisable to get some solder paste, **Fig. 8**. Solder paste is a powdered low melting point solder suspended in a flux paste so no other flux is required. It is tacky to hold components in place during flow soldering and may be sufficient to hold a component in place for hand soldering, but risky. I always use an alternative method of holding the component in place – just in case!

A small amount of paste is applied to each pad. The component is placed and held against the pads while the tip of the soldering iron is applied between the SMD and pad. The paste has a very low melting point and as soon as heat is applied it will melt and flow, making a neat joint. Any paste on the PCB substrate will magically disappear, resulting in a neat joint with no shorts.

Multi-Pin Integrated Circuits

At first multi-pin integrated circuits appear frighteningly tiny, but they are not as difficult to solder as you might at first imagine. The example shown is an AD8307 Log amplifier IC mounting on a small scrap of PCB, **Figs. 9** to **13**, to make test connections easier to create. The best way is to first position the component precisely on the PCB pads and hold it in position. Then slather solder paste over the pins, move the tip of your soldering iron over the SMD legs and if not a nice neat joint, an acceptable joint will be made. A fine tip is not necessary for this. Only a small amount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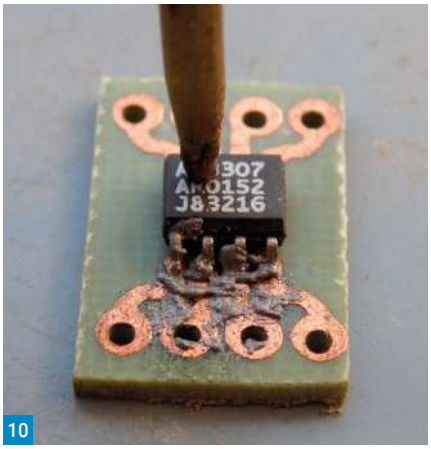

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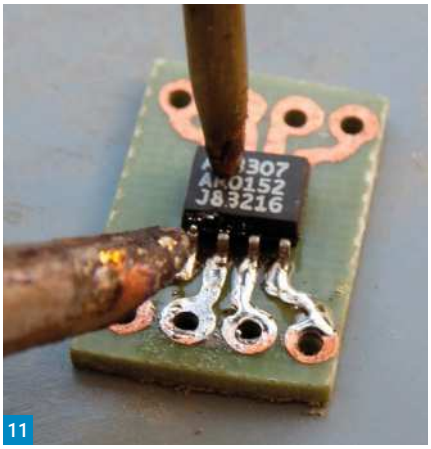

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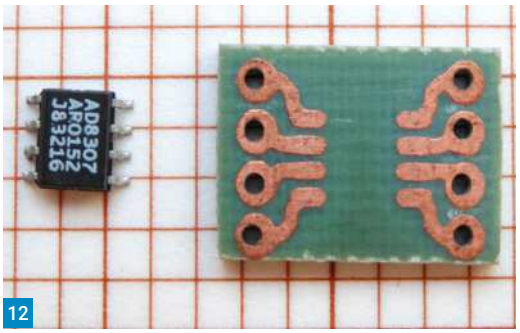

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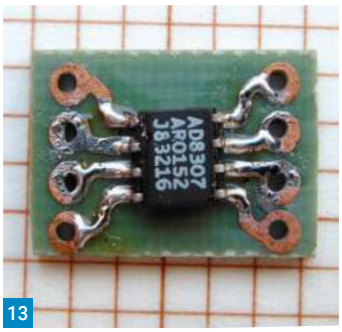

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Figs. 9-13: Soldering an SMD with solder paste. Figs. 14-17: Removing an SMD with small cutting disc.

of solder paste is needed. You can apply the paste before placing the component. The only small drawback is that it may be more difficult to align the pins with the pads.

If you don't have a means of securing the SMD in correct registration, apply solder to one of the corner pads, position the component exactly in place and hold in down with a screwdriver or pointer, then use your soldering iron to secure the corner leg. If all the legs are still correctly positioned, then solder the opposite corner. Finally, if all is still OK, solder the remaining legs.

Removing SMDs

There is no option to use IC sockets with SMDs and replacing an IC can be tedious. Depending upon the proximity of adjacent components, a small butane gas torch can be used to melt the solder on all the pads and nudge the IC away with tweezers or a pointer. Try heating the whole encapsulation of a small component and it should come away. Alternatively, use a cutting disk in a Dremel type tool to cut off the IC legs then tidy up the debris with a soldering iron, **Figs. 14** to **17**. Take care not to allow the cutting disk to dig into the PCB – keep the cutting edge close to or actually on the encapsulation.

You can now practice soldering one of your sacrificial SMDs onto the vacant pads.

SMD Packages: Passive Components.

The size of an SMD will need to be known so that a suitable replacement can be ordered or to create a new PCB layout.

Common passive components such as resistors, capacitors and inductors come in rectangular packages with contacts at each end. For example, in parts lists, you may see the component described as '1K 0603 (1608M)'. This is a 1kΩ resistor, 0.06in x 0.03in, while in brackets is the Metric size: 1.6mm x 0.8mm. The bracketed dimension is often not given.

Table 1 gives passive component dimensions. If the component you are considering only has the one dimension given, say 0603 in the above example, you may be confused because '0603' could be a metric part, 0.6 x 0.3mm or it could be an imperial part 0.06in x 0.03in. If you are ordering from RS, Farnell or Rapid Online, for example, both dimensions will probably be included in the description or a datasheet will be available. Ordering from eBay can be more problematic because the actual dimensions may not always be given. As a general rule though, the code will be for imperial dimensions.

You will notice that Table 1 includes the power ratings for resistors of different sizes. Most are substantially lower than through-hole components although 1206 is rated at 0.25W and 0805 is the usual 0.125W used in most modern signal and logic level circuits.

I would avoid using devices less than 0805 (Imperial). I recently ordered some 0402 capacitors by mistake – they really are too small!

Transistors and Diodes

While you will often find diodes, especially rectifiers and LEDs, in double-ended packages similar to passives, they are frequently in the same three-legged packages as transistors, either SOT23 or SOT223.

SOT or Small Outline Transistor packages most commonly have three pins, but sometimes have more. A four-pin package might house two diodes, or a three-pin SOT may contain two diodes with common anodes or cathodes. Op-Amps sometimes use the SOT package but with more pins. The SOT-23 package is 3mm x 1.75mm x 1.3mm and is used for small signal transistors. The SOT-223 package is used for higher power devices and is 6.7mm x 3.7mm x 1.8mm.

Integrated Circuits

There are numerous packaging options for ICs, many of them too complex to even think about for home construction. I would consider anything up to 40 pins fair game for hand soldering. The outlines we are most likely to handle are SOIC, SOP and QFP.

SOIC, **Fig. 18**, or Small Outline Integrated Circuit, is a Dual in Line (DIL) with extended or 'Gull Wing' pins on a pitch of 1.27mm. They are often used for surface mount equivalents of DIL through-hole devices. SOIC-14 would be a 14-pin DIL surface mount package and is about 40% the size of its through-hole equivalent.

SMD DESCRIPTION		APPROXIMATE DIMENSIONS		RESISTOR POWER
Metric	Imperial	Metric	Imperial	Rating (W)
0201	008004	0.25 × 0.125	0.010 × 0.005	
03015	009005	0.3 × 0.15	0.012 × 0.006	0.02
0402	01005	0.4 × 0.2	0.016 × 0.008	0.031
0603	0201	0.6 × 0.3	0.02 × 0.01	0.05
1005	0402	1.0 × 0.5	0.04 × 0.02	0.062-0.1
1608	0603	1.6 × 0.8	0.06 × 0.03	0.1
2012	0805	2.0 × 1.25	0.08 × 0.05	0.125
2520	1008	0.5 × 2.0	0.10 × 0.08	
3216	1206	0.2 × 1.6	0.125 × 0.06	0.25
3225	1210	0.2 × 2.5	0.125 × 0.10	0.5
4516	1806	0.5 × 1.6	0.18 × 0.06 [20]	
4532	1812	0.5 × 3.2	0.18 × 0.125	0.75
4564	1825	0.5 × 6.4	0.18 × 0.25	0.75
5025	2010	5.0 × 2.5	0.20 × 0.10	0.75
6332	2512	6.3 × 3.2	0.25 × 0.125	1
6863	2725	6.9 × 6.3	0.27 × 0.25	3
7451	2920	7.4 × 5.1	0.29 × 0.20 [21]	

Table 1: Common Passive SMD Dimensions.

Then there are Wide SOIC and Mini-SOIC packages, which require no more explanation. The SOJ package has 'J' leads, which curve under the device body, **Fig. 19**.

Now comes the SOP, Small Outline Package. The basic in-line integrated circuits are very similar to SOIC and may be dimensionally the same, but check carefully before substituting. There are many other smaller versions of this package, the most common being TSOP, SSOP, TSSOP, QSOP and VSOP.

TSOP (Thin Small Outline Package): thinner than the SOIC with a smaller pin spacing of 0.5mm.

SSOP (Shrink Small Outline Package): as TSOP but with a pin spacing of 0.635mm.

TSSOP (Thin Shrink Small Outline Package)

QSOP (Quarter-size Small Outline Package): Again, a pin spacing of 0.635mm.

VSOP (Very Small Outline Package): This is smaller than the QSOP, pin spacing can be 0.4, 0.5, or 0.65mm.

The last package we will seriously consider is the QFP or Quad Flat Package, **Fig. 14**. Like SOP, QFPs have many variants: LQFP, PQFP, CQFP and TQFP being most common.

LQFP (Low Profile Quad Flat Package): pins on all four sides, spacing varies according to purpose, height is no more than 1.4mm.

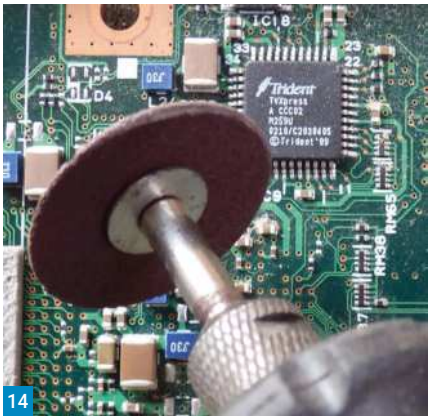
PQFP (Plastic Quad Flat Package): Commonly used for VLSI (Very Large Scale Integration) circuits. They will have narrow pin spacing. CQFP is a ceramic version of PQFP and TQFP is a thin version of PQFP.

The final package to describe, but would I not seriously consider soldering by hand, is the ball grid array, **Fig. 20**. The bottom of the package is populated by a grid of tiny solder balls. These line up with through-board PCB pads leading through to other circuit board layers. In production the IC can be flow soldered or the package itself is heated sufficiently to cause the low melting point solder balls to flow into the joint.

Identifying SMDs

Resistors and capacitors are relatively easy, although you may need a magnifying glass. Three and four figure codes are in common use. Both should be fairly familiar, comprising the first two significant figures and a multiplier: 102 is 10 + 2 noughts = 1000Ω (1kΩ); 472 = 4700Ω (4.7kΩ). 101 = 100Ω, don't forget 100 = 10Ω. The four-figure code is used for high tolerance resistors and comprises the first three significant figures followed by a multiplier: 4702 = 470 + 2 noughts = 47000 (**Fig. 21**).

Capacitors are frequently unmarked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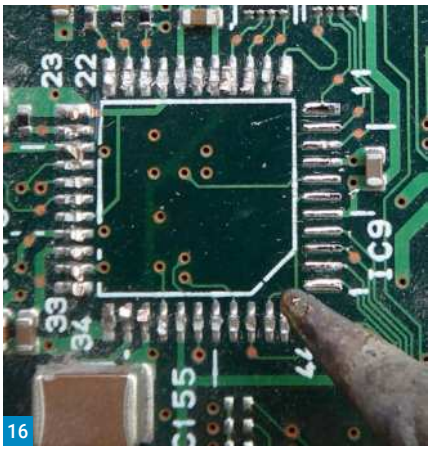
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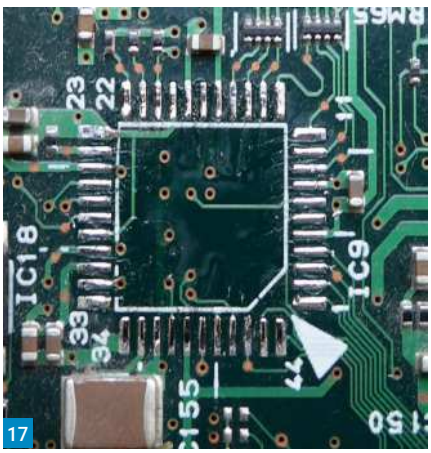
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so it is important to keep them on the supplied reel or in clearly marked bags or trays. Where they are marked the system is similar to resistors: 332 would be 3300pF.

Tantalums and Electrolytics are usually larger and have room for a code like 33µ16: 33µF 16V

There are a number of marking systems for inductors. Most commonly they are marked as resistors or capacitors, but in micro-Henries. Coloured dots and bands are sometimes used and work the same way as standard three-digit resistor codes.

Active devices can be difficult to identify so keep new devices on the supplied reel or in marked trays or packets. For re-work purposes you may have to identify a component on an existing PCB if you don't have a manual with a parts schedule and layout diagram. The problem is that SMDs are too small to carry the usual part numbers, date code and manufacturer's name. Instead, they have a two or three letter code. This is quite a big topic littered with pitfalls and ambiguities so I'm going to give an example and suggest that readers consult the internet. I recently had to replace some BAT54 Shottky diodes. They are in a SOT-23 three-leg package containing two diodes with common cathodes, **Fig. 22**. The markings are 'KL4' and 'S3'. KL4 identifies the device as a dual BAT54 diode with common cathodes. The S3 is a date code that I have not deciphered for this particular device. Unfortunately, there seems to be little standardisation,


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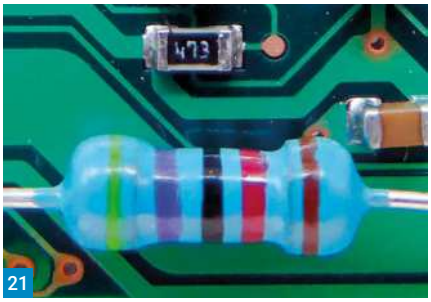

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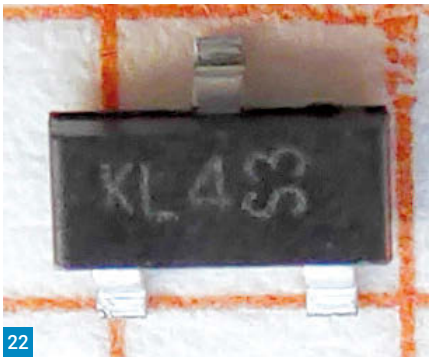

22

Fig. 18: SOIC device, SOPs are similar.
Fig. 19: SMD with 'J' pins curled underneath.
Fig. 20: Ball Grid Array – not for the faint hearted!
Fig. 21: 47kΩ (47000) SMD resistor with 0.25W Thru-hole resistor for comparison.
Fig. 22: BAT54 in SOT23 package showing identification marks.

with many manufacturers adopting their own codes. Searching on 'KL4' will not always bring up BAT54. 'L4 can be more successful but will also highlight other devices carrying the L4' identification. The 'K' is probably a manufacturer mark.

Resources

There are many useful resources on the Internet to help with identification of SMDs, here are a few:

https://tinyurl.com/y5eftkf2
https://tinyurl.com/y62cxbra
www.s-manuals.com/smd
https://tinyurl.com/y2ujz9nv

I hope you have now overcome all fears and will embrace SMDs with enthusiasm. Don't forget – you can practice on a scrap board.

Radio Round-up

MILLS ON THE AIR: This year marks the 25th anniversary of Mills on the Air. Unfortunately, this year's special event this year is likely to be different due to the corona virus pandemic. It is unlikely that most will be able to operate from a Mill (unless they live/work there). Ofcom have modified the usual rules and Mill callsigns can instead operate from supporter's homes. The amateurs will be operating on behalf of the Mill. The application will name the Mill address so operators can move back if the Covid situation changes.

First it is necessary to obtain permission from the Mill, to operate on their behalf. Ensure some information about the mill is available to pass on to stations you contact. Then complete the online NoV application form.

When successful, check out the mills section on Denby Dale ARS website:

DDARS.NET

Complete the form so your callsign/details can be added to the list. Gerald G3SDY reports that he is hoping to use Zoom to allow the public to 'visit' stations too or you may wish to consider streaming on Facebook or the BATC website, etc. Any questions please feel free to e-mail Gerald at

g3sdy@sky.com

GREEK REVOLUTION SPECIAL EVENT: If you have been hearing or working Greek stations using the SX200 and similar prefixes, here is the reason. In 2021, Greece is celebrating the bicentennial of the 1821 Greek Revolution after a period of 400 years of occupation by the Ottoman Turks.

To recognise this anniversary, Greek radio amateurs will be active throughout 2021 with the following special callsigns:

Radio amateurs with a licence of Class 1 will use the prefix SX200 followed by the suffix of their home callsign, e.g. SV1XXX will operate as SX200XXX.

Radio amateurs with a licence of Introductory Level will use the prefix SY200 followed by the suffix of their home callsign, e.g. SY1XXX will operate as SY200XXX.

Club stations will use the prefix SZ200 followed by the suffix of their home callsign, e.g. SZ1XXX will operate as SZ200XXX.

ONLINE COURSES: Essex Ham has produced a useful page giving brief details and links for online amateur radio training courses for the Foundation, Intermediate and Full exams:

https://tinyurl.com/urskp4

The Inspiring Story of Arthur (Artie) Moore

Scott Caldwell tells the tale of a remarkable pioneer of radio.

Scott Caldwell
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The Moore family took over Gelligroes Mill in 1874, and originally supplied the local farming community with feed and seeds. **Arthur (Artie) Moore**, **Fig. 1**, was born on April 29th 1887, in Pontllanfrith, in the Blackwood area of Monmouthshire, Wales. He was born into a time when science and industry were combining to network the world. This technology enabled ships to keep in contact with land even when they were out of range as they could relay messages from other ships. This technological revolution was led by **Guglielmo Marconi** (1874-1937) who was the first to fully exploit the commercialisation of wireless communication, by the marketing of his technology to the Royal Navy and their vast merchant marine fleet that connected the Empire.

Artie overcame serious physical injury and disability to enjoy a full and rewarding life that fulfilled a childhood dream of becoming a pioneer in wireless communication. He was the eldest son of a local miller, **William Moore**. The impressionable young Artie won first prize in a national model competition and received a book entitled *Modern Views on Electricity and Magnetism*, by the renowned British wireless pioneer **Oliver Lodge** (1851-1940). He often defied his father by staying up into the early hours, listening to distant signals that were transmitted by the Royal Navy and merchantmen who protected and connected the British Empire.

Artie suffered a serious accident at the mill, which resulted in the amputation of the lower part of one of his legs. This unfortunate accident had a deep and profound impact on Artie's life and led to an interest in electronics and wireless communications. Unlike his physically more able childhood friends, Artie turned his attention to the emerging and wonderful world of wireless communications, were he was without equal in his local area in terms of intellect and natural ability. To amuse himself and pass the time, Artie conducted a number of experiments. He built a basic spark-gap transmitter and in an attempt to improve reception he relocated his shack to a local farm high up on Mynyddislwyn. Artie applied his engineering talent to charge batteries via a generator that was powered by the mill's water wheel. This in turn supplied Artie with a regular income to fund his latest experiments as he supplied local farms who had no access to electricity, with a continuous supply of batteries.


1

Artie, despite his physical disability, managed to obtain employment at the local colliery. While, working at the colliery, he struck up a friendship with the colliery's electrical engineer, **Richard Jenkins**. They both shared a deep passion for the work of Lodge and together they replicated many of his experiments. Driven by his keen interest and research, Artie began constructing his own rudimentary wireless station. It was operated by a standard spark-gap transmitter and a coherer-based receiver. They embarked on teaching themselves Morse code so that they could also communicate between their homes, Artie at Gelligroes Mill and Jenkins at Ty-Llewed Farm. The first message they exchanged was a request for extra seed for the farm.

CQD SOS Titanic

A loft of the 17th century Gelligroes Mill in the Sirhowy Vally in Wales is the setting at the start of this remarkable story. A young and passionate wireless operator is concentrating and attempting to get the maximum performance out of his primitive apparatus. He is immersed in his reception of a terrifying call for help that broke the silence of the ether and made his blood run cold at the same time: *"CQD CQD CQD, SOS de MGY. Position 41 46N 50 14W. Require immediate assistance. Come at once. We have struck an iceberg. Sinking. We are putting the women off in the boats"*, **Fig. 2**.

2

A final message received sounded even more desperate: *"Come as quickly as possible OM. Our engine room is filling up to the boilers"*. (01:45hrs Titanic time) This was the last wireless message that the rescue ship *RMS Carpathia* directly received as she raced to the stricken *Titanic*. Both **John Phillips**, **Fig. 3**, and **Harold Bride**, **Fig. 4**, realised that the Titanic had little time left before she would founder and that the power supply was beginning to fail. In just over half an hour (02:20hrs) *Titanic* would founder, taking over 1,500 souls with her, and Artie Moore's life would also change forever.

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

Fig. 1: Wireless Pioneer Arthur (Artie) Moore (Pinterest/Public Domain). Fig. 2: A CQD Medal Issued in 1909 for Saving the Life's of the Passenger's from the RMS Republic and SS Florida (Scott Andrew Caldwell Collection). Fig. 3: Titanic's Senior Marconi Operator John G. Phillips (Scott Andrew Caldwell Collection). Fig. 4: Titanic's Junior Marconi Operator Harold S. Bride (Scott Andrew Caldwell Collection). Fig. 5: An early version of a ship's wireless room (Georg Wiessala). Fig. 6: Gelligroes Mill today (Ben Roberts).

One newspaper reported that: *"A young boy from the valleys of South Wales has witnessed through the modern invention of wireless the death of a famous ship thousands of miles away"*. Artie had previously made the front page of the London newspaper, *The Daily Sketch*, in 1911, when he intercepted the Italian government's declaration of war against Libya. He took great delight in sharing the latest news with local residents, who were initially very skeptical although they subsequently changed their opinion after the report was confirmed by the national and local press.

Many locals regarded Artie as a boffin, especially when he began the installation of a long, thin copper wire antenna that ran over the nearby River Sirhowy. Many people still viewed the latest technology with a mixture of suspicion and wonder, despite the unprecendented growth of science and industry in the early 20th century. Artie was so concerned about the distress calls that he received that he decided to report them to the local police who initially dismissed his claims, reminding him that the *Titanic* was regarded as 'unsinkable'.

Titanic's wireless set was extremely powerful at 5kW (The most powerful Marconi transmitter afloat) and had a revolutionary rotatory spark disc-discharger, providing a unique tone that was almost musical, and a guaranteed range of 250-500 miles during daylight and approximately 2,000 miles in darkness, **Fig. 5**. During her sea test she had managed to communicate with wireless stations at both Tenerife and Port Said, approximately 3,000 miles away. This adds credence to the claims that Titanic's distress signals did indeed reach the United Kingdom and the European continent.

Intercepting the Titanic's distress signals propelled Artie to both national and international fame. The Monmouthshire Education Committee offered him a wonderful opportunity to develop his remarkable talent by awarding him a scholarship to attend the British School of Telegraphy in London. Artie's ability also came to the attention of Marconi when a local resident wrote a letter detailing the remarkable reception of the Titanic's distress signals. Marconi was intrigued after reading the letter and decided that he should pay a visit to Artie. He soon realised that Artie was an extremely talented wireless operator and offered him the position of draughtsman after the successful completion of his scholarship.

Recent research has also suggested that the Titanic's distress signals were received by at least two other European wireless stations. This discredits the early view that the Titanic signals were limited to the North Atlantic shipping lanes and the powerful coastal stations of Newfoundland (Canada). The powerful Marconi shore station at the

Further Reading

- Booth, J. and Coughlan, S. (1993) *Titanic Signals of Disaster*. Westbury (UK): White Star Publications.
- Caldwell, S. (2017) 'SOS Titanic!', *Radio User*.
- Caldwell, S. (2018) 'Ship Ahoy, Naughty Boy & the Electric Constable', *Radio User*, 13(11), pp. 27 – 29.
- The Atlantic Daily bulletin. (2020) *Journal of the British Titanic Society*, Autumn 2020, pp. 8 – 11.

Lizard in Cornwall, callsign GLD, received a number of messages from the Titanic. The operator on duty was **Lieutenant-Colonel Baytun Hippisley** (1865 – 1956), who was a pioneering wireless amateur (call sign HLX). He obtained his amateur licence from the Post Office in 1910. More remarkable was the claim from the philosopher and scientist **Professor Carl Unger**, who also received the Titanic's CQD and SOS messages in Vienna (Austria). *The Broadcasting Magazine* in their June 1st 1937 edition provides the reader with a picture that details the primitive apparatus that Professor Unger operated.

The First World War (1914–1918)

At the outbreak of hostilities in August 1914, Artie left his position at Marconi and subsequently joined the Admiralty, working in the research and development of new wireless equipment of the ships of the Royal Navy. In the opening months of the war he supervised the installation of the Marconi wireless apparatus on the Dreadnough-Class battleships, *HMS Invincible* and *HMS Inflexible*. These two battleships were involved in the decisive sea battle near the Falkland Islands on December 8th 1914. Therefore, it was vital that their wireless communication apparatus worked perfectly, given the great distance between the Falkland Islands and the United Kingdom, approximately 8,000 miles of ocean. Artie also worked on installing communication apparatus on armed merchant ships, which conducted clandestine operations on the high seas. They soon became universally known as 'Q Ships'. They were the Royal Navy's response to the submarine menace that targeted the transportation of raw materials that the United Kingdom desperately need to prosecute the war effort against the Central Powers.

This role was a perfect fit for Artie and he remained working for the Admiralty after the Central Powers had capitulated in November 1918. Artie ultimately became a research associate for **Captain Henry Joseph Round MC** (1881 – 1966). The direction-finding equipment that used soft 'C' values and a modified Bellini-Tosi direction system, had been devised by Round just before the outbreak of hostilities. This system was utilised extensively by the Royal Navy in their pursuit of the German fleet during the Battle of Jutland in 1916. Round was also a prolific inventor and had registered no fewer than 117 patent applications during his prestigious career. Both Round and Artie had a good working relationship that combined their remarkable intellectual abilities.

6

Post War Wireless Innovation

After successful completion of his work for the Admiralty, Artie was transferred to Marconi's Liverpool office. He was appointed manager of the newly established Ship Equipment Department. In 1923, he was promoted to the Marconi International Marine Communication Company, based at Avonmouth, where he worked until he retired in 1947. He was greatly respected by the technicians that reported to him.

The innovative spirit never left Artie and in 1932, he successfully patented the Echo-Meter, an early version of Sonar. Councillor **Richard Vines**, Headmaster of Pontllanfraith Technical School, recalled in Artie's obituary that *"His inventive mind gave to science many devices by which he will be remembered as one who succeeded through industry"*.

Artie Moore Amateur Radio Society (AMARS)

The main of purpose of the Artie Moore Amateur Radio Society is its dedication to keeping the memory of the achievements of Artie Moore of Gelligroes Mill, Pontllan Fraith, Blackwood, Caerphilly, alive. The AMARS, periodically sets up an amateur radio station that operates at Gelligroes Mill, **Fig. 6**. They operate under the callsign MW0MNX, in honour of Artie's old callsign MNX. The magical sound of Morse code has once again returned to Gelligroes Mill.

Conclusion

Artie retired from the Marconi Company in 1947, due to ill-health. He had overcome physical disability to reach for the airwaves and achieve his childhood dreams and ambitions. In 1948, he relocated to the warmer climate of Jamaica, in an attempt to recuperate his physical and mental strength. However, he struggled to settle in Jamaica and returned to England after only six months.

On Thursday January 20th 1949, Artie passed away in a Bristol convalescent home. This historic story reminds us that talent, desire, and circumstance are great levellers in a class-based society. Gelligroes Mill was still in use until the mid-1970s, before it succumbed to the advent of modern technology and ceased production. It was restored in 1992, and now operates as the candle factory of **David Constable**.

Inductors and Inductance

Eric Edwards GW8LJJ looks at the basics of inductance.

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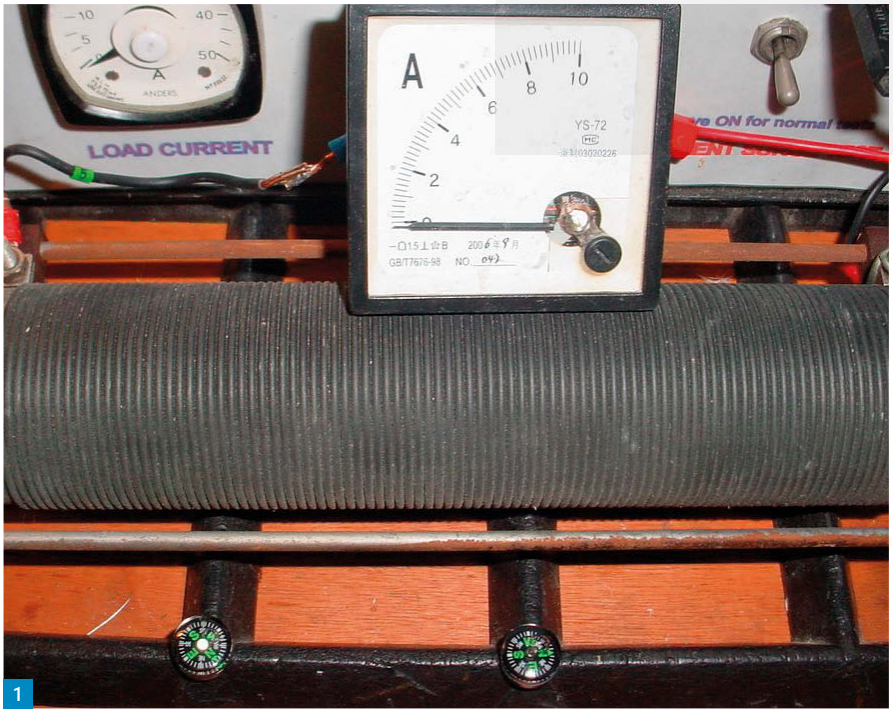
From Wikipedia, the free encyclopaedia: *"In electromagnetism and electronics, inductance is the tendency of an electrical conductor to oppose a change in the electric current flowing through it. The flow of electric current creates a magnetic field around the conductor. The field strength depends on the magnitude of the current, and follows any changes in current. From Faraday's law of induction, any change in magnetic field through a circuit induces an electromotive force (EMF) (voltage) in the conductors, a process known as electromagnetic induction. This induced voltage created by the changing current has the effect of opposing the change in current. This is stated by Lenz's law, and the voltage is called back EMF.*

"Inductance is defined as the ratio of the induced voltage to the rate of change of current causing it. It is a proportionality factor that depends on the geometry of circuit conductors and the magnetic permeability of nearby materials. An electronic component designed to add inductance to a circuit is called an inductor. It typically consists of a coil or helix of wire."

Let's take a Look at the Statement from Above

This induced voltage created by the changing current has the effect of opposing the change in current. This is stated by Lenz's law, and the voltage is called back EMF.

When a coil is connected to a DC power supply with one end connected to the positive terminal and the other at the negative terminal and the voltage is applied (the power supply switched on), current will flow as it does in a resistor. The test coil used in **Figs. 1** and **2** has a resistance of 2.4Ω and an inductance of 1mH. The applied EMF (voltage) is 12V and the current flowing through the coil is 5A. This works out the same if the values were placed in the Ohms law formula V/R=I, where V is 12, R is 2.4 and I is the current. It can be seen that the coil does not reduce the current flow any differently than if there was a 2.4Ω (greater than 5W) resistor fitted instead of the coil. What is different, however, is when the voltage is removed. With a resistor used in place of the coil, when the voltage is removed the current stops flowing as there is nowhere for it to go. A different situation arises when a coil is used. When a current flows through a coil, a magnetic field is generated and this stores energy just as a capacitor stores energy in its force field within its dielectric. When the voltage from the coil is removed and the two ends connected together, the magnetic field collapses and in doing so the energy in the form of voltage is sent back to where it came from. Using a moving coil ammeter to show the current flow also uses the magnetic properties of a coil of wire to indicate the flow of current. Fig. 1 shows the coil connected to the power supply but is not switched on. The two small compasses below the coil are in a resting position. The NORTH indicator is at approximately at 5 o'clock and the ammeter has no current flow indication. When the DC power is applied, the ammeter is showing 5A flowing through the coil and the needles of the compasses are now showing the NORTH points at different positions, Fig. 2. One is at approximately 10 o'clock and the other at almost 9 o'clock indicating that a magnetic field has been created by the current flow.



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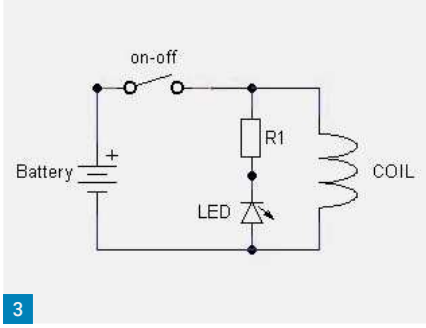
Back EMF

If an LED with a low value current limiter resistor (or not fitted, because at 12V in this setup the LED will not be damaged) was connected in reverse polarity with the cathode, **Fig. 3**, to the coil at the voltage input and the anode to the negative terminal of the power supply, during current flow the LED will not illuminate because it is wired in reverse. When the power supply is disconnected from the coil, the LED momentarily illuminates as the magnetic field collapses, and the energy within the coil is sent back. It finds its way through the LED as its path and creates a short but sharp spike. This is called back EMF and applies to all coils that have a DC power



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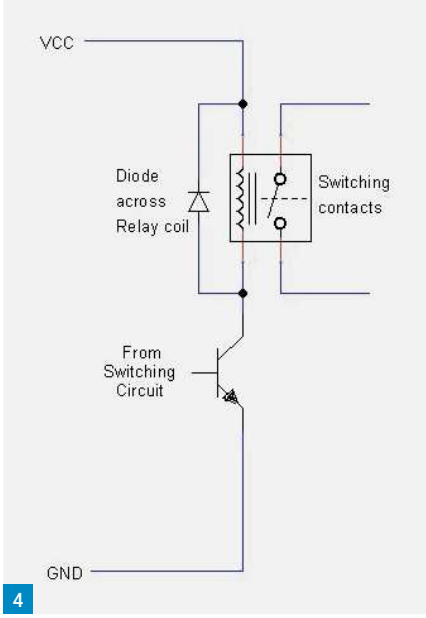

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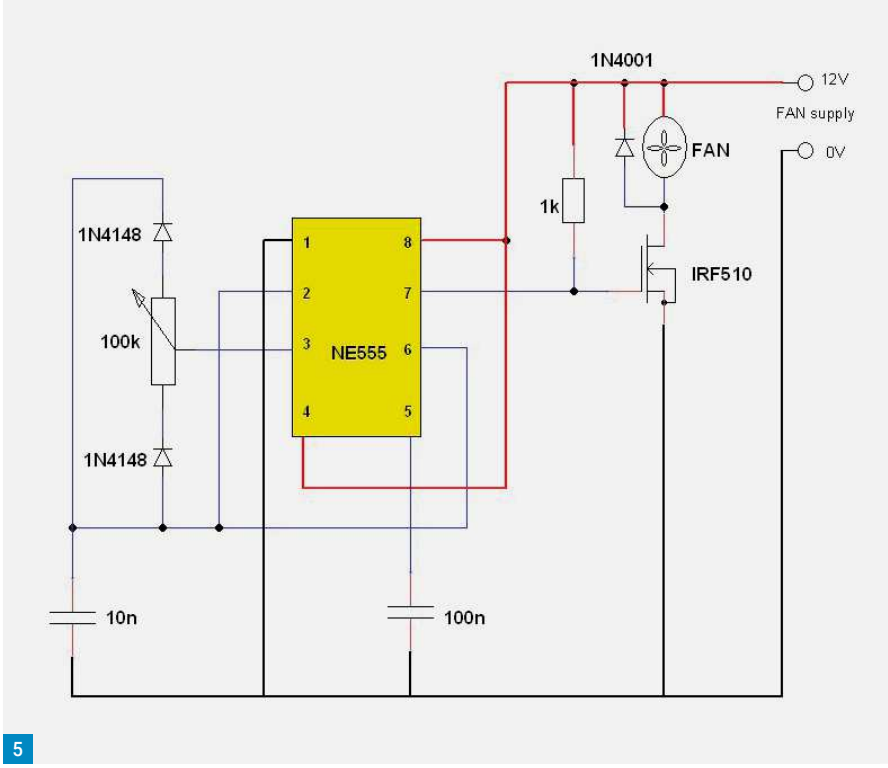

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Fig. 1: No current in coil, both compasses point the same way. Fig. 2: Current through coil, compasses point in different directions. Fig. 3: The LED will light momentarily as the coil discharges. Fig. 4: A diode is used across the relay coil to protect the transistor. Fig. 5: Using an NE555 to achieve pulse width modulation for controlling a fan.

supply disconnected from them, such as a relay or solenoid. The term solenoid is given to any coil that produces a magnetic field. Although wirewound resistors are inductive the magnetic field is contained within the former the wire used is wound on, so no magnetic field is there to cause back EMF.

Relays and Back EMF

It will be noticed in circuits where relays are used to redirect signals or voltages, that there is a diode connected across the relay's coil. This is the same as connecting the diode across the coil in our experiment. It is there to prevent back EMF from travelling through any device the coil is connected to in order to prevent damage to the device. **Fig. 4** shows a transistor with the relay in series with the collector and V_{cc} (+V). The transistor is supplied with a switching signal at the base, which turns the transistor on, activating the relay and closing the relay contacts. When the switching signal is removed, the transistor stops conducting and the relay contacts open. Without a diode connected across the coil (in reverse polarity), the collapsing magnetic field that stored the energy would find a path through the transistor to ground. This could damage the transistor. The diode is placed across the coil to provide a path for the stored energy to collapse. A pulse (spike) from the relay's magnetic field will be more positive than the V_{cc} supply so the diode will conduct.

Inductance

Inductance is the property of a circuit that opposes changes in the flow of current and is nothing more than a length of wire that is wound to form a coil so as to increase the magnetic field. This increased 'flux' increases the wire's self-inductance. The term 'self' is normally left off and the coil is said to have inductance. Inductors are used in lots of places and some examples were mentioned in the last paragraph – the moving coil meter, relays and solenoids. There are many more uses, including resonant tuned circuits as in radio circuits, filters, RF chokes and phase shift networks.

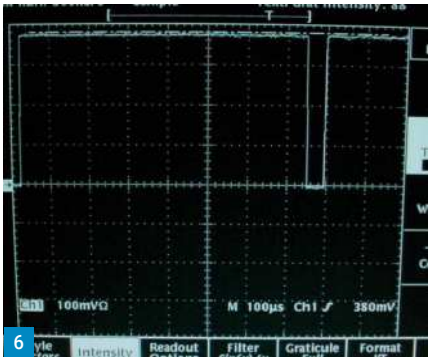
A DC Fan

An electromagnet, which is normally a piece of iron with a coil of wire wound around it, has current through it to create a magnetic field. In a simple motor there are two fixed magnets on either side of the electromagnet. This fixed set of magnets is called the stator (stationary) and the attracting and opposing forces of these poles create a torque. The armature, the iron core with the coil wound around it, produces a magnetic field when current passes through the wire and the magnetic field from the coil attracts the opposite (attracting) poles of the fixed magnets but as it approaches these, there is another opposite (opposing) pole and it rejects it so the rotor moves on to the next attracting pole.

A rotating magnetic field can be created by turning the current through the coil sequentially on and off in the motor. When the rotating magnetic field interacts with the fields of the magnets it exerts a force on the armature, which sets it in a rotating motion. By altering the direction of the current flowing through the coil, you can change the direction of the magnetic field produced by it and hence the direction of rotation. A DC fan, however, usually only rotates in one direction and to use it for suck or blow will depend on how it is mounted in the equipment it is used for cooling.

Fan Speed Control

The seemingly obviously way to control the speed of a fan or DC motor is by adding a variable resistor (potentiometer) in series with the DC supply and the fan. This will



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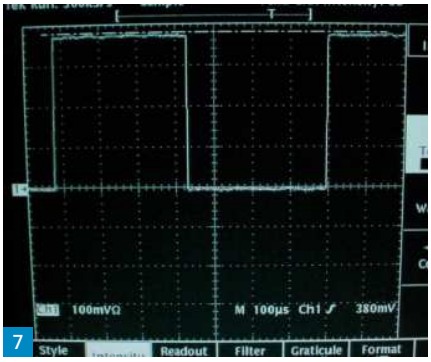

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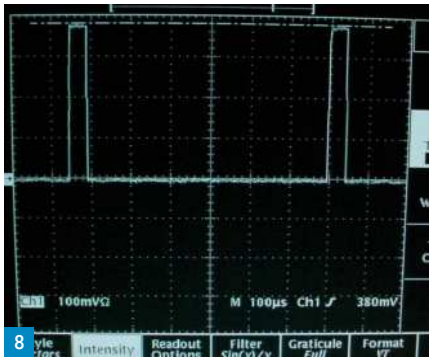

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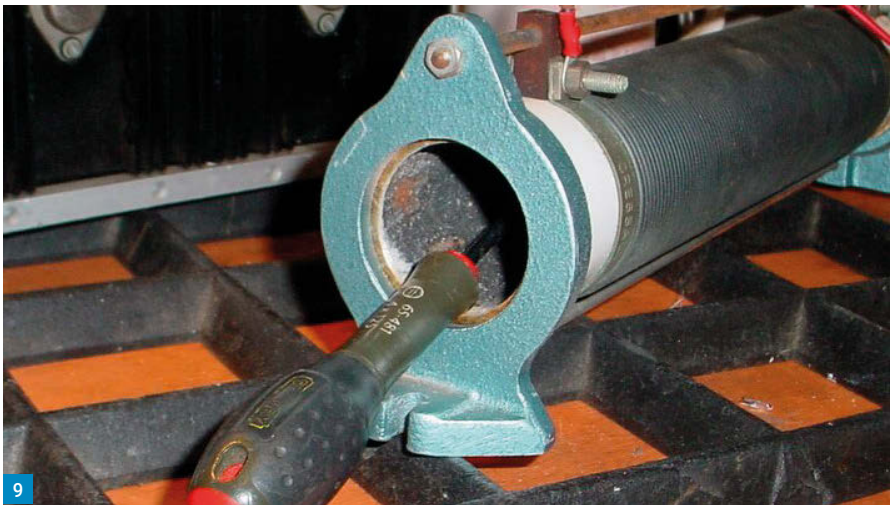
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reduce the current flow and therefore reduce the magnetic field strength. Using Ohm's Law it can be found that by increasing the resistance, the current decreases and the speed of the fan's motor will reduce The problem with that is, as the resistance of the control potentiometer increases, the energy provided by the current will be converted to heat because it has to go somewhere! It will, in fact, be dissipated in the potentiometer, which could burn out. To use a large potentiometer to absorb the heat is not good practice to slow down a motor. The potentiometer could be used to control the current flow through a transistor but again, power dissipation is still a problem and it will be in the transistor if this is used. Again, not good practice so another method needs to be chosen.

Pulse Width Modulation (PWM)

Pulse Width Modulation (PWM) is a simple and straightforward way to control the speed of a DC fan. It uses few components and can be built within a very short time. The circuit. **Fig. 5**, comprises an NE555 timer integrated circuit and a MOSFET as the main (active) components. There are several ways of using the NE555 as a PWM and I have chosen the way as drawn because it gives good results. The 10nF capacitor is part of the timing circuit and charges and discharges via the two 1N4148 diodes at each end of the 100kΩ potentiometer, which sets the rate of charge and discharge and therefore serves as the speed control. This works by adjusting the mark-to-space (M:S) output connected to the gate of the IRF510 MOSFET. A bipolar transistor can be used in the position but a MOSFET was chosen because it has a better on/off function. Semiconductors work best when they are either fully on (saturated) or fully off (non-conducting). Anywhere in between, the device is working in linear mode and drawing current. This can cause problems by getting hot within the device and is known as heat dissipation. The MOSFET used has a very low RDS (Drain to Source Resistance), which provides a very nearly perfect no current drawn when in the on mode so there is no, or very little, heat dissipation. The pulses appearing at the gate of the MOSFET govern the amount of time it is on and off and by adjusting this ratio the speed of the fan is varied. The pulses from pin 7 of the NE555 are shown at **Fig. 6** where the waveform is close to maximum (the top of the waveform is the 'on' voltage, and the bottom is the off) so the fan will be running full speed. **Fig. 7** shows the waveform with a M:S at 50% on and off, so the fan will be running at half speed. The slow speed fan position is seen at **Fig. 8** where the waveform is almost at off (long period between on pulses).

Inductance at AC

The experiment carried out with the coil and compasses used a DC power supply. If we had used AC as the voltage source, there would be no indication on the compasses because the magnetic field would be building up and collapsing due to the reversal of the applied voltage. It will be alternating at the rate of the frequency of the AC supplied and in this test a transformer, to reduce the voltage, was used connected to the 50Hz mains. The compass cannot see this because it is too fast to register.

Fig. 6: The waveform from Pin 7 of the NE555.
Fig. 7: When the waveform has a ratio of 1:1 (i.e. 50% on, 50% off), the fan will run at half speed.
Fig. 8: Waveform when the fan is almost off.
Fig. 9: Demagnetising a screwdriver.

Feel the Field

If a permanent magnet such as that removed from a speaker is held close to the coil when the AC voltage is applied to the coil, a vibration in the magnet can be felt as it is drawn in and out by the magnetic field. The more AC voltage is applied, the more current will be drawn through the coil and the magnetic field will be greater and the effect can be felt in the permanent magnet. If a screwdriver that has a long blade that has been magnetised is pushed inside the coil with the AC voltage applied, the screwdriver will become demagnetised, **Fig. 9**. The stronger the magnetic field, the better it will be at demagnetising.

Next time we will look at mutual inductance.

References

Wikipedia • NE555 datasheet

Acknowledgements

My thanks to **Ray G7BHQ** for reading over the text.

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Starting in the Hobby

Dear Don,
I became interested in radio and data communications at the age of 14. I built a shortwave receiver from a kit, and coded software to interface to ex-GPO modems that could be purchased cheaply at the time. Keen to expand my knowledge, I attended a local radio club where I met a bunch of grumpy old bearded men proclaiming real radios needed valves, and real operators used CW rather than voice. Furthermore, the syllabus for the exam appeared scary and beyond my capabilities. It was not an environment conducive to continued learning. This dampened my interest, and was soon extinguished by other priorities like chasing a football, and then chasing girls. One thing led to another, and before I knew it I had a career, wife and children along with all the associated distractions. However, a few months ago I stumbled across a box that had been in storage for many years, and found an old Lowe HF-150. What a thing of engineering beauty (interestingly, you can see similar design cues in the current Commradio CTX and Elad FDM-Duo). I loaded it with a set of fresh batteries and was enjoying being back on the shortwaves after so many years.

I started exploring the internet to see how things had changed. On the positive side, I discovered the exam process had been restructured, significantly reducing the barriers to entry. Even better, due to Covid, the practical assessments were no longer required during this difficult period, so no need to travel to a club in the evenings or weekends to attend classes – something my work pattern would have precluded. So, I downloaded the Foundation Licence manual, and read it cover to cover in a single sitting. The book acted as a reminder of physics lessons at school (Ohms law, basic electrical circuits) and my previous experience (propagation, antennas). New material included SDR, although this was only briefly described. However, most importantly I was fascinated again and was back into radio!

I booked the first available test, giving me two weeks to prepare. I used this time to read the previous six months of *Practical Wireless* and watch a series of YouTube videos produced to help candidates pass the different exams. It is commendable that people are prepared to volunteer their time to produce videos and study materials, but I did find many of them to be rather sleep-inducing due to the way they were presented and delivered. Reading online forums and magazine letters sections uncovered discussions that had turned me off during my first foray into the hobby, although today it appears real radios don't use software, and real operators now use voice rather than data. OK, maybe a slight exaggeration, but I have certainly read and heard on air this prejudice. The other topic of division appeared to be regarding the current licensing tiers and the how easy entry should (or should not) be. I believe this is the wrong question to be asking, but more on that later.

Going back to the exam, I was given an online briefing by the very friendly and helpful invigilator G4HUE (BTW, those last three callsign letters are very significant in the Land Rover world – Google it). Thanks Andy! The test was easy, and 30 minutes later I had downloaded the Intermediate Licence manual.

Reading this book was when I started to question the process, along with my motivation for continuing the journey towards a Full Licence. It was triggered by the syllabus. For example, I noted the emphasis placed on the technical aspects of electronics: there are nine sections in the exam, with 30% of all questions in the Technical Aspects section. Why? I can understand the reason for this 30+ years ago when the best way to get on air was often to design and/or build and maintain your own equipment, but is that the most appropriate way today? Advances in electronics and manufacturing mean equipment is significantly cheaper and more widely available and accessible today, eliminating the DIY approach as a requirement. It could also be argued this is now the route for more reliable and safer equipment for most people; I would have expected the art of operating to be a more important topic. I also thought about SDR. Most new radios appear to use embedded software or are software based. Yet, there is so little software content in the Intermediate syllabus. Should it not cover software architecture, design and testing given the central role it plays in operating and supporting modern radio equipment? In general, the balance seems off skew.

It appears to me the syllabus has not kept pace with the evolution of wireless design and how it is being used. This is further evidenced by the many different topics I stumbled across in *PW* and on the web. For example, satellite communications, network radio, remote DXpeditions, radio astronomy, nature VLF – none of which are covered other than maybe a paragraph or two, yet I can see such disciplines attracting the interest of new candidates, over and above some of the traditionally tested topics.

Reflecting on my motivations, I realise that I am more than happy with the Foundation limit of 10W for the foreseeable future. In fact, I am quite attracted to the challenge of HF QRP, and the more compact and cheaper equipment avail-

able. So why progress? Two reasons. To continue my learning and to operate outside the UK (I normally travel a great deal and would like to take a radio with me to the remote locations I visit). However, studying takes time and commitment, and to justify over other priorities it needs to be of interest and of value. Referring to the Intermediate syllabus, it is looking difficult to justify, even though I am keen to grow my knowledge in different areas. Looking ahead to the Advanced Licence syllabus it is an even harder sell. Is it worth it just to get the ticket to operate overseas? I am undecided. It is a pity I need to ask myself this question, and I believe the RSGB would like to see more Full Licence holders, so this seems like a missed opportunity and is what prompted me to capture my thinking. It could be argued I can always learn more about my specific interests outside of the licence education process, and I should just get on with it, but is that really the best way to attract new people and encourage their contribution within the fold?

Times have changed (beards are now on-trend, so at least in that respect some may claim to being ahead of their time!) but it seems to me the process may be stuck in the past, and missing out on the opportunity to create new interest and grow the community. I believe this spans well beyond the question of how easy or hard the exams should be, or exactly which topics should be mandated for candidates. Maybe it requires a fresh look, considering the broader role and evolving applications of wireless, while embracing and encouraging the different pathways enthusiasts may wish to follow in order to develop their interests. These interests may not only be focused on the radio technology itself, or even limited to contacting other amateurs. They may be more biased towards other specialised topics such as software architectures and protocols, data mode development, understanding how ULF from nature can be used to monitor or predict geophysical or environmental change, or rapidly deployable radio networks to respond to natural disasters. The last two examples go beyond radio usage into the application of radio to create value for a wider community – in these particular cases using radio as a force for good; a more diverse approach would likely grow the community from a wider demographic.

If a broader and more tailored approach is followed, how would the examinations need to adapt? One option could be to construct a new system allowing candidates to choose their own pathway towards a Full Licence through a roadmap of mandatory modules combined with a minimum number of candidate-selected modules. Mandatory modules would cover knowledge required for safe and legal operating. Additional modules selected from a catalogue of options could include a deep-dive of topics such as microwave communications, IoT, heliophysics, radio design and electronics, DXing from land-based expeditions or yachts at sea, or radio in the community.

In summary, I am suggesting a new approach may be to move away from fixed syllabus exams with arguably sub-optimal topic focus, towards roadmap-based learning that better reflects the needs and interests of a wider group of potential hobbyists. It does not need to stop there. The RSGB (or other affiliated organisation) could use the different module topics as the basis to create communities of interest, engaging people to discuss and contribute to further developing knowledge, addressing challenges and creating new solutions. Working groups could be created within these disciplines to focus on answering complex questions or developing new innovations. This would of course be managed through an appropriate internet platform, maybe also enabling the UK to take the lead and extend collaboration within these groups to wider communities with a shared interest, or to other countries.

Of course, as a green novice, some may say 'what does he know?', which is a fair argument. Also, my suggestions may have previously been identified by the RSGB and discarded for good reasons. But for those who have been in amateur radio for a long time, I trust you are open to listening to others, and challenging yourselves and the current system to see if anything can or needs to be done to keep moving wireless forward, and ensuring the community has a robust future (which may well require letting go of the past). My experience tells me my first ideas are often rubbish, but they do tend to at least provoke discussion and collaboration with others to build out towards better outcomes. I hope this piece has at least been food for thought and I will leave it there for the time being.
Daniel Keely M7EAU

*(**Editor's comment**: Many thanks for this Daniel. I too would argue that the exams are no longer fit for purpose, despite being revised just a couple of years or so back, and need some serious rethinking. As you say, SDR and other technologies are important nowadays and much kit is built from modules rather than discrete components. And, yes, there are many facets of the hobby not covered in the syllabus. You offer an interesting and possible solution – I wonder what other readers think?)*

Jargon

Dear Don,
Isn't it time that embarrassing amateur radio jargon was consigned to the dustbin of history? I'm squeamish enough about using Q codes and arcane language constructs in voice contacts outside contests or traffic nets, but I would dearly love to see the end of the initialisms for Old Man, Young Lady, Old Chap, Old Girl and other 1930s throwbacks. Don't even get me started about the truly awful construct XYL. Here we are trying to attract the radio-centric denizens of Hackaday to the hobby, but still sounding all Cholmondeley-Warner on the air. Can we agree to start talking naturally please?
Neil Smith G4DBN
Goole, E. Yorks

UK Callsigns

Dear Don,
Here comes the cat, and I'm sure the pigeons are congregated and waiting. It seems to me to be fundamentally unfair that newly licensed amateurs in the UK are allowed to choose three callsigns from the old G and M blocks as an alternative to accepting the callsign allocated to them, when we older amateurs have to put up with the callsign given to us.

Please do not misunderstand me: I am not against making newcomers to the hobby welcome (far from it, we need them now more than ever), but am simply unable to see why we old timers are not allowed the same privilege.

You can see why I, as a dedicated CW man, was dismayed to be given a call with the suffix JPZ, which I frequently have to repeat several times before managing to convey it to QSO partners, and sometimes have to give up the attempt. (I should add that it is not my

letter spacing or 'fist' that is the problem, I have been assured of that!) However, I'm not allowed to abandon it for a snappier. even meaningful, alternative. My American callsign, N6OET, is a joy to send in CW, and I would dearly love to be able to choose a British call that is less susceptible to misinterpretation than the one I have. What do other readers think?

Colin Hall GM4JPZ
Dundee

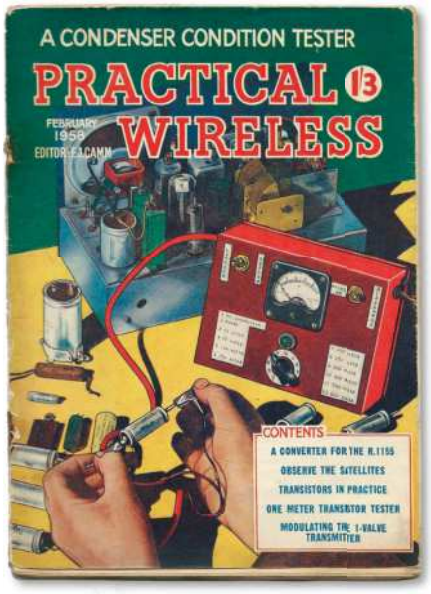
The EA12

Dear Don,

Thank you so much for publishing the article about care of the Eddystone EA12 and particular thanks to the author **Dr Bruce Taylor HB9ANY**. I have one of these receivers and it does need some adjustment so now EA12 owners have the ideal guide for any attention necessary.

A word of caution for readers on the replacement of electrolytic capacitors. I recall from my youthful mistakes that an exploding electrolytic not only makes a mess, but a frightening bang and a pungent smell. Junk box contents are held for long time.

In my case literally for years, so any capacitors that we may have in the junk box may be in no better state than those in the radio. The subject of testing and reforming them was covered in an



article in the February 1958 edition of *Practical Wireless* under the title and with a cover picture of *A Condenser Condition Tester*. My copy has survived so see the attached picture of that cover. For those not fortunate enough to have a stack of old copies of *Practical Wireless*, there are guides on the internet. As an example, see:

https://tinyurl.com/44y33po4

Another method of reforming the capacitors is to bring the radio AC mains supply up slowly (across a period of at least 30 minutes), using a variable transformer (Variac), but these may be scarce nowadays. Note also that Variacs are usually autotransformers so they do not provide safety isolation from the AC mains.

Angus Annan MM1CCR
Blairlogie, Stirling

What's a ZM-2?

Dear Don,

I think there may be an error in G3UGF's article on the Emtech ZM-2 tuner. It says: *"When in circuit for antenna adjustment, the brighter the LED indicator glows, the better the match."*

I have a ZM-2 and the instruction leaflet says: *"...tune for lowest SWR, indicated by the LED going OUT! (their emphasis)"*. This is certainly how my ZM-2 operates.

Of course, it's possible that the ZM-2 circuit has been revised since I purchased mine some years ago, but it might be worth checking.

Keith Ballinger G0RQQ
Lincoln

*(**Richard G3UGF replies**: My apologies – I have checked and the instructions do indeed say the LED goes out. I had written a longer piece on this and cut it down. I think it originally read* "the brighter the LED glows the greater the mis-match"*.)*

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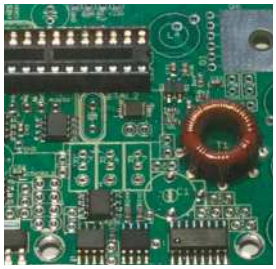

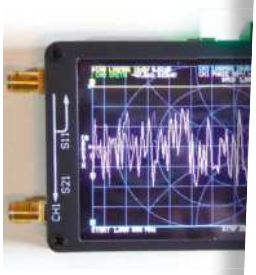

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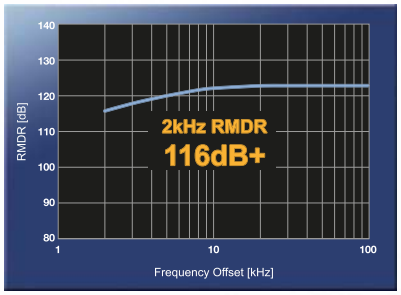

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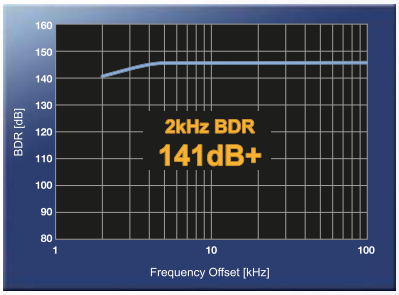

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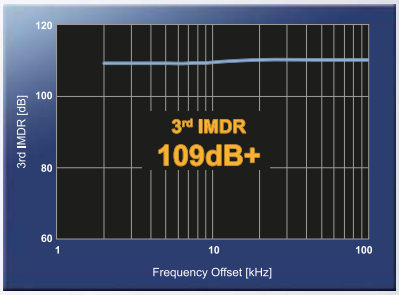

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