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# WIRELESS

FEBRUARY 2024

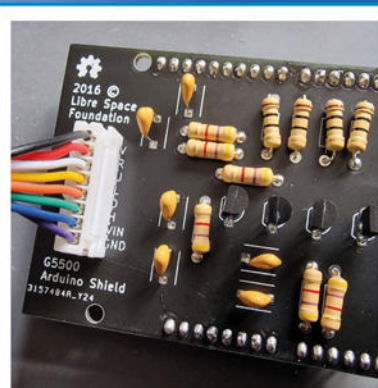
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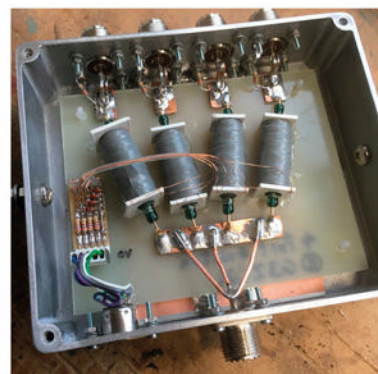
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# Keylines

**A**lthough I'm writing this before Christmas, you will be reading it in the New Year, so Happy New Year! Hopefully HF conditions will continue to improve, and the weather too! (Here in Somerset, we seem to have had nothing but rain for the past several weeks – a number of roads across the Somerset Levels have been impassable – the worst for well over 20 years apparently.)

There should be plenty to look forward to, radio-wise, with most clubs more or less back to 'normal service' these days, plenty of activity on the bands, all being well, rallies and other events gradually starting to pick up again and maybe even some new gear to learn about – it's very quiet at the moment but there are usually announcements as we move towards the US Dayton Hamvention and other major trade shows. And, of course, there's always plenty that we can be doing by way of station improvements, whether by building some new piece of kit, installing a new antenna or whatever. Certainly, the hobby has managed to keep me amused for well over 50 years now and there are still aspects that I have yet to explore!

## Ofcom consultation

Following the recent consultation, Ofcom published its 'Statement: Updating the amateur radio licensing framework' on 11 December. See our News pages for more details although as the Statement runs to three documents, the first of which is over 100 pages, you will almost certainly want to read it online when you have the time to do so.

Along with the main documents, Ofcom have also published the responses, both from individuals and from Essex Ham and the RSGB. As far as I am aware, responses were received from about 1.5% of the UK amateur radio population, although the percentage of 'active' amateurs responding was presumably considerably higher. Nevertheless, the number is disappointing – does it suggest that most amateurs are apathetic about the way we are regulated, or maybe just feel that responding is pointless because Ofcom's mind is made up?

In fairness, most of the changes are fairly innocuous and, indeed, to be welcomed. The one that seems to have generated most controversy is making Regional Secondary Locators (RSLs) optional. This means, for example, that you can drive around the UK operating mobile or portable, while signing your base call sign (G, GM, whatever). Or, even more confusing perhaps, if, say, a Scottish amateur moves to Wales, he can continue to use his GM call sign. At least, this is my understanding. This certainly has potential to confuse overseas amateurs working the UK, and will cause havoc



with contests and awards. The reason seems to be the fear by Ofcom of a legal challenge relating to some sort of discrimination. Time will tell although I suspect most amateurs will continue to air their call signs in accordance with the existing RSL structure.

The new rules are expected to come into place in February 2024 when Ofcom have completed the licence variation process. Meanwhile the overview document states "Licensees can provide representations on these proposed changes by 5:00pm on 22 January 2024. Ofcom will consider all representations that have been provided after this date and decide whether to go ahead with our proposals. We may decide to vary the licences in accordance with our proposal, or with some modifications. We will publish our decisions on the Ofcom website no later than February 2024..." So, there is still time to have your say.

## Active or not?

I referred in the last section to 'active' amateurs. It's an interesting question as to what proportion of UK amateurs are 'active' at any one time. Many get a licence, go through a period of enthusiastic operation and then fall away, perhaps to come back to the hobby later in life (after marriage, children, career, etc). Others may even get the licence to challenge themselves but with little enthusiasm for actually operating. Some want to build equipment and the licence is simply a way of allowing them, when the gear is finished, to undertake on-air tests. Times have certainly changed from when I was first licensed, when most newcomers were in their teens, often pursuing A levels in maths and science, and keen to be active on the bands! But that particular demographic nowadays seems to be more interested in computers, the internet and so on – understandably so but a loss to the hobby.

## Don Field G3XTT

Editor, Practical Wireless Magazine

Read more radio news and reviews at [www.radioenthusiast.co.uk/news](http://www.radioenthusiast.co.uk/news)



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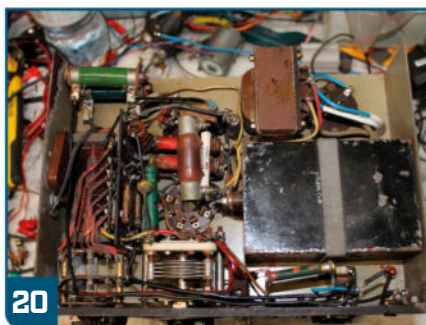
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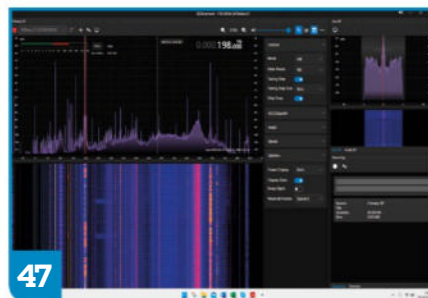
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# Newsdesk

Have you got something to tell our readers about? If so, then email [practicalwireless@warnersgroup.co.uk](mailto:practicalwireless@warnersgroup.co.uk)



## Telonic introduces SIGLENT's SDS7000A Series oscilloscope to the UK

SIGLENT has introduced a new range of high-performance oscilloscopes to the UK with the help of Telonic Instruments Ltd. The SDS7000A oscilloscope range has been developed for dynamic markets, such as telecommunications, wireless technologies and high-speed digital technology. In these industries, oscilloscopes are required to provide expanded functionality to meet not just the increasing demands for acquisition and analysis of high-frequency, complex signals but to meet the growing needs of modern applications.

The SDS7000A is just such an oscilloscope range, offering 12-bit vertical resolution that not only enables the precise imaging of high-frequency signals, but also offers fine differentiation in vertical detection.

More information at:  
<https://tinyurl.com/542x6k8w>

**UPDATING THE AMATEUR RADIO LICENSING FRAMEWORK:** Ofcom have published the results of their recent consultation on amateur licensing, with implementation of the changes to take place in three phases. Full details are on the Ofcom website (see URL below). **Phase 1** relates to new callsign rules and greater flexibility in respect of several areas of operation, such as removing the requirement for Notices of Variation for a number of activities for which they were previously needed. **Phase 2** relates to new Intermediate callsigns, special event callsigns and the number of licences an individual may hold. **Phase 3** will give more flexibility in choosing and changing callsigns. Phases 2 and 3 are dependent on the implementation of a new licensing platform, expected to be ready later in 2024.

<https://tinyurl.com/mu2rtb3a>



**MALTBY & DISTRICT AMATEUR RADIO SOCIETY:** Maltby & District Amateur Radio Society was reformed in August 2023, having closed in 2019. It meets at the Centenary Hall, Bateman Road, Hellaby, Rotherham, South Yorkshire. The Maltby & District Amateur Radio Society does not just do radio, they also branch out to Raspberry PI, Arduino, Electronics and Construction (Radios, Electronic circuits, Antennas etc). Bletchley Park is primarily known for being home to the WW2 Secret Code Breakers and is well worth a visit. It is also home to the National Radio Centre, which is a showcase for radio communications technology. On a recent visit, members of the Maltby & District Amateur Radio Society were able to operate the GB3RS radio station. Contacts were made with several other radio amateurs across the UK, conditions having been impacted by sunspot activity.

After visiting the National Radio Centre, members of the Society visited other areas of Bletchley Park. Members who attended said that it was an excellent day, and they would all like to go back. In a live linkup between Maltby & District Amateur Radio Society and RT Systems (Georgia, USA), members took part in an interactive experience and learned about RT Systems software, and how their support differs from other vendors. This was followed by a Q & A session facilitated by Karin from RT Systems.

Members said that they had enjoyed the presentation and Q & A and had learned a lot about the software.

RT Systems has been at the forefront of amateur radio programming software since 1995 when they introduced their first Radio Programming software for the Yaesu FT-11. Each of their programming software has an easily used interface that makes the radio more understandable. The picture shows Karin from RT Systems on the video linkup.



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# Rallies & Events

All information published here reflects the situation up to and including **18th December 2023**. Readers are advised to always check with the organisers of any rally or event before setting out for a visit. The Radio Enthusiast website [www.radioenthusiast.co.uk](http://www.radioenthusiast.co.uk) has the latest updates, please check it regularly. To get your event on this list, e-mail the full details, as early as possible, to: [practicalwireless@warnersgroup.co.uk](mailto:practicalwireless@warnersgroup.co.uk)

28 January

## LINCOLN SHORT WAVE CLUB WINTER RADIO RALLY:

The Festival Hall, Caistor Road, Market Rasen, LN8 3HT. Doors open at 09.00. Admission £2. Indoor event, ample free car parking. Hot refreshments including our now famous bacon butties. Tables £10 each. Contact Steve M5ZZZ for tables and details: At 14.00 after the Rally there will be a Used Equipment Auction items for the auction will be booked in from 13.00. (BB, CR, FP)

Email: [m5zzz@outlook.com](mailto:m5zzz@outlook.com)

Tel: 0777699069

3 March

## EXETER RADIO AND ELECTRONICS RALLY:

Open 10.00 - 13.00. America Hall, Pinhoe EX4 8PX. Details from Pete G3ZVI

Email: [g3zvi@yahoo.co.uk](mailto:g3zvi@yahoo.co.uk)

Tel: 07714198374

20 April

## 2024 YEovil ARC THIRTY-EIGHTH QRP CONVENTION:

The Digby Hall, Sherborne, Dorset, DT9 3AA, 9.30am to 1.30pm. Admission £3. Talks, Traders, Bring and Buy, club stalls, cafe, parking. Supported by RSGB, G-QRP & Rafars. Contact MOWOB. (BB, CR, CS, FP, RSGB)

http: //Yeovil-arc.com

Email: [derekbowen1949@talktalk.net](mailto:derekbowen1949@talktalk.net)

12 May

## DARTMOOR SPRING RADIO RALLY:

Yelverton War memorial Hall, Meavy Lane, Yelverton, Devon, PL20 6AL. Doors open 10am, Admission £2.50, Free Parking. Contact Roger:

Tel: 07854 088882

Email: [2e0rph@gmail.com](mailto:2e0rph@gmail.com)

## General Rallies Information

<http://www.arri.org/hamfests-and-conventions-calendar>

<http://www.g4rga.org.uk/All.html>

<https://hfdxarc.com/calendar-3/radio-rally-calender>

<https://rsgb.org/main/news/rallies>

[www.radioenthusiast.co.uk](http://www.radioenthusiast.co.uk)

[https://www.hamhub.uk/content/rallies\(pictures\)](https://www.hamhub.uk/content/rallies(pictures))

## Key To Acronyms

BA Buildathon • BB Bring-and-Buy • CBS Car Boot Sale

CR Catering / Refreshments • CS Club Stalls

D Disabled visitors • FM Flea Market

FP Free Parking • L Talks, Lectures and Demos

LB Licensed Bar • MS Meeting Spaces • RF Raffle

RSGB (RSGB) • RU/PW RadioUser/ PW in attendance

SIG Special-Interest Groups • TI Talk-In (Channel)

**NEWS FROM THE RSGB:** The RSGB Examinations Standards Committee has published its annual report, covering the operation of the amateur radio exams during the calendar year of 2022. You can read the report on the RSGB website. Go to:

[rsgb.org/esc](http://rsgb.org/esc)

and click on Minutes, Papers and Reports in the right-hand list.

Following feedback from the amateur radio community, the RSGB's Learning Team is launching a revised Discovery Scheme in the New Year. This will be a revamp of the Individual Scheme from the Beyond Exams initiative and consists of three levels of participation. For more informa-

tion, contact Beyond Exams Coordinator Mark Burrows 2E0SBM via

[be.coordinator@rsgb.org.uk](mailto:be.coordinator@rsgb.org.uk)

At the RSGB 2023 Convention, Brian Coleman G4NNS outlined the plan for the second phase of the UK Meteor Beacon Project. A network of receivers will be developed, streaming their data via a central server for detailed study of individual meteor events. This is a cooperation between the 'worlds' of amateur radio and astronomy. You can watch Brian's presentation on the RSGB YouTube channel. This is supported by the RSGB Legacy Fund, more details about which are at:

[rsgb.org/legacy](http://rsgb.org/legacy)

Following four weeks of deliberations, the 2023 World Radiocommunication Conference concluded in Dubai on Friday 15 December with the signing of the 'Provisional Final Acts' and a closing ceremony. The numerous changes don't formally take effect until 1 January 2025 and preparations are already underway to agree the agenda for future WRC events. The RSGB's special focus pages have the final news report and photos. To view these, visit:

[rsgb.org/wrc-23](http://rsgb.org/wrc-23)

The results will be reviewed by the Spectrum Forum after the Christmas break, alongside IARU and domestic changes. (See also this month's *World of VHF* column regarding the 23cm band)



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David Harris

mydogisfinn@gmail.com

**T**he 50th anniversary of commercial radio in Great Britain passed without much celebration on 8 October 2023, which was the date when LBC first began broadcasting in the London area. LBC was followed on 16 October 1973 Capital (London) and in December 1973 by Clyde (Glasgow). In February 1974 BRMB (Birmingham) began broadcasting followed on 2 April 1974 by Piccadilly (Manchester). A total of 19 Independent Local Radio (ILR) commercial stations were rolled out between 1973 and 1976.

This book, which is published by a Manchester company, celebrates the golden years of Piccadilly Radio from 1974 up until 1988. In 1988 Piccadilly was taken over by Transworld who were then bought by EMAP who in turn were sold to Bauer (in 2008) who now operate the station as Greatest Hits Radio. The authors, **Brian Beech** and **Tony Ingham**, were both part of Piccadilly Radio from its early days. Beech, a former teacher, was a researcher and producer for the station before he embarked upon a career in public relations. Ingham joined as promotions manager and rose to become programme controller. He later worked for Radio City (Liverpool) and also made a career in public relations. This is their first book.

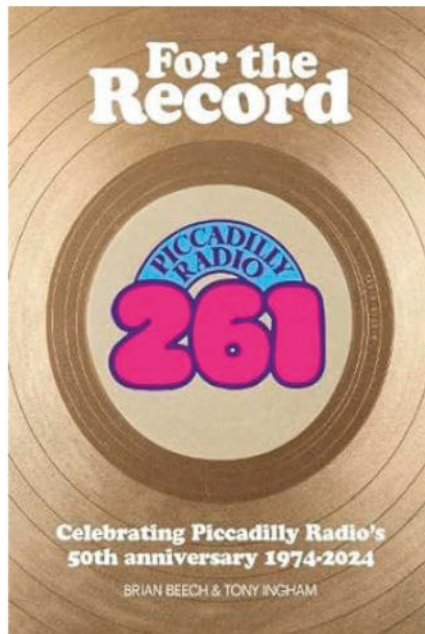
Piccadilly was founded by **Philip Birch** who had run the financially successful offshore station Radio London from 1964 - 1967. Piccadilly began on 2 April 1974 and the first announcer was **Roger Day** (formerly with Radio England, Radio Caroline, Radio Luxembourg, etc.). Roger stayed with Piccadilly until 1979 and he has subsequently worked for BRMB, Invicta and Radio Kent. He is currently a presenter with oldies station Boom Radio. Many other big names in radio worked for Piccadilly in its early years, including **Chris Evans**, **Mark Radcliffe**, **Gary Davies**, **Timmy Mallett** and **Andy Peebles**. **Nick Robinson**, the BBC political journalist, started his media career in the newsroom of Piccadilly Radio.

The early Independent Local Radio commercial stations were very heavily regulated and were also restricted by needle time agreements to the amount of recorded music they could play each day. The station had to provide a varied general service programming, including news, features and talk programmes. In addition to the running costs of the station they had to pay over £100,000 p.a. (the equivalent of £1.25 million today) to the government in licensing fees. The station initially employed 40 staff and had premises in central Manchester at Piccadilly Plaza (after which the station was named).

The station recruited several presenters from United Biscuits Network, which was an internal

## For the Record

**David Harris** reviews a book looking back at the long and distinguished history of Manchester's Piccadilly Radio.



*Celebrating Piccadilly Radio's 50th anniversary 1974 - 2024* by Brian Beech and Tony Ingham. i2i Publishing. £11.95. 173 pp. Pbk. ISBN 9781914933608 [www.i2ipublishing.co.uk](http://www.i2ipublishing.co.uk)

radio station playing music to the workers at biscuit factories. Several well-known radio presenters, including **Dale Winton**, **Roger Scott** and **Nicky Horne**, began their careers with this station. Piccadilly quickly established itself and attracted up to 1.5 million listeners, which was very impressive as the population today of the Greater Manchester area is only 2.8 million. These listening figures enabled the station to sell advertising at premium rates, which in the early years were sufficient to enable the station to cover its huge operating costs. The station provided a full news and sports service and attracted many famous people such as **Sophia Loren**, **David Attenborough** and **Margaret Thatcher**, who all appeared on the station when visiting the Manchester area.

Much of the book is given over to quotes from listeners testifying to how much they enjoyed the station and what an important part it played in their lives. The radio landscape in the UK prior to the launch of commercial radio was dominated by the BBC with its national stations Radio 1, 2, 3 and 4 plus its local stations, including BBC Radio Manchester, which started

in 1970. Piccadilly became very popular because it was focussed on the Manchester area and had a lot of local presenters. It seemed to be a very inclusive employer who would at least give an interview to anyone who wanted to work there regardless of whether they had any previous media experience.

In 1987 the station, which had broadcast simultaneously on 103MHz FM and 1152kHz AM, split into two different stations. They were Key 103 FM, which was a contemporary music station, and Piccadilly Magic AM an oldies/talk station.

The book ends in 1988 when Piccadilly ceases to be an independent local station and began its descent into corporate ownership and frequent rebranding.

The book will certainly provide anyone who lived in Manchester from 1974 - 1988 with a feast of nostalgia. It is very well illustrated with many colour photos of presenters. I felt that the book could have benefited from an extra chapter that looked at the business model of ILR and whether Piccadilly could have been saved as a truly local station. It is disappointing that the 50th anniversary of commercial radio in the UK has gone relatively unnoticed by both the media and academia. Today we have a situation whereby almost all commercial music stations in the UK are owned by just two corporations, Bauer (Absolute, Greatest Hits, Hits, Jazz FM, Kiss, Magic, Scala and some local brands) and Global (Capital, LBC, Heart, Classic FM, Radio X, Gold and Smooth). These stations with their bland mix of pop and dance music have little local content apart from the odd traffic bulletin and some perfunctory local news. **PW**

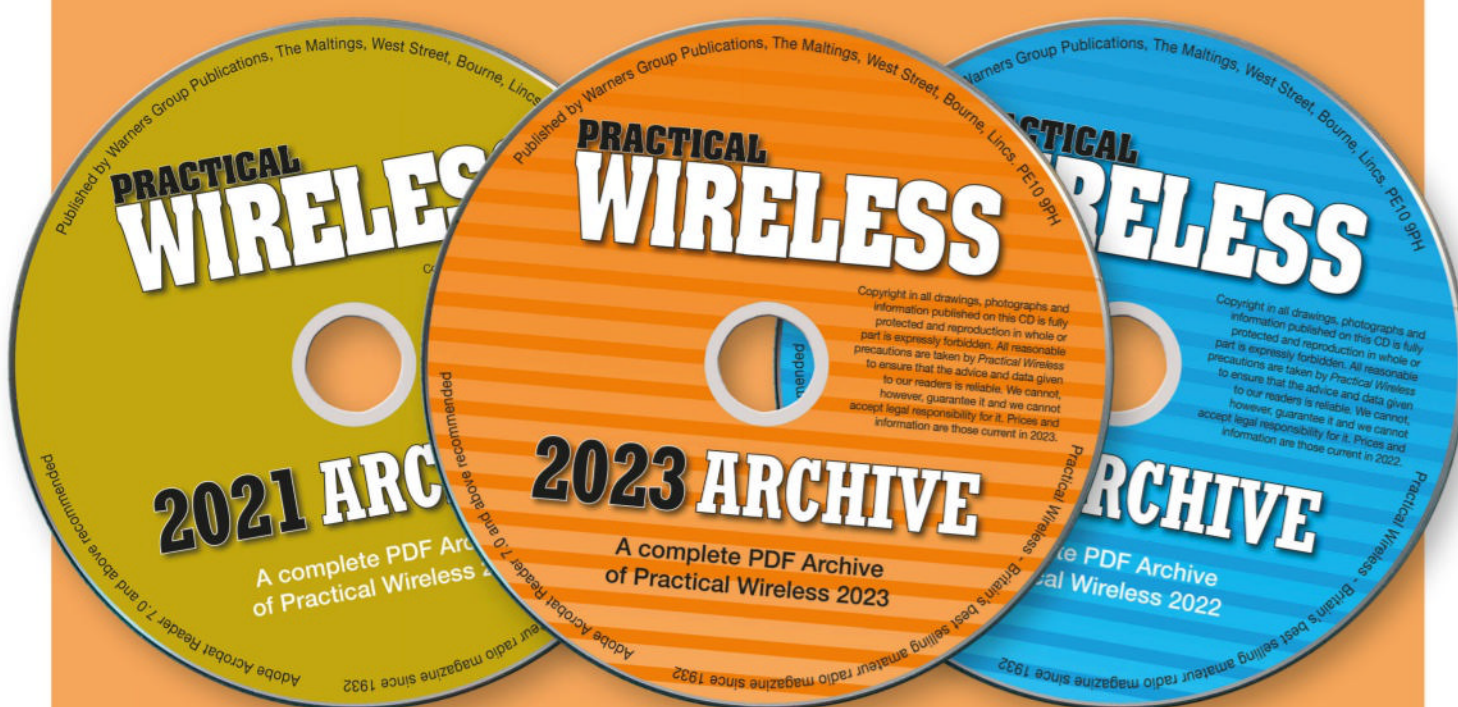
### Furtherreading

- *Local Radio, Going Global* by Guy Starkey, Palgrave Macmillan.. 2015. 202 pp. £18.99. pbk. This book was originally published in hardback in 2011 and remains the only serious study of commercial radio in the UK. **Dr Starkey** (1959 - 2018) had a distinguished career in media and academia which began in 1977 when he was a presenter with Voice of Peace, an offshore station broadcasting to the Middle East.
- *The Piccadilly Story: Piccadilly Radio 261, Manchester* by Philip Radcliffe, Frederick Muller. 1979 (out of print). Beech and Ingham acknowledge the role this early book played in their own research.

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Kevin Ryan

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**D**igital Radio Mondiale (DRM), a digital solution for the AM and FM bands, is very much alive, especially in Asia. Unusually Indonesia is also going to use it in Band III from 174 to 202MHz with the rest allocated to DAB. The fate of DRM on shortwave is mainly in the hands of the international broadcasters although there may be a growing interest among the low-powered European broadcasters such as SE-TA2.

I've used several DRM capable receivers over the many years since DRM broadcasts have been available. China is currently the leading manufacturer of DRM receivers after production of portable DRM receivers faltered in India. Gossell is the leading manufacturer of AM/FM/DRM receivers but with limited production runs.

### Gossell GR-228BP

The GR-228BP is one of the many DRM receivers produced by this company. The specification is available on the Gossell website, including descriptions of the rear connections and the eight function keys on the top of the radio. The GR-228BP has the same facilities as many DAB/FM receivers. Instead of DAB the digital decoder is DRM and the DRM radios usually have an external antenna socket for AM broadcasts.

The *Quick Start Guide* included with the radio is the only documentation available and it is a basic user guide. My radio shipped with a European style two-pin wall adaptor and also included was a five metre long wire antenna meant for indoor use. The radio uses a micro-USB plug (5V@700mA) so many mobile phone or tablet chargers will work.

<https://tinyurl.com/ytwajdzm>

<https://tinyurl.com/5n8m4ykv>

### Power

The radio has an internal chargeable battery rated at 3.7V 2600mAh according to the plate on the receiver. This is the same overall capacity as the NiMH batteries I use in my Pure DAB radio and seems minimal to me. Fully charged they provide about 20 hours of listening time so I expected the same from the GR-228BP. However, it doesn't last anywhere like this time in the DRM mode. I checked that the radio was at 100% charge in the morning, used it to decode DRM for an hour and then switched to standby. In the afternoon battery capacity was down to 39% with the radio giving a 'Low Battery' warning. There seems to be a threshold in battery mode below which the DRM decoder is not enabled.

### Making repairs

There is no obvious way to open the receiver to make any repairs such as replacing the battery pack. The only screws anywhere on the case are



Practical Wireless Rating



A good buy for DRM enthusiasts.

# Gossell GR-228BP DRM receiver

**Kevin Ryan** looks at a handy DRM receiver.

the two TORX type ones for the carrying handle. Undoing them didn't seem to release the control panel from the chassis but I was only applying a gentle pressure. The main body of the receiver is circled by a band of loudspeaker type cloth, **Fig. 1**, securely held in place obscuring any recessed screws.

### DRM mode

The *Quick Start Guide* advises the listener to continually press the Mode button, **Fig. 2**, until DRM shows on the display. It takes two presses to move from one mode to the next. The 'Skip Rotary' knob now tunes the radio to a desired frequency. This rotary is the type you have to turn many times to move forward in frequency. I discovered that by using the Band button, **Fig. 2** again, the radio has a pre-programmed list of broadcast bands starting at FM and MW and will tune to the start frequency for each of the shortwave bands. This feature works in the DRM mode.

### Offairtesting

I found that the 660mm telescopic antenna didn't provide enough signal for consistent reception of the DRM broadcasts. All my DRM listening tests used the multi-band antenna in the loft to provide a higher level of signal.

### Two-line display

The 16-character two-line LCD display is limited in the amount of information it can provide. When starting to decode a DRM service the display shows the frequency and the word 'Tuning'. It will show this status even when there is no signal present. A strong signal will light up the basic signal strength indicators.

### Technical menu

All my other DRM receivers had a 'hidden' technical/engineering menu that showed many of the DRM transmission parameters. The GR-228BP menu is opened by long-pressing the Service but-

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Buttons	
	Power ON/OFF
	Presets
	Menu
	Mode
	Service
	Band
	Scan
	Enter

Fig. 1: Note the layout of the top panel and the wrap-around fabric cover on the body of the receiver. Fig. 2: The eight buttons on the top panel of the receiver. Fig. 3: Typically, the SNR needs to be about 12dB for an MSC using 16QAM and 17dB for 64QAM encoding.

ton and it has several screens of information. The tuning knob moves forward and back among the various screens.

Screen one, **Fig. 3**, has the tuned frequency, signal strength in dBµV, the SNR in dBs and the BER (Bit Error Rate) in scientific notation (e.g. 83e-3). I believe the signal strength is a measure of the RF power in the RF channel. On an empty frequency the signal strength is around 7dBµV. DRM is a multi-carrier system and the SNR is calculated from the average of Modulation Error Rate (MER) of each of the carriers used for the FAC cells in the 4.5kHz bandwidth above the nominal carrier frequency. Once the data bits are extracted from the carriers it is possible to derive the Bit Error Rate as a measure of how many 'bad' bits have been received.

Screen two, **Fig. 4**, details the status of the Cyclical Redundancy Check (CRC) for FAC (Fast Access Channel), SDC (Services Description Channel) and MSC (Main Services Channel) as either ON, OFF or N/A. For decoding of audio and data to happen all three need to be ON. I'm assuming that ON means that the CRC tests true, OFF is available but testing false and N/A means the received data is too damaged to begin the checking process.

Screen three, **Fig. 5**, has the DRM Mode (A-D, but usually A or B), the transmission bandwidth (BW) and the QAM encoding rate for the SDC and the MSC. The FAC is always 4-QAM. Screen four has the data Protection Level and the packet Interleaving rate (usually two seconds but can be 400ms). Screen five has the service label for Service 0 and the audio encoding scheme. The other screens will have the details on services S1 to S3. In the case of the BBC WS the S1 service will usually list the Journaline digital text service



(see below) as BBC WS JL. Typical content of each screen is listed in **Table 1**.

### DRM tests using RRI

I had impressive results with all three morning broadcasts to Western Europe: French at 0500UTC on 11740kHz, English at 0530UTC on 11960kHz and German at 0600UTC on 11620kHz. They have slightly different beams and different encoding schemes. As a comparison, using the DRM decoder plugin in the SDR Uno console I had trouble decoding the English transmission, possibly because it typically uses 64-QAM instead of 16-QAM for the other two. RRI DRM transmissions have since been reduced in number.

### Journaline

The GR-228BP decodes Journaline, the digital text system for DRM. Only the BBC WS for Europe and Funklust use this system. I tested the Journaline decoder on the European service from the BBCWS on 3955kHz. The Journaline decoder detected the service with the display showing 'Receiving...' and that quite quickly changed to 'B\_B\_C\_N\_e\_w\_s'. You open the viewer by hitting the Return button.

Journaline takes a few minutes to build up the list of news headlines and the single sentence news article. The Skip knob lets you scroll up and down the list of news headlines and a second

press of the Return button opens up the associated text as lines of text that flow over the 32 characters of the two-line display. Various characters (\*, ↑, ↓, +, >) delimit the text to help you move up and down the screen. The Settings button moves you back up the Journaline tree.

The Journaline data decoded more quickly on the receiver than usually happens in the DReaM based software decoders. Journaline used to carry three feeds but 3955kHz only had the news from Europe and that probably helped with performance.

### AM performance

The AM mode covers the extended medium wave band (522 – 1710kHz) and shortwave from 2.3 to 26.1MHz. Reception on MW is quite noisy compared to the SDRPlay RSP1A using its 6kHz filter and with the noise reducer on. The Gossell seems have no noise reduction built into the firmware and it shows. In fact, the GR-228BP magnified the digital background noise picked up by my antenna. The radio only demodulates AM-DSB and you can't select sidebands. The GR-228BP has a better performance on shortwave and is on a par with SDR RSP1A.

### Interference rejection

I don't have any test equipment and relied on an off-air test in the 19m band. The same antenna is split

Fig. 4: All three status indicators must be ON to decode DRM audio. Fig. 5: The mode, bandwidth and encoding information. The FAC is always 4QAM.

and fed to both an RSP1A and the Gossell GR-228BP. My wanted signal was Radio Free Europe on 15255kHz in Turkmen from Thailand measuring -74dBm on the SDR RSP1A. The unwanted signals were CGTN Radio from China aimed at Europe on 15245kHz at -55dBm and Adventist World Radio on 15265kHz in Turkish measuring -65dBm.

My wanted signal was audible but with significant 'splash', especially from China. Shortwave signals from transmitters in China are typically modulated to be  $\pm 8$ kHz, easily spreading into adjacent channels. Other tests with three stations spaced 5kHz apart and with tighter control of the sidebands than CGTN use were quite pleasant to listen to.

### FM reception

The skip/tuning knob and the scan button work quite well on this band. The radio supports RDS that you scroll through using the menu button. There are a couple of things to note in that the radio does not display the station name (it just says FM rather than BBC R2, for example) and relies on the radio text to scroll the station name on line two of the display.

On most stations I tuned in the display remained at <Radio text> but eventually my local station *BBC Radio Berkshire* displayed a scrolling band of text. My conclusion was that the RDS decoder needs a strong signal to work consistently.

### Bluetooth

The GR-228 works fine as a speaker. I used the RadioPlayer app on my phone as the audio source and I could Play and Pause the audio and adjust the volume on the GR-228.

A unique thing about this radio is that it has a microphone and the Enter button can control a connected mobile phone. It didn't work quite as described in the manual. I could answer a call but couldn't reject it or end the call. That may well be a flaw in the Android software on my mobile. To be honest I can't quite see why Gossell implemented this feature.

### USB/SD connect

Both these options worked as expected. The controls are basic and the radio has no connections to uPNP devices that you find on DAB receivers based on Frontier Silicon modules. I would have liked to record either audio or DRM I/Q signals to the USB device.

### Buying options

I purchased the GR-228BP on Amazon's UK website. I couldn't fault the service provided by Fuzhou Gulou Ltd. in terms of shipping and later



F	:	1	1	9	6	0	k			2	4	d	B	u	V
S	N	R	1	6	d	B		B	E	R	8	3	e	-	3
F	A	C	I	S	D	C	I	M	S	C		C	R	C	
O	N			N	/	A		O	F	F					
M	o	d	e	:	B		S	D	C	:	1	6	Q	A	M
B	W	:	1	0			M	S	C	:	6	4	Q	A	M
P	r	o	t	e	c	t	i	o	n	:	0	/	1		
I	n	t	e	r	l	e	a	v	e	r	:	2	s		
S	o	:	R	R	I		G	a	I	b	e	n	i		T
t	e	x	t		m	e	s	s	a	g	e				

Table 1: typical content of each technical screen.

answering a few technical questions. The cost was £170.85, including a promotion and delivery charge of £19.90. The latest list price on Amazon is £158.90 but I have seen it as high as £178.80 and this continues to vary with the exchange rate.

### Worth buying?

Is it worth the outlay to own a DRM receiver, especially when shortwave seems to be in decline again? As an enthusiast my answer is yes, mainly because the convenience of a receiver hasn't yet been beaten by apps and PC based solutions. The GR-228BP is a 'no frills' receiver limited mainly by its two-line display.

It is true that shortwave broadcasting has been in decline for many years but new DRM services are coming on air, especially from Germany. Radio SE-TA2 registered a new regular broadcast for the B23 broadcasting season, the enigmatic Music 4 Joy is exploring the use of DRM and there is Funklust and C.M. Obrecht's occasional DRM broadcasts.

DX possibilities are there from RNZI, WINB and China National Radio with the latter being reported on a more regular basis. It is worth remembering that DRM needs a good signal level and you really need an external antenna for the best results. **PW**



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**Don Field G3XTT**

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I have been four times previously to Mauritius but always to travel on to another (DXpedition) location, so I was delighted this year to be invited to join **Olof G0CKV** and others for a contest operation from Mauritius itself. Olof has been going to Mauritius for this contest (CQWW CW on the last weekend of November) for several years and has built up quite a stockpile of equipment and antennas, so it promised to be a great operation. I try to go somewhere outside the UK most years for this one – the pre-eminent CW contest worldwide.

There were seven of us on the team: Olof, **Jamie M0SDV**, **Alan K0AV**, **Dave WD6T**, **Denny KX7M**, **Ranko 403A** and myself. We arrived at various times and by various routes but were all at the contest location a week before the contest, in plenty of time to set up all the antennas, the station equipment and the software to control it all (including logging). And what a location! A rental villa on what is essentially a private island on the north coast of Mauritius, accessed by a short causeway. Seawater all around!

We quickly settled into a routine of putting up antennas early morning and late afternoon, the midday heat being somewhat overwhelming (yes, I know the weather in the UK was terrible at the time! That's why I go elsewhere for the November contest!). We had phased VDAs (vertical dipole arrays) for 10, 15 and 20m, a vertical dipole for 40m, a quarter wave vertical for 80m and a loaded vertical for 160m. Plus omnidirectional verticals for 10, 15 and 20 given that the VDA arrays were aimed at Europe/North America and we wanted to be able cover other directions too, and also a K9AY receive loop for 160/80/40m, shared between those stations.

Next came station build – five Elecraft K3 transceivers plus a Flex 6700, and a variety of linear amplifiers, though mainly SPE 1.3K and 1.5K models, chosen for their light weight. So, we had a complete station for each of the six contest bands 160 through 10m. But that is just the start. PCs have to be set up using the DXLog contest logging software, with the software configured for a networked environment – important for seeing which frequencies the various stations are on and passing 'multipliers' between the bands.

Once it's all assembled comes the acid test, running all stations at full power (800W is allowed in Mauritius) to check whether there are any interactions, inter-station problems of various sorts. The good news was that these were minimal, probably because we had been careful to achieve maximum separation between the main antennas. We were also using bandpass filters between each transceiver and amplifier, in addition to further (high power) filters on the



## A visit to Mauritius

Don relates the tale of his recent trip to Mauritius for the CQWW CW Contest but also has a look at the amateur radio scene on the island.

output of each amplifier. You can never have too many filters!

During the contest 'spots' are delivered from the worldwide RBN and Cluster networks but, of course, they can be from anywhere in the world so there is no guarantee that the spotted stations will be audible in Mauritius. So, in addition, we had several SDRs, receiving locally and feeding into our network – a guarantee that anything they spotted would actually be audible with us.

By way of an experiment, Ranko 403A was also determined to run a second, in-band station on 15m. This involved installing an omnidirectional antenna well away from the main 15m antenna (about 250m was what we were able to manage, with locally sourced coaxial cable), and, due to the SO2R (single-op, two radio) capabilities of the Flex 6700, having a second operator scanning the band away from our 'run' frequency and, where appropriate, interrupting the run station to work additional multipliers or even previously unworked stations.

### The contest

As we were four hours ahead of GMT, the contest started for us at 0400 local time. Propagation from Mauritius, being relatively close to the equator, follows a well-known trend, which is that only the highest bands are open during much of the day because of absorption at the lower frequencies but, of course, the high

bands tend to drop out at night, albeit the 20m band is open for much of the night. 160 and 80m don't really come into their own until a couple of hours after sunset, again because daytime absorption has to dissipate. The best time for north-south propagation on the low bands tends to be when it is local midnight halfway between us and the distant station. But for the longest paths to the west, into the USA, the best time is close to or at our sunrise. However, the first night of the contest low band conditions were very poor and, to make matters worse, there was a CME (coronal mass ejection) that passed earth around 0835UTC on the Saturday, which impacted all the bands to some extent.

Generally speaking, the signals on the higher bands were strong from all areas, albeit our main 20m operator noted that the band was in considerably better shape on the Sunday than on the Saturday, presumably as the effect of the CME was wearing off by then. Sadly, the low bands were well down on the previous year – very noisy and with weak signals other than just before our sunrise.

On the Sunday afternoon we were visited by several of the local amateurs, including **Francois 3B8HI**, **Bryan 3B8HO** (who gained his Class A licence just a couple of months earlier, having previously been 3B8BBH) and **Patrice 3B8FA** who I had worked on 6m FT8 just over a year ago. Patrice was telling me that he had

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**Photo 1: Don at one of the operating positions.**

**Photo 2: During the contest, l to r, Dave WD6T, Denny KX7M, Ranko 403A, Alan K0AV.**

**Photo 3: Our little 'island' with some of the antennas visible. Photo 4: MARS logo.**

previously been active on 2m EME and was now active through QO-100 (with, I gather, over 100 countries worked).

With seven operators we all had plenty of operating opportunities and the contest ended with us claiming a score of 24.6m points from 10,300 contacts. Finishing at 4am left the operators on the last shift rather tired but we were all up and about reasonably early on the Monday to start taking down antennas and dismantling the stations.

### Amateur radio in Mauritius

When I visit new places I like to learn about the local amateur radio situation. Mauritius is a well-developed island and has an active radio club – the Mauritius Amateur Radio Society (URL below and they also have a Facebook page).

#### 3b8mars.org

MARS was founded in 1968 although amateur radio on the island has a distinguished history going back to pre-WWII years. Radio amateurs had their equipment confiscated at the start of the war and some were fined but the authorities quickly realised they needed competent CW operators to monitor enemy transmissions and came cap-in-hand to the radio amateurs to help out, which of course they did. One amateur, VQ8AD, was asked by the Admiralty to go to the Chagos to install and operate a radio station there. That young man enrolled himself in the Royal Navy and sailed for Diego Garcia where he installed, maintained and operated his radio station to signal to Mauritius of any abnormal shipping movements in the Chagos. Messages were passed to another amateur in Beau Bassin and he would communicate those messages to the Admiralty radio station in Vacoas by the landline via the Beau Bassin Police Station. Some names associated with the above operations are **Paul Caboche VQ8AD** (later 3B8AD, who became a SK in 2012 at the age of 94), **Henri DiAgnels VQ8AE**, **Volcy de Robillard VQ8AS**, **Raoul Thomas VQ8A?**, **Lenny Mazery VQ8AB** and **Jean Regnaud VQ8AA** to name just a few.

As a country, Mauritius includes the inhabited island of Rodrigues some 560km (350mi) to the north-east, and other scattered coral atolls such as Cargados Carajos and Agalega. Nowadays the callsign prefix for Mauritius itself is 3B8, while Rodrigues is 3B9, Agalega is 3B6 and St Brandon 3B7. 3B9 counts as a separate 'entity' for DXCC awards, as does 3B6/3B7.

There are two classes of licence, with full licensees authorised to run 800W. There are



currently about 45 permanent licensees on the island (as against visitors such as ourselves), a mix of locals and ex-pats (such as **Clive 3B8CW** who worked across the world with Cable & Wireless but chose to retire in Mauritius). Interest in amateur radio has increased since MARS was authorised to conduct licence examinations. As in many other countries, the national regulator has more than enough on its plate without wanting to be too involved in the administration of amateur radio.

One of the stalwarts of amateur radio in Mauritius for very many years was **Jacky 3B8CF**. Sadly Jacky passed away on 17 November, shortly before our visit. Jacky, born in 1943, was first licensed in 1967 as VQ8CF. Other calls he held were 3B6CF, 3B7CF, 3B9CF, 3B8CF/3B7, VQ9SM (Diego Garcia) and KB1PR. His son **Ashwin 3B8GL** carries on the family amateur radio tradition.

Local operators tend to steer clear of HF operation, partly because many houses have



limited space and also because HF antennas can be a liability when the annual cyclones hit. But there is quite a lot of interest in QO-100 operation, which is also convenient insofar as a dish can be set up on a small footprint. There is also coverage of much of the island with 2m repeaters.

Visitor licensing is relatively straightforward via the ICTA website. All the documentation can be prepared and sent electronically, although the site recommends that it is sent at least three months before your visit to allow the necessary checks to be made. Visitor callsigns are in the form of 3B8/homecall. **PW**

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**Richard Constantine G3UGF**

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Perhaps a sentiment not echoed by your neighbours but as most amateurs have more than one radio these days, a convenient multi-purpose second or even third string to the antenna bow is always welcome. Sometimes you just need that extra capability to monitor something or make a quick contact without having to re-route cables, connectors and adapters. I know that I do so does the discone fit the bill?

I first encountered this type of antenna back in the 1980s at the height of the wideband scanning receiver boom, just before the emergency services and mobile phones went digital and spoiled the fun of eavesdropping.

Before the days of online, 'buy it now' my company commissioned and sold hundreds of VHF/UHF discones and scanning receiver packages, retail and mail order. Initially, I didn't see how these strange devices could work but spotting rugged VHF/UHF discones on navy ships and military vehicles convinced me that they must do.

The discone dates back to a patented 1945 design by the wonderfully named **Armig G Kandoian** who worked for the forerunner of the ITT Corporation, in New York. The design was first conceived for fuselage mounting in a protective dome on aircraft. The lower part can be a true metal cone or radial elements representing an equilateral triangle. The length of the longest element determining the lowest frequency of operation. Later design parameters also recommend that element legs be joined together by a wire ring at the bottom of the cone to enhance the cone effect, not something you see in modern commercial designs. The angle of the cone, the distance between the cone shape and the upper disc is critical, as is the distance between them. Everything needs to be calculated correctly for the intended frequency range. In a true discone the upper disc diameter insulated from the lower cone, should equal 0.7 of the diameters of the base of the cone shape.

According to the *ARRL Antenna Handbook*, a discone is capable of good impedance characteristics over a 10:1 frequency range. The handbook also contains formulae and dimensions to build a full-size practical HF version covering 7-30MHz using an 11m (36ft) mast, 24 x 11.5m (38ft) wires forming the cone and 8 x 8.1m (26ft 7in) wires in a star shape forming the top, quite a beast but I'd love to have a go!

Lots of interesting discone stuff is now more readily available than ever before on the internet and it's worth a look even if it's just out of curiosity. Knowing all this peaked my interest when I was offered the chance to review the latest Skyking TXHF-6. By comparison, to the full-size equivalent, a diminutive load-discone strikes me as something of a hybrid.

The TXHF-6 combines a receive capability between 3.00-1000MHz and a 200 watts PEP trans-



## SkyKing TXHF-6 – a very different Discone

**Richard Constantine G3UGF** says "You can never have too many antennas!"

mit capability on 3.5/7/14/21/29/50MHz, which is unusual. Plus, it has the option to substitute 14MHz for 10MHz and 21MHz for 18 MHz resonators if you prefer, more later.

### On arrival

It arrived tightly packed in one of those now ubiquitous clear view yellow plastic sleeves and the only tools I needed to fully assemble it being a 10mm spanner and a crosshead screwdriver as a 2.5mm Allen key is included for tuning adjustments.

The 75cm (29.5in) polished alloy 32mm (1¼in) diameter support tube side mounts to a mast of anything up to 57mm (2¼in) in diameter by means of bespoke cast alloy brackets and U-bolts. However, I wouldn't recommend it. I discovered later just how much this type of antenna is affected by its surroundings. A mast of half the maximum diameter is to be preferred.

The clever part is the custom chrome finish centre, shown in **Fig. 1**. It's similar to other Skyking designs but has only three lower elements forming the cone.

Harking back to the design parameters I mentioned earlier, three is just enough to form an equilateral triangle. All of the elements, **Fig. 2**, attach to the centre by means of pre-tapped threaded studing and secured by 10mm securing locking nuts.

For a permanent installation I would suggest using something like copper-slip or conductive grease for longevity and easy future removal.

Each of the three lower elements is of identical length at 83cm (19in). If my memory serves me correctly, this is around a quarter wave at 144MHz. The antenna isn't designed to operate above 50MHz but I guess the rods were readily available from the maker's other antennas.

### What's different?

Unlike a conventional array the six horizontal elements are what you might call base loaded, adjustable whips, covering the various amateur bands. Each inductor is approximately 15mm in diameter and designed to accommodate an adjustable length ground stainless steel whip, secured by a grub screw.

Larger diameter inductors would have a higher Q factor. Perhaps chasing a small increase in performance might lead to greater interaction between inductors and diminishing returns as the whole thing would need to be scaled up to accommodate the additional weight.

The 80m coil is something of a potential bird perch at a whopping 49cm in length with an inductance of 297µH – a quick CQ would likely see them off.

Assembling the TXHF-6 is straightforward. It's best done by first removing the central hub from its

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Fig. 1: Central hub.



Fig. 2: Elements ready for assembly.

support tube, held in place by a single bolt, so as to connect a PL259 terminated coaxial cable. Doing it this way avoids getting poked in the eye when the elements are in place. As for attaching the elements, the only real way to do this is with the support tube already fixed to the intended mast.

There's a single A4 instruction sheet included in the pack. It gives recommended lengths for the initial set up of the band elements, calculated from the grub screw fixing to the tip. In addition to the six appropriate whips already installed on the band coils, two additional whips are included. These are replacements for use with the optional bands, 10MHz and 18MHz. Personally, I would be tempted to use these in preference to the non-WARC ones as they make a nice monitor for band condition/activity, avoiding the ever-growing contest clashes.

There's no information given as to which resonator goes where on the top radius. For that reason, I used my time-honoured method employed when installing earth/counterpoise radials. I placed 3.5MHz opposite 7MHz and 14MHz opposite 28MHz so as to minimise mutual coupling. The remaining two bands were then placed opposite each other, on the diagonal.

### Setting up

Two things I expected to find were narrow bandwidth and higher average VSWR for transmission purposes. I was not disappointed. Indeed, the design of not just this model but disconses in general is a typical VSWR of 1.5. This is not as bad as it appears in power loss/reflection terms at around 44%. It's OK but not ideal for 21st century, solid-state power amplifiers.

Compact disconses are not usually used as main station devices at HF. At the outset of this review I indicated that's not where I see them best used as they have other benefits. Using an antenna matching unit can easily keep a power amplifier happy while broadening the usable frequency range.

Back to the story .... I was looking to see if I could

better the quoted average VSWR and indeed I did, just about. On the higher bands I measured 1.32 for a spot frequency and 1.4 overall, but the two lowest bands were definitely 1.5 at best.

On behalf of readers, I always like to start any exercise of this type with the maker's written instructions so all of the whips were set to the recommended lengths. Not everyone has a Chinese Vector Network Analyser (VNA) in their back pocket, although they are becoming much more available and competitively priced these days. For that reason, I like to start with the good old VSWR meter readings across each band, just as a clue as to where the natural resonance is or isn't.

This proved harder than usual, particularly on the two lowest frequencies. They were way out of band at the initial whip lengths. The higher the frequency the closer they were to the band. The reason was somewhat obvious when I stopped to think about it. The radiating elements were parallel to the ground beneath the mast, making the test height critical. Fortunately, my test gear includes a telescopic mast. The higher it went, the better the readings became.

For a permanent installation it's preferable to sleeve several ferrites over the coax and mount it atop a mast, rather than close to a chimney stack etc. The TXHF-6 needed to be at least 7m above ground to give acceptable results. What followed this revelation was a pleasant afternoon of upping/downing and whip adjusting.

### What did I learn?

There were small interactions with other elements but my original decision on element placement seemed to pay off. Height and definitely clear space are absolutely essential to achieve a decent match. Bandwidth on the highest band was around an average 30kHz but down to a few kilohertz on 3.5MHz. I'd recommend prospective users decide and record which part of any band they prefer.

After a lot of self-debate and coffee I bit the bullet,

messed up the whip lengths and started again, this time using a VNA. It's fair to say that having taken a lot of time previously I was slightly cheating as I already knew the correct answers. The VNA was much more straightforward. It also gave a better information as to the overall bandwidth range. Treat yourself to a VNA or put it on your next present list.

### Performance

I was under no illusions that a discone would replace my other antennas and expected it to be way down in signal strength. Not so, as it did provide credible results on an SDR receiver, especially when a few dBs of preamplifier were added, and was also usable for general coverage reception.

Transmit wise, it definitely works reasonably well in conjunction with an autotuner, but don't expect strong signal reports with QRP power levels. It has potential for data modes and beacon monitoring. My local 50MHz repeater isn't line of sight and is around 15 miles away over the hills. It was workable but not very strong, presumably due to cross polarisation. SSB mode would likely be better as most stations use horizontal polarisation. Shame I couldn't find anyone to contact.

### What's in a name?

In the true sense of the word and reading the original design; is it a true discone? Perhaps not quite...

Can you say than an Electric Vehicle is a car? Of course, you can ... It looks like one, it performs like one so it is one. On that basis the TXHF-6 is a, 'hybrid-discone' and that makes it not only interesting but useful.

It's well made and an innovative design. Provided it's mounted high and clear of its surroundings and some time is taken to optimise things, it represents value for money.

My thanks to Moonraker for the kind loan of the TXHF-6, extended somewhat due many rainy November days! TXHF-6 is available at £129.95 at time of press. **PW**

**Billy McFarland GM6DX**  
gm6dx@outlook.com

I was looking to interface my Yaesu rotator controller with PC control and I found a few options available online. I worked my way through them looking for a simple low-cost option and came across the K3NG Arduino-based controllers. Like all PC rotator controllers I needed some software and for that I used PST rotator. Having made the decision to make the Arduino based controller I ordered up some parts.

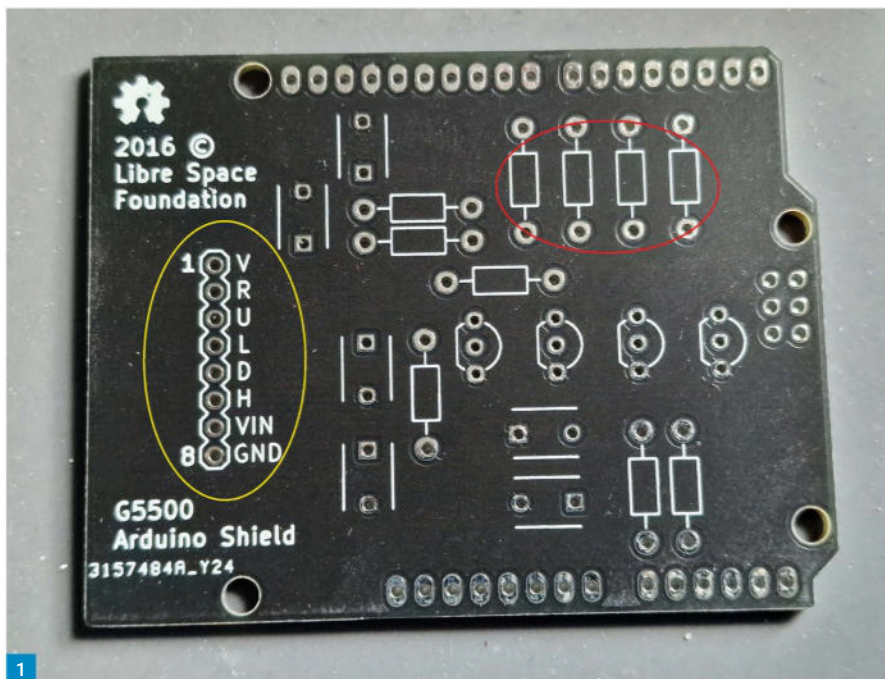
- 1 x Arduino R3 (or similar)
- 1 x G5500 Shield (I got lots of these made up when ordering some other PCBs but you can order them from Libre Space Foundation)
- 4 x 1kΩ resistors
- 6 x 4.7kΩ resistors
- 4 x transistors (2N2222 or similar)
- 6 x 103 capacitors
- 1 x enclosure
- 1 x 8 pin din socket and connector
- 1 x 8 pin JST connector or small amounts of 24awg wire.

Before I proceed with the description on how to make this I recommend that you read up on how to program an Arduino or at least on how to send/write a program to the Arduino R3. Also, you need to ensure that your Yaesu controller has a 6-pin mini din or 8-pin din socket which allows connection to an interface. The controllers that this was tested on were the G1000DXC and the G5500. The first stage is to take your PCB/G5500 Arduino shield and start to add the components. Looking at **Fig. 1** the group of four resistors within the red circle is where the 4 x 1kΩ resistors get placed. The yellow circle highlights the pin numbers for which the wires get connected between the shield and the 8-pin din socket. Luckily there are not too many other components so simply add the remaining 4.7kΩ resistors, capacitors and transistors. **Fig. 2** shows these items being added. Once all the parts have been added it is time to add the pins to the underside of the shield, which allows the connection of the shield to the actual Arduino board. This can be a pain in the backside and I have found it easier to use an old Arduino clone, hot glued into a plastic case, to act as a holder of the pins, which then allows me to solder the pins in place onto the shield easily. **Fig. 3** shows this set up. To finish off this shield you need to add eight wires to the front of the PCB. I used an 8-pin JST connector that I had lying about but you can solder direct onto the board. **Fig. 4** shows the complete board.

Now that our shield has been assembled it is time to flash/program our Arduino R3. Open up the Arduino writing program (Arduino IDE) and visit my files at this link:

<https://shorturl.at/mwHS1>

Save this folder onto your desktop and open



## Control the controller

**Billy McFarland GM6DX** has an Arduino-based project to control a Yaesu rotator from your PC.

the k3ng\_rotator\_controller.INO file. Upload this file onto your Arduino board and that is the programming stage complete.

Take your programmed Arduino and place the shield on top, making sure the pins line up with the sockets. Now you need to fit the assembled Arduino into an enclosure. I used a black metal enclosure as I found metal works best for RF issues. However, you need to ensure the Arduino R3 is isolated from the base of the metal enclosure preventing any electrical shorts occurring. As well as having access to the USB-B connector you also need to fit an 8-pin din socket, which I recommend as being placed at the back of the enclosure. **Fig. 5** shows my enclosure under construction with the 8-pin din socket on the rear panel. Once the enclosure is just about finished we need to wire up the 8-pin din socket with our shield. Pin 1 on the shield goes to pin 1 on the din socket and continues in a 'straight through' order, pin 2 to pin 2 etc. **Fig. 6** shows the position of each pin numbers from looking into the connector as well as what each pin is for. This is useful for when wiring a cable to suit your model of Yaesu controller. When it comes to wiring up the 8-pin socket, the use of multi-coloured wire makes the job a lot easier. **Fig. 7** shows the socket wired up. Complete the assembly of your interface, double-checking you can insert a USB cable into the R3 board and also access the 8-pin socket freely. **Fig. 8** shows the

completed interface unit.

Once complete we need to make up a cable in order to make a connection between your interface unit and the controller. To start on the cable, get a pre-made 6-pin mini din cable and cut off one connector. Take an 8-pin din plug and fit this to the end that you have just cut off. Ensure the pin wiring is as follows (for most Yaesu controllers which have a 6-pin din socket on the controller). Pins from the 8-pin din plug going to the 6-pin mini din as follows:

2 goes to 1, 4 goes to 2, 6 goes to 4, 8 goes to 5 and finally connections 3 and 6 of 6-pin mini din get connected together.

For the G5500 rotator it is a straight-through 8-pin din cable. The final step is to connect it all up physically and set up the PST rotator program. This project is very simple to do and does not require a lot of skill. Having said that, it does take a bit to set up with the software, which to discuss would be a complete article on its own. To help you out I have created a step-by-step guide on a PDF which can be found here:

<https://shorturl.at/zFOPS>

This details the PST rotator software and how to check the calibration of the rotator. In addition, you can see a short demo of my custom Arduino controller working here:

<https://shorturl.at/gyTZ8>

As always any questions please email me at [gm6dx@outlook.com](mailto:gm6dx@outlook.com)



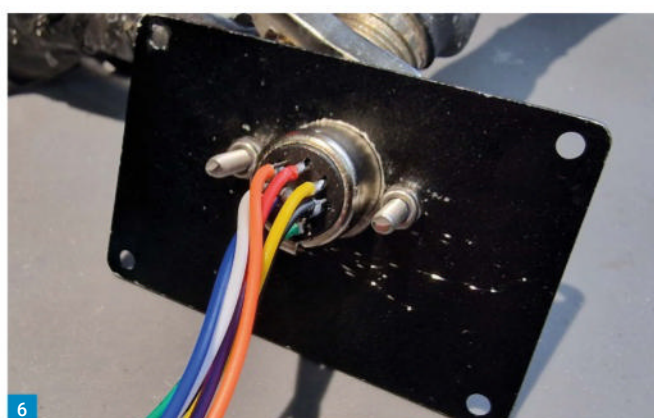
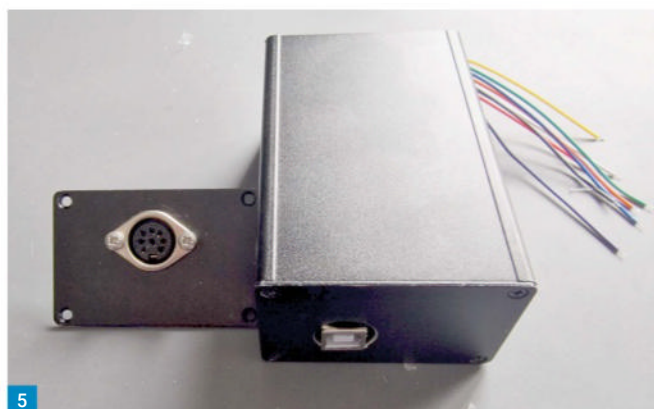
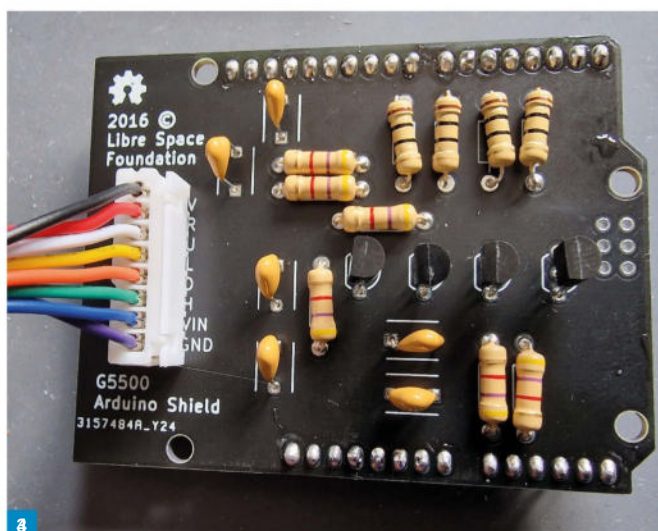
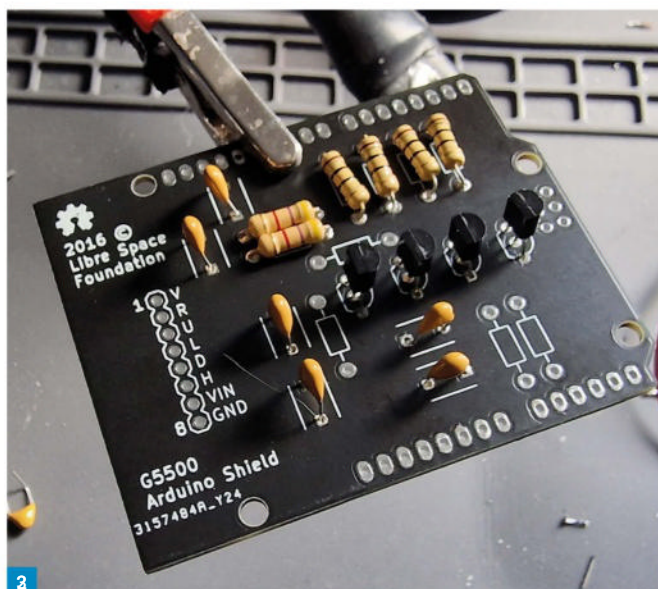
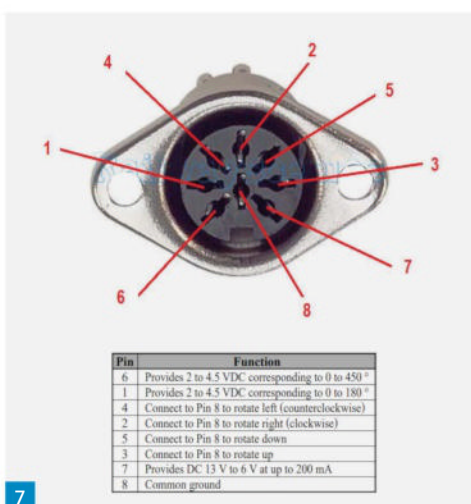


Fig. 1: Location of resistors and capacitors. Fig. 2: Adding the components. Fig. 3: Board soldered to Arduino shield. Fig. 4: The finished board. Fig. 5: Enclosure under construction. Fig. 6: Pin locations and functions. Fig. 7: Wiring of the socket. Fig. 8: The completed unit.



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**Peter Russell G8FWY**

peter.russell@steamrail.co.uk

**F**irst, an explanation. I think it was in October that my daughter said to me "Dad, do you want an Army morse code thingy for Christmas?" Well, as you might guess, I hadn't a clue what she was talking about – and neither did she! So, of course, I said yes.

A little while before Christmas and she arrives with a rather hefty looking item in a carrier bag and says "Happy Christmas, Dad". Out of the bag comes a very rusty metal cased 'thing' about 10 inches cubed. It had obviously had a hard life, probably languishing in a damp shed for several years, the meter was broken and its paint peeling.

OK, so this was going to be a project that would take some time and I had a few others on the go, so in my 'spare' time I did a bit of research.

Turned out this was a WW2 portable CW transmitter, used mainly by the Marines. Using three valves; 5Z3 (rectifier), 6V6 (oscillator) and 807 (PA), it was capable of about 30 watts and covered 2.9 to 22MHz. Normally accompanied by a CR100 receiver and a petrol generator. Some portable setup!

I thought I was reasonably familiar with most WW2 wireless sets – I started my short wave listening on a 19 set that cost me £2/10 (that's £2.50 to you young 'uns) and followed that with an R1155 – but this one I'd never heard of.

Finding the information about this set took a bit of time and I could find very few references to it. I only found two museums that had examples of it, so I assume it must be quite rare. I did manage to find an instruction book with the circuit, components list and operating instructions, so that was a good start.

Now, I've watched enough *Repair Shop* to know that the proper thing to do would be a sympathetic restoration, not scrub all the rust and paint off and re-paint, but to try to preserve its history. Also, to try – where possible – to use original components for repairs.

I made a start about the end of January, first removing the set from its case. Someone had been in there before me and had done a bit of re-wiring, thankfully easy to undo and put right. Now for a close inspection. A word of warning here for anyone thinking of working on old valve equipment. Valves were powered by very high DC voltages – in this case about 750V – more than enough to kill you.

But before you can power it up there are several checks you need to make. Whoever had been in there before me had unsoldered the high voltage supply to the rectifier and taped up the wires. I had to wonder why – and I soon found out. Now, a little more looking around and I homed in on the mains input connector. A



1

## Restoring an Admiralty Pattern X2113A Transmitter Type 5C

**Peter Russell G8FWY** undertakes a fascinating restoration.

two-pin round plug, which could be put in either way round. And no earth connection.

Certainly not up to current standards, but it is 70 years old and it was designed to run off a portable generator. In the interests of safety, I decided to change it for a three-pin miniature Bulgin plug and socket but, of course, the Bulgin was slightly smaller in diameter. I cut off the bezel from the original socket and turned a ring of aluminium to the same outer diameter. I mounted the new socket on the ring and mounted the whole thing using the original bezel.

Another obvious problem was the aerial ammeter. This was a thermocouple device, measuring up to 0.5A. Try as I might, I could not find a replacement. I eventually had to settle for another thermocouple type, this being a 0.35A one. As you might guess, it was too small to fit the hole! As the original was too far gone to even contemplate a repair, I cannibalised it. I fitted the new meter inside the casing of the old one with a bit of epoxy putty and even if I do say it myself, it looks pretty good.

After further inspection of the mains wiring, I



2

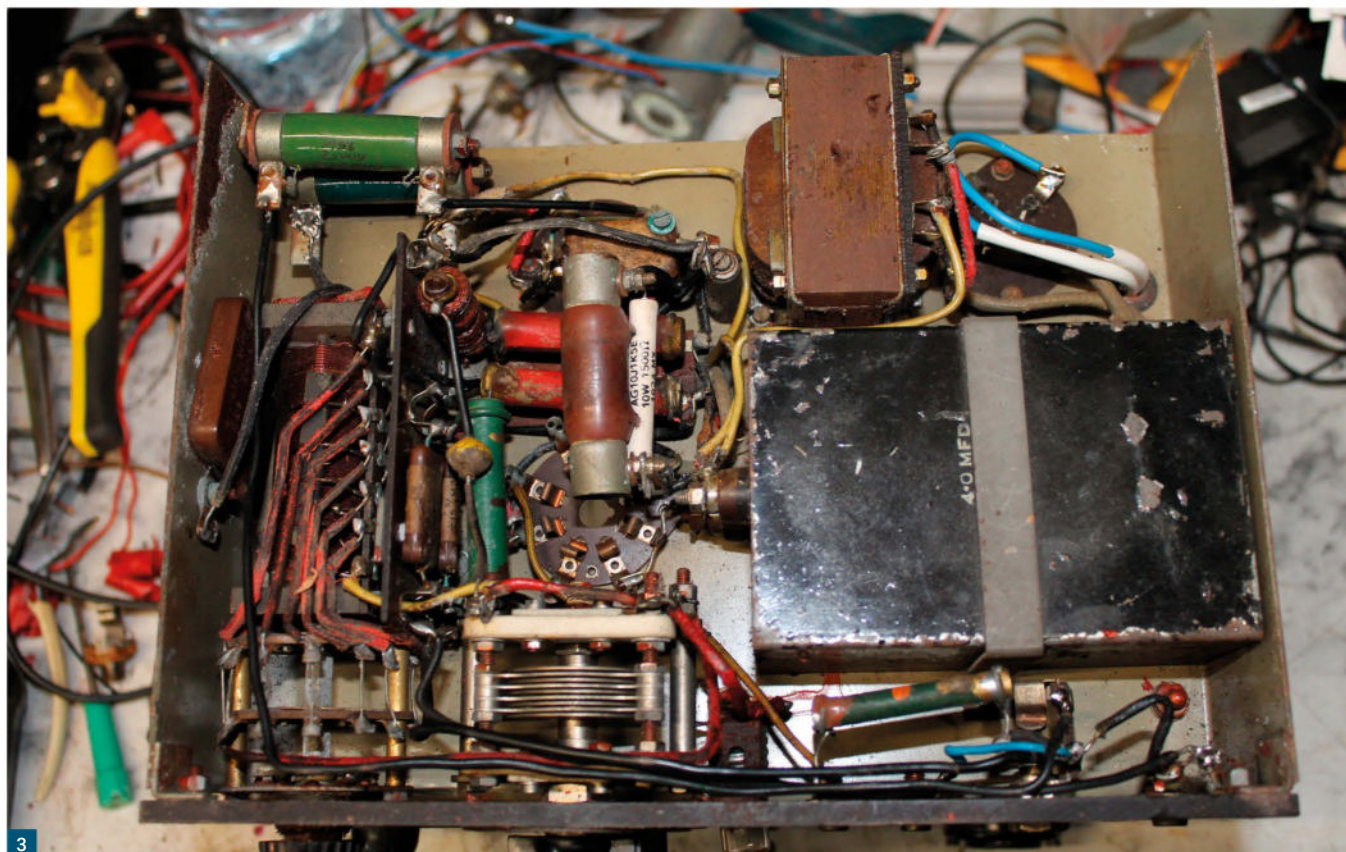
applied some power. All three valves lit up and no smoke!

As the transmitter normally runs at around 750V HT, it should not be a problem to apply a 500V megger to the HT line. It measured fairly high.

A further visual inspection indicated that there might be a problem with a large wirewound resistor. Sure enough it was open circuit and it was supposed to be 1.5kΩ. This was a 10W resistor supplying HT to the 807 and it was badly overheated. Working down the chain and I found a 4000pF silvered mica

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**Photo 1: The set on arrival**

**Photo 2: Three-pin mains connector fitted.**

**Photo 3: A look inside, showing the replacement 1.5kΩ resistor. Photo 4: Old and replacement aerial ammeters. Photo 5: The new meter fitted.**

capacitor was almost a full short.

The resistor wasn't a problem. I found one of appropriate rating and mounted it across the terminals of the original. The 4000pF was a bit more of a problem. Inspection of the circuit diagram indicated that it was an RF bypass on the HT line. The only replacement I could find was a Russian one of 3900pF, which I bought from Romania.

OK, two problems solved. I did some more checks on various components and couldn't find any more.

When it came to restoring the transformer HV leads I found that the insulation was starting to crack up. I installed some new sleeving along the full length of the wires and rewired them to the rectifier. Powering up and the HT came up nice and slowly (you wouldn't get that with transistors!) and settled at 750V. No bangs, smoke or sizzles.

Now, the HT smoothing capacitor was supposed to be a non-polarised 4μF, but my little component tester didn't quite know what to make of it, sometimes indicating 2μF. This

capacitor was a large can, about 2½ x 1½ x 4in and it was a devil to get out. I think the set had been built around it! Now I had it on the bench I tested it again. This time the tester gave me a constant reading of 2μF. It had to be replaced.

Once again, a trawl of the internet and the only one I could find (at a reasonable price) was in Greece. I ordered it and it duly arrived – in a plastic bag swimming with oil. I got a refund and was assured by the supplier that the oil was not PCB! The only suitable capacitors I could find were electrolytics.

I eventually decided to use 2 x 16μF and 1 x 8μF, all 500V working, in series to give 4μF

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6

**Photo 6: The finished project - looking a lot better!**

1500V, and to 'hide' them inside the original can.

That was fun! Cutting the lid off the can and the whole thing was filled with pitch. The only way to get it out was to warm the can and let the pitch run out. Messy! I installed the new capacitors with plenty of insulation and re-sealed the can with epoxy. A quick check with the component tester said 4µF.

Now, this set relies on a crystal to set its frequency, but I didn't have one. An on-air chat with a friend produced a 3.52MHz one. So, crystal plugged in and set powered. A quick tune and the neon indicator in the oscillator glowed brightly. Now to find a Morse key.

Before I plugged in the key, a few moments thought. What was I going to use for a dummy load? What would I expect the output impedance to be? This set was designed to use a long wire aerial of 100 to 200 feet. It certainly

wouldn't be anything near 50Ω.

Let's look at this from another angle. If the meter reads 0.25A (half full scale) and the transmitter rated output is 30W, then we can get a rough approximation of the output impedance. From Ohms Law  $P/(I^2) = R$  (I said it was rough!). So,  $30/0.0625 = 480\Omega$ . We can calculate that the output impedance at full scale current must be about 100Ω.

I wasn't interested in the power output, just a load to dump any power into, so I made up a 2:1 transformer on a ferrite ring and fed it into a standard 50Ω dummy load.

Dummy load connected, set powered up and oscillator tuned. Key down and as you would expect from an 807, a nice blue glow. Tuning the PA and output coupling, I couldn't get much in the way of aerial current, but I was able to see what was happening on a spectrum analyser. It needed very careful tuning to achieve a clean output.

A slight aside here: when I was doing my research, I found that in the early 1950s a

modification was produced for this set to prevent interference to Band 1 television. I couldn't find any details, but it must have been a low pass filter. This set is a great harmonic generator if it isn't perfectly tuned! I certainly won't be operating it on 80 metres!

## The cosmetics

So, I now have a WW2 CW transmitter, repaired and restored to working order, but still in a rusty old box. Time to do the cosmetics. A load of fine wire wool, lots of hours and a lot of elbow grease and most of the rust disappeared. I even found a brass ID plate that I hadn't noticed before.

This has been my first restoration in the radio arena – I've restored a few steam engines, but that's different – and it has been a thoroughly fascinating project. But what to do with it? As I said earlier, I won't be putting it on the air.

I suppose it should be in a museum as I'm sure there can't be many of them left. **PW**

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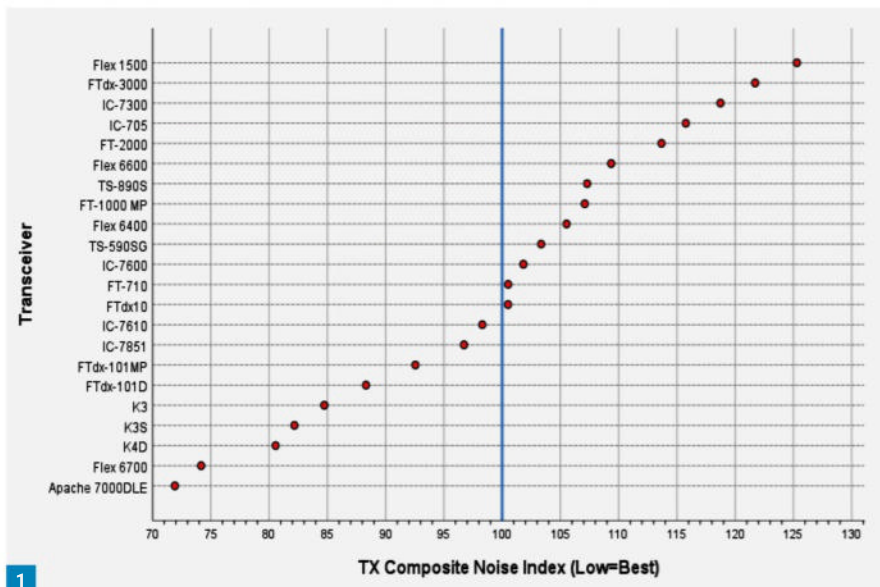
When Rob Sherwood NC0B's article in the November 2019 issue of *QST* appeared, it set a mental benchmark for amateur radio operators and manufacturers [1]. The paper, *It's Time to Clean Up Our Transmitters*, identified the performance element left behind by transceiver manufacturers: *transmit noise*. He outlined three key elements of transmitter output that can be problematic.

One is *broadband transmitter noise*. This is most noticed during times of multiple operators in a common vicinity (such as Field Day or any group operating activity). It's the *composite noise* that receivers detect from the airwaves. Often, composite noise is called phase noise in ARRL Lab's graphics summary but it is the AM noise component that is more important to reception rather than purely phase noise. The roll-off of composite noise after a specified bandwidth offset is what is best measured.

A second element of transmitter performance is *key clicks* from CW carriers. The rise time in modern transceivers can be adjusted but default settings often produce terrible key clicks (Sherwood 2019: 39). Once again, it's the offset-specific performance in rise time that can be associated with as much as 25dB difference in key clicks. This can create significant interference for the reception of frequency-adjacent weak CW signals.

A third element is *SSB splatter*. No doubt that readers have heard the wideband splatter of SSB odd-order intermodulation on a conventional radio. It is especially visible when directly viewed on a modern SDR-based waterfall receiver. These are caused by non-linearity in the amplifier stages which, while present in most modern transmitters, can exceed the nominal 2.1 to 3kHz transmit bandwidth. How much ('splatter') depends on several factors. Operators can be oblivious to the speech processor settings or use too much drive that is needed into an RF amplifier. Even with judicious operator behavior, splatter bandwidth can be excessive. Many 100-watt radios have higher odd-order intermodulation at their top power output than at much lower levels. The lower settings are what amplifier manufacturers frequently caution users about but many exceed the recommendations. What's put into the air waves is more than many hams realise!

While Sherwood's article set a mental benchmark for hams, it is not known how much impact it has had on manufacturers. It was also not the first admonition calling for improved transmitter performance. As Sherwood's popular bench test suite has demonstrated, *receiver* performance has significantly improved over the last decade or so (see Howell 2021a,b). But transmitter performance does not even meet



## Transmit Quality Among Modern Transceivers (Pt I)

Frank M. Howell K4FMH discusses issues of transmit quality.

the measured transmit purity of Rob's venerable Collins 32S-3. He thus demonstrated the long-standing nature of the transmit purity problem emanating from manufacturers.

A corollary issue is that many bench test reviews – the ARRL *QST* reviews are a prime example – only present graphics of summary data, presented in what some have called obtuse, and do not yield explicit comparisons to other radios. **Jim Brown K9YC** (2014), for instance, obtained some of the spreadsheet files from (former) ARRL Lab Manager **Bob Allison** to construct more meaningful representations of transmitter performance. He began that paper with this proviso:

*"Meanwhile, transmitters have largely been ignored; the result is a mess on our bands, especially during contests. The work presented here is part of an effort to correct that situation. Let's begin by studying plots ARRL lab test data for the keying spectra 5kHz either side of a CW signal."*

Brown concluded that the data analysed therein documented the 'RF trash' commonly heard on the ham bands that is produced by the transceiver.

But what of the manufacturers' response in the eight years since K9YC's well-read study? He

surprisingly concluded that *money tends to buy a 'dirty' transmitter* and that poor CW performance 'runs in families' (manufacturers). Jim also called for an improvement in how the ARRL tests radios, especially in SSB testing and in the need for more direct wording in reviews. Jim's directive was simply, *"If a rig transmits phase noise 20dB louder than competing radios, the ARRL review should say that in plain English, and state that such radios should not be used to drive a power amplifier."* There have been others who have called for changes in how the ARRL tests, or presents test results, in their Laboratory. **Leif Åsbrink SM5BSZ** also raised similar issues with example test data back in 2005 and again in 2014. The clear need is for more independent reviews where no advertising is attached to the testing organisation or individual.

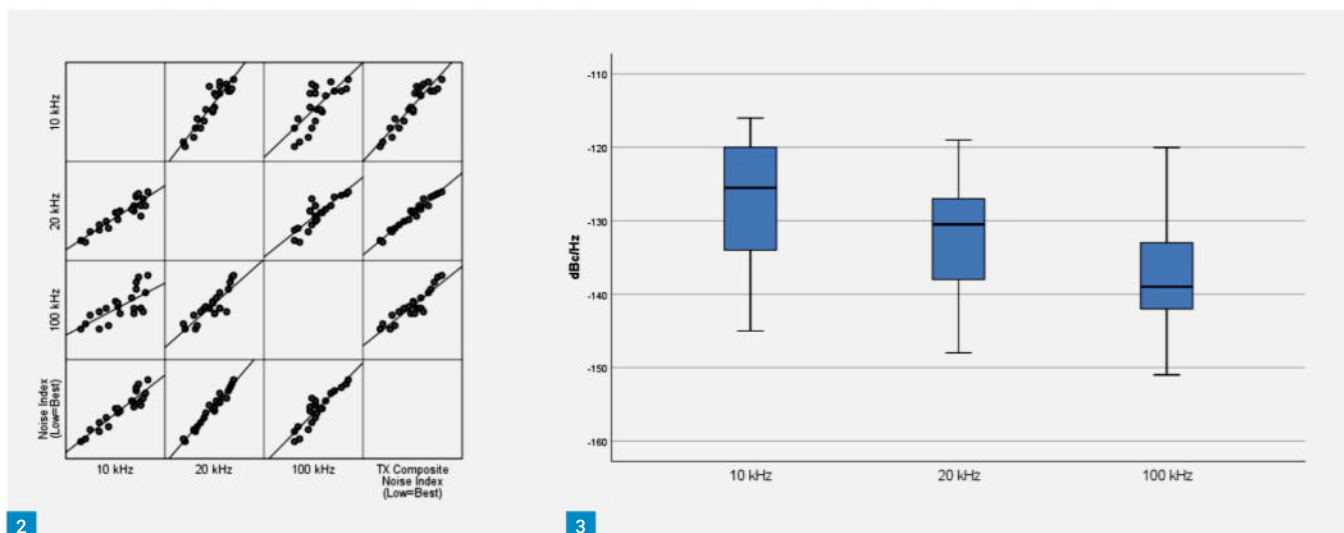
### New data and comparisons

While there are not as many transceivers as in the Sherwood Receive Table, a team of European amateurs and Rob Sherwood have tested many modern transceivers for transmitter purity. Their results have been curated by **Rick Westerman DJ0IP** on his website:

[www.dj0ip.de/transceivers/tx-noise](http://www.dj0ip.de/transceivers/tx-noise)

They are presented in tabular and graphical





**Fig. 1: Ordered Dot Plot of Transmit Composite Noise Index in Rank Order (upper), Scatter Plot (lower). Fig. 2: Scatter plot matrix of transmitter noise measurements. Fig. 3: Box plots of transmit noise components.**

form. These represent the *only public set of transmitter tests* that directly respond to Sherwood's three elements of transmitter quality. I have extracted several segments of those bench tests covering 20 modern transceivers, coupled with data from Sherwood NC0B, including recent entries into the market (Elecraft K4D, Yaesu FTdx10 and FT-710). Due to the smaller number of radios on which SSB splatter and CW key clicks were measured, I only utilise transmit composite noise here. For each transceiver, I match it with the Sherwood Receiver Table data and my composite Sherwood Performance Index of those nine measurements (see Howell 2021a,b and [foxmikehotel.com](http://foxmikehotel.com)). These are supplemented with year of product release, price at market entry, and average eHam rating from my research published in the *ARRL National Contesting Journal* (and curated at [foxmikehotel.com](http://foxmikehotel.com)).

This is Part I of a three-part series in *Practical Wireless*. I provide a description and a visualisation of which transceivers perform better than others on transmit composite noise. This is fundamentally new information for amateur operators. In Part II, I compare transmit quality to Sherwood's receive performance measurements, transceiver price and year of entry into the marketplace, and how hams evaluate the transceiver as consumers. In Part III, I provide a summary grouping of these HF transceivers so that amateurs can see which ones are similar on transmit noise, receive performance, price at market entry and general satisfaction among amateur operators. This is the data-driven outcome of this study. In several aspects of the research, additional extended and user-interactive results are available at [foxmikehotel.com](http://foxmikehotel.com).

com [2].

The strength of this research design is *internal validity* [3]. Each transceiver was tested by procedures disclosed to the public and comparable to common testing standards. The weakness is *external validity*. It represents a small portion of the modern transceivers being manufactured today. The reader should bear in mind that this is 'speculative reasoning' using the best publicly-available bench test data for transmit composite noise. But it is the *only* such study that both examines transmit and receive performance as well as market entry price and satisfaction by hams in modern transceivers. As Sherwood lamented (2019), it is past time that more focus be placed on transmitter measurements to match those for receivers. But starting with what is available is just that, a start. Even with limited generalisability to all manufacturers and all transceivers in release today, the results are telling with regard to Sherwood's argument.

## Data and results

The bench measurements are mostly from amateurs affiliated with the TK0C DX group in Corsica, led by **Robi Vilhar S53WW**. Rob Sherwood NC0B also contributed to those measurements as outlined on the DJ0IP website [4]. The results are organised by the description of composite noise using various statistical and graphic visualisations. The main tools are tables listing the various data; a dot plot [5] ordered on the metric of the underlying transmit measurement; and a scatter plot [6] with additional characteristics identified through color glyphs (e.g., manufacturer) and labels (e.g., transceiver). A linear regression line [7] is used in the scatter plots to give the reader a sense of the association between the two plotted variables. Reference lines in each scatter plot are used to frame the data into halves or quadrants, assisting the reader in visualising transceivers that have

the most desirable characteristics displayed in the graph.

Measurements of transmitter composite noise, **Fig. 1**, were taken using 100W (or less for a few radios) as described at the DJ0IP website [8]. Tests were made using the 20m band. I use all three frequency offsets to best compare differences across transceivers (10, 20 and 100kHz). The radios tested included in my analysis include the Elecraft K4D and the Yaesu FTdx10 and FT-710 from Sherwood (private communication). **Table 1** contains the list of radios and their composite noise measurements at three frequency offsets. Because the specific measurements correlate so highly, **Fig. 2**, I used principal components analysis (PCA) to create a *linearly-weighted index* reflecting all of the measurements of composite noise (see Howell 2021a for details on this procedure). Note that since noise is undesirable, a *lower* score on this index refers to lower transmit noise.

To assist the reader in comparing each radio, I've added the average noise figure and a measure of how each radio varies across offset frequencies, the standard deviation [9]. Sherwood noted that differences in this measurement are important (Sherwood 2019: 39). For instance, the difference between the lowest (Apache 7000DLE) and highest (Flex 1500) composite noise is 29dB. Even if the second highest radio is used to equalise the transmit power (Yaesu FTDX3000), since the Flex 1500 is a QRP radio, the difference is still 27dB.

Comparing the offset frequency measurements, the noise does fall off as the offset gets larger for every radio (higher frequency away, less noise heard). But not so much for some! The standard deviation column captures this (lack of) variation. The lowest values are 0.47 for the FTDX3000 with not much better for the K3S. However, it's key to keep the average in mind as the K3S has a much lower composite noise level at all three offsets. The highest variation across offsets are observed

Manufacturer	Transceiver	TX Noise: 10kHz Offset (dBc/Hz)	TX Noise: 20kHz Offset (dBc/Hz)	TX Noise: 100kHz Offset (dBc/Hz)	Avg TX Noise (dBc/Hz)	SD TX Noise (dBc/Hz)	TX Composite Noise Index (T-Score)
Anan	Apache 7000DLE	-145	-147	-151	-147.67	2.49	72.61
Elecraft	K3	-133	-140	-149	-140.67	6.55	85.12
	K3S	-141	-142*	-143	-142.00	.82	82.63
	K4D	-137	-141	-151	-143.00	5.89	81.05
Flex	Flex 1500	-116	-119	-120	-118.33	1.70	124.71
	Flex 6400	-122	-127	-139	-129.33	7.13	105.42
	Flex 6600	-118	-123	-141	-127.33	9.88	109.15
	Flex 6700	-143	-148*	-148	-146.33	2.36	74.81
Icom	IC-705	-121	-122	-128	-123.67	3.09	115.40
	IC-7300+	-121	-121	-124	-122.00	1.41	118.30
	IC-7600	-122	-130	-142	-131.33	8.22	101.80
	IC-7610	-128	-130	-142	-133.33	6.18	98.35
	IC-7851	-129	-135*	-138	-134.00	3.74	96.83
Kenwood	TS-590SG	-119	-133	-139	-130.33	8.38	103.29
	TS-890S	-119	-127	-139	-128.33	8.22	107.14
Yaesu	FT-1000MP	-123	-129	-133	-128.33	4.11	106.94
	FT-2000	-117	-127	-130	-124.67	5.56	113.36
	FTdx101D	-137	-138	-141	-138.67	1.70	88.62
	FTdx101MP	-134	-136	-139	-136.33	2.05	92.75
	FTdx3000	-120	-120#	-121	-120.33	.47	121.21
	FTdx10	-130	-131	-135	-132.00	2.16	100.50
	FT-710	-129	-131	-136	-132.00	2.94	100.51

Note: Each TX noise measurement is at a specified bandwidth in dBc/Hz. An average of the three transceiver measurements is shown along with the variation across bandwidths expressed as the standard deviation. The TX Noise Index is a T-Score based upon principal component analysis with a mean of 100, SD of 15. A lower score is better since less noise is desirable. It comes from a linear composite index of the three individual measures. + measured at 30 watts. \* Measurement taken from Sherwood reports on the transceiver. # Interpolated in consultation with Rob NC0B.

**Table 1. Transmit Composite Noise Components and Index**

for the Flex 6600 (9.88) and TS-590SG. Thus, some transceivers have significantly varying roll-off values across these offsets.

The set of box plots in Fig. 3 illustrate the overall decline in median composite noise across larger frequency offsets. This is *between* all transceivers rather than *within* them as the standard deviation represents. But the variation across all transceivers does not decline with offsets, which makes the specific numbers in Table 1 important to examine in detail for each transceiver. The variation *within* each transceiver *across* the frequency offsets shows how consistent the realised engineering design turned out to be in bench testing. It is important not to confuse the two ways of examining these data within each radio as a characteristic versus comparisons across all of them.

The final column contains the transmit composite index score, which has a mean of 100 and standard deviation of 15. Using the standard deviation as a guide, comparing transceivers in terms of fractions of a standard deviation is a common and useful practice. The scatter plot matrix in Fig. 2 shows how each offset's measurement is highly correlated with the other two, suggesting that the index validly represents rig-to-rig differences in overall transmit noise.

I compare transceivers on the composite index in Fig. 1 using a ranked dot plot in the upper panel where each transceiver on the left is sorted in order of the composite noise index along the bottom. There is significant variation across radios tested, something that Sherwood expressed clear and critical concern about (as did Brown and Asbrink). The ordered dot plot demonstrates how a simple *ranking* of radios on bench tests can mask significant gaps in the actual continuous data from the test.

The transceivers with the lowest composite transmit noise are the Apache 7000DLE and the Flex 6700. Third place is held by the Elecraft K4D but there is a 12-point gap between the 6700 and K4D. This is almost one standard deviation of 15 points, a *large* gap. All of the Elecraft transceivers fall into rank order, followed by the Yaesu FTdx101 radios (the D and MP versions). Icom's recent flagship transceivers, the 7851 and 7610, rank next, showing that the later 7851 had lower noise than its immediate predecessor.

The new Yaesu HF radios, the FTdx10 and FT-710, are next and have almost the exact same measured noise. As one follows this rank-ordering, the next break in the continuous index is after the Flex 6600 and the Yaesu FT-2000. Note that two Flex radios differ on this index

of composite transmit noise. The 6600 model scores worse than their entry-level 6400 radio, whereas their top model, the 6700, was nearly the best. Kenwood's latest transceiver, the TS-890S, falls above the median (100) with higher noise, even higher than their older mid-range radio, the TS-590SG. The very popular Icom transceivers, the 7300 and the newer 705, have among the highest measured transmit composite noise in these radios. The highest is the Flex QRP rig, the 1500 (no longer in production).

## Conclusions on Part I

Rob Sherwood's mental benchmark (2019) for how transmit purity fits into manufacturing design and production served as my point of departure. I've added here how transmit noise fits into a consumer's paradigm of measured receive performance, price and satisfaction with transceivers. These results place a finer point on these issues than previously available. Several key findings are worth noting from this investigation.

Consistent with Sherwood's concerns, there is a significant variation among modern transceivers in transmitter composite noise. This was true even within the same manufacturer's radios. The single exception to this might be those made by



Elecraft. They have had a nominal continuous improvement in the measures observed in these data. Further evaluation of transceiver particulars is left to the reader for which I provide additional interactive tools at [foxmikehotel.com](http://foxmikehotel.com)

In Part II, I will compare the transmit noise measured on these HF transceivers to Sherwood's receive performance tests, their year and price at market-entry and the overall satisfaction with them as rated on the popular website, [eHam.net](http://eHam.net). There are surprises for the reader that will be made clear as to how in modern HF transceivers cost is related to performance, in which the transmit performance is best, and how well others say they enjoy them.

## References

[1] The advice of Rob Sherwood NC0B is gratefully acknowledged. He has been a terrific amateur radio colleague and superb Elmer of the RF measurement of transceivers and receivers. Any errors of fact or interpretation should be attributable to the author alone. The comments, suggestions and encouragement of Dr. Scott Wright KOMD are also acknowledged. The genesis of this paper owes to his urging me to pursue the inclusion of measurements on transmit purity

as a part of extending my earlier work that he published as NCJ Editor.

[2] See <http://tinyurl.com/4v536t38>. Additional results and interactive tools are also available there.

[3] See <http://tinyurl.com/33hbrb9e>.

[4] For the transmit composite noise data, some measurements for the 20kHz frequency offset were not reported on the DJ0IP.de website for a few transceivers. As denoted for each relevant entry in Table 1, these measurements were obtained either through Sherwood's additional test reports at Sherweng.com (often also contained at the DJ0IP website (<http://tinyurl.com/yt93288h>) or by interpolation in concert with Rob Sherwood (private communication)). Where both Vilhar and Sherwood contributed measurements, the Sherwood ones were used here.

[5] See <http://tinyurl.com/ys77a67p>.

[6] See <http://tinyurl.com/bddvw97b>.

[7] See <http://tinyurl.com/3653ffw3>.

[8] <http://tinyurl.com/5y5x6ryh>. Sherwood (2019: 39) notes that also testing at 30-40 watts would be very useful as this represents the typical output power level used to drive a linear amplifier.

[9] See <http://tinyurl.com/2bm526r8>.

## Further reading

- Leif Asbrink SM5BSZ. Real life dynamic range of Modern Amateur Transceivers: The correct way to measure transceiver quality. *CQ VHF* Fall 2005: 25ff. See also: <http://tinyurl.com/2mbh9k9t>
- Jim Brown K9YC. A Comparison of ARRL Lab Data for Selected Transceivers. September 7, 2014. Online resource: <http://tinyurl.com/mupptvdc>
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**F**arnborough Airport is to be the first UK airport to adopt a next generation 'hybrid digital control tower' working position, as part of a new project for NATS and the leading digital tower supplier, Searidge Technologies. The new digital working capability will enable controllers to manage aircraft both by direct visual reference from the control tower windows as they do today, enhanced by a fully interactive panoramic video presentation on screen displaying key parts of the airfield.

Strategically placed ultra-high-definition cameras will provide the controllers with views of distant areas or those obscured from the tower. Searidge's technology platform will give the controllers access to tools that provide improved tracking of the whole airport surface via integration of new ADS-B surveillance and 'head-up' labelling of the panoramic video. This will allow the controllers to monitor individual aircraft and airport vehicles more effectively, boosting safety and efficiency, especially in low visibility. The deployment at Farnborough will be the first live deployment for Searidge in the UK, following the installation of a non-operational digital tower 'laboratory' at Heathrow in 2018.

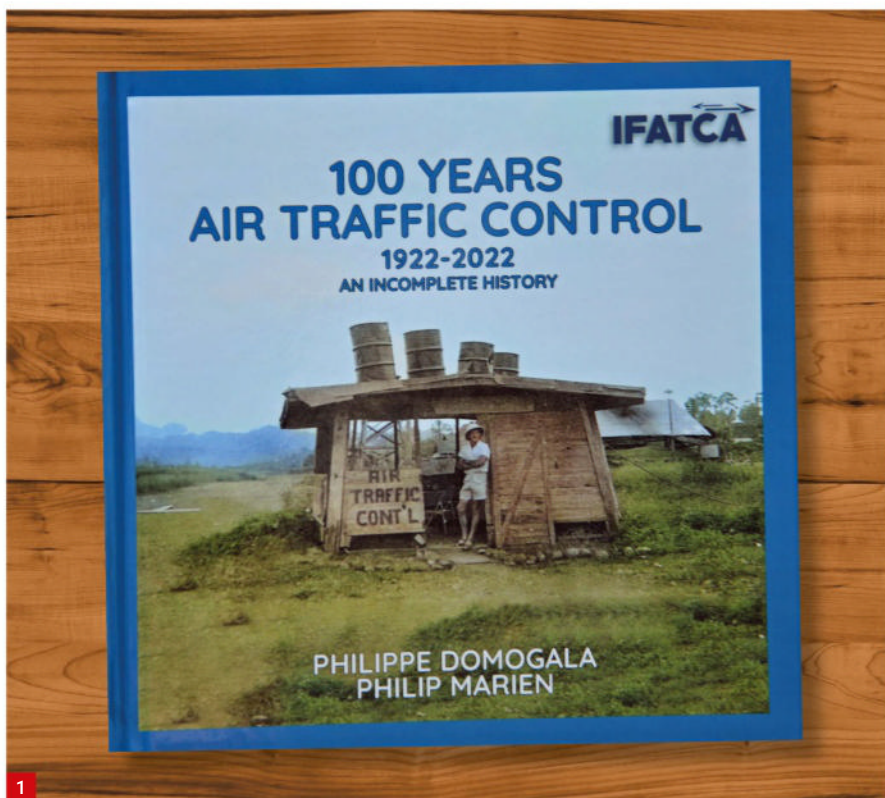
## Moving intelligence-gathering to space

A USAF general has said that the Pentagon should consider moving more intelligence-gathering technology from aircraft to less vulnerable spacecraft.

The USAF's diverse fleet of intelligence aircraft perform a variety of missions, including intercepting enemy signals, missile tracking, and following ground movements. Many of those aircraft are decades old, some dating to the 1960s. While they have been overhauled and modernised with newer technology numerous times, they are expensive to fly and are vulnerable to long-range missiles.

They also require large support crews, all positioned at forward operating bases that must have room and board for the airmen, fuel for the aircraft, defences, medical evaluation teams, and search-and-rescue assets. A high-flying satellite needs none of that. The USAF is already replacing some of its older aircraft, such as the E-3 AWACS, with newer types. At the same time, the Space Force is buying hundreds of small satellites for missile tracking, communication, and other military functions to augment larger, more expensive intelligence methods.

Moving intelligence sensors from aircraft to satellites is said not to be difficult and in many cases could result in the military getting more modern technology, faster than if the same sensors were installed in an aircraft. The Pentagon's Space Development Agency will launch three new satellite constellations over the next six years. Just like the aircraft-mounted sensors, the satellites could connect directly to tactical aircraft and share intelligence.



## Hybrid remote tower expands in the UK

**David Smith** has the latest news on developments in the world of aviation.

### Unlocking the potentials of drones

Cranfield Airport in Bedfordshire has been selected by the Civil Aviation Authority to participate in a Temporary Reserved Area (TRA) Regulatory Sandbox accommodating the operation of unmanned and manned aircraft in unsegregated airspace. The TRA designation will enable Cranfield Airport to host projects and trials that will help to integrate unmanned aircraft into shared airspace. With estimates that the increased use of drones could contribute £45 billion to the UK economy by 2030, their commercial use is expected to expand rapidly in the coming years. Developing the technical capacity and expertise to operate them safely alongside other aircraft is vital.

The TRA Sandbox forms part of the Airspace Modernisation Strategy, which outlines plans for the development and modernisation of UK airspace. The Cranfield TRA will facilitate an open access trials environment managed by Cranfield's Air Traffic Control. Live testing of operations in a beyond visual line-of-sight test environment and related technologies will provide safety evidence and

help to establish standards, enabling the CAA to develop regulatory guidance in this crucial area.

### 100 Years of Air Traffic Control 1922-2022

On the occasion of 100 Years of Air Traffic Control in 2022, the International Federation of Air Traffic Controllers' Associations, IFATCA, commissioned a book that examines how air traffic control started and changed over the past century. Air traffic control was not invented, it evolved out of necessity, following hindsight-realizations that aviation could be made safer and more efficient. In many cases, the trigger was one or more accidents that created a need to improve.

Major events involving ATC errors, outdated procedures, primitive navigational aids and a variety of other factors are analysed. Throughout the text, there are lots of anecdotes. To cite just one example, in principle no airport international code starts with an I, J, Q or X. However, the only code beginning with J is assigned to the Jezero Crater on Mars, where the Mars rover launched 'Ingenuity', a

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helicopter that made the first powered, controlled flight on another world. To commemorate the occasion, ICAO assigned the 'Marsport' the special code JZRO.

The book does not aim to be an all-encompassing, detailed account but looks at key events that shaped the way ATC is today. Although sub-titled 'An Incomplete History', it covers a huge amount of material in its 384 pages and 652 illustrations. The sections comprise 'The Pre-History of ATC', '1922-1940 The Need for ATC', '1940-1960 The Second War Dividend', '1960-1980 Jet Age, Safety & Conflicts', '1980-2000 Reality Strikes', '2000-Present Capacity Vs Crises', 'Around the World', followed by an Epilogue.

The authors write that they have tried to identify pivotal points, sadly, too often accidents, that triggered changes or improvements. These were copied by others and eventually made into standards or recommended best practices. They also note that some of the procedures still in use today are rooted in a distant past, sometimes even before 1922. As a retired controller, I found this book highly interesting and I recommend it to anyone who would like a comprehensive overview of the subject. See the website for ordering details.

[www.atc100years.org](http://www.atc100years.org)

Photo: 100 Years of ATC book cover.

## London Gatwick's plan to become a dual-runway airport

Gatwick is said to be world's busiest single runway, achieving up to 55 movements an hour. It has, however, reached maximum capacity and the airport operator has proposed to bring the existing parallel northern runway into routine use for departures. It currently serves as a standby when the main runway is blocked or needs work done to it.

The problem is that to meet international safety standards and enable simultaneous use, the northern runway's centre line must be moved by 12 metres. The considerable work required will take place within the existing airport boundary, making the project not only innovative, but also low impact. A government decision whether or not to permit the plan is expected in 2024. If approved, the northern runway should be ready for routine use by the end of the decade.

By bringing the existing northern runway into use, Gatwick will be able to add additional hourly aircraft movements in peak times, using existing flight-paths. It is predicted around 75 million passengers will travel through the airport each year by the late

2030s – an increase of 61% on 2019 numbers – with an annual limit of 386,000 commercial air traffic movements.

A number of USAF aircraft have been seen recently not showing any Mode-S at all. The flight tracker websites were not at fault; the pilots have just turned off their Mode-S transponders. C-17s, C-130s and KC-135s have been noted doing this. It appears to be a logical extension of the removal of the serials painted on the aircraft. It will be interesting to see how this develops, as most modern ATC calculates conflicts based on the Mode-S rates of climb/descent. The calculation without Mode-S is not as accurate.

## Frequency & operational news

Contributed by reader **Godfrey Manning G4GLM**.

At Liverpool, 'Radar in the Tower' will be implemented at times of low traffic. This is where just one controller operates both the Approach Radar and Aerodrome functions, resulting in the radar service being restricted.


Edinburgh ATIS (Aerodrome Terminal Information Service) remains on 131.355MHz but to listen to the information via the 'phone, note that the number has changed to 0131-348 4823.

Pilots must consult official promulgations. **PW**

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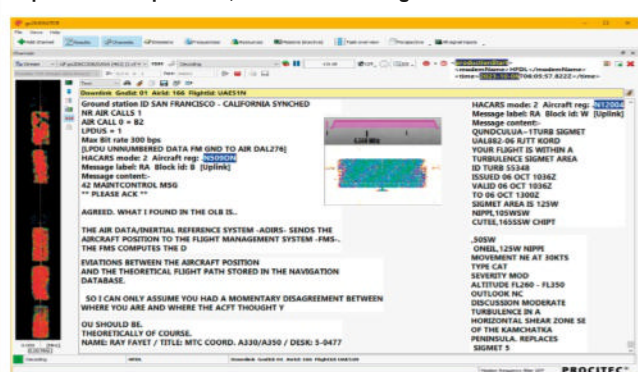
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**Keith Rawlings G4MIU**  
keith.g4miu@gmail.com

In the October 2023 issue of *PW* I gave a brief summary of the Quansheng UV-5K. This little hand portable is a dual-band VHF/UHF handheld transceiver with a stated maximum power output of 5W within the amateur bands and also AM airband reception. However, airband reception was found to be very poor and transmit harmonics could have been a lot better. Nonetheless the radio is cheap and easy to use. See the October *PW* issue for further details.

### Enter the Quansheng UV-K5(8)

At the time of writing there is considerable interest in a new model of the UV-K5, the UV-K5(8). The 'new' radio, **Fig. 1**, seems identical to the earlier model but is claimed to have some improvements.

### Differences?

The UV-K5(8) is the same size, and has the same general layout, as the UV-5K but the speaker housing is now slightly different as is the LCD surround. The LCD itself has been changed from a white background to a gentler amber colour. The speaker has apparently been improved but I found the audio is still piercing, especially when the volume is set to a high level. The A/B rocker switch on the UV-5K has been replaced with separate buttons and that seems to be it. Band coverage is still the same too:

- 50.0000-76.0000MHz (RX only)
- 108.0000-135.9750MHz (RX only)
- 136.0000-173.9750MHz (TX and RX both)
- 174.0000-349.9750MHz (RX only)
- 350.0000-399.9750MHz (RX only)
- 400.0000-469.9750MHz (TX and RX both)
- 470.0000-600.0000MHz (RX only)
- A document on the FCC website seems to confirm the radios are, electronically at least, identical!

<http://tinyurl.com/yx9sf92p>

### Areplacement

As I had given my UV-K5 to my son I replaced it with a UV-5K(8), which was ordered directly from the AliExpress website and arrived within five days. It came with an antenna, belt clip, drop-in charger, wrist strap and user manual.

I did not order a package that included a programming lead as I already had one for the UV-K5. I just went for the cheapest offering I could find on the website, which was £10.28 inc VAT delivered!

Both radios use the same CPS programming software, which can be downloaded from the manufacturer's website or, alternatively,



## More on the Quansheng UV-K5

**Keith Rawlings G4MIU** revisits the UV-K5, describing the options available with the new firmware.

the popular CHIRP programmer can be used. Unfortunately, in the new radio AM airband reception is just as poor as with the UV-K5 thus is pretty much unusable in this mode. However, for airband listeners the good news is that a freely available fix exists for this.

By simply upgrading the radio's firmware with a suitable 'User Generated Firmware' file better quality AM reception becomes possible. There are a number of firmware files online, which have kindly been made available by fellow enthusiasts. I chose to use

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the popular Egzumer file on my radio, which is presently running at V0.19. Full details may be found here:

<http://tinyurl.com/yzz6hpp2>

There are different ways to get the new firmware into the radio. One way is to directly select the various parameters found on the webpage below to select just the features you want and then send the changes to the radio:

<http://tinyurl.com/y3k646zy>

There is a similar site here:

<https://uvmod.leechermods.com>

Another way is to go to the following webpage, reading the instructions on this page first:

<http://tinyurl.com/ypa7xjvt>

Then click onto 'Egzumer firmware releases' and click on the latest release 'flash with a browser' caption. You should see a box with 'Flasher' in the top left corner and the latest Egzumer file in the 'browse' window (If you have another firmware file saved on your computer you can instead load and use this here if you wish).

Next select 'Flash Firmware'. A box will appear and here you select the correct Comport for your interface. Click 'Connect' and the new firmware will be sent to the radio. Switch off and on then EGZUMER v0.19 should be displayed on the bottom of screen, assuming you have used this file.

Yet another method is to use a small application called Portable Radio Update Tools. Put the radio into programming mode as before, run this program, select the correct Comport, load the appropriate firmware file, which will previously have to be stored

on your computer. Click 'Connect' and then 'Update' and the file will be loaded to the radio.

This program may be found in the files section of the **Quansheng UV Series Radio User & Modification Group Worldwide** Facebook Group files section.

### Atip!

Make a copy of your original firmware, or download a copy off the manufacturer's website, and the radio can be easily restored to its original configuration if needed. Note that ideally you will still need the CPS software to program the memories and key functions on the radio.

In the case of the Egzumer firmware you will now have a radio with a number of added features with, as my son calls it, 'a cool looking' Spectrum Scope, **Fig. 2**, USB reception, backlight dimming, RSSI meter, long press button instead of F+, and, importantly for airband monitors, a working AM receiver with 8.33kHz steps, **Fig. 3**, among other improvements.

I have found reception in the civilian airband is now perfectly OK considering the cost of the radio and for those that do, Mil airband reception is also improved.

The receiver does still have a tendency to overload on strong local signals. As it is possible to inhibit the transmitter the radio also makes for a cheap general-purpose scanner for the unlicensed listener which now covers the frequency range 18 ~ 660MHz and 840 ~ 1300MHz in AM, FM, USB and also WBFM from 88-108MHz.

It is possible to open up the transmit side so that the radio is capable of radiating outside of the amateur bands. However, caution is needed here as it has been found that, although the fundamental frequency output can be very low outside of the standard bands, harmonics can be seen to mimic a porcupine with multiple spurs all along the RF Spectrum! A quick check with the UV-K5(8) transmitting low power into a dummy load on 50MHz while feeding a TinySA Ultra via a 40dB tap demonstrated almost identical levels on the 3rd, 4th and 5th harmonics as the fundamental.

Should you wish to wideband the transmit then you need to access the 'Hidden Menu'. To do this hold PTT + Side Button 1 and then turn on the radio but do so with caution.

The new firmware offers a number of features, many more than can be described here, but you do also lose some of the standard features. For example, I have not found a way to now clone the two radios, so I recommend you thoroughly read and digest the wiki page first before deciding to make any changes, which are at your own risk.

As stated the UV-K5 and the UV-K5(8) are identical so if you already have the UV-K5 I can confirm the Egzumer firmware also works on that model, including the improvements to AM reception.

If you want a cheap VHF/UHF handy that also doubles up as a wideband scanner, then the UV-K5 family look like they are a bargain. I bought my one here but I advise to shop around as prices seem to vary with the wind:

<http://tinyurl.com/bdp2mymf>

Read more radio news and reviews at [www.radioenthusiast.co.uk/news](http://www.radioenthusiast.co.uk/news)

**Mike Richards G4WNC**

practicalwireless@warnersgroup.co.uk

**R**egular readers will know I use a Hermes Lite 2 transceiver when operating data modes. Whenever I mention it at club talks, I often get asked my opinion on the rig and how I utilise it. As a result, I thought it might be helpful to run through some of the details here.

I'll start with some background on the development of the transceiver. The Hermes Lite 2 is an offshoot of the High-Performance Software Defined Radio (HPSDR) project that's been running for some time. The project aimed to produce a high-performance SDR design for home construction. The project has gone through many iterations, and the most well-known outcome has been the ANAN series of high-performance transceivers. While the HPSDR project began using a modular approach, the Hermes sub-project sought to combine the best of the HPSDR modules into a single-board QRP solution. It was the Hermes sub-project that directly evolved into the ANAN range. However, the Hermes was still a relatively expensive and complex project due to the choice of Analogue-to-Digital converter (ADC) and Field Programmable Gate Array (FPGA). The Hermes Lite project was based on the original Hermes architecture but utilised a broadband modem chip (AD 9866) from Analog Devices. This versatile chip contains both the ADC and DAC (Digital-to-Analogue Converter) stages required for a direct digital down conversion (DDC) SDR transceiver. As it's produced in bulk for the broadband market, the chip is relatively cheap at around £30 each in small quantities instead of around £100 each for just the LTC-2208 ADC, used in many high-end SDRs.

The downside of the AD9866 is a lower bit depth with 12-bit ADC and DAC instead of the 16 bits of the full Hermes. However, this is not a problem in practice and can be managed with good software, firmware and hardware design. Due to the lower bit depth, the Hermes Lite can use a less powerful and thus cheaper FPGA to handle the high-speed data processing. Despite all these changes, the Hermes Lite is a sophisticated transceiver and an advanced home-build project. I started building one from component level, but handling the tiny SMD components was difficult. The solution for the Hermes Lite team has been to work with a PCB assembly house to create a part-built project with all the SMD components pre-assembled. This solution has been very successful and the developers have a good working relationship with MakerFabs to produce fully assembled main circuit boards. These boards are currently available for \$269 (£220).

In addition to the main board, you will also need a filter board and a case. **James Ahlstrom**



1

## Hermes Lite 2

**Mike Richards G4WNC** introduces the Hermes Lite 2 and explains how to get it up and running.

**N2ADR** designed the Hermes Lite 2 filter board, and it's an ideal match for the Hermes Lite 2 main board. MakerFabs also have an enclosure and endplates available to complete the project. The total price for the two boards, enclosure and express shipping from China is currently around the £300 mark, which is a tempting price for what is an excellent QRP (5 watts) DDC SDR transceiver, **Fig. 1**. NB: It's important to note that the Hermes Lite 2 remains a homebrew project, so any problems will need to be resolved with the help of the Hermes Lite user group. You should expect minimal support from MakerFabs.

### Using the Hermes Lite 2

The Hermes Lite 2 transceiver is a network-connected device, so all communications with the SDR software flow via the Ethernet. As a result, the rig doesn't need to be in front of you and can be tucked away close to the antenna. Several SDR software packages support the Hermes Lite 2, including Thetis, Power SDR and Quisk. However, I prefer to use **Simon Brown's** SDR Console because Simon provides excellent support for the Hermes Lite 2 and the optional Hermes IO board. The IO board is a recent development that can switch external devices such as my HARDROCK-50 PA and 50MHz transverter. SDR Console also features excellent spectrum displays and offers a vast range of customisation of the interface appearance and signal processing. One area that often confuses

is virtual audio cables, commonly known as VACs, that route the audio signals.

**Fig. 2** shows a block diagram of the interconnections used for my data modes operation. Whereas traditional data mode setups require a USB or internal soundcard to handle the transmit and receive audio, digital SDR stations can almost completely avoid the analogue conversion. We can maintain the highest fidelity by routing the demodulated audio in the digital domain. There are several VACs out there, but I prefer the VAC by **Eugene Muzychenko** that you'll find here:

<https://vac.muzychenko.net/en>

I've been using this VAC for many years, and it's always been a reliable option. The software can create multiple VACs, and the associated control panel, **Fig. 3**, lets you configure the VAC characteristics where necessary. However, the default settings are fine for regular data modes operation. I only need analogue audio when I want to listen to the signal. From **Fig. 2** you will see that I use an audio repeater application. This helpful utility is bundled with the VAC package and lets you route any input source to any output device, **Fig. 4**. In my case, the output device is my Mackie Producer USB audio interface. This interface is a bit OTT for monitoring data modes, but I also use it to process a microphone input when I'm giving Zoom talks as, when combined with a Rode microphone, it produces excellent audio with my voice. For most data modes installations,

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Fig. 1: Hermes Lite 2 transceiver.

Fig. 2: Block diagram showing virtual audio and serial port connections for SDRs.

Fig. 3: Virtual Audio Cable control panel.

Fig. 4: VAC audio repeater control panel.

a simple £15 USB audio interface or your computer's internal soundcard will suffice for monitoring.

## Virtual Serial Port

While most data modes can be operated without direct control of your rig, for some, like VarAC, rig control makes operation so much more convenient. In the same way we can use VACs to route our audio digitally, we can use a virtual serial port (VSP) to handle the rig connection entirely in the digital domain. VSPs are also known as null modems because they behave like a pair of modems connected back-to-back, Fig. 5. Several VSPs are available, but I have found the free com0com VSP to be very reliable for data modes operation. The software is available here:

<http://tinyurl.com/5b67frn6>

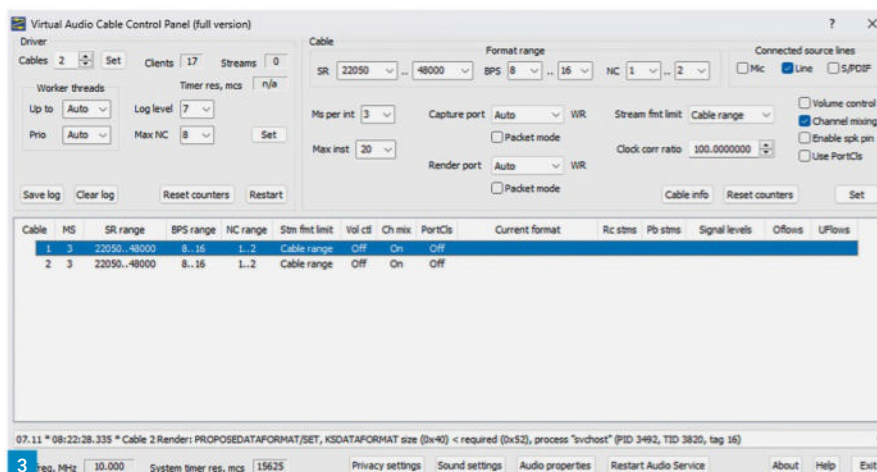
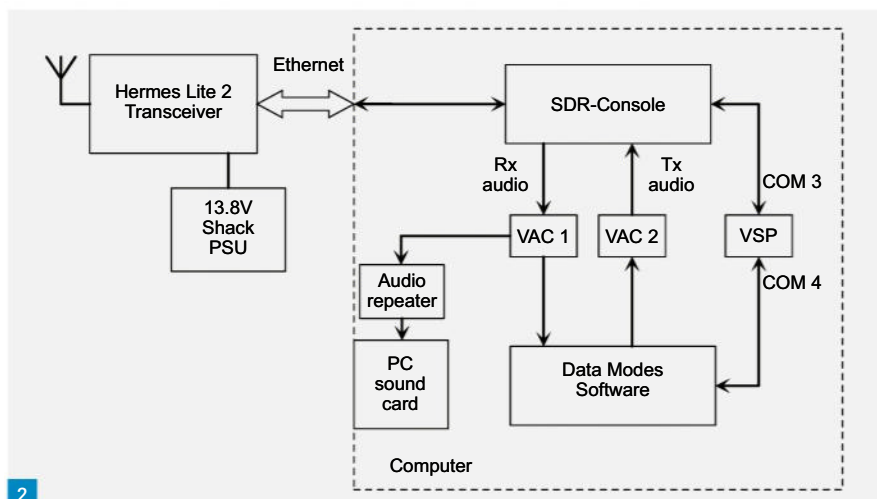
Once installed, you must change the com0com setup before the ports will be visible in your data modes software. To do this, open the com0com Setup panel and tick the "use Ports class" box for both installed ports, Fig. 6. This will change the names to begin with COM. The ports should be visible if you close the setup software and restart your data modes and SDR software. The installed VSPs are bi-directional, but you must use them as a pair. For example, you could use COM3 in the Data modes software, but then you must use its partner, COM4 in the SDR software. Data signals will pass in both directions from COM3 to COM4 and vice versa. The next stage in rig control is to set the rig emulation. Most SDR software packages include the ability to mimic a popular rig type and respond appropriately. In the case of SDR-Console, it emulates a Kenwood TS-2000 and responds to those commands. It doesn't support the full range of commands, but all the basics are covered. In most cases, we will only use rig control to change frequency and handle Tx/Rx switching.

## Configuring SDR-Console

SDR-Console is a complex application, so you might need help to get started, Fig. 7. The first step is downloading the software from the following site:

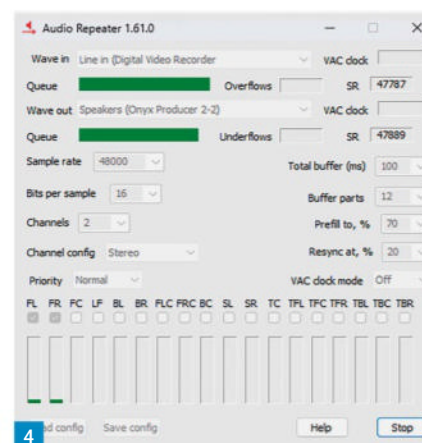
[www.sdr-radio.com/download](http://www.sdr-radio.com/download)

The site carries many adverts, so you need to scroll down to near the bottom, where you'll see options to download (V3.3 at time of writing) from Dropbox or OneDrive. Once downloaded, run the installer and follow the prompts to complete the installation. When you first run SDR-Console, it needs to find your Hermes



Lite. First, ensure your SDR is powered up and connected to the network. Next, you click the Definitions box in Radio Definitions followed by the Search button and choose Hermes-Lite from the drop-down menu, Fig. 8. If all is well, your rig will be found, and you'll see the option to add the Hermes Lite. You can select the Hermes Lite on the following menu and click Start to transfer control to SDR-Console. You should see activity in the spectrum display to indicate all is well. Ensure the Receiver DSP panel is showing on the left of the display by choosing the Receive tab at the top and clicking DSP under the View section, Fig. 9. This will toggle the Receive DSP panel on/off. This panel is required to control the receive mode and to route the receive audio. For our application, we want the receive audio sent to our data modes software using a VAC, so use the drop-down menu just below the frequency display to choose your VAC. Next, we need to display the transmit DSP panel by using the Transmit tab at the top and toggling the DSP button on/off. With the transmit panel open, select the desired VAC with the drop-down next to the mic symbol.

We can now move on to configure the rig control link between SDR-Console and your



Hermes Lite. The first step is to select the Tools tab at the top and choose Controllers from the Program Options panel. Here, you can set the COM port for rig control, Fig. 10. Remember that the VSPs operate in pairs, so use one half of the pair here and the other half in your data modes software. SDR-Console includes a helpful tool that monitors the commands flowing on the serial port. This tool is invaluable for solving rig control problems. The tool is called I/O Monitor and is available from the CAT menu

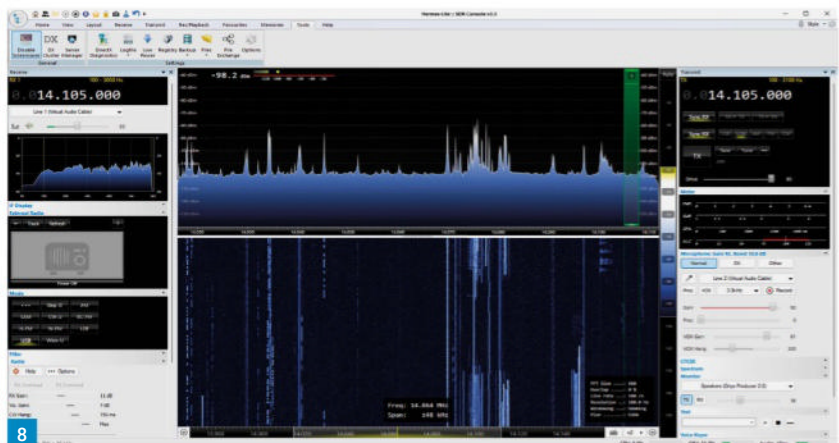
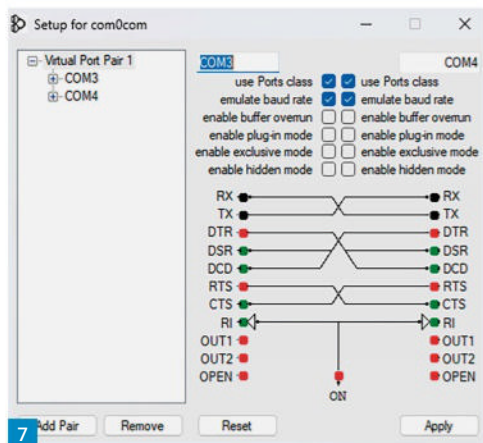
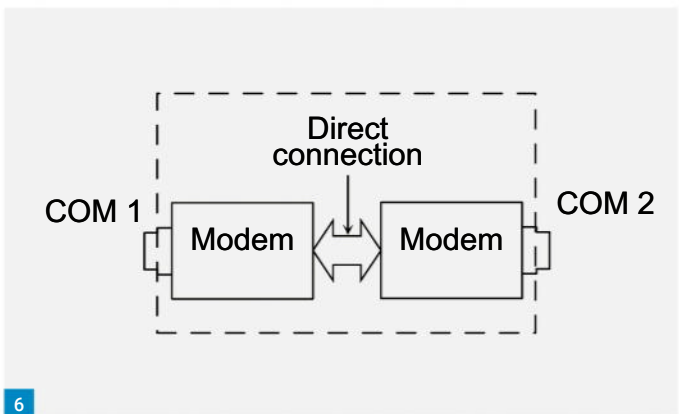
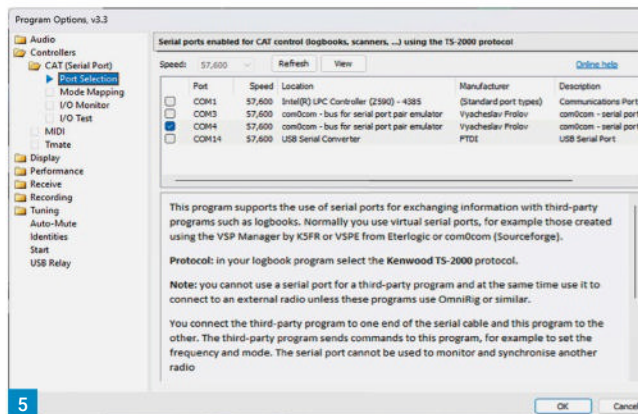
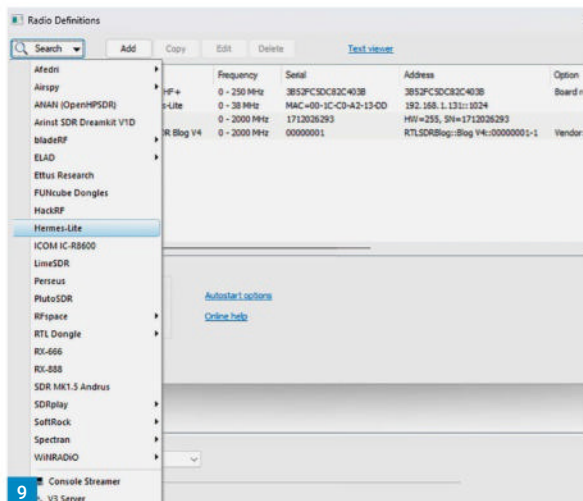


Fig. 5: Virtual Serial Port or Null Modem. Fig. 6: com0com control panel. Fig. 7: SDR-Console in use with Hermes Lite 2 transceiver. Fig. 8: Searching for Hermes-Lite. Fig. 9: SDR Console Rx Panel. Fig. 10: SDR-Console rig control panel.



in SDR-Console. The final step is to open your data modes software and ensure you have the transmit and receive audio routed correctly. You can also check the rig control settings, which should use the other half of the VSP pair with the rig set to TS-2000 and a baud rate of 57600. When using VarAC, there isn't a TS-2000 option in the built-in rig control, but I have found that selecting TS-850 works well. If all appears to be working, the final step is to set the transmit drive levels. The Hermes Lite usually requires quite high drive levels, so I set the drive and Mic gain in SDR-Console to 90. I then use the Tune control

and Tx drive slider to adjust the drive level in the data modes application. SDR-Console includes useful transmit metering in the Tx DSP panel. There is also a critical Tx overload indicator toward the bottom of the Receive DSP panel.

I've found the Hermes Lite 2 to be an excellent QRP rig and an interesting homebrew project. The support from the user groups is excellent and there is plenty of active development that's refining the performance and adding new features. There's even a version of the FPGA gateway that supports ten concurrent receivers! **PW**



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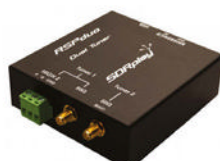
Full details see:

[HamRadio.co.uk/RSP1A](http://HamRadio.co.uk/RSP1A)



RSP1A: The perfect entry-level SDR receiver – the lowest cost option, with a single antenna input, the RSP1A is perfect for both newcomers and retired hams returning to their teenage hobby. Simply attach a USB cable to your computer and download the free software from [www.sdrplay.com](http://www.sdrplay.com) and you're away. The RSP1A is also popular as a "panadapter" accessory to add a high resolution spectrum display to older transceivers.

SDRplay – makers of the world's most popular mid-range SDR receivers, with over 100,000 already sold worldwide. Manufactured in factories in Peterborough and Hartlepool, SDRplay's UK-designed radios offer superb general coverage receiver functionality from VLF through to 2GHz. As you "spin the dial" you can see the signals on up to 10MHz of spectrum at a time. Using 14-bit ADC technology and numerous banks of innovative filters, there is no comparison with the cheaper 8-bit dongles out there! All you need to add is a computer and an antenna. SDRplay provide free Windows-based SDRUno software and, coming soon, SDRconnect software for Windows, Mac or Linux. The software is optimised for the hardware and includes ham-band "preset" buttons for ease of use. The great thing about an SDRplay RSP is that once you own one, you continue to get performance enhancements from the ever-evolving software updates which are provided free of charge. SDRplay is renowned for providing outstanding UK-based customer support, with on-line documentation and video guides and, most importantly, same-day one-to-one support via their website.



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**NEW**



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For more details see [HamRadio.co.uk/DigiRig](http://HamRadio.co.uk/DigiRig)

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**Steve Telenius-Lowe PJ4DX**  
teleniuslowe@gmail.com

**O**fcom issued a statement 'Updating the amateur radio licensing framework' on the deadline day for this column, 11 December; almost all their original proposals will be implemented, beginning in February. Those with the greatest impact on HF operating were discussed in the September 2023 *HF Highlights*.

The Space Weather Prediction Center, part of the US government's National Oceanic and Atmospheric Administration, recently issued a revised prediction for Solar Cycle 25, suggesting that activity will peak between January and October *this* year, rather than in mid-2025 as had previously been predicted.

A new trend seems to be for DX stations to supplement the operators physically at the location with one or more stations being operated remotely. The VP6A Ducie Island DXpedition last June had only one 'local' station but three more run by 34 operators from all over the world. In November, PR0T (Trindade and Martim Vaz, **Fig. 1**) had three operators on the island plus an additional station run by 10 more operators in Brazil and Europe. And in the 2023 CQ World Wide CW contest, PJ2T had seven operators at the station in Curacao, **Fig. 2**, plus one more who operated remotely from Seattle. Look for this trend to become more common on forthcoming DXpeditions!

## The month on the air

It's been another really busy month on the air. 4W8X seemed to be absolutely everywhere! Timor-Leste is the other side of the world from Bonaire, around 18,500km away, yet were easy to work here on all bands from 3.5 to 50MHz.

With 708AD and 708AE still active, RA9USU arrived on Socotra Island: 7073T was on FT8 and CW from 11 November for two weeks.

VK9XY on Christmas Island (the one in the Indian Ocean, not the Pacific) was another FT8/CW operation. YL2GM and EA5EL were active from 15 to 27 November, after which they moved on to the Cocos (Keeling) Islands, from where they operated as VK9CY until 7 December.

H44WA on the Solomon Islands was on the air from 15 to 29 November using CW, SSB and FT8 on all bands 1.8 to 28MHz.

PR0T (see above) was a brief operation from the rarely activated Trindade and Martim Vaz Islands, 1100km off the coast of Brazil. The team (or should that be teams?) made over 18,500 QSOs between 16 and 20 November.

Five experienced French amateurs put XW4DX on the air from Laos, **Fig. 3**, between 18 and 26 November. They made over 43,000 QSOs, almost equally divided between SSB, CW and FT8. Working Laos is really tough from here but I eventually made QSOs on three bands, so I felt



## Another busy month

With lots of expeditions and some excellent propagation, **Steve Telenius-Lowe PJ4DX** has another full postbag.

the team did a great job.

9L5M was a one-man DXpedition from Sierra Leone by **Shabu MOKRI** between 26 November and 5 December. Shabu made nearly 21,000 QSOs on FT8 and CW and was worked here on all bands from 7 to 28MHz.

VU7A, operated by **Krish W4VKU**, was another one-man operation, this one from the Lakshadweep Islands. He started on 4 December and was worked first call by myself and also **Eva PJ4EVA**.

T32TT from Christmas Island (this time the one in the Pacific Ocean, not the Indian!) started on 5 December and was scheduled to be on the air for about three weeks. This was another activity by the Rebel DX Group, which stated it would be a "90% digital activity" with 12 digi stations (FT8 and FT4) plus two on CW and one on SSB.

## What to look for in February

The TX5S Clipperton Island DXpedition (see January *HF Highlights*) is scheduled to be on the air from 17 January until about 2 February.

You wait years for an operation from Yemen and then four come along almost at once! Following hot on the heels of 708AD, 708AE and 7073T, **Vlad OK2WX** is planning activity as 702WX between 25 January and 12 February. He has said his focus will be on 1.8 – 7MHz.

The Intrepid DX Group is scheduled to operate as H40WA from Temotu Province (Solomon Islands, but a separate entity for DXCC) from 22 February until 7 March (this operation was originally scheduled for October – November 2023 but had to be postponed). Eight

experienced operators will use CW, SSB and FT8 on all bands.

[intrepid-dx.com/h40wa](https://intrepid-dx.com/h40wa)

The annual RSGB FT4 contest series recommences on 26 February at 2000 to 2130UTC. This year the 10 and 15m bands have been added, so the contests take place on all five contest bands between 3.5 and 28MHz. Eva PJ4EVA and I, operating under my callsign, won the overall 100W Non-UK section in 2023, **Fig. 4**. The full rules are at:

[rsgbcc.org/hf/rules/2024/r80m\\_ft4.shtml](https://rsgbcc.org/hf/rules/2024/r80m_ft4.shtml)

## Readers' news

**Tim Kirby GW4VXE** uses the GW4VXE call on FT8 and **GW4MM** on CW. His station is shown in **Fig. 5**. Tim wrote "There have been so many expeditions to chase, it was sometimes hard to know which to go for first. Occasionally, chaos ensued as one expedition's pile-up merged into another! Although I prefer to work new countries on CW, I'm not proud and am very happy to pick them up on FT8. This was particularly useful with some of the busier and more distant expeditions like PR0T, VK9XY and ZL7A. I was away from home for most of the CQWW CW weekend, although I managed a few hours towards the end of the contest. During the ARRL 10m contest weekend the winds were very strong here on the Pembrokeshire coast, so I'd taken my DX Commander vertical down – but I built a shorter vertical for 10m on a fibreglass pole, which survived the storm and seemed to work all right!"

**Jim Bovill PA3FDR** reckoned that "November got off to a good start with three DX QSOs

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Fig. 1: Trindade Island, home of PR0T (photo: Simone Marinho, Wikipedia). Fig. 2: Antennas at the PJ2T contest station on Curacao. Fig. 3: Typical street wiring in Laos: it's no surprise that local noise levels are often a problem in the Far East! Fig. 4: The 2024 RSGB FT4 contest series begins on 28 February. Fig. 5: The HF station of Tim GW4VXE / GW4MM. Fig. 6: The well-disguised magnetic loop used by Mike EA7KIP.



(VK8DR, BD7ISO, HI8DAR) during the first 10 minutes of the first day of the month. The rest of the week followed better than I could have hoped for with contacts with New Caledonia (FK8HM), Uzbekistan (UK8OM), Botswana (A25R, operated by yet another Russian DX team), Tajikistan (EY8MM) and the remote South Atlantic island of St Helena (ZD7CTO). Highlights later in the month were Suriname (PZ5MA), Norfolk Island (VK9DX), Jordan (JY4CH), Kyrgyzstan (EX8MLE) and Greenland (OX7AKT). Despite being very scarce for most of the month I did manage a few QSOs with Japan towards the end of the month; normally these are by far the most abundant of my DX contacts. All in all a satisfactory collection of QSOs, so I am rather content with my simple antenna consisting of about 25m of wire stretched around the garden at 8 to 10m above the ground, connected directly to my IC-7300 via an Icom AH4 ATU."

**Carl Mason GW0VSW** wrote "I managed an entry in the CQ WW CW contest using my Xiegu G90, 5W and my new inverted G5RV. Conditions were reasonable and contacts were made on all bands 160 – 10m. I used one half of the G5RV to work 160m by making a simple adapter and was surprised to make 28 QSOs. My output must have been OK or the other stations had good ears! I copied CN3A and D4C but was unable to make contact."

**Mike Wilson EA7KIP/G4GOU** says he has now



moved to a new permanent QTH near Estepona in Spain where he "recently added an MFJ-1786 magnetic loop on the terrace. However, the residents' association decided that they no longer wanted satellite dishes attached to terraces and if they can't have a dish why should I have an antenna? This called for measures to make the new loop 'disappear' (Fig. 6). The results with the hidden loop running 35W have been good, and on 10m in particular this month, with contacts with 228 stations in the first three weeks of November, the best DX being Japan (J16IHG and JH3JRC) at 11,000km followed by several Brazilian stations with PY5JO at over 8000km and HC1M in Ecuador on FT8 and a few contacts in the USA on CW.

"I was also recently visited by a team from Channel 5 TV who were filming for the 'Bargain-loving Brits In The Sun' show where they spent a few hours filming me demonstrating the hobby in action whilst operating on FT8 and DMR. This is likely to be shown in early 2024."

**Reg Williams G000F** wrote that "For some time I had been trying to work VK9XY Christmas Island. It was the very last day of operation there, where I worked them in the early evening on 7MHz FT8. They then moved to their next location, Cocos (Keeling) Islands, where they operated as VK9CY. Strangely enough, I worked them on their very first day of operation, 7MHz FT8 in the early evening. The Timor-Leste DXpedition, 4W8X, was heard on 7MHz SSB mid-month but I was unable to work them though fortunate enough to work them later in the month on 10MHz FT4 in the early evening and on 14MHz FT8 later in the month.

"The DX Clusters are very useful for spotting the DX stations. One of my favourites is DXHeat where I can enter search callsigns for particular stations and still have the main cluster form

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running, which can be filtered for band, mode, prefix etc. Club Log's 'livestream' is good for stations that participate, indicating what bands and modes they are operating on."

**Owen Williams G0PHY** thought that "There were some highlights this month as well as a couple of 'lowlights'. The month started well with TJ9MD worked on both 14 and 28MHz. This weekend I had a couple of sessions on 28MHz in the ARRL contest and was very pleased to have worked VR2XAN for a new band-slot. Now for the lowlights: I failed to break through the pile-ups trying to work XW4DX. I spent more hours than I care to recall calling on various bands. I had one session on 21MHz when I thought maybe there was something wrong with my station but I tuned around and worked K4VIC and FG/OK6RA. Another surprise was not hearing 4W8X at any great strength despite the beams that they had available. I made my first QSOs using FT8 this month. I had three QSOs on 14MHz using just 20 watts. The best DX was KO4DCR."

**Etienne Vrebo OS8D** made about 700 QSOs this month, mainly with castles chasers, **Fig. 7**. He has now worked 263 DXCC entities on SSB only. "It's OK for me and I think missing mostly islands DXpeditions, and some countries without activity... I'm happy with my catches this month without having to wait in long pile-ups. As already mentioned, I'm not very patient and leave quickly after some calls to the DX station having in mind they'll come back soon – could not always be true!" Etienne added that he worked TX7L (Marquesas Islands) using only 60W as he had forgotten to warm up his linear amplifier. I had a similar experience during the month: I heard **Vincent F4BKV**, the operator at XW4DX in Laos, on 24MHz SSB asking Europe to stand by: "last call for North America". Laos is the most difficult part of the world to work from Bonaire and I also did not have the amplifier on, so called with about 60W as I did not relish having to battle it out against all the Europeans. Amazingly Vincent copied my signal: this was the only time I heard XW4DX on either SSB or CW.

A brief note from **Kev Hewitt ZB2GI** accompanying his 'Band highlights' thanked me for the QSO I had with Kev on 28MHz SSB when he was operating from the top of the Rock, **Fig. 8**. He was using a Yaesu FT-450 at under 100W output to a home-made 2-element Moxon beam.

## 28MHz beacons

The 28MHz beacon report for November by **Neil Clarke G0CAS** starts with a look at the North American beacons. On 28200 4U1UN in New York was heard every day of the month whereas W6WX in California was only heard on 11 days. In Canada, VA3KAH 28168 and VE3TEN 28175 were both logged on 28 days and VE1VDM 28174 and VA3SRC were heard on 26. On the west coast, VE7MTY 28197 was only logged

on four occasions. Back to 28200, where South American beacons LU4AA and OA4B were heard on 30 and 23 days respectively. Staying on 28200 VK6RBP was logged on 19 days and, while ZL6B was only heard on six days, interestingly ZL3TEN 28228 was heard on 16. Within Europe, Sporadic E took place particularly on the mornings of the 15th and 26th. Now, a bit of a conundrum: GB3XMB 28287 was heard on four consecutive days during daylight hours only from the 10th with signals peaking 559 and little QSB. What made it interesting is that the distance from my QTH is 250 miles making it too long a distance for ground wave and too short for sky wave. No tropo or auroral propagation was taking place. Checking with a Web SDR in Scandinavia it was active all month. Something to mull over and keep eye on – or should that be an ear?

## Band highlights

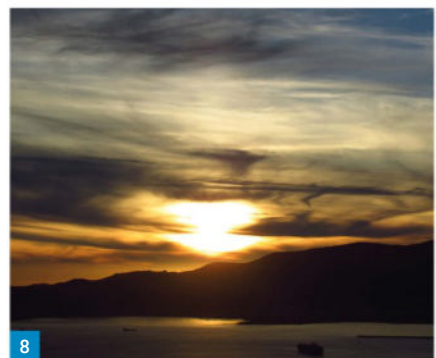
**Key:** Q = QRP, M = 100W, H = >100W, S = Single-element antenna, B = Beam (see January HF Highlights for a more detailed explanation.)

**Tim GW4VXE/GW4MM (HS): 7MHz (CW):** 5Z4VJ, KP4AA. **10MHz FT8:** 7O8AD, UN7LZ, ZL3PIE, ZL7A. **14MHz CW:** 4W8X, 8P9A, EX0ET, PJ4/K4BAI, V26K. **18MHz CW:** 4W8X, PJ4/KU8E, TO0T (=FJ). **18MHz FT8:** ZL7A. **21MHz CW:** 4W8X, TI7W, PJ2/NA2U, PJ4K, V26K, XE3MA. **21MHz FT8:** VK9XY. **24MHz CW:** 7O8AD, V26K. **24MHz FT8:** 4L4DX, 7Q6M, BA3KY, PR0T. **28MHz CW:** 6Y6N, D4DX, FY5KE, S79/G3WPH, TO9W, PJ2ND, PJ4K, TI7W, V26K, ZD7BG, ZF9CW.

**Jim PA3FDR (MS): 7MHz FT8:** 4L7T, WP4BQV. **10MHz FT8:** JY4CH, K6AFW. **14MHz FT4:** A65D, OX7AKT, PP6EOJ, RW9AD, VE3XN, W9CA. **14MHz FT8:** 4J75M, HZ1UAE, PW8BR, R8OAE, VA3KGB, VU2WJ. **18MHz FT4:** FR4OS. **18MHz FT8:** A25R, HI3SD, JA3TJA, PZ5MA, UA0QNI, ZL3NB. **21MHz FT4:** BG7SFE, FK8HM, KP4JRS, KX8X, RA0AER, UN2PL, VE9NC, YC3BVG. **21MHz FT8:** BG5GLV, HL3GOB, JA2VZ, KC6SEH, RM0F/P, UN7LAX, VK2LAW, VK8DR, VK9DX, VR2XZK, YC9UZU, ZL1BQD. **24MHz FT4:** VP8LP. **24MHz FT8:** BV2NF, CX1VH, D2UY, HL5BLI, N7LD, PP5ZP, UA0SR, VK2WJ, VK5PO. **28MHz FT4:** A61DI, HI8DAR, JL1HOV, KP3RE, RV9CT, UN7BDZ, VO1IRA, W7CT. **28MHz FT8:** A61QQ, A91UAE, BD4UJ, EX8MLE, EY8MM, HL3WAT, JA2FJP, N8NH, PU5CVB, RW0SR, VK8DR, VR2XMT.

**Carl GW0VSW (QS): 1.8MHz CW:** LX/DD2ML, LY0UKR, OH2PM, OK1GK, S56X, SK6KU, US5WE, YL3FT. **1.8MHz FT8:** DF8IU, OK6RA, ON4LUC, OZ3OE, SM5A. **3.5MHz CW:** C37N, CR3W, N5DX (plus "a good number of Stateside contacts"). **7MHz CW:** 4Z5LA, CN3A, D4C, K3LR, PP3W, RM9A.

**Reg G00OF (MS): 7MHz FT8:** 5W1SA, VK9CY, VK9XY. **10MHz FT8:** VK9DX. **10MHz FT4:** 4W8X. **14MHz FT8:** 4W8X. **18MHz FT8:** FK8FM. **21MHz FT8:** FK8GM. **21MHz FT4:** VP8LP. **28MHz FT8:** HP2NG.



**Fig. 7: OS8D/P** deep in the Belgian countryside on 20 November. **Fig. 8: Sunset** from the ZB2GI operating position at the top of the Rock.

**Owen G0PHY (HS): 14MHz SSB:** OX7AKT, TJ9MD. **18MHz SSB:** TO9W. **21MHz SSB:** FG/OK6RA, K4VIC. **24MHz SSB:** W1NA. **28MHz SSB:** A41CK, ED8X, PR3K, TA3DE, TJ9MD, VR2XAN, W5PR, ZP0X.

**Etienne OS8D (HB): 14MHz SSB:** 4W8X, AP5ARS, HS0ZOA, KP3RE, OX7AKT, TX7L. **18MHz SSB:** 3D2AG, OX5DM, TJ9MD, ZL7A. **21MHz SSB:** 4W8X, 7O8AE, TO9W (=FS), V4/N2HX, XW4DX. **24MHz SSB:** 3B8/M0SDV, 5H3MB, 7O8AE, A25R, TJ9MD, V31CQ, XW4DX. **28MHz SSB:** 7O8AE, CO6HLP, DS3EXX, FY4JI, PJ4/KU8E, VP2V/W1DED, VU2XO.

**Kev ZB2GI (MS, MB): 5MHz FT8:** N3NT, VE1RY. **28MHz SSB:** K6YRA, PJ4DX, PP5GW, TI5VMJ, V31XX, VE9BS, WP4AKF, ZP9HTL, XE1XR, YB9/DL3KZA. **28MHz FT8:** 9L5M, K6MBY, LU1WCL, NP3XF, TA3BD, VA2EW.

## Signing off

Thanks to all contributors. Please send all input for this column to [teleniuslowe@gmail.com](mailto:teleniuslowe@gmail.com) by the 11th of each month. For the April issue the deadline is 11 February. 73, Steve PJ4DX **PW**



**Colin Redwood G6MXL**  
practicalwireless@warnersgroup.co.uk

**W**elcome to the first *What Next* of 2024. I last looked at a number of Special Interest Groups in May 2020. At the time I was conscious that I hadn't covered them all, so this month I am going to look at several that I didn't cover in May 2020.

### CDXC

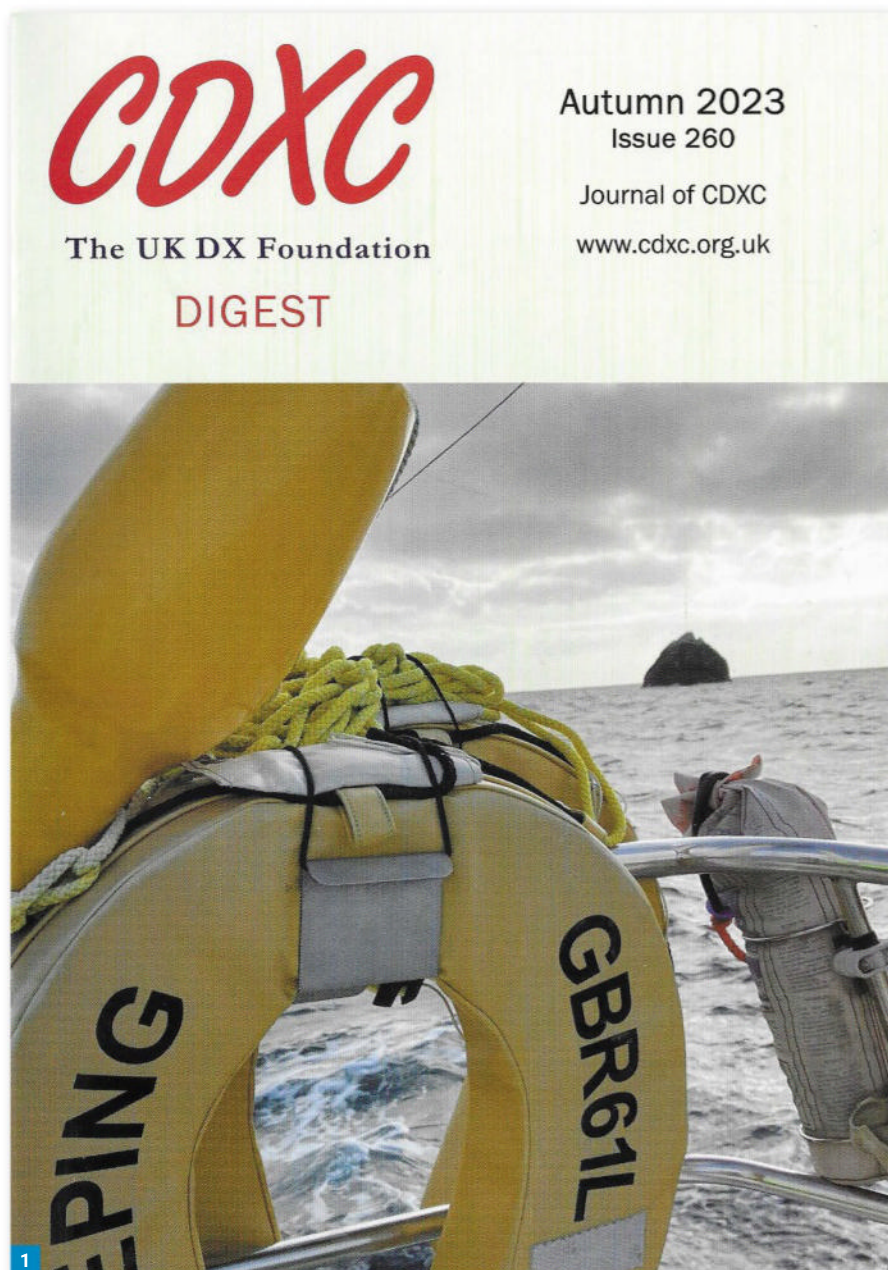
If you enjoy DXing or contesting, then the CDXC might well be of interest to you. The CDXC is the UK's premier DX Foundation, with just over 700 members, and is dedicated to encouraging excellence in DXing and contest operating. It began in the 1980s and was formed by a small group of keen UK DXers based in the Chilterns. Since then, CDXC has grown substantially with members sharing a common interest in HF DX and contesting, drawn together by their shared values of high standards of operating and DXing skills, becoming one of the largest and most respected DX groups in the world. Members include the majority of the UK's top DXers and testers, plus an increasingly large international membership. Characterised by a supportive and encouraging approach to all members, CDXC is an influential organisation, which develops and enriches the world of HF amateur radio for its members and DXers worldwide.

Membership is open to anyone in the world, including shortwave listeners. As a guideline, CDXC expects members to have worked or heard 100 DXCC entities before applying to join. Although evidence is not required, I'd suggest that a screen shot of your DXCC Award Account from Logbook of The World (LoTW) would be an easy way of demonstrating your interest in DXing.

CDXC counts a number of Foundation and Intermediate callsign holders among its membership. Your membership application also needs support from two existing members. If you do not know an existing member, or have yet to meet the guideline for DXCCs, please do not be discouraged! Send your application anyway, with a covering letter, and CDXC will give it serious consideration.

CDXC publishes a quarterly magazine, **Fig. 1**, back numbers of which can be downloaded by members from its website. A major aspect of CDXC activity is sponsoring of HF DXpeditions, ranging from donations and provision of equipment for smaller operations, to large-scale logistical support, including for example, by accommodating DXpedition team members during their UK stopovers on the way to some exotic DX location.

CDXC also issues a number of achievement awards, including the Penallt Trophy awarded



## Special Interest Groups

Ready to focus on a particular niche activity with the hobby? **Colin Redwood G6MXL** looks at some of the groups contributing to such activities.

to the club member who contacts the greatest number of countries on the LF bands during March each year. The RSGB CDXC Cup is awarded to the leading single operator UK/ Channel Islands/ Isle of Man entrant in the CQ Worldwide SSB Contest High Power, Single Operator Section. The club issues Merit Awards recognising outstanding contributions to HF DXing and also supports the Geoff Watts Memorial Trophy for the annual RSGB IOTA Contest.

CDXC organises a number of social get-togethers such as the annual dinner and DGM while also attending events such as Friedrichshafen and the RSGB Convention. These events are well supported – the CDXC stand at the RSGB Convention in 2023 was certainly very busy! CDXC also attends several of the major UK rallies and there are also the

**Fig. 1: The CDXC Digest.**

Read more radio news and reviews at [www.radioenthusiast.co.uk/news](http://www.radioenthusiast.co.uk/news)

**Fig. 2: The RSGB ARDF book. Fig. 3: The quarterly magazine, Signal, from VMARS.**

'unscheduled' meetings with visiting overseas DXers as and when opportunities arise.

Subscriptions to CDXC are £18 per annum for UK members, and £24 per annum for overseas members. CDXC has a useful website with information about its awards, merchandise etc. Back issues of Digest are also available, with the most recent issues only available to paid-up members:

<https://cdxc.org.uk>

Oh, and last but not least, the current CDXC President is none other than our editor, **Don G3XTT!**

### ARDF

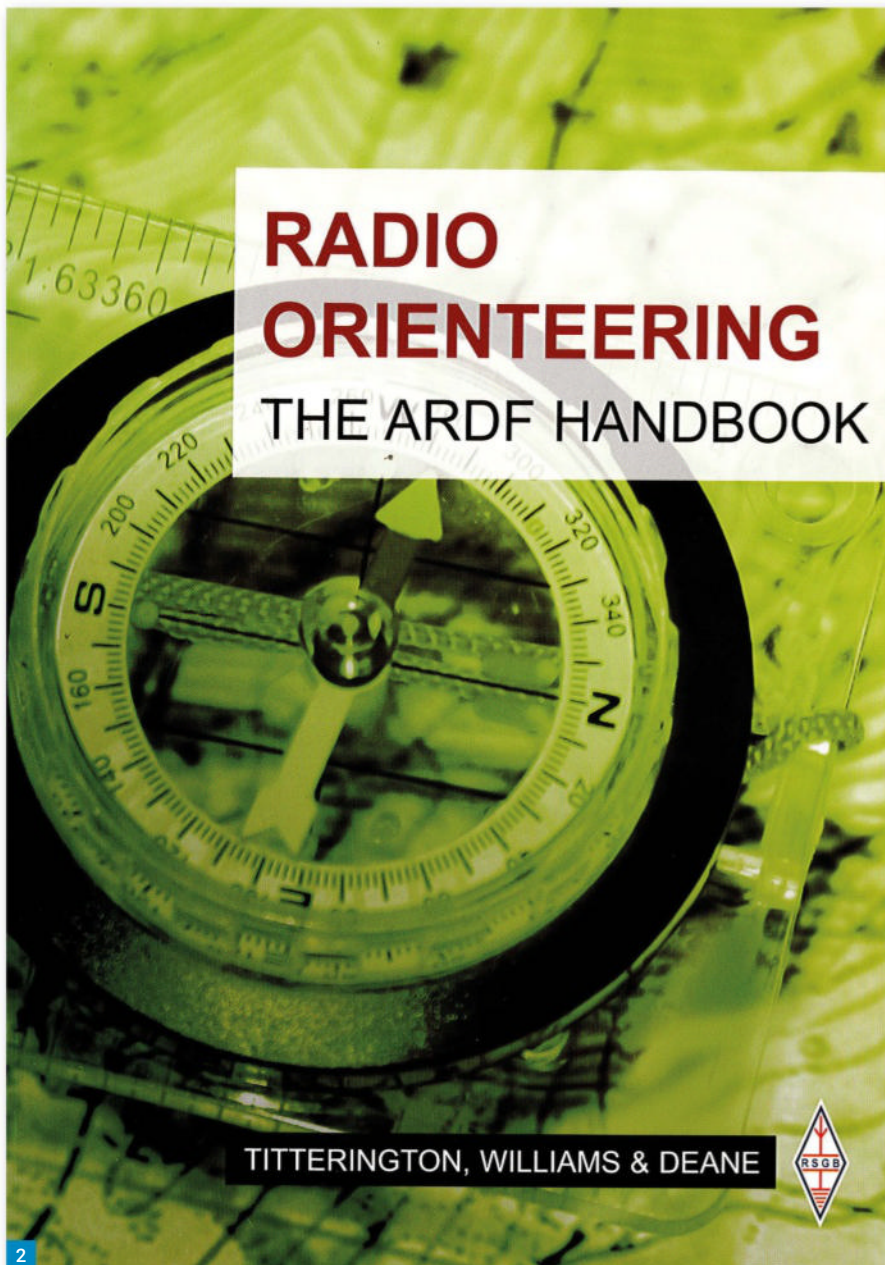
Amateur Radio Direction Finding (ARDF) is a radio-based orienteering activity. It involves competing with others to locate hidden transmitters, known as foxes. While speed is of the essence (running) if you want to try to win, it is perfectly feasible to walk between the various transmitters and still have a great sense of achievement of finding all the transmitters. As the competitors are only using receivers, there is no need to even have an amateur radio licence to participate.

Most ARDF activity takes place on either the 80m or 2m bands. Many amateurs design and build their own ARDF equipment. Many find a simple non-channelised AM receiver used in conjunction with a lightweight antenna works well. This is certainly the preferred setup for most competitors, although a modified amateur band handheld radio will get you started. Building a simple ARDF receiver can be a good beginner's construction project. The 2m band can be more technically challenging as competitors have to deal with signals being reflected from trees and other obstructions.

During the year, the RSGB run a number of 'Taster' sessions, often held in the Midlands. These sessions typically will include some tuition and practical exercises to help build confidence in using ARDF receivers. The event starts with a session to find out about an 80m direction finding receiver, and then using it to locate a single transmitter.

The session then moves on to finding two transmitters that transmit one after the other, before moving on to a 5-transmitter course. 80m receivers are loaned to newcomers. Other equipment needed includes a compass with a rectangular base, a whistle for safety purposes, a spirit-based red pen and a lightweight A4 board to which the map can be attached with plastic tape.

You might also prefer to use your own headphones fitted with a 3.5mm jack plug. In addition, you'd be well advised to wear clothing



suitable for walking in the woods (waterproof if the weather looks likely to be inclement).

The ARDF groups within the RSGB are trying to get more ARDF events happening in the various regions of the UK, as ARDF is a minority interest and few clubs will have sufficient members interested in ARDF to organise and run ARDF events within a club.

There is an excellent book available from the RSGB on ARDF, **Fig. 2**. The RSGB also have a great video on ARDF as part of their Tonight at 8 series. The main presenter is **Bob Titterton G3ORY** who is the RSGB's ARDF Chair and one of the authors of the book.

<https://tinyurl.com/38zysmkj>

If ARDF appeals to you, I'd suggest contacting Bob by email:

[ardf.chairman@rsgb.org.uk](mailto:ardf.chairman@rsgb.org.uk)

### VMARS

The Vintage & Military Amateur Radio Society (VMARS) is based in the UK, but with an international reach. It was set up in 1999 with the aims of encouraging the conservation, restoration and use of 'classic' electronic equipment, with a principal focus on wireless techniques, whether applied to communications, RADAR or other pulsed signalling systems – but not neglecting line communication, audio recording, mine detecting and so on. In addition, VMARS encourages the recording of electronics related history and the preservation of the knowledge and skills needed for using traditional modes of communications, such as analogue AM, analogue FM, and Morse Code by radio amateurs. VMARS encourages the use of traditional types of components, such as valves and leaded

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# Signal

The Journal of the Vintage and Military Amateur Radio Society

Issue 48: August 2018





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components and the maintenance and restoration of earlier styles of construction. The main VMARS website can be found at:

[www.vmars.org.uk](http://www.vmars.org.uk)

VMARS has a growing archive of manuals, circuit diagrams, magazines and other historic literature with about 10,000 items physically stored in an archive held at the Thorpe Camp Museum in Lincolnshire. An ongoing programme of document cleaning, scanning and digitising is undertaken by Society volunteers who then catalogue and index the documents before placing them onto the website (below) for free open access to anyone who wants to use them.

[www.vmarsmanuals.co.uk](http://www.vmarsmanuals.co.uk)

One of the benefits of membership of VMARS are auctions of vintage and military equipment. These are generally held at various Midland

locations in order to enable access for the maximum number of members to attend. Sales are usually catalogued with illustrations and the details circulated with the monthly *News Sheet* prior to auction day. In some instances where very large quantities of equipment are being sold, items are sold un-catalogued and as seen on auction day. Some VMARS auctions have also been carried out online using ZOOM. These auctions remain for VMARS registered members only and full details are published in the regular monthly *News Sheet* and online in the VMARS forums.

There is a VMARS online trading site for members. A wide range of equipment and spares can be bought and sold on here. The monthly *News Sheet* also contains member's sales advertisements for their surplus equipment and

spares. VMARS members can also buy some of the substantial quantity of valves which the society holds for members who are restoring or repairing equipment.

Annual membership subscriptions to VMARS are £28 for UK amateurs, £31 for those in Europe and £32 elsewhere. Benefits include the quarterly journal *Signal*, Fig. 3, by post and monthly news sheet via the internet. Members can pay extra for the monthly news sheet to be posted to them.

## RNARS

If you currently work or have previously worked in the Royal Navy, the Royal Marines or the Merchant Navy, then the Royal Naval Amateur Radio Society (RNARS) may be of interest to you. Not only does it promote and foster amateur radio activity within the Royal Navy, the Royal Marines and other Naval services such as the RNLi, it liaises with the radio societies of the other UK Services and with other Navies throughout the world. RNARS was founded in 1960 and has a current membership of over 600 worldwide. It has an excellent leaflet which describes the RNARS:

<https://tinyurl.com/bdhk6e7s>

RNARS publish a quarterly newsletter, which is available electronically or by post. Subscriptions are currently £5 per annum for electronic delivery of the newsletter or £15 by post. The current Headquarters of the Society is in *HMS Collingwood*, Fareham, Hampshire. Membership is open to all radio amateurs with an interest in maritime affairs, including EN52. Besides individuals, clubs and societies can also join. The RNARS has an annual open day each year at *HMS Collingwood*.

[www.rnars.org.uk](http://www.rnars.org.uk)

RNARS has a comprehensive list of regular skeds on a variety of bands and modes, which members are encouraged to join in.

[www.rnars.org.uk/schedules%20frequencies.html](http://www.rnars.org.uk/schedules%20frequencies.html)

## RSARS

Full membership of the Royal Signals Amateur Radio Society (RSARS) is open to those who are either a serving or retired member of Royal Signals (the Royal Corps of Signals), including Royal Signals TA. Associate membership is open to others who are serving in or retired from the Army or territorial Army, cadets, Commonwealth forces, NATO forces with close links to the Royal Signals etc. *Mercury* is the name of the society's journal, which is published three times a year. The society's website contains more information about the society, and contains links to a variety of antenna designs and a few other construction projects. One on a battery box and charging circuit for a Yaseu FT-817 particularly caught my eye.

<https://rsars.org.uk>

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Keith Rawlings G4MIU  
keith.g4miu@gmail.com

I mentioned last month that many years ago I had a homemade two-element 10m Yagi.

This was based on a design by Orr W6SAI presented in the *Beam Antenna Handbook*, Fig. 1.

It was constructed using 1in diameter x 10swg aluminium tube for the elements and sections of 2x4in timber to support the antenna. The timber was formed as an 'H' with the centre of the H being the boom and the 'legs' of the H were the supports for the elements. The matching section for the design, as taken from the book, was made up from some twin mains lead to act as 75Ω twin lead and some RG58 50Ω coax. The overall design was extremely solid and quite heavy.

With 10m being active at present I felt a yen to make another one so, this month I will begin describing the construction of my new two-element beam.

I did consider a Moxon Rectangle, but settled on the beam, for now at least, as it would be slightly easier to make. This time around though, the beam would need to be much lighter as it would be mounted on my LMA telescopic mast. I would stick with two elements due to the fact that when the mast was down anything larger would likely foul on the roof of my garage.

In addition, I wanted to use materials that I had lying around so once again timber would be used. I had a length of modestly sized 25x25mm timber for the boom and to support the elements I had some 65x10mm flat timber. For the elements I had a quantity of 8mm diameter aluminium tube and I could 3D print the standoffs needed for supporting the elements. The photo, Fig. 2, shows the beam under construction.

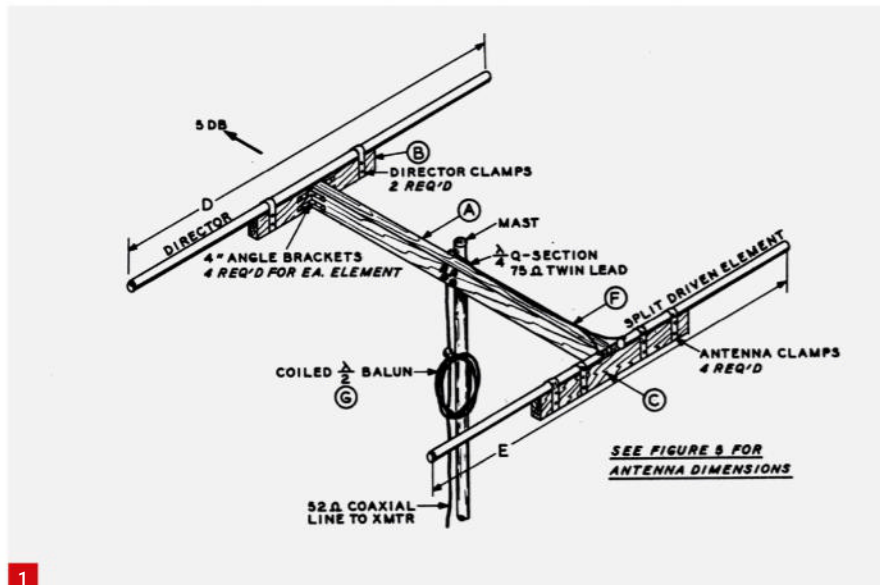
## Design

I don't have the handbook anymore but it was a simple matter to Google and find the formula needed to calculate the beams dimensions. It is important to note that there can be many variations of a Yagi, even a simple two-element one!

Do we want maximum forward gain, best Front-to-Back Ratio (F/B), widest bandwidth, a 50Ω match, or accept the need for a matching device where impedances are other than 50Ω, or a combination of all of these?

These factors are affected by the spacing between elements, the length of reflector and driven elements and also the height of the antenna above ground. Consequently, there would seem to be an unending number of dimensions to be had. Understandably there may be some compromise between the highest gain, the highest front-to-back ratio, adequate operating bandwidth, and feedpoint impedance.

For my new beam I decided on a reflector and driven element configuration, for simplicity a feedpoint of close to 50Ω was desirable and I



# A simple lightweight two-element beam for 10m

Keith Rawlings G4MIU starts to build a 10m Yagi and also has a further update on AN-SOF.

wanted a good VSWR bandwidth to cover as much of the band as possible.

For a two-element beam it will be found that element spacing of around  $0.16\lambda$  will provide a feedpoint impedance around 50Ω and also give a favourable F/B ratio but at the expense of slightly lower forward gain.

With a target frequency of 28.4MHz I started off by using the formula of reflector length in metres =  $150/f$ , driven element length in metres =  $138/f$  and an element spacing of  $0.16\lambda$  to obtain the dimensions. This gave me a total length of 5.281m for the reflector and 4.859m for the driven element with a spacing of 1.689m.

I entered the dimensions into AN-SOF to see what it thought of the design. With the antenna simulated at 8m calculated dimensions looked ok with a simulated 10.2dBi of forward gain at 15° elevation, 9.5dB F/B and an SWR of 1.47:1 at 28.4MHz with a feedpoint impedance of 42Ω. Interestingly AN-SOF estimated that I would have a 2:1 VSWR bandwidth from 28.0 to 29.9MHz, Figs 3, 4 and 5, which surprised me a little considering the small diameter of the tube being used. It was noted the simulated radiation pattern remained well behaved over this VSWR range.

## Construction

The elements are made from 8mm diameter thick-walled aluminium tubes, which are 4m long. These were a special type of tube that I had made up as

far back as the mid 70's (no, I don't throw anything away and these tubes are now sitting in their fourth workshop!). This tube has a wall thickness that leaves the I/D the correct tapping size for a 2BA thread, which is 0.1575in.

So not only is the tube quite strong while still being light, it has an internal bore that can easily be opened up to 4.2mm (0.165in) to accept an M5 thread and this would be useful to attach connections at the feedpoint.

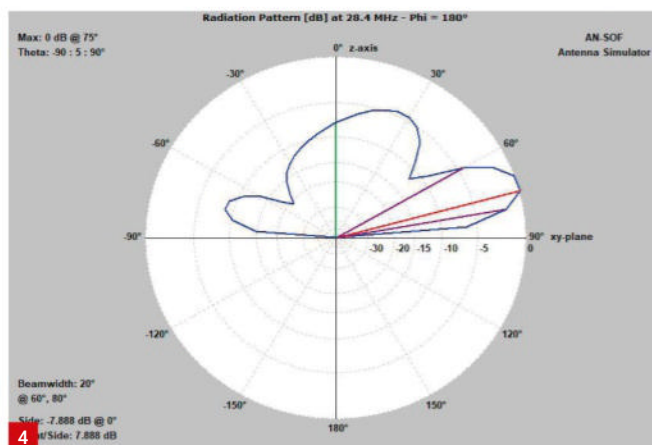
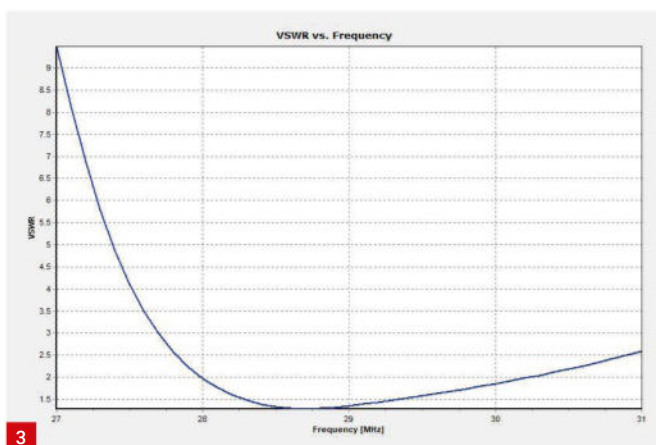
As the total element lengths were longer than the 4m lengths of the tubes, I would have to use four lengths and cut them to size. Two tubes were cut for the driven element making two separate parts to form a dipole, Fig. 6.

The reflector however is best made from one complete section, which in this case is 5.37m, clearly longer than the 4m material to hand. Consequently, I took two lengths of tube, cut them to half of the required dimension and made up a coupler to join the two together. The coupler was made from a length of 16mm diameter aluminium rod, which was cut to 100mm long and drilled through 8.5mm to clear the tube. The coupler was then cross drilled and tapped to M6 to take stainless steel grub screws to secure the elements, see Fig. 7.

The flat timber was cut to two lengths of 600mm and drilled through the centre line to take the element standoff spacers. Along with the boom this was then treated with a few coats of Sadolin wood stain for weather proofing.

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## Standoffspacers

The elements would need fixing to the timber supports and for this I needed some spacers. I did think about making them from some nylon 66 rod I have in the workshop but this would have meant machining them. Being lazy I considered it easier to 3D print them instead.

They were designed using FreeCad. This package will also create the .stl file needed for the slicing software, the output of which is loaded into the 3D printer, in my case an Ender 3 Max. FreeCad makes it a simple job of designing parts for 3D printing and I think it took me no more than five minutes to have a finished design.

I chose to make the standoffs round, mainly because I still had in my mind the use of the round Nylon 66 rod. I could have designed them as rectangular blocks and, in retrospect, they may have been better had I done so. They measure 25mm dia by 30mm high with a cross hole of 8.5mm diameter to clear the elements at 15mm (half way). There is

an M5 threaded hole axially through centre.

The printer was set up with a 0.8mm nozzle. This is rather coarse, which meant the standoffs have a slightly rougher finish to them than normal. I used PET-G filament and after printing a first off to make sure everything was OK I ran off a further nine to give me ten in total, three each for the driven elements and four in total to support the reflector.

## Balun

As the feedpoint impedance of the driven element was near to 50Ω, a simple 1:1 BALUN could be used to match what is a balanced dipole to the unbalanced coaxial feeder. In my junk box I had a BALUN as described by **Moxon G6XXN** in *HF Antennas for all Locations*. It has ten trifilar wound turns of 22swg enamel wire, which are wound on a short piece of ferrite rod from an old transistor radio, as per Moxon's description. The design has been proven capable of handling 100W so should

**Fig. 1: The original W6AI design (taken from the editor's copy of the book). Fig. 2: Two-element beam under construction. Fig. 3: AN-SOF predicted VSWR plot. Fig. 4: AN-SOF predicted Elevation at 8m 2D plot.**

work satisfactorily in this application.

I decided to 3D print a box to mount the BALUN in and this would then simply be cable-tied to the boom. A common mode choke using some RG174 wound over a ferrite core may also be added later.

I will continue with the final dimensions found after tweaking the design, assembly, adjustment and testing of the beam next month.

Timber can be sourced from the likes of B&Q, Wickes etc. Google brought up one source for 8mm x 4m thin-walled tubes but at £17.64 each length plus shipping they are not cheap:

<http://tinyurl.com/mnxue8fu>

Further reading:

<http://on5au.be/content/a10/yagi/beam2.html>

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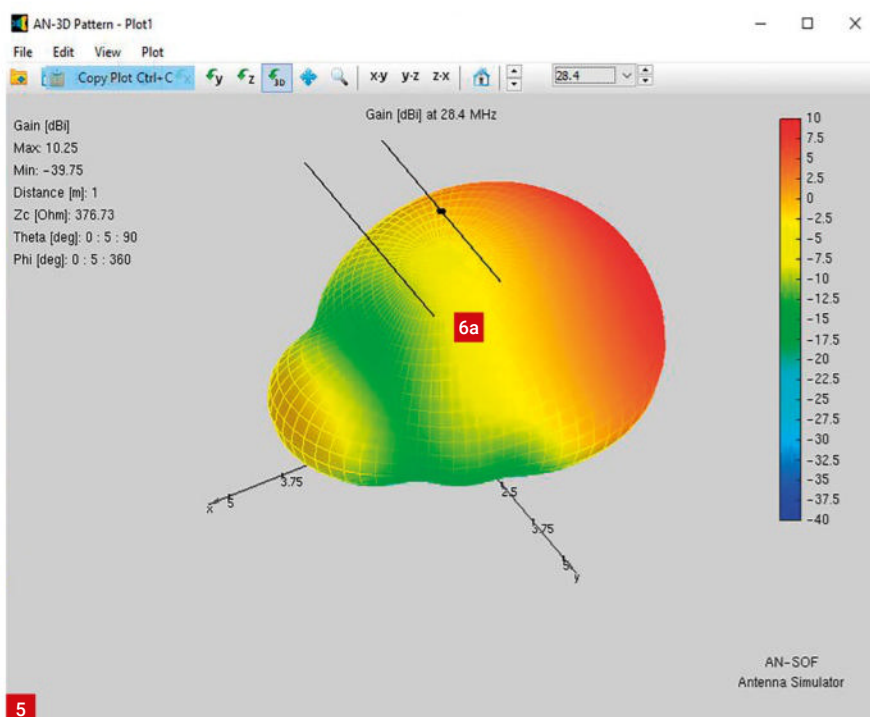


Fig. 5: AN-SOF predicted 3D plot looking down.

Fig. 6: Feedpoint detail and BALUN.

Fig. 7: Reflector element coupler detail.

and current sources.

## 6. Import and Export of 'LD 4' Command:

The 'LD 4' (fixed load impedance) NEC command can now be imported and exported, complementing the existing support for 'LD 0' (RLC impedance) and 'LD 5' (wire conductivity) commands.

## 7. Performance Enhancements:

The algorithms for obtaining current distribution have been optimised for faster results while maintaining the high accuracy that AN-SOF is known for.

<https://antennasimulator.com>

## EMF compliance and AN-SOF simulator

I have mentioned previously that AN-SOF antenna simulator could be suitable to evaluate antenna designs that are not in the RSGB EMF calculator. Tony from AN-SOF was kind enough to write brief details for me to include in the column on how this may be achieved and promised to look further into this involved subject.

As promised, he has now completed part one of *Evaluating EMF Compliance: A guide to Far Field RF Exposure Assessments*, the details of which arrived just as I was completing this month's missive.

This is a significant paper for the amateur because it looks not only at criteria from the American FCC but also UK OFCOM. In addition, the amateur perspective is considered as well as the professional view. It is a good example of a comprehensive yet understandable description of the subject. A model of an amateur 17m two-element Delta Loop is used as an example and a model is available for download.

The key elements of this article include. Recognising EMF compliance assessment is essential for ensuring RF exposure safety. That EIRP is a crucial parameter in EMF compliance assessment.

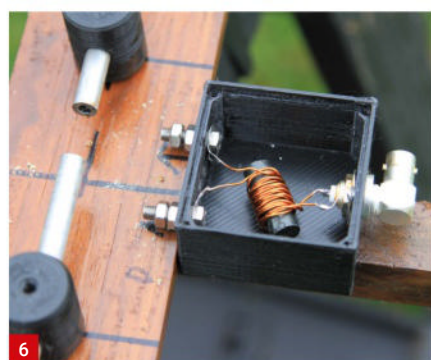
- Antenna configuration and feedlines influence EIRP values.
- The near-far field boundary determines the appropriate methodology for EMF compliance calculations.
- AN-SOF can be used to model antenna configurations and perform accurate EIRP calculations.

The first part of this two-article series focuses on far-field RF exposure assessments. The second part will look into **near-field assessments** and **exclusion zone** calculations, which will provide a complete understanding of EMF compliance evaluation techniques.

I have not had time to fully digest the details of the paper but will report back on it in due course.

<http://tinyurl.com/3thr6rk2>

That's it for another month! **PW**



## AN-SOF; further upgrades and using the simulator to evaluate EMF compliance

Version 8.90 has been released. This Version features several enhancements and new features where, thanks to user feedback, the focus has been on improving usability, expanding functionality, and optimising simulation capabilities.

### New Features:

#### 1. Segments per Wavelength:

Introducing the 'Segments per Wavelength' option, allowing for efficient convergence analysis by adjusting the number of wire segments based on their lengths measured in wavelengths. Use the 'Selection Box' tool to enclose the wires you wish to modify and navigate to Edit > Modify for easy implementation.

#### 2. Enhanced Scale Wires Command:

The 'Scale Wires' command now offers two options – 'Single Factor' and 'Advanced'. 'Single Factor' enables uniform scaling along the X, Y, and Z axes, while 'Advanced' allows users to apply dif-

ferent scaling factors, facilitating deformation by stretching or compressing wires in various directions.

#### 3. TL Command Import and Export:

Added import and export functionality for the 'TL' command in NEC files, enabling the transmission line descriptions to be seamlessly integrated into the simulation. Transmission lines can also be imported in 'Bulk Simulation', and exported to Scilab files for script-based parameter variation.

#### 4. Transmission Line Manipulation:

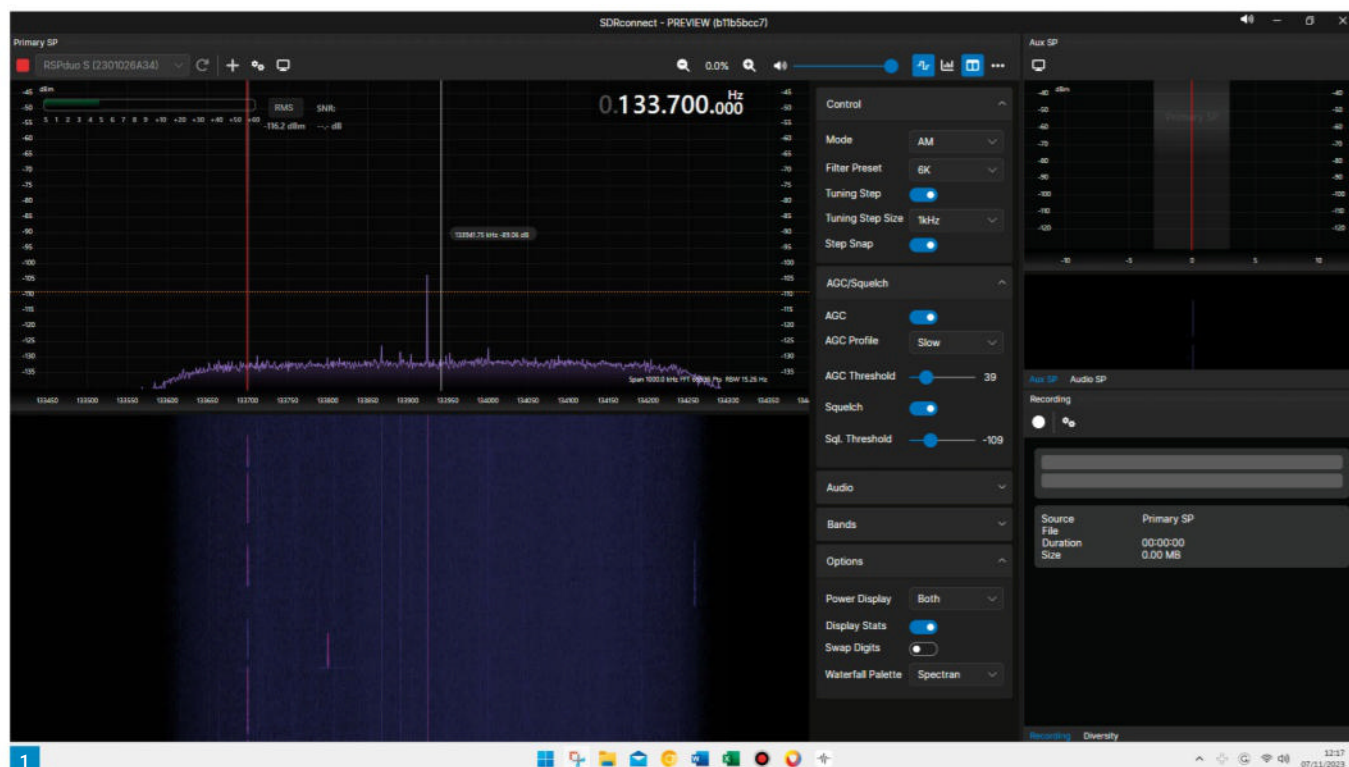
Commands for moving, rotating, and scaling now extend to transmission lines, preserving wire-transmission line connections during transformations. This streamlines the editing process for enhanced user convenience.

#### 5. Fixed Load Impedance (R+jX):

A new load type, 'Fixed Load Impedance', has been introduced, where the reactance (X) does not scale with frequency. This feature is useful for quick antenna tuning by adding an opposite reactance to the antenna input reactance. Fixed internal impedance (R+jX) can also be set for voltage

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Georg Wiessala  
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A little more detail came through recently about *SDRconnect*, the much-talked-about new SDR and server5 software suite by British makers SDRplay. When SDRplay introduced its first SDR (the RSP1) a decade ago, the team could see the need for a wideband SDR receiver, which overcame the basic limitations of the relatively cheap 8-bit dongles then available.

The company's beam of innovation focused on the use of a 12-bit (and later 14-bit) analogue-to-digital conversion (ADC) technology and an extensive set of filters to curtail both 'phantom' signals and intermodulation products. At that time – it seems an age ago now – *HDSDR*, *SDR Console* and *SDR#* ('SDR Sharp') were among the freely available SDR software packages for radio enthusiasts. By 2016, Airspy had also introduced an SDR of their own. Since Airspy developed the SDR# suite, the firm understandably restricted the SDR's use to its own hardware.

Against this backdrop, it became obvious that SDRplay was going to need to provide some proprietary SDR software in order to achieve optimum performance. Following a collaboration with the author of the Italian-based 'Studio 1', SDRplay developed that software, naming it *SDRuno*.

### Modes and functions

SDRplay has developed this line for its range of RSPs ever since. RSP owners have enjoyed regular additions to *SDRuno* over recent years, including

# The new SDRconnect software

**Georg Wiessala** discusses the development history of the popular SDRconnect software.

'scanner' and 'scheduler' functionalities. The specialised hardware of the *RSPdx* and *RSPduo* led to features such as an 'HDR mode' (below 2MHz) and Diversity Reception (*RSPduo*).

A diversity system is a communications infrastructure with two (or more) paths or channels. The outputs of these are then combined to give a single received signal and thus reduce any effects of fading (*Oxford Dictionary of Electronics and Electrical Engineering*, 2018: 157). This comes into play when an optimum signal impulse is selected automatically from among the available choices.

However, there were perceived limitations with *SDRuno* – it is restricted to Windows, and it does not support remote operation. The architecture could take a bit of getting used to. Therefore, SDRplay developed a completely new solution: *SDRconnect*.

### A preview version

From August 2023, SDRplay then released the 'preview' version, which runs on *Windows*, *MacOS* and *Linux*. SDRconnect comes with server software making it ideal for running a remote

RSP on say a *Raspberry Pi*. The preview version seems stable. There will be regular updates adding features, such as, once again, the 'scanner' and 'scheduler', as well as the first migrated plugins from *SDRuno*.

By the way, any additional plugin applications will be named 'modules' in *SDRconnect*. In the new *SDRconnect* software, you can visualise up to 10MHz of spectrum and select a signal just as though it were connected directly to your computer.

### A first road test: SDRconnect in use

I was allowed to take a look at *SDRconnect* in November/December 2023. As I usually do, I attempted to achieve optimum reception with as many signals, and on as many modes as was possible in my modestly-equipped shack.

Therefore, the screenshots on these pages are meant to demonstrate a wide range of signals and modes experimented with over the last few weeks. It was also good to try out the software's basic facility to have several windows ('instances') open at the same time for monitoring and tracking purposes. This can be useful on both HF and

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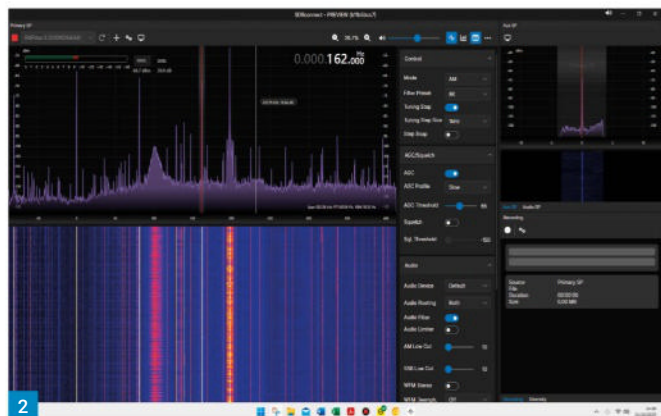


Fig. 1: Airband. Fig. 2: Allouis (162kHz).

Fig. 3: AM MW. Fig. 4: DCF77.

Fig. 5: DWD 147.3kHz.

VHF and can provide clues as to propagation conditions and transmission times.

I tested the software on, among others, the following transmissions (see screenshots attached):

- Time Signal Stations on VLF and LW (e.g. 60 and 77.5kHz, Allouis, 162kHz)
- LW European DWD weather information on around 147.3kHz
- Dutch 'Pirates' on the European X-Band (1600kHz)
- Some Non-Directional Beacons (NDB)
- LW and MW UK Broadcast Stations (e.g. 198 and 909, 1026 and 1368kHz)
- A few radio amateur transmissions (e.g. 21.237kHz)

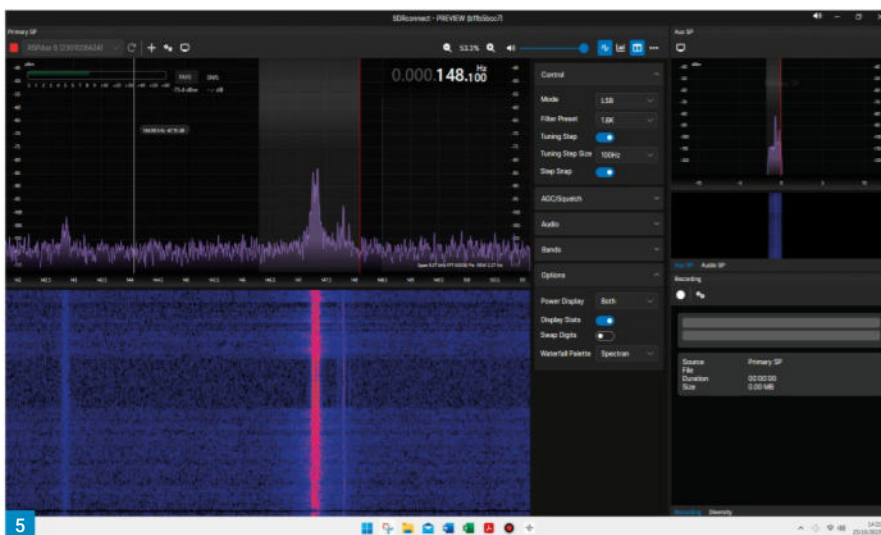
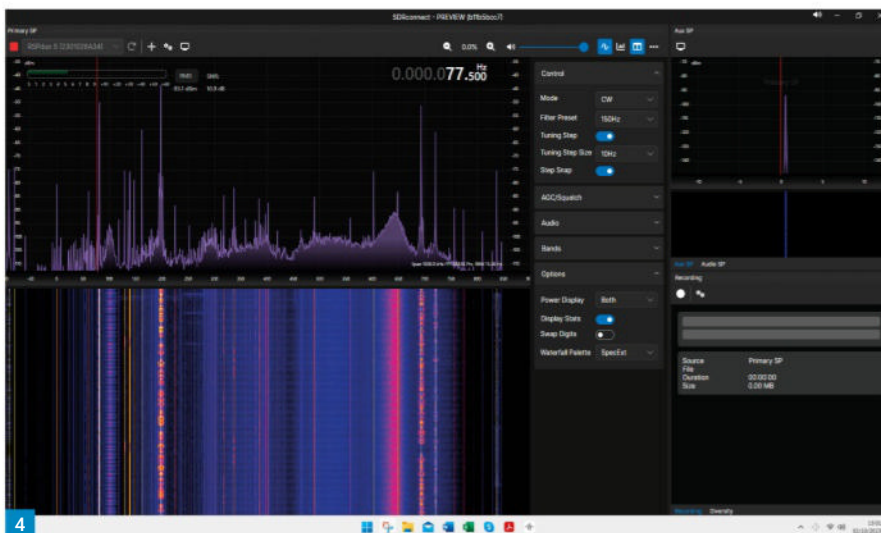
In all these areas, and on many more bands besides – for instance, Airband and, of course, FM, I was more than happy with the results, and I found the software to be both flexible and user-friendly. It also invites experimentation and education, in terms of citizen science and, perhaps, colleges.

On the HF bands, I used the new Chameleon CHA RXL and PRO models, since I had these in the shack for another review (*The Spectrum Monitor*, October and December 2023) as well as the Wellbrook ALA-1530LN – now out of production – with comparable, and excellent, performance results. In other areas, such as Airband, I connected a standard Discone antenna, and one of my favourites, the Diamond RHS1000.

## In conclusion

It's early days for this remote server/SDR software, and some much more in-depth testing will, no doubt, be undertaken by enthusiasts and specialists alike, especially on the remote server facilities of the software, I would guess (see next page for specifications). However, in my humble view, SDRplay have, once again, confirmed their innovative potential here, as well as their market-leading position in the SDR field.

I feel that *SDRconnect* will appeal to a wide range



of users and radio enthusiasts. I am looking forward to more functions being added and to other future developments of this software suite.

There are step-by-step video guides for installing and running both the SDR and the server software in the video guides at the URLs below. Note you will need Windows 10 and a 64-bit system. SDRconnect is happy with SDRplay on the same PC.

The RSP family of SDR receivers are available directly from SDRplay Ltd. (See URL, below) and a global network of resellers.

My sincere thanks are due to **Jon Hudson** at SDRplay for the loan of the SDRplay RSPdx review receiver.

[www.sdrplay.com/purchasehome](http://www.sdrplay.com/purchasehome)

[www.sdrplay.com/sdrconnect](http://www.sdrplay.com/sdrconnect)

[www.sdrplay.com/sdrconnectvidguides](http://www.sdrplay.com/sdrconnectvidguides)

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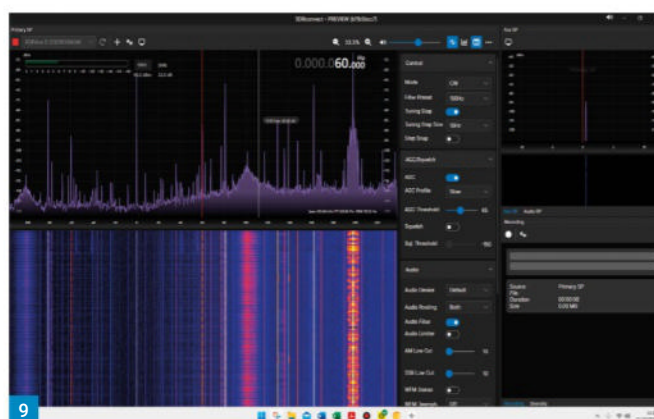
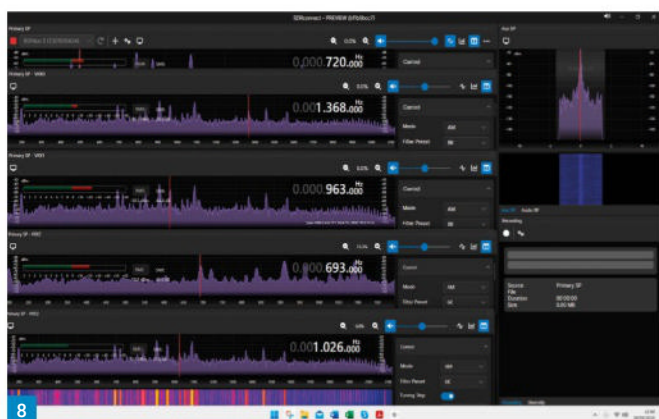
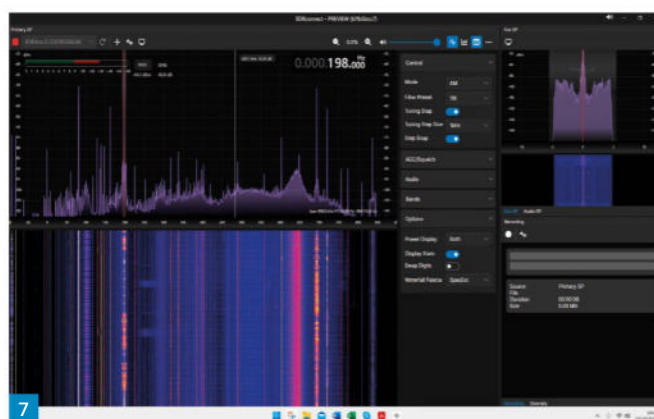
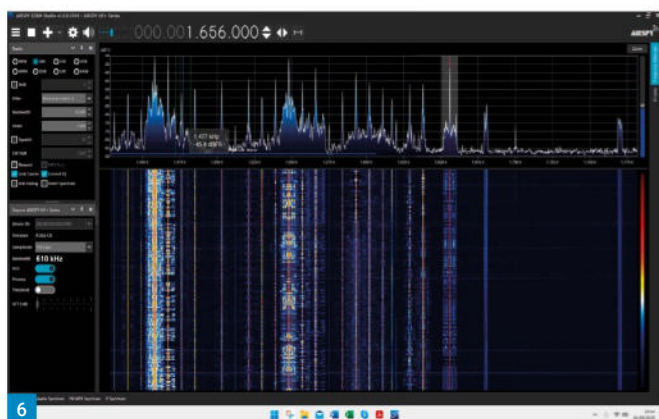
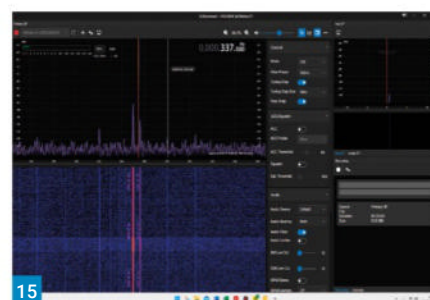
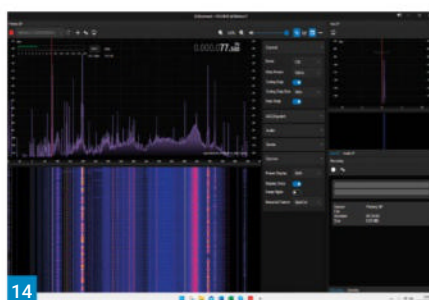
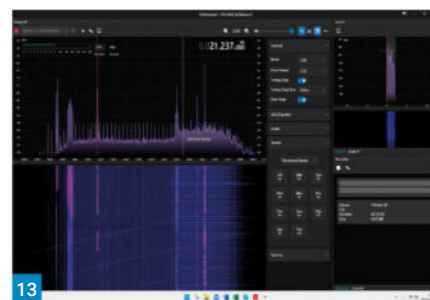
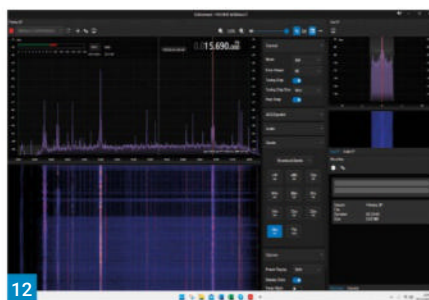
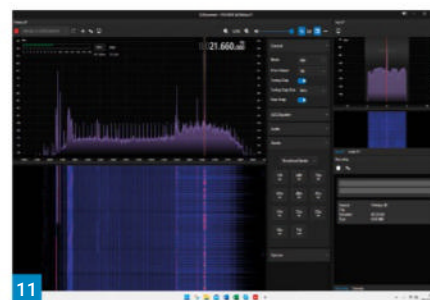
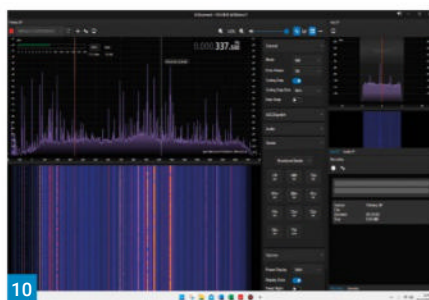


Fig. 6: EU X-band. Fig. 7: LW. Fig. 8: Many windows on MW. Fig. 9: MSF. Fig. 10: NDB. Fig. 11: Saudi Arabia. Fig. 12: SW. Fig. 13: Ukrainian amateur. Fig. 14: VLF on SDRconnect. Fig. 15: Warton BAE beacon (337.5kHz).

## SDRconnect: Basic Specifications (A-Z)

- Ability to allocate the Aux SP to different tuners in Dual-Tuner mode for the RSPduo and for additional VRXs
- Band framing
- Built-in support for all model RSPs except the original RSP1
- Calibrated power meter and S-meter
- HDR mode support for the RSPdx
- Headless server command line options
- Manual Diversity Control for the RSPduo
- Multiple VRXs with basic radio controls
- Remote server with two streaming modes across both LAN and WAN (internet): a) Full IQ and b) Audio – a streaming mode which provides a very efficient way of displaying a large spectral bandwidth across a network with limited data throughput.
- Saving and reloading settings
- SNR measurement
- Support for RSPduo Single and Dual Tuner mode (two tuners) within a single instance of SDRconnect
- Support for un-docking and re-docking of panels.

(Source: SDRplay website:  
<https://tinyurl.com/4pn7pk4f>)



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**Garry Smith**

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For the Coronation of **Queen Elizabeth II** on 2 June 1953, foreign-language staff of the BBC's *External Services* covered the proceedings from a number of separate positions along the processional route. Places and facilities were also found for 213 commentators who attended from overseas broadcasting services. The *Outside Broadcast* producer for audio directed the entire sound programme in English from a specially constructed *Central Control Room (CCR)* housed just outside *Westminster Abbey*. The outputs of the television cameras in the Abbey and at the West door were also selected and controlled from the CCR, **Fig. 1**. The individual camera outputs were displayed continuously on the six lower screens while the two above showed the picture leaving the Abbey control room and the actual signal being received from the Alexandra Palace transmitter.

The television producer, who was responsible for the entire coverage at the Abbey and the processional route, operated from an equivalent special control room in *Broadcasting House*, **Fig. 2**. The sound and television producers both had at their disposal a complete communications system, linking them with every commentary position under their direction, and facilities for switching from one programme source to another at will. To some extent, the sound and television operations were complementary. The output of several of the sound effects microphones in the Abbey and elsewhere was superimposed onto the television broadcast. Television receivers installed at specific sound commentary positions along the route enabled commentators to follow what was happening in the Abbey and at other points beyond their range of vision. Some of the overseas broadcasters supplemented their commentaries with descriptions of the *Coronation Service* as they saw it on television screens.

The BBC sound broadcasts were relayed by nearly 3,000 stations in 75 different countries. Some 450 of these stations were in *British Commonwealth and Colonial Territories*, 2,000 were in the USA, and the remainder were in Europe and elsewhere. The main English-language programme was heard simultaneously throughout Australia, New Zealand, South Africa, and over the greater part of Canada, Malaya, Ceylon (now Sri Lanka), the West Indies, and the Pacific area. In the USA, all four national networks carried the broadcast in full, or in part.

## Vintage coronation television equipment

This month's saunter through vintage copies of forlorn newspapers and magazines has un-



## BBC coronations Pt x

**Keith Hamer** and **Garry Smith** continue the special series looking back at the BBC's coverage of Coronations since 1937. There is also a Coronation vintage television advertisement from the archives, including a detailed description of the 'Pye' company. There are more unique details about Roland Pièce, the pioneer of Swiss radio broadcasts, from family archives supplied by his Grand-Nephew, and PW reader, Pierre Yves-Pièce. The series charting the rise and fall of BBC 198kHz transmissions focuses on the Droitwich Station. We also continue our series about the development of Swiss Radio and Television since 1922.

earthed an advertisement by *Pye Limited*, which was released to the public two months ahead of the 1953 Coronation, **Fig. 3**. The advertisement dates from 3 April 1953. The text has been left in its original format to reflect the spelling, grammar and punctuation of the time. This is the full, and extremely brief, description of the 14-inch **New Pye Automatic Picture Control TV** receiver.

### "APOLOGIES

to the thousands of our customers who prefer to wait for delivery of an Automatic Picture Control TV set, so far made only by Pye. We have made great efforts to meet the huge demand. But even with this, we regret that there may be a few weeks' delay.  
14" TV 67 GNS.

**The NEW PYE AUTOMATIC PICTURE CONTROL TV**  
PYE LIMITED OF CAMBRIDGE"

This advertisement, placed by Pye in various publications in time for the 1953 Coronation, certainly had an unusual, although perhaps a fully intended, eye-catching headline in that it apologised

for the fact that the company seemed to have been caught off-guard, being unable to produce enough television sets! The other intriguing brief mention is that Pye were the first to have *Automatic Picture Control (APC)*.

APC was incorporated into Pye televisions to help prevent the problem of the picture fluttering or breaking up due to multipath reflections of the transmitted signal, for example from aircraft passing overhead. This was a common problem in early receivers. It also had an early example of *flywheel sync*, which allowed satisfactory reception at up to 100 miles from the transmitter in favourable locations.

The Pye company was originally established in Cambridge by **William George Pye** in 1896 when he left his job as superintendent at the workshop of the *Cavendish Laboratory*, which was officially opened at the *University of Cambridge* on 16 June 1874. The laboratory was named after the physicist and chemist, **Henry Cavendish**, who was born in October 1731. He later became famous for discovering hydrogen or 'inflammable air' as he originally



Fig. 1: The specially constructed *Central Control Room* for the 1953 *Coronation*, housed just outside *Westminster Abbey*. Fig. 2: The special control room in *Broadcasting House*.

Fig. 3: An advertisement, dated 3 April 1953, for the new 14in *Pye* television receiver with *Automatic Picture Control*. Fig. 4: The experimental long-wave station at *Chelmsford* in 1924.

called it. Just as an aside, the authors' school in Derby was also named after him.

William Pye initially started his business to produce scientific instruments for use in research and teaching and sold his devices to universities and schools. The company was known as *W. G. Pye & Co. Limited* and manufactured a vast array of specialised equipment, including ionisation gauges, thermocouple galvanometers, electrostatic voltmeters, Kelvin, Kohlrausch and Wheatstone bridges, plus cathetometers. The latter device is an instrument for measuring vertical distances between two points with great accuracy where it's impractical to use a standard physical scale.

At the outbreak of *World War One* in 1914, Pye had 40 employees manufacturing instruments for teaching and research. The war increased demand for their precision instruments and the War Office needed experimental thermionic valves. The manufacture of such components gave the company the technical knowledge required to be among the first to develop a wireless receiver when public broadcasts began from the *British Broadcasting Company Limited* in 1922. Instruments continued to be designed and manufactured by *W G Pye & Co. Limited*, located in York Street, Cambridge. A separate company was formed to produce wireless components in a factory called *Cambridge Works* at Church Path, Chesterton.

In 1924, William Pye was encouraged by **Charles Orr Stanley** to produce complete wireless receivers rather than simply components. C. O. Stanley was born in Cappoquin, County Waterford, Éire on 15 April 1899. Being heavily involved in telecommunications, he was employed by Pye to manage their radio division. In 1926 he devised a system for producing radios in kit form. At that time, the vast majority of listeners were using crystal sets.

In 1928, he purchased *W. G. Pye & Co. Limited* with a down-payment of £60,000 and established a new company called *Pye Radio Limited*, which later became *Pye Limited*. A chain of small component-manufacturing factories was established across East Anglia.

When *Pye Radio Limited* wanted to establish their *Television Development Department* in 1931, they recruited **Peter Goldmark**, a 27-year-old Hungarian engineer. He initially started work on 30-line mechanically-scanned television based on the principle invented by **John Logie Baird**,



but later progressed to electronic scanning. When the **Duke of Kent** visited the Pye facilities, he was heard to say the following comment about television: "*It will never replace cricket!*" Peter Goldmark left Pye and joined the *Columbia Broadcasting System (CBS)* in the USA. He was acknowledged as being responsible for inventing the LP record and the *sequential colour television* system. Perhaps not too surprisingly, he later became Director of CBS Labs, but remained in contact with Pye.

With the advent of television from the Alexandra Palace transmitter, which had a nominal 25-mile radius service area, the Pye company discovered that one of their premises in East Anglia was about 50 miles from the transmitter. Work immediately commenced to build a high-gain receiver that could pick up these transmissions. In 1936, when the BBC began regular television broadcasts, Pye marketed a nine-inch receiver. In 1937, Pye released a five-inch television receiver, which cost 21 guineas (£22.05).

Encouraged by their 1937 success, which used a novel *Tuned Radio Frequency (TRF)* design, Pye wanted a higher quality valve than they could produce on their own. Following discussions with *Mullard* and the research department of *Philips* in the Netherlands, plus some innovative modifications by Pye's **Baden John Edwards** and **Donald Jackson**, which included the addition of a metal shield, the resultant valve was the *EF50 pentode*, which was vital for the Pye 45MHz TRF design. The new valve produced a stable television set that was able to receive transmissions at up to five times the distance of any of Pye's competitors. Within two years, the company had sold over 2,000 sets.

During *World War Two*, as part of the 'war effort', Pye began manufacturing military equipment as



well as developing a *proximity fuse*. The basic design of the fuse was completed in 1941, but the highly sensitive technology was placed under the control of **Sir Henry Tizard GCB AFC FRS** for final evaluation. He was a British chemist and inventor who helped to develop radar during the War. He also devised the concept of *toluene numbers*, which later became known as *octane ratings*, used to classify petrol. In 1944, the 'proximity fuse' destroyed many enemy 'flying bombs'. In later life, he led the first serious studies of UFO's! Meanwhile, Pye concentrated on developing airborne radar systems, ASDIC (*Anti-Submarine Detection Investigation Committee*) and light-weight, low-power radios for troops.

In 1948, Pye produced a variety of broadcast television equipment, including cameras, which were popular with the BBC. The first practical television camera was the *Mk.1 Photicon*. This was fitted with a special miniature *Image Iconoscope*



**Fig. 5: Construction of the BBC Droitwich transmitter began in 1933. Over 900 tons of concrete were used to form a plinth to carry the transmitting mast. Fig. 6: A tribute to Ernest Alexandre Ansermet, conductor of the *Orchestre de la Suisse Romande* which became the official SRG-SSR orchestra in 1938. The plaque was encountered by the authors near the Montreux**

tube called the *Photicon*, developed by Pye Cathodeon, based in Church Street, Chesterton, Cambridge. The camera had an electronic viewfinder rather than the standard optical type. A Mk.2 version of this camera was used by the BBC at their *Lime Grove Studios* for the production of 'light entertainment' programmes.

In 1955, the Pye company diversified into music production with discs bearing the *Pye Records* label. This was following their acquisitions of *Nixa Records* and *Polygon Records*. The latter record label had originally been established by **Leslie Clark** and **Alan A Freeman** to control distribution of the recordings of the former's daughter, **Petula Clark**. Pye's best-known artists in the early days included **The Searchers**, **Status Quo**, **The Kinks**, **Sandie Shaw** and, of course, Petula herself. A subsidiary company called *Pye International Records* was formed in 1958 and distributed many American labels in the UK. Among the company's first releases were the instantly forgettable *Dooby Dooby Wah* by **Richie Valens** and *Wowee!* from **The Pets**.

The Pye Mk.6 Image Orthicon camera, known as the *PC60*, was the final version to be supplied to the BBC Outside Broadcasts department in

1963 for a new fleet of eight O.B. vans. These cameras were the first generation of O.B. cameras to feature a zoom lens, rather than a turret system. The three-tube cameras were known for their reliability but were so heavy that they had to be carried by several people. The Pye PC60 was eventually replaced by the BBC in favour of *EMI 2001* cameras.

In 1971, Pye released a series of 4-D Stereo LP recordings. These were designed for playback in 4-channel quadrasonic sound. The system used a matrix format employing four sound channels, which were 'encoded' into two stereo album tracks. These were subsequently 'decoded' into the original four sound channels. Unfortunately, due to poor decode performance, this early system failed to match the accuracy or channel separation of later matrix formats.

In 1960, Pye faced financial difficulties and in a bid to carry on, they merged with their rival, *ECKO*. By 1966, the financial problems were so severe that the *ECKO* factory in Southend-on-Sea was closed to save money. In 1967, Philips acquired a majority shareholding and in 1976, Pye was bought outright by the Dutch company. The Pye factory at Lowestoft was subsequently sold to *Sanyo* in 1982. Teak-clad television receivers continued to be produced under the brand name *Pye Chelsea* and were popular with television rental companies such as *Radio Rentals*, *Rumblelows* and *Wigfalls*. One of the authors was a television engineer with *Wigfalls* for 18 years. The company was the last to supply Pye receivers on rental and withdrew them in 1988.

In 2009, Sanyo closed the television produc-

tion site at Lowestoft. Ultimately, Philips moved the manufacture of Pye televisions to Singapore. Following many changes of ownership and company names, the final one being *Pye Unicam* in Mercers Row, Cambridge, it seems that the last vestige of Pye's existence was transferred to Germany and China. All ties with Cambridge ended when the *Pye Unicam* site was closed down in 2014.

## Roland Pièce archives: part IV

The following information has been sent from Bex in Switzerland by **Pierre-Yves Pièce**, Grand-Nephew of **Roland Pièce**, the pioneer of radio broadcasts in Switzerland.

As early as 1911, the City of Lausanne had its own airfield at *La Blécherette*, one of the first civil airfields in Switzerland. In the early 1920s, the municipality of Lausanne took the necessary steps to establish an international aeronautical link with France. The municipal mayor, **Paul Rosset** (1872-1954), asked Roland Pièce, who was studying engineering at the University of Lausanne's *Faculty of Science and School of Engineering*, to look into the possibility of setting up a radio station in Lausanne. Enthusiastic about the idea, the young student went to Paris in 1921 to make contact with the French aeronautical service and visit the facilities at *Le Bourget Airfield*. Back in Switzerland, he suggested to the municipality of Lausanne to purchase a radio system similar to the one used by the French.

Events then followed in quick succession. A first test flight with a *Goliath Farman* biplane





took place in October 1921. The aircraft left Paris but had to return mid-flight to have a damaged radiator repaired. The Goliath eventually continued its journey with an overnight stopover in Dijon. The aircraft landed safely at La Blécherette on Friday 28 October 1921, with a number of personalities on board who were welcomed by the municipal councillor, **Monsieur Boiceau**. The provisional radio and telephone link was provided by **Jean Lugeon** (1898-1976), who later became the director of the *Swiss Central Meteorological Institute* in Zürich.

### The rise and fall of 198kHz, part III

Following experimental long-wave broadcasts from the station at Chelmsford in 1924, **Fig. 4**, and the subsequent opening of the world's first permanent LW transmitter at Borough Hill, near Daventry, on 27 July 1925, the BBC began to search for a new location to erect a mast that would serve a much larger geographical area. Once permission had been obtained from various government departments, in particular the *General Post Office*, and following exhaustive engineering tests, a site

was chosen in the civil parish of Dodderhill, just outside the village of Wychbold, three miles north-east of Droitwich in Worcestershire. Construction work for the new transmitter began in 1933. Over 900 tons of concrete were poured into deep excavations to form a monolith block to carry the transmitting mast, **Fig. 5**.

The new station was installed to provide a far more robust service to all the existing listeners who previously tuned into the *Daventry 5XX Station*. However, there were additional advantages with the new Droitwich transmitter. The signal quality from the Daventry 5XX long-wave station was not as high as those from the smaller regional medium-wave transmitters located in large cities. There were certain special difficulties in connection with quality when using a long wavelength because a cut-off of the higher frequencies could arise from the design of the aerial, which had nothing to do with the low-frequency circuits of the transmitter. This, however, was rectified in the new long-wave station at Droitwich and listeners experienced not only a stronger signal, which meant less interference but, in addition, overall better



sound quality comparable with that from the regional transmitters.

### Service information: Switzerland, part XII

In 1938, the two separate SRG-SSR orchestras that had previously been assigned to the Lausanne and Geneva studios were disbanded and replaced by the *Orchestre de la Suisse Romande (OSR)* under the Swiss-born conductor, **Ernest Alexandre Ansermet**. This was his own orchestra which he formed in 1918, together with **Paul Lachenal**. The change to the OSR orchestra was not initially very popular with listeners.

The OSR began to perform concerts on a regular basis for Swiss radio. The orchestra also had a long-standing contract with *Decca Records* and made over 300 recordings for the company, beginning in 1947 with *La mer*, composed by **Claude Debussy**. In May 1954, Decca produced several discs featuring the OSR. These were acknowledged as being the first commercial stereophonic recordings to be made in Europe.

Ernest Ansermet was born in Vevey on the shore of Lac Léman (usually, and incorrectly, referred to as 'Lake Geneva') on 11 November 1883. Originally, he was a mathematics professor, teaching at the *University of Lausanne*, but his main passion was music and he was one of the first in the field of classical music to take jazz seriously. He also became one of the greatest conductors of his era.

In 1912, he was appointed as conductor of the *Kursaal Orchestra* in Montreux (the municipal Casino). Last August, while the authors were strolling along the beautiful flower-bedecked promenade near the Kursaal, they discovered a tribute to the conductor of the OSR, which became the official orchestra of SRG-SSR, **Fig. 6**.

Ernest Alexandre Ansermet remained the music director of the OSR for 49 years, from 1918 until 1967. He died in Geneva on 20 February 1969, at the age of 85.

### Stay tuned!

All photos this month are by Keith and Garry or from their archive collection. Please send archive photographs, information or suggestions for future topics via the email addresses shown at the top of this column. **PW**

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1

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**F**rom the earliest of times, armies have used some form of signalling. Great Britain was one of the pioneers of radio innovation, having developed the first practical wireless technology system in the 19th century. Radio communication was a vital element of modern warfare, for which the previously dominant landline-based telephone was inadequate. Britain invested heavily in radio research and development between the wars creating a well-established radio industry, so that by the time of WWII radio communication between base and ground troops and their supporting armoured vehicles was essential to support efficient command and control.

### Royal Armoured Corps

**WS No. 11.** Wireless Set No. 11 was introduced in 1938 and is arguably one of the most successful British military radios of WWII. By 1940, the British Expeditionary Force was employing Wireless Sets No.11 in France for short-range communications on a frequency of 4.2-7.5MHz between armoured fighting vehicles (AFVs) or as a ground station, with a range of up to 20 miles, when large quantities were captured by the Wehrmacht after the Dunkirk evacuation. Sized 22 x 50 x 30cm, the set was later used

## Portable military radio communications of WWII

**Graham Caldwell** begins a series of articles on WWII portable military radio equipment, including their collecting potential, beginning with the British Army (this first part has previously appeared in *The Armourer* magazine).

by the Long Range Desert Group in Libya and Tunisia for long-range communications when deep behind enemy lines. No.11 sets have always been popular with collectors and amateur radio enthusiasts, but today they have become much rarer to find; one selling recently by a Canadian retailer for £1,200.

**WS No.19** is one of the iconic vintage radios used by the British and Commonwealth forces during WWII. It was developed in 1940 by Pye Radio in response to a requirement for an updated tactical communications radio for AFVs, including tanks. The Mk. II model came out in 1941 and the Mk. III model in 1942. A majority of Canadian produced sets used English/Cyrillic front panel lettering due to a Lend-Lease contract for the Soviet Red Army. The set had three channels: A Set was a High

Frequency radio transceiver intended for radio communications up to 50 miles; B Set was a VHF transceiver intended for short range line-of-sight use up to one mile and Intercom was an audio amplifier to enable crew members within the vehicle to communicate with each other. Frequency ranges are: A Set: 2-8MHz and B Set: 229-241MHz. Size: 45 x 25 x 33cm. Later in the war, the importance of co-operation with infantry added WS No. 38 alongside (see below) specifically to complement the No. 19 set in a vehicle setup. The WS No.19 set came onto the surplus market in the 1960s and you can still find WS No.19s for sale online. Prices currently on eBay range from £250 (a Mk. III requiring restoration) to £1,400 (a complete Mk. II) plus a complete jeep set is offered for £1,750. There is also a WS No.19 *Working Instructions* booklet

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Fig. 1: Wireless Set No.11 (overleaf) was introduced in 1939 for use in tanks and AFVs, plus it was used by the Long Range Desert Group in the Western Desert from 1942 ([mapleleafup.net](http://mapleleafup.net)). Fig. 2: Wireless Set No.19 is one of the most common WWII radios found for sale and continues to be popular with amateur radio enthusiasts. From 1941 it was the main set fitted to tank and AFVs ([image.wftw.nl](http://image.wftw.nl)).

Fig. 3: The easily removable Wireless Set No.19 to be set up as a ground station, is seen here being operated inside a Sherman tank in 1943 ([nam.ac.uk](http://nam.ac.uk)). Fig. 4: Introduced in 1940, Wireless Set No. 18 was the standard WWII British Army short wave man-pack in Mk's II and III. It was used throughout North Africa, Italy, S.E. Asia and North-West Europe ([image.wftw.nl](http://image.wftw.nl)). Fig. 5: British infantry operating a Wireless Set No.18 man-pack radio in 1944. One man operated the set while the other carried the spare batteries and accessories.

on eBay for £24.95.

### The infantry

**WS No.18** was introduced in 1940 and became one of the army's widely used portable radio sets. It was a man-pack set weighing 16kg that operated in the high frequency (HF) band of 6-9MHz providing short range voice and Morse communication between infantry units. It was housed in a pressed steel case, embodying a rucksack canvas frame and was carried by a two-man team, so that one operated the set while the other carried the spare batteries and accessories. Size: 26.7 x 27.9 x 44.5cm. It was extensively used in North Africa, Italy, S.E. Asia

and N.W. Europe, including at Arnhem, with more than 76,000 sets produced. A complete WS No.18 set is currently for sale on eBay for £1,300.

**WS No.38** was another important man-pack radio of WWII, which was developed in 1941. Its frequency coverage was 7.3-9MHz, with a range of two miles, using a sectional rod aerial and was very light at 10kg, yet small enough to be carried on the left breast secured by a brace-hook and ring to the webbing equipment. Size 22.8 x 16.5 x 10.0cm. Over 100,000 Mk. II sets were produced and a No.38 AFV was later developed for use in military vehicles. Late in the war a Mk. III was introduced, which saw

marked improvements in the radio's netting and tuning abilities and was 'tropicalised' using a diecast aluminium and hermetically sealed casing for jungle operations, but its low production numbers meant that it's now very rare to find one. On eBay there are currently several No.38 Mk II's available for between £250 and £310 with most requiring various amounts of restoration.

### Airborne operations

**WS No.22** is a short-wave wireless set that was in standard use during WWII by airborne troops and anti-aircraft units and was one of the principal general purpose sets dropped

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by the 1st Airborne Division at Arnhem. It was primarily a vehicle set-up, but was easy enough to remove to be used as a ground station. Its general appearance, dimensions and frequency range resemble those of set No.19 (see above) but with a number of technical differences. Frequency range was 2.0–8.0MHz with a range of 20 miles, sized 44.5 x 21.6 x 34.3cm. The sets proved unreliable at Arnhem over distances of two to three miles; the official report on Arnhem's communication failures (and not only for the No.22 sets) highlight a combination of insufficient range, lack of replacement batteries, incorrect crystals fitted, the terrain factor and insufficient training provided in radio communication to the wireless set operators. No.22 sets are rarely seen on the open market, but the Belgium radio supplier, myantcilitaryradio.com, is offering one in working order, including power supply and all original accessories, for €2,050 (£1,760).

**WS No.68P.** This set was similar to the No.18 set (see above) but with a lower frequency

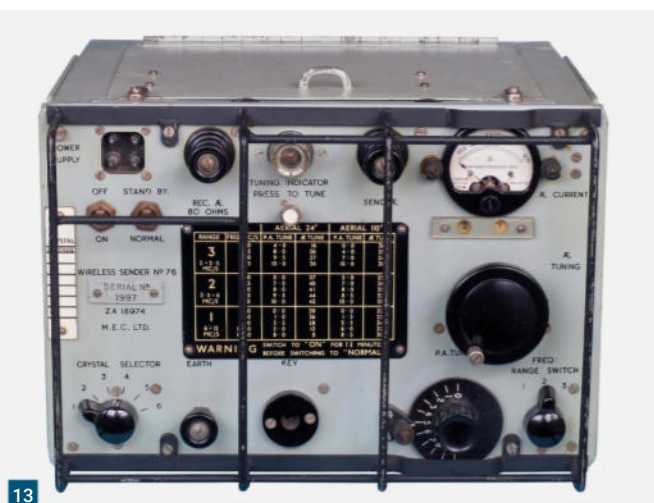
range. The No.68P transceiver covered 1.75–2.9MHz and was in general use by the British Army, including for airborne-drop operations. Sized 27.9 x 44.5 x 26.7cm, they provided short-range communication between company and battalion headquarters, or could be carried as man-pack on the march. Variants were No.68R and 68T with a higher frequency of 3.0–5.2MHz. Currently on eBay is the very sought after WS 68T set, claimed to be complete, for £2,495.

**WS 76.** Wireless Set No.76 was developed especially for the British Airborne Forces in 1942, because radio communication from brigade headquarters to parachute battalions

hundreds of miles away became a critical requirement. The problem was solved by adapting Admiralty Type 65, a portable Royal Navy beach party radio system, consisting of a 5G transmitter and R109A receiver. The resultant long-range radio had to be lightweight, yet robust, built to survive a drop by parachute and have a wide frequency coverage. The No.76, twinned with its R109A receiver, transmitted Morse (CW) only, was lightweight at 13.6kg and had a frequency coverage of 2–12MHz, sized 30.5 x 21.0 x 31.1cm. Its impressive range of up to 300 miles was achieved by using a 110ft wire aerial supported on two 12ft masts, the array

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totally portable. The first operational use of WS No. 76 was with the 1st Air Landing Brigade during the 1943 Sicily landings. WS 76 sets are scarce, but on eBay there is an R109A Radio Receiver for the 76 being offered for £290. Also on eBay is an original WWII British Army wireless headset, DLR No. 1 4035A (webbed headband) for £49.95.

### Combined Operations Command

**WS 46.** Soon after Combined Operations was formed in 1940, which used air and naval units to deliver army Commandos to the continent to raid selected German targets, it became necessary to develop communications for beach-assault landings. Wireless Set No. 46, a

Fig. 10: One of the numerous portable man-pack radios that 1st Airborne Division took to Arnhem was Wireless Set No. 68R/T and its variant No. 68P. Illustrated is the lower-frequency 68P (*image wftw.nl*). Fig. 11: Wireless Set No. 76 was developed especially for the British Airborne Forces in 1942 to provide long-range radio communication to base from parachute battalions hundreds of miles away in the field (*image wftw.nl*). Fig. 12: The R109 Reception Set was part of the WS No. 76 system, allowing communication to flow both ways (*image wftw.nl*). Fig. 13: Wireless Set No. 46 was a lightweight, waterproof sender/receiver developed in 1942 for communications during beach-assault landings by Combined Operations Command (*image wftw.nl*).

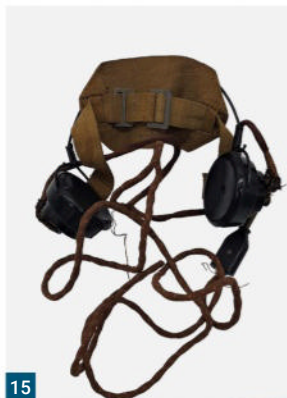
very strongly built, waterproof and lightweight man-pack sender/receiver, weighing only 10.9kg and sized 19.1 x 11.4 x 31.8cm, was accepted for operational use in 1942. It was crystal controlled to avoid time consuming tuning when quickly establishing communications during landings and beach recovery. Frequency was

3.4-9.1MHz with a range of ten miles. Its metal case was contained in a canvas back-pack (or pouch). A WS 46 set complete in its pouch with separate canvas battery back-pack, headphones and box of accessories, will cost you €2,350 (£2,020) from Westland.nl in the Netherlands.

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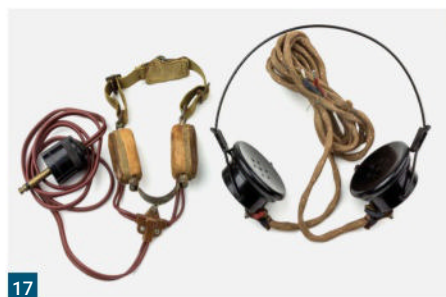
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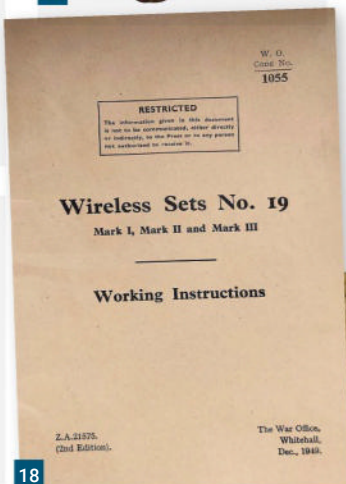
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Fig. 14: An example of a Type 3 Mk. II (B2) transmitter and receiver radio set built within a suitcase for concealment, which were used by British SOE and intelligence agents during WWII (*image wftw.nl*). Fig. 15: WWII DLR No. 1 4035A radio headset with a webbing headband. One similar to this is for sale on eBay for £49.50. Fig. 16: Morse key and plug assembly No.8 for Wireless Set No.18. Examples of this and key and plug assembly No.9 for Wireless Set No.19, are frequently found on eBay for around the £60 mark (*image wftw.nl*). Fig. 17: This Wireless Set No.38 throat mic, plug-in connector and Bakelite headset marked 'S.G.B.C.L.R.', sold recently for US\$50 (£40) at Alexander Historical Auctions, Maryland USA (*alexautographs.com*). Fig. 18: This *Working Instructions* manual for the British WWII Wireless Set No. 19 is currently on eBay for £24.95. Fig. 19: This Wireless Set No.38 Mk. II, complete with harness, antenna bag (with antennas) junction box, headset, haversack, satchels-bag, throat-mic and booklets, was sold by JM-Militaria, Netherlands, for €525 (£450) (*Jm-militaria.com*).

## Special Operations Executive

**Type 3 Mk. II (B2).** The British Type 3 Mk. II, commonly known as the B2, is arguably the most well-known spy radio set used during WWII. It was designed in 1942 by **Major John Brown** for use by the Special Operations Executive (SOE) and issued to British agents and resistance groups operating in German occupied France and other European countries. As an option, it could be dropped by parachute in a waterproof container to groups already operating in-theatre. Housed in a leather suitcase, it was considered too large to carry unobtrusively, resulting in the much smaller A Mk. III (A3) variant produced later at the Marconi New Street factory in Chelmsford, but this had a limited frequency range and a reduced power output. The suitcase consisted of three units: a receiver (RX) a transmitter (TX) and a power supply unit (PSU) plus a box of spares and accessories. The TX is located mounted at centre top, with the RX mounted below it. The PSU is on the right for easy RX

or TX connection. The spares box is housed on the left with the Morse key mounted on its lid. When in operation the lid of the spares box is placed on the table to allow for operation of the Morse key. B2's dimensions are 35.0 x 25.5 x 14.0cm and it weighed 15.5kg with a frequency of 3.1-15.2MHz, powered by AC 90-250V 40-60Hz or a 6V battery. The smaller A3 suitcase variant had a reduced frequency range of 3.2-9.5MHz and a reduced power output of 5W. A part-complete and part-modified Type 3 Mk. II sold a few years ago on eBay US for US\$1,100, but complete originals are mostly in museums and if one were to come up for sale, it would fetch anything between US\$5,000 to US\$8,000.

## Accessories and spare parts

The best place to start looking for those items needed to restore your WWII military wireless is eBay. For example, seller Tomjones50 (4205) always offers a wide range, which currently includes a case of four No.2T

(Z.A.28479) valves for Wireless Set No.38 for £69.99 and a control unit No.16 to fit Wireless Sets Nos.19 and 38AFV for £49.00. Newcomers to the subject are recommended to join the Wireless-Set-Group-Forum at the Royal Signals site (URL below) for open exchanges of information about collecting, restoring and operating all forms of comms equipment used by the Allied forces of WWII. The website also has a free Manuals and Military Communication Documentation section free to members.

[royalsignals.org.uk](http://royalsignals.org.uk)

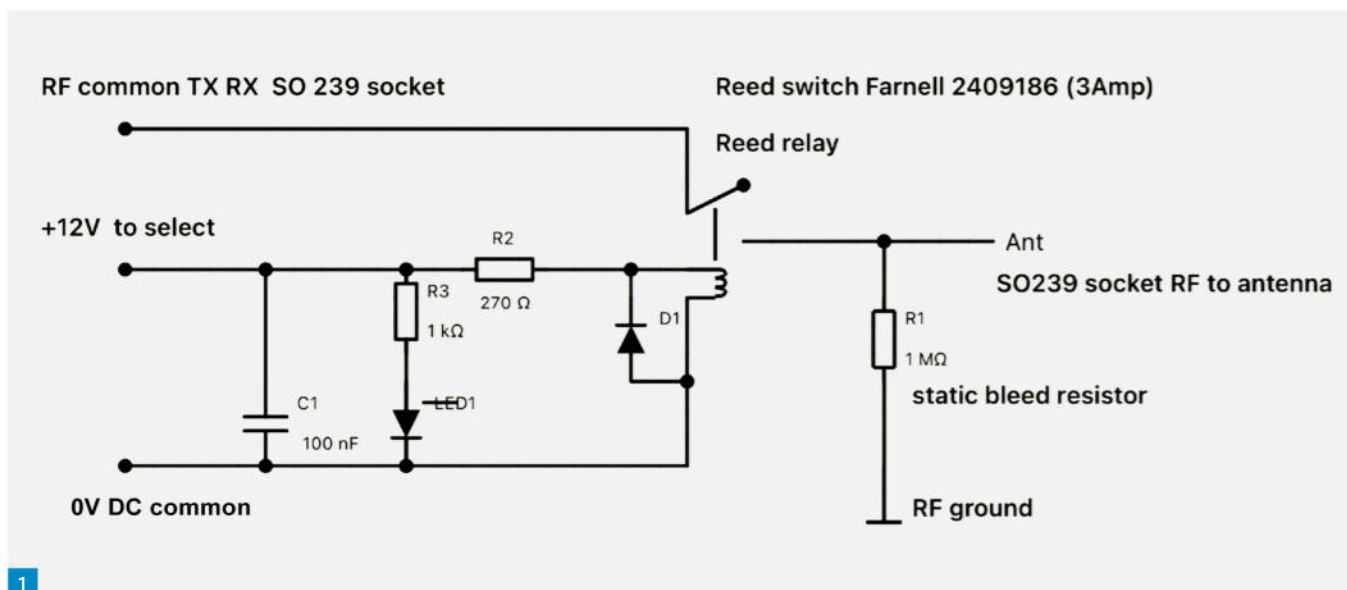
## Acknowledgement

Thanks are due to **Mr Louis Meulstee**, website owner of *Wireless for the Warrior* (below) who supplied images and valuable technical information. Prices and availability of sets mentioned were current at the time of publication in the November 2023 issue of *The Armourer*.

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## Remote Antenna Switch Box

Edward Jones G3ZLX offers a design for an antenna switch using reed switches.

A long time ago when first licensed I bought a bunch of unusual glass tubes called reed switches at a rally. For want of anything else to do with them, I made a 3-port antenna selector, which has been in operation for several decades since (yes, that long!). As the reeds are magnetically operated, the antenna selection could be placed remotely and operated electrically by switch, rig or computer.

Since then, more antennas have appeared at this QTH so a replacement four-port box became necessary and was an opportunity to build a new one. While the reed switches are still available in distribution [1], it seems there are no cost-effective actuating coils on the market any more. Happily, the manufacturer's data sheet gives enough information to wind one, but that's for later.

At times, I've heard quite disparaging comments on the use of reed switches versus common relays for antenna switching, even at HF frequencies, quite unjustifiably I think. In RF terms, the switches have ideal characteristics for the task. They are physically 50mm long, the connecting points are at opposite ends and the contacts are encased in glass so can withstand high voltages. The contacts can carry up to 5A with an open-contact capacitance of only 0.8pF, which gives a very high isolation at HF frequencies. Switching speed is only a couple of milliseconds, which could handle automatic switching for cross-band or separate Tx/Rx antenna operation. Usefully, the antennas can be automatically disconnected when shack power is turned off, reassuring when the lightning storms pass by. Measurements (see later) show no adverse effects on SWR as long as good construction methods are

used. After all, the impedance of SO239/PL259 connectors is hardly reliable or constant and the size of the switch box is very small compared to the wavelength of HF signals on the coax transmission line, so offers negligible discontinuity.

### The design

The antenna selector box is based on the circuit shown in Fig. 1. Construct one copy of this circuit for each antenna output port required, in my case four ports; join the common RF inputs together. A port is activated by supplying a DC voltage to the relay coil with LED1 + R3 used to show this at the box. Diode D1 is used to quench reverse voltage on the coil at switch-off and R2 limits the current through the coil; C1 decouples any RF pick-up on the DC wiring. Resistor R1 provides a static voltage leak when the switch is open and being very high resistance has negligible effect on line impedance.

Designing the actuation coil is more interesting. Although reed switches are more commonly used with small bar-magnets, they work just as well with a solenoid coil. The suggested reeds are the largest available and at 7mm diameter fit nicely inside a plastic drinking straw. The tube length was kept to 30mm to avoid the coil getting too close to the connection tags. The addition of some thin ABS end plates at 10mm square makes a convenient

coil former, Fig. 2.

The manufacturer's datasheet quotes an operational sensitivity of 60At (ampere-turns) minimum, leaving the choice of operating voltage, current and coil turns as a compromise choice to be made by the designer. The relationship is:

$$\text{Coil\_Turns} = \text{Ampere\_Turns} / \text{Operating\_Current}$$

In my case, I decided to use a typical relay current of around 35mA so, to give a slightly higher drive of 63At, this implies a coil made of 1800 turns. The coil size depends on the wire used as:

$$\text{Turns\_per\_Layer} = (\text{Former\_Length} / \text{Wire\_Diameter})$$

$$\text{Layers} = \text{Coil\_Turns} / \text{Turns\_per\_Layer}$$

Using the smallest diameter enamelled copper wire available in the 'spares' box, 0.2mm (32swg), over a 30mm length gives 150 turns per layer resulting in 12 layers on the coil former. As the number of turns is not so critical, counting layers while winding is much easier than counting turns – just be neat! See the photo, Fig. 3, for the final coils alongside a reed switch before wrapping in insulating tape. As you can see, I got better at winding the coils!

Looking at wire resistance tables and calculating the total wire length suggests that number of turns has a resistance of about

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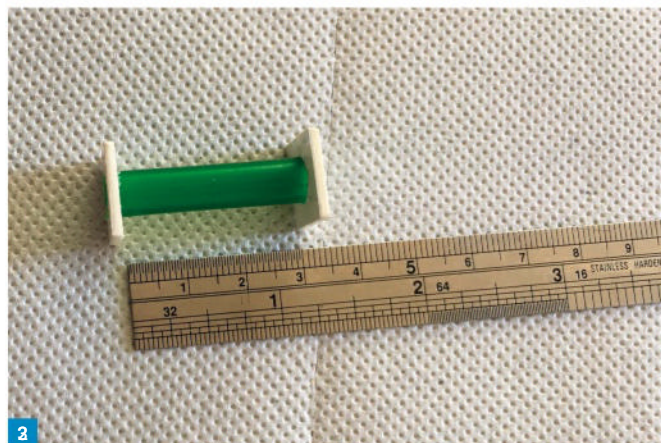


Fig. 1: Antenna switch port circuit.

Fig. 2: The switch coil former.

Fig. 3: The completed solenoid coils.

Fig. 4: Conductive ground plane in place.

Fig. 5: Switch box layout CAD drawing.

30Ω so, using a 12V and 35mA drive, a current limiting resistor of about 312Ω is needed.

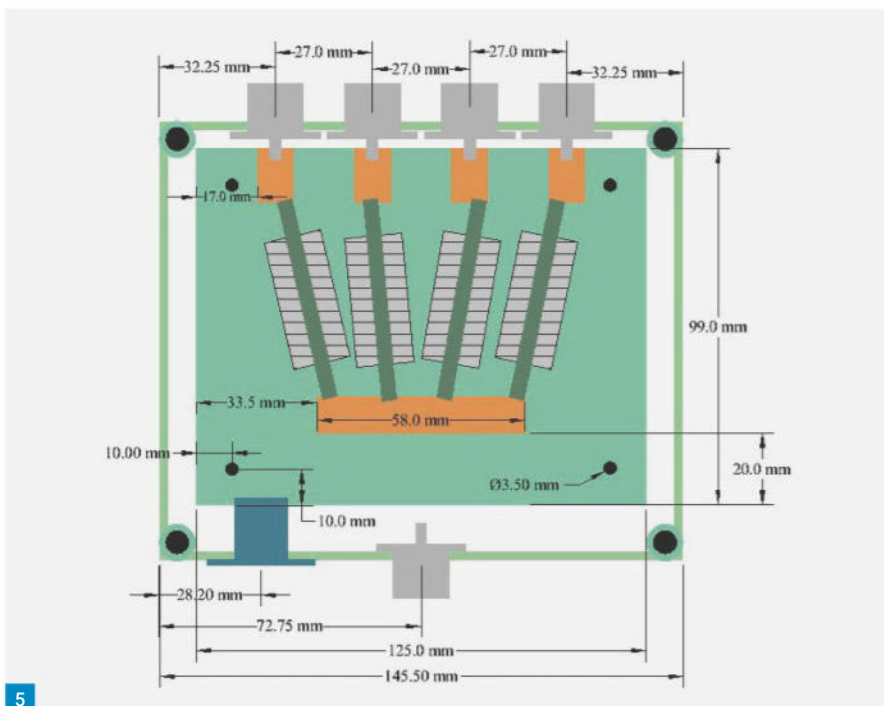
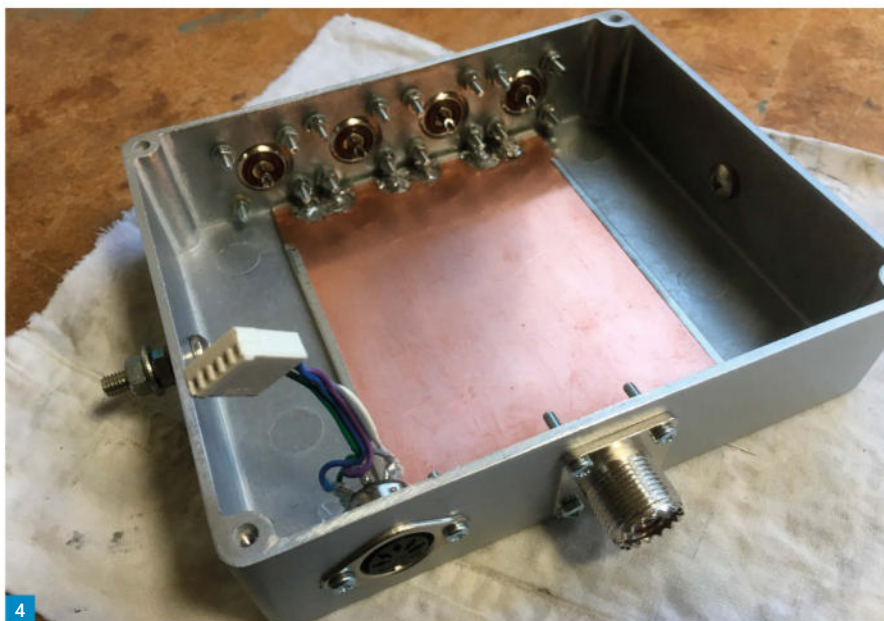
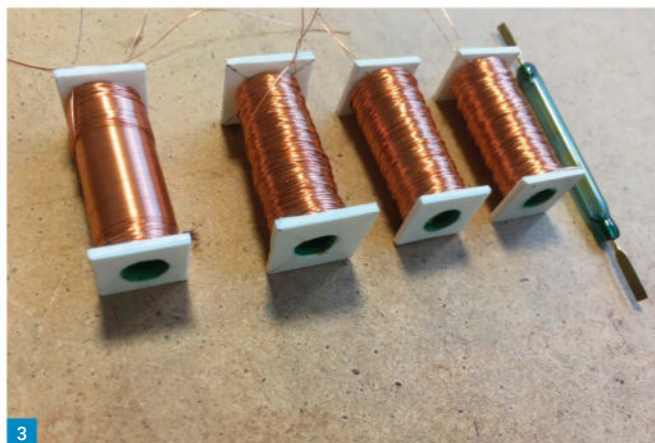
$$\text{Limit\_R} = (\text{Drive\_Volts} / \text{Operating\_Current}) - \text{Coil\_Resistance}$$

The nearest lower preferred value of 270Ω will be acceptable, yielding the slightly higher drive current of 40mA, increasing the magnetic field on the switch a little, which improves switching force.

## Construction

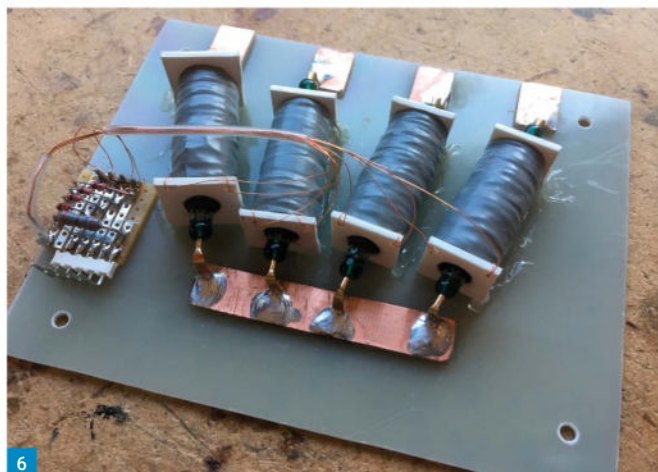
Naturally, being RF, the switches are assembled into a diecast steel box 150 x 110mm. The input socket is placed centrally on one side with the output sockets on the opposite side. To provide a good quality conductive path through the box, a sheet of double-sided copper circuit board is used to line the base of the box, connecting to the SO239 socket shells via solder tags and mounting bolts, Fig. 4. The reed switches and coils are mounted on a fibreglass carrier board to which strips of copper board are glued to form the contact points; see Figs 5 and 6. This method avoids any strain on the switches when plugging / unplugging coax cables later on. Be very careful not to stress the glass when bending the connection tags on the reed switches as breaking the glass will ruin the switch. The carrier board is supported on plastic adhesive PCB mounts, 3mm high. As the intended frequency range is up to 50MHz, no special screening was used between the coils/switches.

The choice of multi-pole connector for the selector DC inputs is not critical, I used a 5-way 180° DIN socket. Do make sure the DC wiring including the common 0V wire is completely isolated from the metal case to avoid RF ground loop problems; do NOT 'ground' the 0V wire to the case. When the copper baseboard and



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Frequency MHz	VNA Output dBm	Port Signal dBm	Isolation dB
3.65	-3.5	-95	-92
7.15	-3.0	-95	-92
14.15	-2.9	-89	-86
21.15	-3.3	-86	-83
29.15	-4.2	-84	-80
50.15	-5.3	-77	-72
70.15	-4.8	-67	-62
75.15	-4.8	-66	-61
103.00	-1.9	-49	-47
145.00	-5.5	-55	-50

**Table 1: port isolation test**

carrier board are fitted into the box, the SO239 sockets can be connected up using thick copper wire; the coil wiring and supporting components can be mounted, dead-bug style, on a small piece of board and placed to one side. See Fig. 7 for the final constructed appearance.

## Analysis

Two types of test were done before the switch box was put into service – SWR into a dummy load and port isolation with one port activated into a dummy load. The equipment used to make the measurements was a Metro-VNA network analyser, a TinySA spectrum analyser and a 50Ω dummy load, as shown in Fig. 8. Fig. 9 shows the SWR to a dummy load through the activated port for six key amateur bands; none was worse than 1.05:1 and almost identical values were obtained when connecting the VNA directly to the dummy load, omitting the switch box entirely.

For the isolation test, the Metro-VNA was used as a signal generator, providing about -4dBm signal level, which was connected to the common port. A dummy load was attached to an outer port and that port activated, similar to Fig. 9. The Tiny SA was connected to an adjacent antenna port and the signal level noted on each key amateur band. Table 1 shows the values measured; the noise level on the TinySA showed as -100dBm. The measurements show



**Fig. 6: Switches assembled on the baseboard.**

**Fig. 7: Completed assembly wired to the sockets.**

**Fig. 8: Testing SWR against a dummy load.**

**Fig. 9: SWR readings with active switch in circuit.**

excellent isolation up to 50MHz with a reduced isolation around 100MHz; this improved again at 145MHz, suggesting it could be used on that band too and adding some internal screening may well improve that.

## Conclusion

For the bands intended, the isolation is considerably better than values quoted for simple, mechanical antenna switches with no increase in transmission line SWR noted. This was a much better performance than originally anticipated and a reassurance that it would be safe to use as a multiple rig selector instead, even at higher power levels.

There has also been interest recently in automatic antenna disconnection boxes to



provide isolation during lightning storms, instead of repeatedly unplugging the coaxial cables. This design naturally includes that function too; with no power, all switches are open. The flexibility of this circuit design permits as many or as few ports as required to be combined to suit the circumstances.

## Reference

[1] Farnell order code 2409186, 3A/5A reed switch. **PW**



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**A**lthough we have been seeing F2 propagation (often in combination with Es) for a little while, most of the paths we have experienced, from the UK at least, have had a fairly large North – South component to them. It has not been until recently that we have seen some East – West paths open up. Of course, this is to be expected as we head towards the peak of the sunspot cycle, but it is always exciting when it happens.

Here at **GW4VXE** I had started to think about taking the 6m beam down, as it's a bit vulnerable to the winter storms and there hadn't been any DX for me in a few weeks. Although I missed it, there was an opening from Western Europe to the East Coast of the USA on 28 November. Forewarned is forearmed and the next day, I had the beam pointing to the west from around midday onwards and was rewarded with three North American stations around 1400UTC. As you'll see in the band reports section, there have been other openings, around the same time, with some excellent signals.

## F2 propagation on 50MHz

The most notable VHF event this month, as **Tim Kirby GW4VXE** reports, was a widespread F2 opening on the 6m band.

### Auroral E?

With the increased solar activity, auroral activity has picked up. Another event was visible here in Pembrokeshire on 1 December, **Fig. 1**. The previous weekend, **Justin G4TSH**, one of the team at the M6T contest station in Suffolk for CQWW CW, was able to see the aurora with the naked eye. It's debatable whether or not it was a welcome sight during a major HF contest, of course. Interestingly, though **Les Rayburn N1LF** noticed some Es on the FM band on the evening of 1 December and we speculated that perhaps this was Auroral E. Auroral E can be distinguished from 'regular' auroral propagation because a CW note will be T9, ie not distorted. I mention this possible Auroral E as a prompt not

only to FM DXers, but also to 70MHz enthusiasts. Auroral E can extend to the 144MHz band on occasion, although I think I can only recall one occasion when I've heard it (a station in Northern Finland from my parents' house and first QTH in Cheltenham), though perhaps I have not been listening at the right times.

### Good news for 1296MHz

During the WRC-23 World Radiocommunication Conference a new footnote to the 23cm amateur band has been added, which draws attention to a recommendation providing guidance for radio amateurs to avoid interference to radio navigation systems. On the IARU website, IARU President **Tim Ellam VE6SH**, noted "This is a

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Fig. 1: The Aurora on 1 December, captured at GW4VXE. Fig. 2: Patrick WD9EWK out and about operating on the satellites.

very good result for the amateur services. The decision reached at WRC-23 on this agenda item makes no change to the table of allocations nor incorporates by reference M.2164 into the Radio Regulations. The addition of a footnote that provides guidance to administrations in the event of interference to the RNSS is a good regulatory outcome for amateurs and the primary users of this band."

Particular thanks should be directed to **Barry Lewis G4SJH** who has led much of this work.

It seems that 23cm enthusiasts can probably breathe a sigh of relief, although it's possible that there may be some changes recommended to the bandplan. I have seen some possibilities mentioned online and once the position becomes a little more certain, I will include details in the column.

### FT8 and Windows update—beware!

I was recently engaged in calling ZL7A on FT8 on an HF band. I was keen to work the expedition so I had the amplifier on. I called for a couple of periods and suddenly saw a message on my screen 'GW4VXE Idiot'. Slightly affronted, I wondered what I had done to incur someone's wrath (the problem with this sort of message is that you can't tell! Perhaps an email would have been better). I tried to work it out. I was calling on the right period, so it wasn't that. I wondered what the signal was like. Oh! A quick check showed that the computer was seriously overdriving the rig and no doubt doing ghastly things to the signal. The thing was, that I hadn't left it like that! I can only assume that a recent Windows update had reset the audio level and left me overdriving the rig. 'GW4VXE Idiot' indeed! I mention this as a gentle warning that it may be best to check your audio levels after running a Windows update on your computer.

### The 8m band

**Roger Laphorn G3XBM** (Cambridge) writes, "I am being spotted in the Caribbean most days on 8m FT8 despite my 2.5W and low dipole. I have worked all the Caribbean stations active on 8m FT8 and have been spotted one way in the USA and Canada several times. Activity may be quieter until February and March. I must say, I have been impressed with 8m. When the F2 MUF is high enough, 8m behaves like 10m. Hopefully we will see a small 8m Es opening around New Year".

**Paul Farley G7PUV** (Sussex) who operates as G9PUV on the band says that he has been able to work the Caribbean and South African stations on a daily basis! He writes that he was delighted to be heard by N3IZN (DM13) on 29 November.



**Kevin Hewitt ZB2GI** uses an IC-7300 and a 5m wire connected via a 9:1 balun to receive signals on the band and heard 4X1BG (KM72), PJ4MM (FK52) and ZR1ADI (JF95).

### The 6m band

It's good to hear from **Peter Taylor G8BCG** (Loose) who has recently moved house, although his shack is staying where it was! He hasn't had too much time to operate on 6m, but writes, "After several days of failing with 4W8X on EME with a single 6M8GJ I hoisted my 4 x 8el array and worked them 'first call' on Q65A for DXCC #268. They were on EME from 144 to 1296 and I think **Bernie ZS4TX** worked them on all bands. 4W8X was a BIG DXpedition. In contrast, **Shabu Ramakrishnan MOKRI** was a one-man band as 9L5M in Sierra Leone in memory of **Fred Curtis G3SVK**. Shabu was an easy QSO on 50.313 FT8".

**Steve Telenius-Lowe PJ4DX** reports that he found conditions on 6m to be generally poor during the second half of November, with only the occasional DX contact, although one was spectacular: on 16 November he worked 4W8X, a 6m All Time New One for Steve. "Timor-Leste is over 18,400km from Bonaire, so I was really pleased with this one, DXCC number 154 on Six". He says the rest of the month was also poor, but on 1 December he caught a spectacular opening.

"It started at 1330UTC (9.30am here) with VE1CHL and VE1SKY coming in. Nothing too unusual there, but VE1SKY gave me a great report of +15dB so I figured that the band might open up well. Ten minutes later it did open, to Europe, starting with OZ, then SM. At 1344 I worked **Chris G4IFX**, followed a little later by M0CTP, GM4WJA and EI4KF. The Scandinavians were the most

prevalent signals but I also worked into Germany, Poland, Czechia, the Slovak Republic and the Netherlands.

"There were so many stations calling that at 1409 I decided to QSY to FT4 to speed things up a bit. On 50.318 FT4 I worked the Netherlands, Belgium, Poland, Sweden as well as GM7PKT and **Rob GM3YTS**. However, it soon dried up: it is a pity more people do not use FT4 during such openings, signals are almost always strong enough to make the contact and twice as many QSOs can be made in the limited time that the band is open.

"Back on FT8, the band was still wide open to Scandinavia and Germany. OZ3MC gave me the almost ridiculous report of +20dB and the waterfall display was looking like 20m on a good day. I was on the point of QSYing to 6m SSB when in the middle of all those Europeans I saw 4W8X calling CQ and not getting any takers. Despite having worked the station in November, I could not resist calling again, if only to let him know he was being received in the Caribbean. He came back first call, a duplicate contact but a justifiable one I think. I spotted him on the DX Cluster and I saw he worked a few other Caribbean stations plus several Indonesians that were totally inaudible here; such are the vagaries of propagation on Six. Shortly after the QSO with 4W8X the band started to fade and this great opening ended as it had begun, with a string of OZ stations.

"From 2 to 6 December I did not make any QSOs at all on Six, but starting from about 2130UTC on the 7th there was a good opening to VK and ZL. VK3BD, VK3DUT, ZL3RJ, ZL3NW and ZL3RC were all worked within about 15 minutes but

although signals were reasonable there seemed to be a lack of activity from VK and ZL. What was interesting is that most openings to VK from here are either to Queensland or New South Wales, VK4 and VK2, or – if the band opens to Indonesia – to Darwin in the Northern Territory, VK8. This is the first time I have worked any VK3 stations in Victoria on Six.”

**Don G3XTT** (Wells) was on for the opening on 1 December and says that the propagation was amazing. He writes that there were several HC stations all at +20 or so on FT8, along with TI, TG, HP, J3, YS, V3, 9Y, PJ4, HI, KP4, W and VE. Costa Rica was a new country for Don.

Although here at GW4VXE, I was in the shack at the time of the opening, I was engrossed in trying to save some money on my car insurance. It was not until that this was done that I looked across to the 6m screen and saw it full of DX! Sadly, the opening was on the way out, but I was delighted to work HC2FG for a new country – Ecuador had always eluded me in the summer openings – along with contacts with K1TO (EL87), K4WI (EM62) and NN4X (EL98) and an old friend of the column, **Jim GM4FVM** (IO85) on backscatter. Looking back through the WSJT. all file, after the opening, I could see that TI2CC, in particular, had been a huge signal along with HR2DDL and some others. Next time, perhaps!

Kev ZB2GI worked EA7/YL3GS (IM76) and V51JH (JG77) on the band over the month, using his whip antenna poked out of the window using a broomstick.

## The 2m band

Roger G3XBM reports being active during the UK Activity contest using 10W and his big-wheel omnidirectional antenna. He uses the same setup successfully on 70cm.

## Satellites

Peter G8BCG writes that M0KRI had been persuaded to take a small 30cm dish to Sierra Leone as part of his 9L5M activity. Shabu worked quite a few stations on FT8, many of whom thought that a 9L popping up out of nowhere must have been a pirate! Peter missed Shabu's FT8 activity but caught him on SSB for Peter's country number 159 on satellites.

**Patrick Stoddard WD9EWK** (Phoenix) writes, “On 24 November, ‘Black Friday’ – the day after the Thanksgiving holiday in the USA – I avoided the crowds in the stores looking for bargains. Instead, I made a drive to northern Arizona to activate three grids on some satellite passes [Fig. 2]. I went west of the city of Flagstaff about 25 miles to the DM35/DM45 grid line along old route 66 (the highway that once connected Chicago to Los Angeles) in a national forest. From this spot, I worked a couple of AO-91 passes as snow started to fall. I had hoped to avoid snow, but it was a light snowfall that went



for a couple of hours. After I finished working those passes, I drove back to Flagstaff on the I-40 freeway. Snow was still falling, and had accumulated along the road.

“Instead of lingering in Flagstaff, I started to head home, making a stop about 20 miles south of Flagstaff inside grid DM44. I worked a TEVEL-5 pass from here, logging **Endaf N6UTC** (also MW1BQO) on FM and D-STAR. I also worked a couple of other stations in FM from this stop. I made a short video of this TEVEL-5 pass, which includes the QSOs with N6UTC on both D-STAR and FM:

[https://youtu.be/B-bvbpFx\\_Yg](https://youtu.be/B-bvbpFx_Yg)

“After the TEVEL-5 pass, I drove back to Phoenix, where temperatures were around 72°F/22°C, compared to the below-freezing temperatures in northern Arizona”.

**Andy Britton MM0AGB** (Aberdeen) kindly sent some details of the Aberdeen Amateur Radio Society's activity as GB2BD, celebrating 100 years of the BBC in Aberdeen, **Fig. 3**. Andy writes, “Aberdeen Broadcasting House looked nearly impossible to get a signal at due to a line of very old very large trees. The only place we could see the satellite was near the end of the driveway, which meant a cable run to the operating position of around 80 metres.

“The dish setup is a three-turn helical antenna set onto a piece of PCB material with a hole cut in it the same diameter as the LNB front aperture. This is secured with screws to a plastic pipe clamp made by Stauff that had the correct diameter for the LNB. To reduce the weight I abandoned the metal plates either side of the plastic clamp itself. The white cover was made

**Fig. 3: The QO-100 system used at GB2BD in Aberdeen.**

from a Covid wipes container and glued into place with hot melt.

“In the black wheelie box is the modulator unit and the power amplifier with some power distribution. I cut a hole in the side of the black box and used a tank plumbing fitting so I had a 45° downward entry pipe to prevent water ingress. Through this pipe passes the mains power, Cat 5, LNB and Helical feed cables.

“The key to this setup is using the Adalm Pluto with its ability to connect to a Cat 5 cable using a USB to Cat 5 adapter. I mounted an old router in the same box as the Pluto and its chain of amplifiers along with a bias-T to power the LNB. The modulator box also has the PSU for the amplifiers and router. The amplifier box contains a re-used Nokia amplifier with temperature monitoring and cooling, controlled by an Arduino board along with PSUs required.

“The big advantage of packaging the portable kit this way is that you can locate the dish a long way away from the laptop that runs your favourite SDR software, in my case SDR console. At the laptop end you only need power for the laptop and a USB headset and a comfy chair!”

**Jef Van Raepenbusch ON8NT** (Aalter) monitored the ARISS QSO on 17 November.

A bit of a quieter month this time. If you have any news that you've been meaning to send in for a while, it could be a good time to do it. Thanks to everyone who's contributed to the column this month – please keep the information coming. **PW**



Roger J Cooke G3LDI  
roger@g3ldi.co.uk

**A**s this is my first column of 2024, a very happy and Morsey 2024 to all CW operators. May the sunspot cycle stay at maximum for a few years more!

### Morse Telegraph Club

A recent request for some information on Railway Morse piqued my interest and I followed the thread. It led me to the Morse Telegraph Club. I had never heard of it before. It's no wonder really as it is a US-based organisation. However, it has a lot of members and a regular newsletter called *Dots and Dashes*. It deals essentially with historical information and accounts of those employed in the telegraph industry and information about the evolution of telegraph technology.

MTC is the World's leading authority on telegraph history and has played a large part in the making of documentaries and films that include anything to do with Morse Code.

There are some sample Newsletters that can be viewed. Most of the articles are Railroad related, but they are very interesting to read. Take a look:

<http://tinyurl.com/yyhr67d3>

### Are you amphibious?

Well, I never did learn to swim, being ducked badly when I was 11 years old I was always scared of the water.

However, I guess you have realised now that I meant ambidextrous. This is interesting in that, as a pianist, of course I am ambidextrous, with left and right hands playing different music. However, I never even conceived of trying to send with both hands. **Chris G4CCX**, one of our local tutors, now an SK unfortunately, was able to do this. He spent some time practising this and was quite adept with either hand.

In an article found on the internet, an abstract can be read here:

<https://pubmed.ncbi.nlm.nih.gov/2286193/>

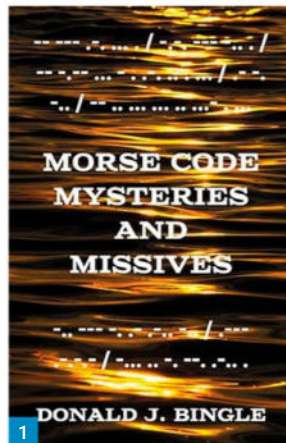
It mentions those of us that use both hands for various activities, typists, pianists and so on and makes very interesting reading. Sending Morse is peculiar to using ONE hand, but at the same time it is possible to train the other hand to also send Morse. I am not sure if it helps to change the paddle contacts or not.

One comment from **Doug N4IJ** states: "I am left-handed and learned to send dashes with my thumb, dots with other fingers. I don't know if I would have been faster or more accurate the other way. What I have found is when I operate Field Day, for example, I don't usually have to change anything if using another person's paddle".

Some amateurs when they first trained for their licence decided to learn to send with their left hand so that they could write up the log with their

# A Morse miscellany

**Roger Cooke G3LDI** has another selection of Morse related topics.



right hand. That would apply way back in the days of 'no computers' of course.

In the days of my youth, being a pianist I had very supple hands. I never even thought about learning to send as a lefty. I would hold the pen normally and when sending I would just slide the pen up between my first and second finger. I was really fast with that method so did not need an alternative solution.

I played tennis right-handed but I played rugby with my left foot to convert a try, drop kicks etc. I hated the game by the way! **Rafael Nadal** uses his left hand to play tennis even though he is right-handed. He was taught to use his left hand because his coach thought it would be an advantage. **Robin Haase** is left-handed but uses his right hand to play tennis.

### Bottom line

I guess it is up to the student to decide which hand he would like to use with a Morse key, but it is less important these days so just use whichever one you feel more comfortable with.

### Morse Code Mysteries and Missives: three tales in Morse code

*Morse Code Mysteries and Missives*, **Fig. 1**, includes three stories, each one of which is first presented in printed Morse code, then audio links are given to listen to the Morse code, then the stories are repeated in clear English text at the back of the book. The purpose of this book is not to teach you Morse code; it is to let those who have basic coding skills and experience with Morse code practice decoding on something more interesting than short phrases, kids books, and dry practice manuals. It can also be great fun for fans of puzzles and cryptography.

<https://tinyurl.com/46pxms5w>

**Fig. 1: The Morse Code Mysteries and Missives book. Fig. 2: Key found at the Isle of Wight Radio Society.**

### Morse key identification

I had a reply to my request for a Morse key identification (see December *PW* and the photographs in *Morse Mode*). It was from **Annabel Edgar**: "Morse Key Set: LMK Manufacturing Co Ltd 1940 An original 1940 code tapper key and case. Manufacturer and date engraved on base of tapper. Metal case quite worn with original paint chipped in places and some corrosion though looks fairly superficial. Bakelite bits in good condition and metalwork would probably clean up nicely. Seems to be in working order, though not tested wired up. Have not opened case to inspect inside components. Key action seems smooth to this non-expert. Has a lovely 'feel' to the tapper action. Braided cable worn in places. Weight 1kg".

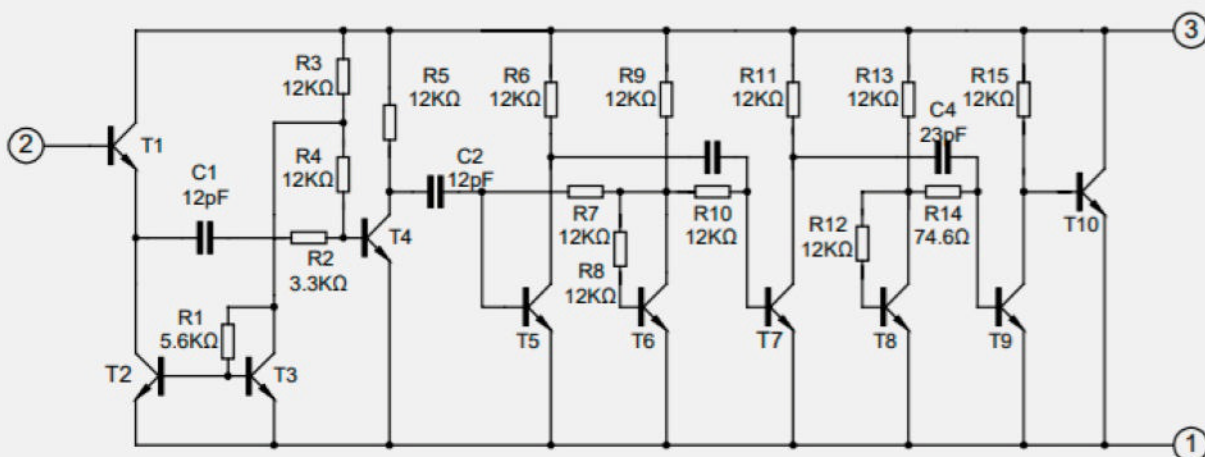
I love the reference to the Morse key as a 'Tapper'. Unfortunately, most of the general public seem to think that 'tapping' a Morse key is the correct way of using it.

I also received another request for identification of a Morse key, **Fig. 2**: "The Isle of Wight Radio Society has recently had a fairly serious shack tidy up/rearrangement and, in the process of doing that, we rediscovered the key shown in the attachments.

"It works well enough as an ordinary key plugged into any of our HF rigs, but does seem overly complex for that function alone. We wondered if you might be able to shed any light on what all the internal gubbins, and the external ON-OFF switch, were designed to do? **Rod Angel G4ZUP**".

Please send all your comments, offerings, information and especially pictures to: [roger@g3ldi.co.uk](mailto:roger@g3ldi.co.uk) 73 and May the Morse be with you! **PW**

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**Daimon Tilley G4USI**  
practicalwireless@warnersgroup.co.uk

It is not that long since *RadioUser* was wound-up and the bringing across of some of its content into this magazine has not been welcomed by everyone, but I know Don has done his best to cater for new readers as well as existing ones. For myself, I welcome the addition of this new content, even though it is not all to my personal taste. I think it important to continue to represent and accommodate the great diversity that encompasses being involved, practically, with wireless, although I hope that we don't return to the days of 'build an organ'! It is with this in mind that, this month, I am stepping outside of my normal practice of dealing with amateur band equipment.

Recently Don mentioned the *Take Twenty* series of articles that used to run in *PW* – projects that took no more than 20 components and cost less than 20 shillings. That got me casting my mind back to my early days and one of the first constructional projects I ever made – the matchbox radio. This radio, built in a matchbox to showcase its diminutive size, was based around the ZN414 'radio on a chip' by Ferranti.

## History

The ZN414 was a three-pin IC in a metal transistor package, the T018, giving it the appearance of the old BC108, but later moved to the plastic T092 format. This incredible little device contained a complete AM radio, including ten transistors, four capacitors and 15 resistors, was of the TRF (Tuned Radio Frequency) type and ran from around 1.5V, Fig. 1. One merely connected a tuned circuit, consisting of a ferrite rod and variable capacitor, to the input and a high impedance earpiece to the output with a mercury cell (used at the time for hearing aids).

I decided to revisit this circuit in this month's *On a Budget* in keeping with the broader aspects

# MW Matchbox Receiver

**Daimon Tilley G4USI** gets all nostalgic, recreating a project from his past.

of *Practical Wireless* as well as a sense of nostalgia. While it certainly has fewer than 20 components, in the *Take Twenty* sense, making it for 20 shillings (about £1) could be a challenge!

At the time I built my first one of these radios in the early 80s, small cardboard matchboxes were ubiquitous, and though my family didn't smoke, you could find them just about everywhere. I don't recall where I got mine but I remember my sense of excitement at actually trying to fit a radio into it.

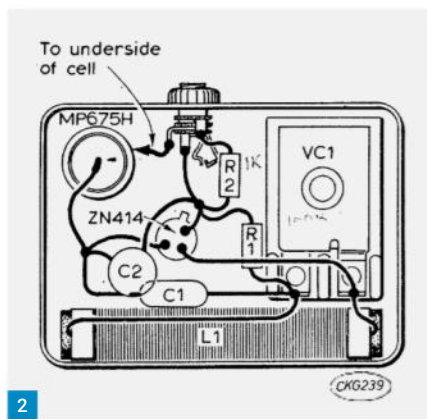
To start I did some web searching to look for

circuits, which are often very similar as most work is done on the chip itself. As a result, I came across some fabulous archive material. From what I can discover, the first popular magazine article to feature the chip was our very own *PW* in January 1973. Titled *The Mighty Midget*, the article, by **Halvor Moorshead**, made reference to a November 1972 episode of *Tomorrows World* on BBC1, which featured the transistor. Unfortunately, while some of the *Tomorrows World* programmes are available online, this one isn't. You can, however, still see the original *PW* article here:

<https://tinyurl.com/2h976raj>

Although I was only six years old at the time of the article, a number of years later I was given a stack of old *PWs* by a local amateur and remember seeing this article and being fascinated by it. This early version was built inside a snuff box rather than a matchbox, used point-to-point wiring, and was featured as a fob on a keyring, the author reckoning on a build cost of £2. A crystal earpiece was directly driven by the ZN414. The photo, Fig. 2, shows how the radio components were laid out in the snuffbox.

The next reference I found was an article in the September 1975 edition of *Everyday Electronics*, entitled the *Matchbox Receiver* by **FG Rayer**. The circuit was very similar to the *PW* one, but with the addition of a BC107 audio amplifier stage. This design used an ingenious method of 'On/Off' switching. This involved a modified headphone jack, which made contact with the battery when plugging in the headphones. The unit was built on matrix board and a tiny trimmer capacitor was used to save space. The photos,



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Fig. 1: Circuit of the ZN414.

Fig. 2: Layout of the original PW design.

Fig. 3: The FG Rayer design from *Everyday Electronics*. Fig. 4: The EE circuit.

Fig. 5: TA7642 pinout. Fig. 6: Final schematic.

Figs 3 and 4, are from this magazine. This full article can be viewed here:

<https://tinyurl.com/4catwhpr>

Fast-forward another seven years, to May 1982, and *Elektor* magazine featured their *Miniature MW Receiver* project, based on an earlier design in the March 1981 magazine. It is interesting that nearly ten years had passed since the chip featured on *Tomorrow's World* and in *PW*, and here in *Elektor* is almost the identical circuit to that in *Everyday Electronics*. I guess that must say something about the pace of change at the time, where miniaturisation may have reached a temporary plateau, which clearly has now been surpassed. *Elektor* also built this radio into a matchbox, and it is this circuit that I built in 1982. I would love to include a picture of their layout, but as *Elektor* is still published, they have withdrawn their old magazines from the World Radio History archive and back issues can only be accessed with a subscription. I am lucky enough to have a copy of this article and can say that the design used the same modified audio jack to act as on-off switching as the *EE* article. All three articles used a 1.3V Mercury button cell as the power source and it is interesting to note that *Elektor* claims such a battery would deliver between 400-500 hours of listening.

At some point in history (I could not find out when) the ZN414 ceased production. Thankfully an almost identical chip, the TA7642, was produced and is still available today. There was also a chip called the MK484. During my research, I did come across a really interesting website that outlines some of the history of these two chips and their incorporation in different designs. The website can be found here:

<https://tinyurl.com/mfds7sfs>

A further more recent circuit can be found here:

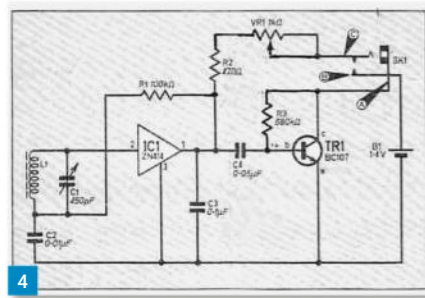
[www.petervis.com/Radios/ta7642/ta7642.html](http://www.petervis.com/Radios/ta7642/ta7642.html)

This one uses an LM386 amplifier stager. I also noticed that Kanga Products do a kit based on this chip, which also covers Radio 4 Long Wave (due to cease in 2024) and has an RF gain control. The kit costs £17.50 and includes all components and a PCB. It is available here:

<https://tinyurl.com/ya6d3mpm>

## Building it 50 years later!

So, with some interesting history out of the way, it was time to build my own, for the second time. My first task was to find a small matchbox and the components. Small matchboxes are much less common these days, but then I spied one in my garage – it had been storing craft knife

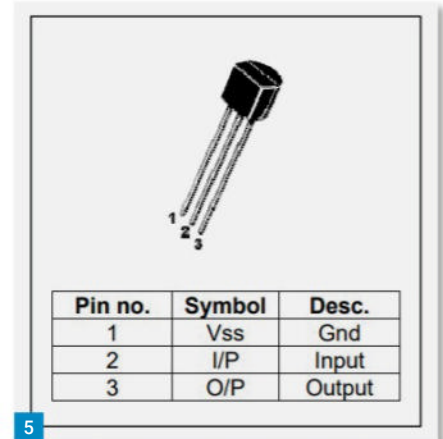


blades for at least 20 years and moved house with me three times! The TA 7642 can be brought in a number of places, including Kanga, but I got mine from the G-QRP Club shop for 75p. The pin-out is shown in Fig. 5. Polyvaricon capacitors are thankfully still available, and mine cost £1.75 from G-QRP Sales. The final tricky thing to source was a ferrite rod, now not at all common. While I had a few old 70s transistor radios, I had none I wished to wreck! Thankfully a friend at my local club came to the rescue with one from his junk box.

Everything else I needed I already had in the shack, so the cost to me was £2.25 – pretty good for an *On a Budget* article, but if you needed to buy everything from scratch, I reckon you could do it for a fiver or so.

So, next to decide upon was the circuit to use. This was not too difficult as they are all just variations on a common theme. In the end, I opted for a combination of the circuit from *Elektor* that I built originally, replacing the audio amplifier with a 2N2222, as used in the circuit from Kanga. I did not include the LW or RF Gain facilities from the Kanga circuit as these were prohibitive in a matchbox case. My final circuit is shown in Fig. 6. For the ferrite rod, I began with 100 turns of 30 SWG wire, but more of that later.

I decided to build the prototype on breadboard, and here both the benefits and disadvantages of the breadboard were apparent. On the positive side, I was able to make component changes easily to assess impact, but on the negative side,

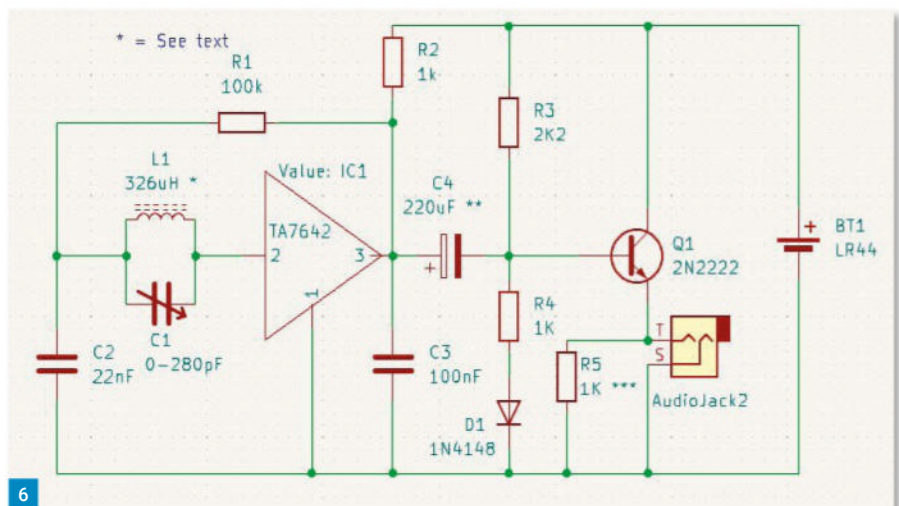


performance was poor. Sensitivity and audio levels were far too low and only one station, BBC Radio Wales, could be heard at all.

Hoping that this poor performance was due to the inherent lengthy jumper wires and breadboard tracks leading to stray capacitance and inductance, as well as reducing the already small signal strength, I went ahead and played with components to optimise them on the breadboard, Fig. 7, hoping those changes would translate positively on the finished design.

In playing around with components I discovered that changes to C4, from an original value of a non-polarised 150nF capacitor to 100nF, improved volume, but then I tried a 220µF electrolytic and this brought a substantial benefit in volume, but of course would take up a much greater space in the box. I then omitted R5 completely. I believe R5 is there to assist with the load provided by the headphones. Various circuits advise playing with this value. The internal resistance of the headphones I used (from an old phone) was about 1kΩ and removal of R5 made no perceived difference in the circuit.

Incidentally, a mono jack is shown in the circuit. In practice I used a stereo one, merely wiring the tip and ring connections together to get audio in both earpieces.



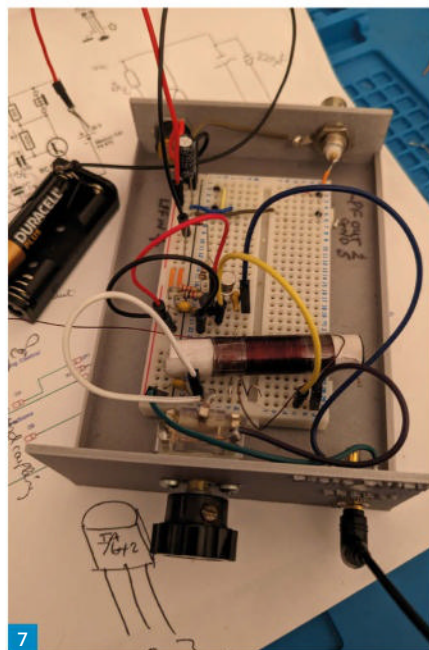
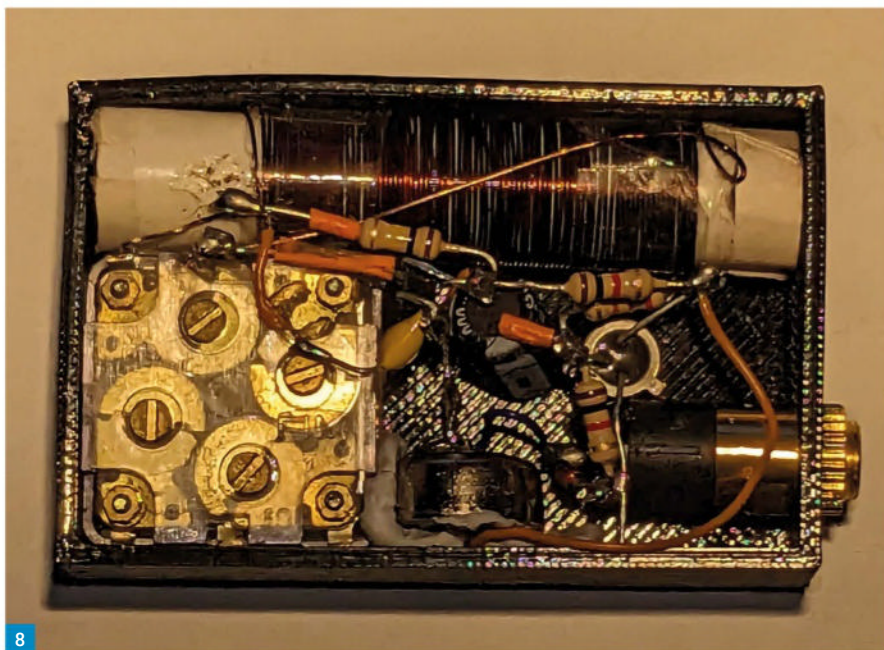


Fig. 7: Breadboard prototype.

Fig. 8: All crammed in!

Fig. 9: The completed project.



The final note on the circuit is the inductor or ferrite rod antenna. How many turns of wire you need depends on the value of your capacitor. Typically, people tend to aim for a  $300\mu\text{H}$  coil with a  $300\text{pF}$  capacitor. You can mess around with this by trial and error if you wish. I used 30 SWG wire, the smallest I had, and started with the *Elektron* magazine recommendation of 100 turns on my 9mm ferrite rod, but when measuring its inductance found it to be  $413\mu\text{H}$ . Using an online calculator:

<https://tinyurl.com/mrxrnj69>

I was able to enter my known  $280\text{pF}$  of capacitance and determine I needed an inductance of  $326\mu\text{H}$ , which I achieved by removing turns (I didn't count how many, but ended up with between about 15 or 20 turns less than I started with).

Commercially, ferrite rod antennas were wound using special Litz wire as it gives better performance. However, at nearly £10 for a 50m reel, it didn't seem worth it, and I am happy with the performance I have. It would be really interesting to do a side-by-side comparison though.

Then began the removal of the components from the breadboard to be re-used in the matchbox base. As small matchboxes are uncommon now, rather than wreck my fragile cardboard one I decided to 3D print one, so careful measurement and a quick CAD design followed. A couple of hours later I had 3D printed matchbox base and case. Having drilled the holes for the polyvaricon capacitor and installed the ferrite rod and stereo jack socket, the space

left available really was quite tiny!

Nevertheless, with great care and some heatshrink tubing judiciously placed on some component leads, construction was soon underway. I ended up soldering wires to the LR44 battery and to the circuit permanently for testing, un-soldering on completion to preserve the battery. I now need to find a really tiny slide switch – mine are small, but not small enough! The photo, **Fig. 8**, shows the packed construction in the base of the case and **Fig. 9** shows the matchbox sleeve two-thirds of the way closed.

The moment of truth arrived! Soldering on the positive wire from the battery into the circuit brought it to life, with good strong signals and good audio levels. It was time to walk the dog in the fields, so the radio went in my pocket as

we walked, tuning around the band as we went. It was becoming dusk, and here (12 miles West of Taunton) I had good signals from *BBC Radio Wales*, *TalkSport* and *BBC Radio Somerset*.

So, almost 51 years after the first *PW* article, and 41 years after making my first version, I had made a lovely little matchbox radio – and I was delighted! The sheer joy of re-living my early ventures in radio, combined with the never-ending amazement that I am using something I built myself, came together to put a really broad smile on my face.

I wonder how long versions of this little marvel of a chip will be around? I think I might buy a few more and try to build a more refined set for the shack – it should be fun. Why not give it a go yourself? **PW**



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## Gordon King

### Dear Don,

I am the son of the late **Gordon J King**, he wrote many articles for *Practical Wireless*. I thought it might be of interest to your readers that on 18 November 2023 a blue plaque was unveiled at 6 New Road, Brixham, Devon in memory of Gordon. I have attached a picture of the plaque that was taken by me. I have also had a family run of his memoirs *Kingcups* and *Dynamos* published and there is a copy in Brixham library.

**Michael King**

*(Editor's comment: Thank you Michael. Gordon was licensed as G4VFX and wrote extensively for PW over a number of years as well as writing something like 40 technical books. He was born in 1922 and died in 2010. An obituary appeared in the October 2010 issue of PW)*

# Your Letters

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## Tony Smith G4FAL,SK

### Dear Don,

I'm the daughter of **Tony Smith G4FAL**. I'm writing to let you know that very sadly, my dad died yesterday. I know he has been a contributor to *Practical Wireless* for some time. Here is a short obituary:

Regular *Practical Wireless* contributor Tony Smith G4FAL died on 30 November 2023. He was 91. Tony's first articles were published when he was working as an NHS hospital administrator: he was a health and safety expert and his writing regularly appeared in the *Health Services Journal* and other specialist magazines. When he turned 50, in 1982, he retired from the NHS and launched a new career combining his writing and research skills with his interest in amateur radio, and particularly Morse Code.

He was editor of the English language edition of *Morsum Magnificat* ('for all Morse enthusiasts') from 1986 to 1990, then consultant editor for another nine years (PDFs of all copies available at [www.n7cfo.com/tgph/Dwnlds/mm/mm.htm](http://www.n7cfo.com/tgph/Dwnlds/mm/mm.htm)). He wrote both technical and historical articles for many specialist radio publications and was published in translation all over the world. He was a columnist for *Everyday*

*Electronics* for more than a decade and also wrote a regular spot in *Amateur Radio*. The last article he wrote for *Practical Wireless* appeared in the January 2024 issue.

**Jane Smith**

*(Editor's comment: Our thanks to Jane for sharing this. Tony did indeed write regularly for PW and, quite literally, his most recent article had only just gone to press when I received this sad message. Our condolences to Jane and the family)*



# Next Month

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



**PORTABLE MILITARY RADIO COMMUNICATIONS OF WWII:** Graham Caldwell continues his series of articles on WWII portable radio equipment, including their collecting potential.

**BIRTH OF THE SUPERHET:** Dr Bruce Taylor HB9ANY describes the early development of one of the most important inventions in the history of radio.

**USING THOSE FIXED POWER SUPPLIES:** Dr Samuel Ritchie EI9FZB has, over the years, accumulated a number of fixed power supplies. In a set of three articles he looks at maximising the utility of these type of supplies.

**HOW TO USE A BASIC OSCILLOSCOPE:** Chris Murphy MOHLS looks at using this invaluable lab tool.

**TRANSMIT QUALITY AMONG MODERN TRANSCEIVERS:** Frank Howell K4FMH continues his look at this thorny subject.

**THE YAESU FT-710 HF TRANSCEIVER:** Vin Robinson G4JTR undertakes a quantitative analysis and calibration of the spectrum scope.

There are all your other regular columns too, including HF Highlights, World of VHF, Antennas, Book Reviews, Vintage TV & Radio and Data Modes as well as your Letters, the latest News and more.

**PRACTICAL WIRELESS** [www.radioenthusiast.co.uk](http://www.radioenthusiast.co.uk)  
RadioUser  
APRIL 2023 THE UK'S NUMBER ONE AMATEUR RADIO MAGAZINE SINCE 1932

**REVIEWS GALORE!** Five products tested, from antennas to SDR

**THE YAESU FTM-500DE**  
First details of this keenly awaited dual-band mobile digital transceiver inside

**HAVING FUN IN THE SUN**  
Expeditions aided by record highs in the sunspot count

**Classic**  
Morse Def...

**HISTORY** Inside the Bijou Three receiver  
Archive pictures of the 'cheap and efficient' models from the PW vaults

**GOING DIESEL**  
An alternative way to heat up your shack

The publishers reserve the right to change content according to circumstances.

**MARCH 2024 ISSUE**  
ON SALE 8<sup>TH</sup> FEBRUARY 2024  
AT ALL GOOD NEWSAGENTS

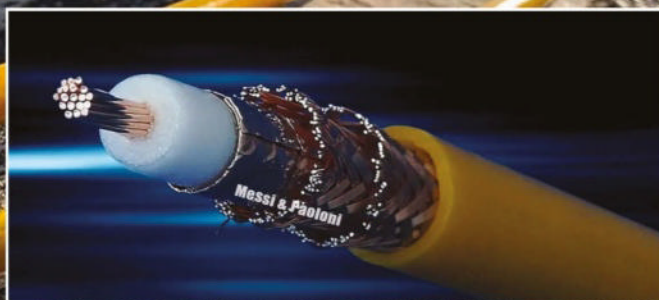


# POTA-FLEX 7 Messi & Paoloni Coax Cable

**Either 6m or 15m option**

## BUNDLE INCLUDES:

- ✓ 15 OR 6 meters of POTAFLEX 7 Coaxial Cable
- ✓ 1 POTA-Speed (cable un/winder for fast and correct cable management)
- ✓ 2 UHF EVOLUTION (PL259) Connectors, preassembled by our technicians
- ✓ 2 Silicon Seal S, high thickness silicone sheath to relieve mechanical tension in the cable-connector connection
- ✓ 1 UHF Female - BNC Male Adapter
- ✓ 1 Reusable adhesive Velcro to attach one of the ends to the body of the POTA-Speed



**Available Soon at ML&S**

## Introducing The DX Commander Range

### Antenna Tow Ball Mount £49.00



The mount is designed to fit any tow-ball, both the bolt on type – and the swan neck version as shown in the photos. Made from 12mm thick mild steel, 10mm high-tensile steel bolts and Barencor 10mm V bolts and stainless washers.

### 10m (SOTA) Expedition Travel Pole £68.50



10m high, 17 section Telescopic Pole. Includes beautifully crafted protective cloth bag. Approximate length (when extended) 9.5m

Weight: 1.3kg  
Packed length: 70cms  
Wall thickness; from 1.6mm (bottom) to 0.5mm (top)  
Pole diameter: 47mm  
With DX Commander Lower Screw Cap: 56mm

### 10m Classic Telescopic Flag Pole Antenna Support £49.99



These are the best selling heavy duty telescopic antenna support on the market. With over 1000 sold and a 100% track record.

These poles come packaged brand new, 1.2m length with a protective plastic see-through snap-top temporary dispatch bag. They telescope to at least 9.6m in length (sometimes a bit more depending on factory manufacturing tolerance) and weigh 1.4 kilos. If you need less height, just remove the appropriate number of sections off the top.

The inside diameter of this "10m" pole is 44.5mm (1 3/4 inch) which means you can internally sleeve an aluminium or fibreglass tube inside the base of the pole to give you lots of options for mounting. The top section is a solid section (not hollow) which is nearly impossible to break and has a tiny metal loop for aerial mounting options, for instance to loop the top of an inverted L though.

Don't confuse these heavy duty flag pole antennas with

cheap fishing pole copies that snap in the wind and sold as "professional" and sorted antennas.

### 12m Extra Long Telescopic Antenna Support Mini- eXtreme Nebula £129.00



Here we have for your delight, the cut-down version of the full DX Commander 18m Nebula in a reduced package, extending to 12.4m (40.5 feet) in total length when extended.

DO NOT confuse this with another 12m pole on the market, this pole has:  
Stiffer Walls  
Heavier weight (by 20%)  
Custom Screw Base  
Longer when extended

### 7m Telescopic Antenna Pole for Dipoles, Doublets and Verticals £39.00



New 7m telescopic pole. This is the small version of its big brother, the 10m DX Commander and delivers you just under 7m in height.

Specification:  
Length: 6.8m  
Max diameter of pole inc screw-over end cap 45mm  
Max diameter of lower tube: 36mm  
Lower diameter of second tube: 32mm  
Wall thickness: 1.3mm

If you need a heavier pole, take a look at the 10m version.

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### DXCommander Guy Ring £7.50 each

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# The Best of the Best

## *A Superb All-around Wide-Coverage Transceiver*

### **FT-991A** 100W

**HF/50/144/430MHz TRANSCEIVER**

- Includes HF through UHF with one Radio
- Supports SSB/CW/AM/FM and C4FM digital
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- Built in Real-Time Spectrum Scope Display
- 3.5-inch TFT Colour Touch Panel Display
- 100 Watts (2 Meter & 70 Centimeter: 50 Watts) of Solid Performance



\* External Speaker SP-10: Optional



\* External Speaker SP-30: Optional

## *The New Standard High Performance SDR Transceiver*

### **FTDX10** 100W

**HF/50MHz TRANSCEIVER**

- Hybrid SDR Receiver (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- 5-inch TFT Colour Touch Panel with 3DSS<sup>\*1</sup> Visual Display
- Superior Operating Performance by means of the MPVD<sup>\*3</sup>

## *The World Leading HF Transceiver with Hybrid SDR*

*In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP*

### **FTDX101MP** 200W

**HF/50MHz TRANSCEIVER**

*The Ultimate*

### **FTDX101D** 100W

**HF/50MHz TRANSCEIVER**

- Dual Hybrid SDR Receivers (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- VC-Tune (Variable Capacitor Tuning) Signal Peaking
- IF DSP enables Superb Interference Rejection
- 7-inch TFT Colour Touch Panel with 3DSS<sup>\*1</sup> Visual Display
- Superior Operating Performance by means of ABI<sup>\*2</sup> & MPVD<sup>\*3</sup>



\* Microphone M-1: Optional

\* Photo shows the FTDX101MP

\*<sup>1</sup> 3DSS: 3-Dimensional Spectrum Stream

\*<sup>2</sup> ABI: Active Band Indicator

\*<sup>3</sup> MPVD: Multi-Purpose VFO Outer Dial

**YAESU**  
Radio for Professionals

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Specifications subject to change without notice. Some accessories and/or options may only be standard in some areas. Check with your local Yaesu Dealer for specific details.