PRACTICAL WIRELESS

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ICOM ID-52

Practical Wireless REVIEW

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Higher Frequency

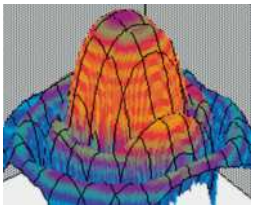
InnovAntennas' 4-Element 50MHz LFA Yagi reviewed

Keep Soldering On

A handy artisan soldering platform for home projects

GEAR A Deeper Look at Microwave Antennas

This month we focus on microwave, millimetrewave & terahertz versions



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Practical Wireless
Warners Group Publications plc
The Maltings, West Street
Bourne, Lincs PE10 9PH
www.warnersgroup.co.uk
Tel 01778 391000

Editor
Don Field G3XTT
practicalwireless@warnersgroup.co.uk
Designer
Mike Edwards
mike.edwards@warnersgroup.co.uk
Advertisement Manager
Kristina Green
01778 392096
kristina.green@warnersgroup.co.uk
Production Manager
Nicola Glossop
nicola.glossop@warnersgroup.co.uk
Production Assistant
Charlotte Bamford
Charlotte.bamford@warnersgroup.co.uk
Marketing Manager
Katherine Brown
katherine.brown@warnersgroup.co.uk
Marketing Executive
Luke Hider
luke.hider@warnersgroup.co.uk
Publisher
Rob McDonnell
robm@warnersgroup.co.uk

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

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This month's *Letters* include memories of *PW*, linear amplifiers, whither amateur radio and more.

I actually managed to get away during March, to the Gambia principally for the RSGB Commonwealth Contest. This was my first trip outside the UK since I was last in the Gambia in November 2019. Very enjoyable and I was able to work about 1500 contacts outside the contest too, on CW and FT8. The Commonwealth Contest (or BERU – the British Empire Radio Union – as it used to be called) has a long and illustrious history but nowadays there are very few expats and other overseas residents who take part. So, the contest very much relies on UK amateurs travelling abroad for the occasion. This year's travellers went to Uganda, Barbados, the Caymans, Malta and Belize, and there was activity from UK amateurs resident in Cyprus and Kenya to add to the mix. But, as always, the majority of activity was from the UK, Canada and Australia/New Zealand.

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Ukraine Situation

A number of amateur radio bodies and contest organisers have responded to the current situation in the Ukraine by, for example, disallowing entries from Russian amateurs. And, of course, Ukrainian amateurs remain off the air for the time being, although there are reports that some have

been busy helping the Ukraine armed forces with communication issues. Let's hope this tragic situation is resolved soon, before many more lose their lives.

Need a Hand?

While the article *Need a Hand* by **Frank Howell K4FMH** in this issue refers largely to US suppliers, I am including it because the ideas are sound and, for the most part, UK alternatives should be available. Frank was motivated to complete this project by ideas from **Michael Jones GW7BBY**, as he explains. If nothing else, I hope it will suggest some ideas for the home workshop.

Reviews

We feature three reviews this time, with at least two more to come next month. I know that reviews are popular and I find it reassuring to know that new equipment is still appearing . As well as transceivers, the range of ancillary equipment, from test equipment, antenna analysers, antennas, power supplies and suchlike, is expanding constantly.

Giles Read G1MFG (SK)

The RSGB has announced the sad news that **Giles Read G1MFG**, who was the *RadCom* Technical Editor, became a Silent Key recently. Only a few days beforehand he had been diagnosed with an aggressive cancer. I and **Peter Kirby** (then RSGB General Manager) interviewed Giles for the *RadCom* post when I was an RSGB Board Member, and he proved to be an excellent and conscientious technical editor. Our thoughts are with his partner **Heather**.

Don Field G3XTT
Editor, *Practical Wireless Magazine*

Newsdesk

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

New from ML&S

The IC-705 has probably spawned more rig accessories than most radios in the last 20 years. ML&S think this one, the 705 Meter, is the most exciting though!

- Mode
- Filter settings
- Real-time display of operating frequency
- SWR, Real Power or S-Meter, in both text & a Needle on the usual radio-style scale.
- For more information see:

HamRadio.co.uk/705Meter

The DigiRig Mobile is a tiny new digital modes interface that:

- combines audio codec, serial CAT interface and PTT switch
- supports full featured CAT interface: PTT, bands, tuning etc. (not just VOX based PTT)
- uses a single USB connection to computer minimising the cables mess
- serial computer aided transceiver (CAT) port can be configured for logic levels, RS-232, CI-V or TX-500
- works with all major OS flavours: Windows, MacOS and Linux
- permanently available independently from CAT port an open-collector PTT switch controlled by RTS signal of the COM port to interface Handies/Mobiles etc.
- auxiliary connection points to CM108 codec
- uses widely supported CP2102 serial interface & CM108 audio codec

For more details see:

HamRadio.co.uk/DigiRig

While not brand new, ML&S report that the Elad FDM-S3 SDR is back in stock after a long delay due to component shortages.

- 9kHz-108MHz receive
- Twin antenna input
- 8 low & high bandpass filters
- 3-stage attenuator
- Selectable Pre-amp
- 4 independent receivers scanned simultaneously
- 24MHz bandwidth
- Sampling rate up to 122.8MHz variable
- Optional GNSS antenna
- Free FDM-SW2 software
- Compatible with Simon Brown's SDR Console

For more details see:

HamRadio.co.uk/FDMS3

RSGB 2022 CONVENTION: The RSGB is planning a hybrid Convention in October this year that will combine the benefits of meeting in person with access to high-quality content online for those who can't attend. The Society would like to hear your views to help shape this event and would welcome comments from all radio amateurs, whether an RSGB member or not. It is also looking for a Convention Chair to lead the team of people who create the 2022 Convention. The RSGB Convention web page has links to a short video, the brief survey and fuller information for the Convention Chair role:

www.rsgb.org/convention

PLATINUM JUBILEE: The RSGB is offering a wide variety of amateur radio activities to celebrate the Queen's Platinum Jubilee. From special event stations to an innovation competition, a radio tournament and an operating award, the Society hopes there is something for everyone. You can read an outline of each of the activities now and further details will follow shortly. Take a look at the Society's website at:

www.rsgb.org/jubilee

RSGB LEGACY COMMITTEE: The RSGB Legacy Fund, thanks to the generosity of donors, has significant financial resources available to encourage and develop amateur radio. The Legacy Committee (a subcommittee of the RSGB Board) considers proposals for grants to be given to projects from the RSGB Legacy Fund. The RSGB is seeking members to join the Legacy Committee, preferably with experience of grant applications or experience within the charitable sector. For more information see the RSGB website.

METEOR SCATTER BEACON: The Radio Society of Great Britain (RSGB) has announced that its Legacy Committee has agreed to fund a 50MHz beacon specifically aimed at studying meteor events above the UK. The RSGB website reports, *"Unlike conventional propagation beacons, this will beam vertically up using circular polarization. The 50MHz band is particularly suitable for observing meteors by radio as they create an ionised trail strongly reflective to radio at that frequency, while they burn up on entry to the Earth's atmosphere. The beacon is to be located at the Sherwood Observatory of the Mansfield and Sutton Astronomical Society, a central location for UK coverage".*

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

LATEST RAOTA MAGAZINE: The spring 2022 issue of *OT News* outlines details of a 'get together' planned for May 2022. With members spread across the UK, and some in other countries, RAOTA does not have a regular club meeting place. Instead, they rely on radio nets, the magazine, and the occasional 'get together' to keep in touch.

The 'article of the year' award for 2021 was won by *'100 years of Shortwaves'* by G3RZP & M0DAF. A wide range of subjects are covered this time. Two book reviews 'Backing Bletchley' and 'EMC & RFI Know How'; another in the series of cartoons from G4GHU; and a Morse key made from Meccano by G4GQL.

G4JCP has produced an article entitled *"Does Amateur Radio have a future?"*, which will undoubtedly provoke comments, and G4MRV takes readers on a trip down memory lane with a piece on Sinclair electronics.

W3WEG provides a cautionary tale about ATU and Balun losses, while G4GQL takes a fresh look at an old favourite, the Yaesu FT-900.

GW3XJQ presents the 90th birthday party of GW4HXO, and shares details of his life.

To find out more, write to: RAOTA Membership Secretary, 65 Montgomery Street, Hove, East Sussex, BN3 5BE, or visit the RAOTA website at: **www.raota.org**

SOME UK AMATEURS NOW LICENSED FOR 40MHZ: (from *Southgate Amateur Radio News*) John EI7GL reports Ofcom is now issuing some UK radio amateurs with temporary Innovation and Research licences to transmit in the 40MHz band

On his blog John writes: Roger G3XBM in the east of England can operate from the 2nd of April for one year with 5W. Roger writes... *"After a very long wait OFCOM has approved my 8m TX permit that runs from April 2nd for a year. It permits me to use 40-42MHz with digital modes (including CW) at 5W ERP max. I expect to erect a wire dipole, which is directed towards Europe.*

"I expect to be mostly on FT8 around 40.676MHz with precise frequency done in liaison with others. What I hope is all 8m FT8 stations can be monitored with one USB dial setting, but spaced out. 5W should certainly cover Europe with Es. I shall try some local CW crossband QSOs, but hope to be on FT8 24/7."

It is understood G0JJL, G0JHC and G7PUV either have or are applying for licences.

Read the full blog post at: **https://tinyurl.com/2p86ntf9**

FISTS – CELEBRATING 35 YEARS OF PROMOTING MORSE: 2022 marks the 35th anniversary of FISTS CW Club. FISTS was created by Geo G3ZQS (SK) in September 1987. Naturally, FISTS will be celebrating this milestone.

Chris G5VZ tells us that during those 35 years, FISTS has become what is probably the best known open-membership CW group in the world. As the motto says, *"When you've worked a FISTS, you've worked a friend"*.

Since its inception FISTS has encouraged collaboration between experienced operators and those who are beginners or improvers. This mixture includes former military and maritime professionals and radio amateurs with many years of on-air CW experience, alongside those less experienced, who have a desire to use Morse on the amateur bands and to develop their personal skills.

From its British base in Darwen, Lancashire the club grew into what is now known as FISTS Europe, alongside a North American Chapter plus FISTS East Asia and FISTS Down Under (see websites below):

www.fists.co.uk
www.fistsna.org
feacw.net
www.fdu.org.au

David Perry G4YVM has created an activity to mark this auspicious year. It focuses on the number 35, of course. He says, *"To celebrate our 35th birthday we have formulated not just an activity but one with prizes. The details are laid out on our website and the activity is open to all: members and non-members alike. We hope that non-members will join FISTS, of course, but just join in for the love of SFBM's finest contribution!"*

The dates, rules and – of course – the prizes are all revealed at: **https://fists.co.uk/ac2022**

USEFUL APP: This simple HF Propagation app for Android by Apkmonk provides current solar data to your Android phone. It's available from their website and the Google Play Store. Read more about it at the link below: **https://tinyurl.com/yckrz24b**

New from Moonraker

Moonraker have a handy new product in the form of the Ampro Heavy Duty 3/8 Dipole Centre. Designed for pole or tripod mounting, this device will take two whip antennas such as two Ampro whips or two MRQ-213 whips to make a dipole. Supplied with two V-bolts for fixing to tripod or mast, horizontal or vertical (up to 50mm). Coax fitting is SO-239. The bundle kit gives you all you need to make a dipole 20m through to 4m. Priced at £24.95, see the Moonraker website for further details: **https://tinyurl.com/yf5h9zud**

HAM PAYLOAD GOING TO THE CHINESE SPACE STATION: The International Amateur Radio Union (IARU) satellite frequency coordination panel reports that an application has been submitted for an amateur radio payload to be hosted on the Chinese Tiangong space station. The coordination request states:

"CSSARC is the amateur radio payload for Chinese Space Station, proposed by Chinese Radio Amateurs Club (CRAC), Aerospace System Engineering Research Institute of Shanghai (ASES) and Harbin Institute of Technology (HIT)".

The first phase of the payload is capable of providing the following functions utilising the VHF/UHF amateur radio band:

- V/V or U/U crew voice
- V/U or U/V FM repeater
- V/V or U/U 1k2 AFSK digipeater
- V/V or U/U SSTV or digital image

The payload will provide resources for radio amateurs worldwide to make contacts with onboard astronauts or communicate with each other. It will also play a role in inspiring students to pursue interests and careers in science, technology, engineering, and math, and to encourage more people to get interested in amateur radio. The planned launch from Wenchang is scheduled for the third quarter of this year. (Thanks to AMSAT UK)

NEWARK HAMFEST 2022: The National Hamfest at Newark Showground will resume this year but on a different weekend. Put 14/15 October into your diaries for this one.

Rallies & Events

Due to the ongoing Coronavirus situation, the calendar remains very changeable at the moment, and there will be more cancellations and postponements. Information published here reflects the situation up to and including 28th March 2022. Readers are advised to check carefully with the organisers of any event, before setting out for a visit. The Radio Enthusiast website will have updates, please check here regularly. To get your event on this list, e-mail details as early as possible: **wiessala@hotmail.com**

24 April
ANDOVER RADIO CLUB SPRING BOOT SALE: Wildhern Village Hall, SP11 0JE. (just north of Andover). Open for sellers at 9 am; buyers: 10 am. The cost is £8 per boot and £2 for buyers. Tables in the Hall £10. Organised by The Andover Radio Amateur Club:
arac@arac.org.uk
http://www.arac.org.uk

24 April
CAMBRIDGE REPEATER GROUP RALLY: Foxton Village Hall, Hardman Road, Foxton, Cambridge, Cambs CB22 6RN; Doors open at 9.30 am for the public (7.30 am for traders). Admission is £3. (BB, CBS, CR, TI, TBS).
Lawrence, M0LCM: 07941-972724
rally2022@cambridgerepeaters.net
www.cambridgerepeaters.net

24 April
NARSA (NORTHERN AMATEUR RADIO SOCIETIES ASSOCIATION) EXHIBITION: Norbreck Castle Exhibition Centre, Blackpool FY2 9AA
Dave M0OBW: 01270 761 608
dwilson@btinternet.com
www.narsa.org.uk

1 May
THORPE CAMP VISITOR CENTRE, RADIO AMATEUR (HAMFEST) RALLY: Thorpe Camp, Tattershall, Thorpe, Lincolnshire, Open to the public from 9 am to 1 pm; open to traders at 6.30 am. £4 per person, under 12 Free. Food on-site and car parking inside the grounds.
Anthony Freeman: 07956 654481

2 May
DARTMOOR RADIO RALLY: The Yelverton War Memorial Hall, Meavy Lane, Yelverton. Devon, PL20 6AL. Doors open at 10 am and admission is £2.50 (BB | CR | FP | TS).
Roger: 07854 088882
2e0rph@gmail.com

7 May
CDXC DX CONVENTION 2022 (LOUGHBOROUGH)
http://www.cdxc.org.uk
https://tinyurl.com/3tfetch5

8 May
LOUGH ERNE AMATEUR RADIO CLUB ANNUAL RALLY 2022: Arena @ Share Discovery Village; 221 Lisnaskea Road; Lisnaskea, Co. Fermanagh, BT92 0JZ; Northern Ireland. Opening at 11.30 am (9.30 am for traders). Facilities are available on-site for breakfast, tea, coffee and lunches. For those wishing to stay in the area for the weekend, there may be some Châlets available on-site. Please contact Reception directly at:
www.sharevillage.org
Traders: Alan R Gault Chairman at:
alan.r.gault@btinternet.com
https://tinyurl.com/4end75em

14 May
BARRY ARS RALLY: Sully Sports & Social Club, South Road, Sully nr Barry CF64 5SP. Open to traders from 7.30 am and to the public from 9.30 am. Admission is £2.50 (FP).

20-22 May
DAYTON HAMVENTION : World's largest amateur radio show, now in its 70th year. Major manufacturers, numerous smaller traders, a massive flea market, world-class lectures. Strong ARRL and RSGB presence, including bookstall.
https://hamvention.org

22 May
DUNSTABLE DOWNS RC NATIONAL AMATEUR RADIO CAR BOOT SALE: Stockwood Park, Luton. All the usual facilities will be there, further details on:
www.ddrcbootsale.org

5 June
SPALDING RADIO RALLY: Holbeach United Youth FC, Pennyhill Road, Holbeach, Lincs PE12 &PR. Doors open at 10 am (disabled 9.30 am), and entry is £3. (CBS | CR | FM | RF | TS)
Graham, G8NWC: 07754 619 701
rally2022@sdars.org.uk

11 June
ROCHDALE & DISTRICT AMATEUR RADIO SOCIETY SUMMER RALLY: St Vincent de Paul's, Caldershaw Road, off Edenfield Road (A680), Norden, Rochdale OL12 7QR. Open to the public at 10.15 am; disabled visitors at 10 am.
Robert M0NVQ: 0777 811 3333
m0nvq@outlook.com

12 June
SNADARC JUNCTION 28 RADIO RALLY: Alfreton and District Amateur Radio Club, South Normanton. Alfreton Leisure Centre, DE55 7BD. Tables still £10 and Admission£3. Everything is indoors with a meeting room, bar, refreshments and full Café onsite. Opening at 10:15, traders will have access from 08:00.
Alan Jones M0OLT: 01332 679913
secretary@snadarc.com
www.snadarc.com

12 June
MENDIPS RALLY: Farrington Gurney Memorial Hall, Church Lane, Farrington Gurney, Somerset, BS39 6TY. Open 9.30 am (traders 7:30 am). Entrance £3 (FP). Indoor & Field pitches. Tables: inside £8 | outside £5.
Luke Kelly, 2E0VHV: 07870 168 197
mendipsrally@hotmail.com

18 June
BANGOR & DISTRICT ARS RALLY : Ballygilbert Presbyterian Church, 376 Belfast Road, Ballyrobert, Bangor BT19 1UH. Doors open at 11.30 am.
Andrew MI0OBR: 07980 846 272

19 June
EAST SUFFOLK WIRELESS REVIVAL (IPSWICH RALLY): Kirton Recreation Ground, Back Road, Kirton IP10 0PW (just off the A14). Doors open at 9.30 am and the entry fee for visitors is £2. Trade tables are from £10. (BB | CBS | CR | FP | RSGB | SIG | TS | GB4SWR HF station).
Kevin G8MXV: 07710 046 846
www.eswr.org.uk

24-26 June
HAM RADIO FRIEDRICHSHAFEN: Exhibitors & visitors from 52 countries, large flea market with around 300 stalls. Talks, meetings, socialising, and more.
https://tinyurl.com/2p8up2rc

25 June
GI-QRP CONVENTION: Tandragee Golf Club, 11 Markethill Road, Tandragee, Craigavon BT62 2ER. Ample parking and disabled access. Doors open at 9 am. Presentations start at 10 am. There will be an opportunity to work the GQRP Club callsign GI5LOW for the first time in the week leading up to the Convention and the weekend of the Convention. Held in association with the GQRP Club. (BA | CR | L | LB | RF | SIG | TS).
Philip MI0MSO: 078 4902 5760
r8.giqrp@gmail.com

26 June
NEWBURY RADIO RALLY: Following two years of postponement due to COVID restrictions, the Newbury rally is now back. It will take place at Newbury Showground, Priors Court Road, Hermitage, Thatcham, Berks. RG18 9QZ (Next to J13 of the M4). The is organised and run by the Newbury And District Amateur Radio Society (NADARS) and attracts visitors from all over the country.
https://www.nadars.org.uk/rally.asp
http://www.nadars.org.uk

3 July
BARFORD NORFOLK ARC RADIO RALLY
www.norfolkamateurradio.org

3 July
CORNISH RAC RALLY: Penair School, St Clement, Truro, Cornwall TR1 1TN. Doors open at 10 am. Admission is £2. (BB | CR | D TS | Local Club Stands).
Ken Tarry G0FIC: 01209 821073
pendennis38@btinternet.com
www.gx4crc.com

17 July
MCMICHAEL AMATEUR RADIO RALLY & CAR BOOT SALE The McMichael Rally begins at 09:30 am, with car boot setup from 8:30 am. The location is: Reading Rugby Club, Sonning Lane (B4446) – just off the A4 at Sonning, east of Reading RG4 6ST, NGR SU 753 747. Admission: £3 per person. Car boot sale: £10 per pitch, no booking required. No dogs are allowed, except for assistance dogs (CBS | FP | SIG).
https://mcmichaelrally.org.uk
rally@radarc.org
traders@radarc.org

BB **Bring-and-Buy** CBS **Car Boot Sale** CR **Catering /Refreshments** D **Disabled visitors** FP **Free Parking** L **Lectures** RF **Raffle** RSGB **(RSGB) Book Stall** RU/PW **RU/ PW in attendance** SIG **Special-Interest Groups** TI **Talk-In (Channel)** TS **Trade**

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

Don Field G3XTT
practicalwireless@warnersgroup.co.uk

PW at 90 Years

As Practical Wireless approaches its 90th birthday, we take the opportunity to look back at its illustrious history, decade by decade.

We're getting quite modern now – the 70s! Our decade starts with the September 1972 issue, **Fig. 1**. We're still seeing lots of advertisements, especially for broadcast receivers and hi-fi, with the occasional electronic organ kit (pretty ambitious for the time) and, as I mentioned last time, quite a number of ads offering training in electronics and related subjects. One advertisement was for sea-going radio officers – those were the days! And plenty of advertisements offering components, including, of course, both valves and transistors.

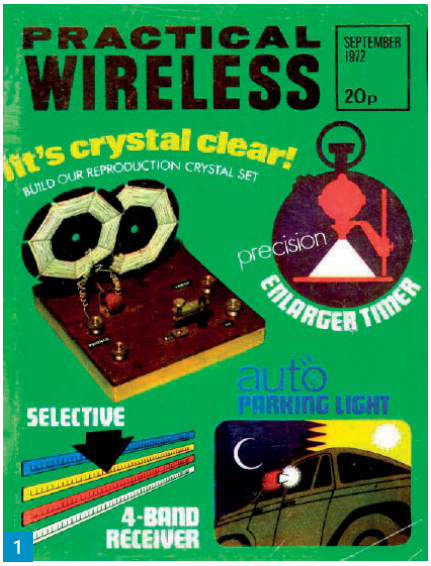
Computer Design of ICs!

But for those of you who think the 70s is actually ancient history, how about this from the editorial in that issue: *We recently visited the Southampton plant of Mullard and saw how the integrated circuit designer, having determined the basic performance requirements and circuit elements, then enlists the aid of a computer with disc stores and a graphics unit. He can simulate circuits on the computer and obtain a readout of predicted performance.*

Having found the optimum circuit elements, he then calls on the computer to provide cost and performance comparisons using different technologies of manufacture. The computer then takes the designer's rough IC layout and feeds in his information, using a special 'language' calls out transistor types from the computer memory store. The drawing for the mask is then generated by the computer.

As a parallel operation, the computer examines the logic design of the circuit and is programmed to determine which test procedures and stimuli are wanted for the computer-testing of the complete circuit. Chips incorporating up to 6,000 transistors and all their interconnections can be designed without making a single error.

I found that quite remarkable – integrated circuits being designed by computer and 50 years ago! As well as the cover-featured crystal set (taking readers back to a simpler time!) our old friend **FG Rayer G3OGR** had Part 1 of a 2m transmitter (using valves, of course), along with a '4-valve receiver with variable selectivity'. No one could accuse him of slackness! And we'd reached Part 10 of a series on transistor circuitry for beginners. There were columns for medium, short wave and amateur band reception reports.



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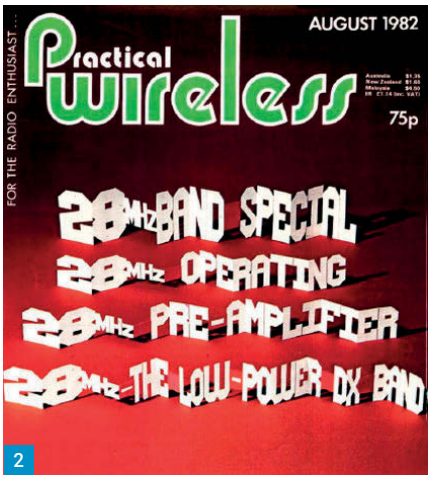

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Fig. 1: The September 1972 cover.
Fig. 2: The August 1982 cover.

1977

Halfway through our decade, in September 1977, the price had doubled, from 20p to 40p, reflecting 1970s inflation. And a 'new' look, with a different font – maybe to justify that high price! I see that by now the assistant editor was **Eric Dowdeswell G4AR**, who wrote the amateur bands column in the magazine too. He was pretty active on the bands – I had a number of QSOs with him, all on 160m between 1969 and 1975.

That issue also featured the start of a new series on passing the amateur radio examination, by **John Thornton Lawrence GW3JGA** and **Ken Mc Coy GW8CMY**.

And, guess what, it featured Part 1 of a General Purpose SW Receiver project by FG Rayer G3OGR, and using transistors too!

I seem to recall that at that time I was more interested in reading *PCW* (*Practical Computer World*) than *Practical Wireless* – that's where there seemed to be more happening. But thank goodness I stuck with amateur radio too – computing has become far too commoditised these days, in my view at least, whereas amateur radio still leaves room for experimentation.

Ending the Decade

So, let's end the decade with the August 1982 issue, by which time the cover price had increased yet again, to a whopping 75p. And as you can see from the cover, **Fig. 2**, there was plenty inside about the 28MHz amateur band, which makes a nice change from all those hi-fi projects and similar that had typically been on the cover. And along the way there had been an influx (a veritable explosion!) of amateur radio retailers advertising in *PW*'s pages, notably Lowe Electronics, South Midland Communications, Waters and Stanton, Gemini Electronics, Lee Electronics, Wood & Douglas, Microwave Modules, H Lexton (the East London Ham Store), Amateur Electronics UK, Datong Electronics, Amateur Radio Exchange, Stephen James Ltd, Bredhurst Electronics, Amcomm, SEM, AKD, Ward Electronics, Sota Communication Systems (not to be confused with Summits on the Air!), Thanet Electronics (agents for Icom) and others offering amateur radio kit alongside other radio and hi-fi gear, including J Birkett who continued to advertise in these pages until very recently. All these were indicative of rapid growth in UK amateur radio, also reflected in the editorial pages, which were much more focused on amateur radio rather than 'other' electronics. The editor was an amateur – **Geoff Arnold G3GSR** – I'm not sure whether the content reflected his interests or whether he had been appointed because the magazine needed to focus more on amateur radio.

Richard Constantine G3UGF
practicalwireless@warnersgroup.co.uk

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Accessories from Paradan

Richard Constantine G3UGF reflects on Thunder, Lightning, Paradan and a 'Round Tuit'.

Has anyone every given you a beer mat style Round Tuit to make a point? Usually they are given by partners or those to whom you've made an as yet, unfulfilled promise.

Well, it's confession time. I've received several verbal and a couple of physical ones in my time. Reminders of domestic jobs never done or finished, because I've never got, 'around to it'. I also have a long list of personal ones mostly radio related. I have many things I've meant or intended to do and they still only exist in my head.

I've always meant to make an automatic earthing system for my antennas, to protect my radios' front ends from static build up or, hopefully, the consequences of nearby lightning. If I'm honest with myself, I've taken far too many chances over the years. Thus far, I've managed to avoid a major disaster and not had to argue an insurance claim on my house policy, but there's time. I've only lost one receiver front end that I can't fix but the potential for something more devastating is only ever one thunder cloud away.

There are four different types of lightning, including ball and sheet.

Sheet lightning takes place between clouds that are at different potentials. However, it's the stuff that reaches the ground that concerns me. It's horrendous to think that what begins as a series of negative charges at the base of a storm cloud, is attracted to a positively charged source, in a sort of stepped pattern at around 200,000+ miles an hour.

When it finds one, the lightening discharge travels along the pathway at around 200 million miles an hour! (*National Geographic*)

If that charged grounding source is your antenna or somewhere nearby, you are at serious risk of a range of side effects or, in the worst-case scenario becoming a, 'Silent Key'.

I have experienced a couple of direct lightning strikes in my life, both during rare, highly charged and violent, winter Thundersnow events, due to a mix of high winds, hail and really heavy snowfall. Once at sea and later inside the equipment cabin at the base of a 46m tower on a comm's site 400+ metres above sea level. I was standing on a wet duck-board, over 2-3cm of water and saved only by my wellingtons, but that's another story.

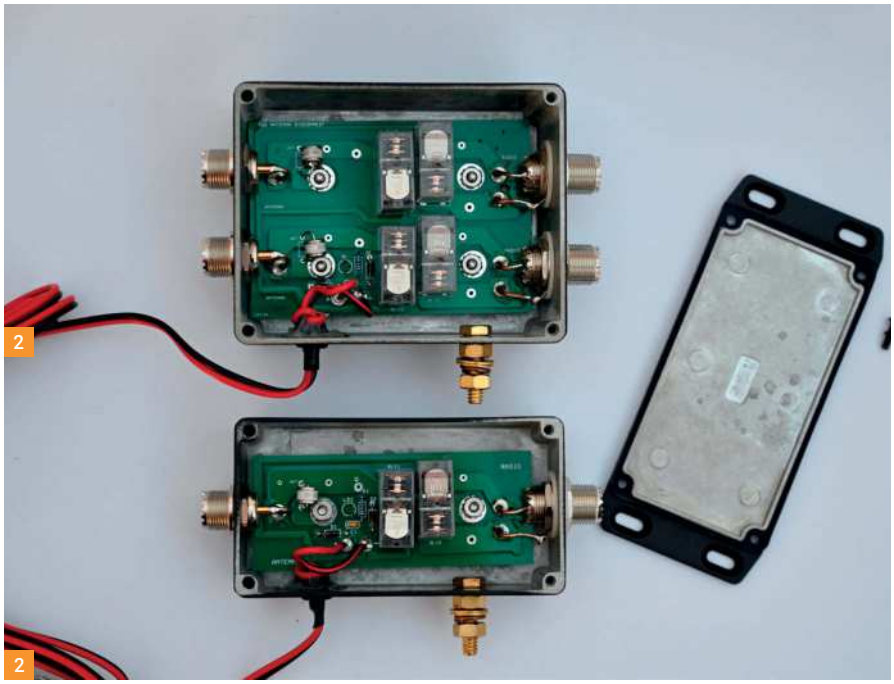
Ground lightning typically strikes from a height of around 46m (150ft), the same height as the tower. I wish I had known that before it happened to me.

Whenever I hear the rumble of thunder I instinctively check to see if I've remembered to disconnect my antennas manually the last time I operated, usually not. If I'm not at home, I just have to hope that I have. While houses may be earthed via various utility supplies are you sure that yours is and what about your antennas?

The Paradan Solution

Now a company in Florida has possibly saved me from myself and created one less job to do, subject to my getting 'around to it'.

Fig. 1: Single and Double antenna units. Fig. 2: Single and Double units internal construction. Fig. 3: Remote installation for two antennas. Fig. 4: Radio on-sensor. Fig. 5: Handbook diagrams for all options.



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Paradan Radio is producing a range of useful products, including 50Ω automatic antenna disconnect units designed for use between 1.8 and 54MHz, **Figs. 1** and **2**. The actuators are currently available for a single antenna or as a two-antenna combined version. The photo, **Fig. 3**, shows the dual unit set up with two antennas.

With a nominal 60mA, 12V (10-18V) external DC supply connected, antennas are through-linked as normal. The DC supply has additional onboard circuitry to stop RF affecting the operation of the relays. Additionally, a gas discharge tube (GDT) is connected across the RF line for static discharge and added protection.

A GDT works in a similar way to a fluorescent light. It has two electrodes suspended in a sealed container filled with a Noble gas under pressure. The gas used determines the striking voltage at which it conducts. In this application, once the threshold is reached, high voltage static causes the GDT to conduct and is discharged to earth. Hopefully it's going to take place well below the threshold that leaves anyone exposed to the potential (pun) of receiver static charge damage, subject to an appropriate, low resistance DC earth, of course.

Removing the power supply to the unit immediately de-energises the internal 15A relay contacts, that are rated for use up to 1.5kW of RF.

This action isolates both the inner and outer of the feedline coax. The input feedline coax is now completely isolated from both the Paradan unit and the antenna. As a further precaution the centre pin of the antenna end coax socket becomes directly connected to the case.

It's recommended that the case earthing bolt is, in turn, connected to a suitable earth by means of a minimum 10-gauge heavy duty wire. This cable needs to provide as low a resistance on the antenna side as is practical for maximum protection, in the event of nearby lightning. Disconnecting both inner and outer of the input coaxial cable ensures complete isolation of the radio end of system as there is no longer a through route.

Both single and double units are housed in gasket sealed, diecast alloy and stove enamelled enclosures. While both enclosures are very substantial units, complete with case seals and mounting lugs for easy installation, I wouldn't suggest that they are suitable for prolonged use outdoors without further weather protection.

Curiously, the units provided for evaluation had RCA phono plugs already fitted to the DC supply cables. Included in each package were Red and Black 'Powerpole' connectors (not my favourites) and four Red size, crimp style cable joiners. Neither device has an in-line fuse fitted.

Used stand-alone, you need to provide your own.

Radio-ON Sensor

While this may seem a little odd at first sight, all is revealed by a closer look at the third item in the Paradan line up.

It's the optional use, 'Radio-ON' sensor, **Fig. 4**. While not essential, in certain applications it can be beneficial if also used in conjunction with the main DC supply powering the station radio equipment, **Fig. 5**.

The sensor connects directly to the Paradan antenna units, using the RCA phono socket output. Its purpose is to ensure that the disconnection is automatic on close-down in certain cases.

You may ask, why do I need this extra, belt and braces item to ensure that the system works? Well, not everyone does but read on …

Not all radio installations are the same and not everyone's circumstances are the same. Perhaps it's worth considering that this is a neat and convenient, one-stop

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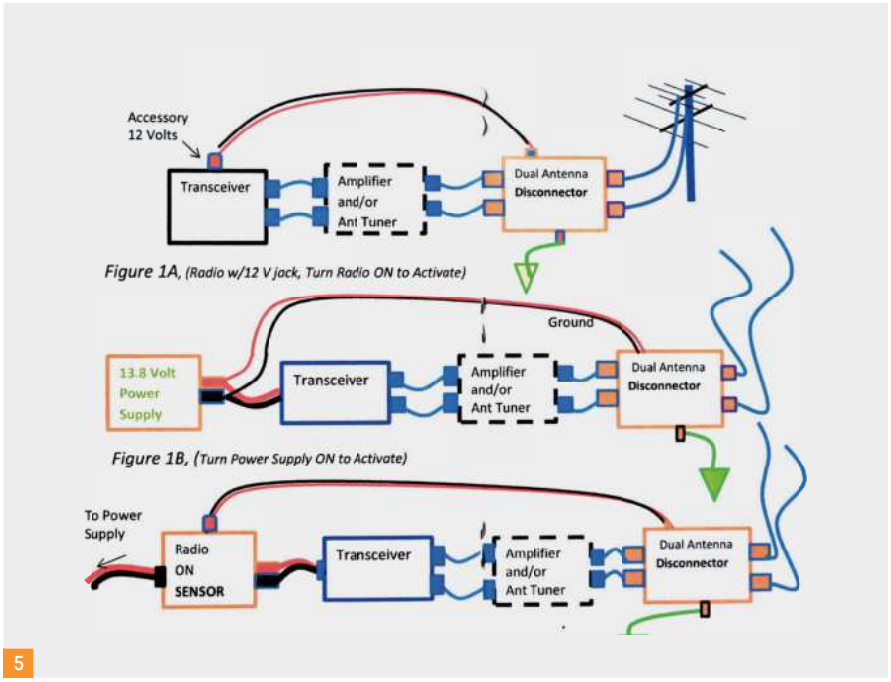

5

option to directly close down much of or even the whole station via a single action. When the station power unit goes off, the protection kicks in.

It can become part of a simple plug-and-play system where the station is DC supplied either internally or externally but does not have an auxiliary 12V DC output on the radio itself.

Like the actuators, the Radio-On sensor operates between 10-16V DC and consumes 60mA. It has a current sensing fuse system and a convenient LED 'power applied' indicator. Designed to be fitted in-line with the main DC supply to the radio, it provides power to automatically engage or disengage the antenna system.

It's also fitted with separate output, 30A binding posts, compatible with banana type plugs or ring or spade terminals. Mounted at desk level, it makes a convenient jumping off point for any other DC powered, ancillary equipment. Particularly useful where a heavy linear, mains power unit is at floor level, or some distance away.

Switch off the main supply and everything is off (QRO Linear Amplifier excepted).

You have the confidence to know that everything is safe, your antennas are at earth potential and isolated from your equipment in the shack. A useful unit I think for the increasingly forgetful like me – it's an age thing!

Earthing and PME

In the context of this article it would be remiss of me not to mention the thorny topic of DC earths, RF earths and Protective Multiple Earthing (PME) AC mains supply. Radio amateurs need to be aware of the possible hazards of having their stations earthed by both the mains supply and separately by their antenna systems, on a permanent basis.

Searching Google Images brings up lots of PME diagrams and alternative systems such as TN-S, TN-C-S and TT. What system is in use at any particular location is loosely based around the age of a property. This is not set in stone and changes may have been made over the years due to re-wiring and upgrades etc. It's important to know what system is currently in use.

When I last moved house, I made a written request to my provider and received confirmation of PME at my new location.

I would strongly recommend if they haven't done so already, that every *PW* reader downloads the RSGB's EMC07 document, in order to be mindful of what system they may have. Document EMC07 sheds light on the particular dangers of a disconnected neutral AC line, either within a property or the supply cable. Statistically, it's surely a rare possibility. That said, it's something that nevertheless might occur at any time. Road works, building work, demolition and nearby lighting strikes spring to my mind. Using an externally grounded antenna system that is also permanently connected to the radio system increases the risk factor. Therefore, isolating the station for the many hours that it's typically not in use seems to me to be a good way to reduce the risk factor.

Every amateur's radio station will be different. I'm guessing that a typical Paradan type setup will end up being installed indoors. Yes, it's easy and convenient but is it really a good idea?

I would suggest a better solution where practical is to have the antenna coax routed in such a way as to be closer to the external earth. Placing an actuator outdoors with a shorter earth cable can improve the low resistance path for static and lightning while reducing risk to the main station. Doing so may require a little more thought and effort but the benefits seem pretty obvious.

At my location I have a summerhouse and store, some 20m away from my property and several metres higher than the house. I've long wanted to remote my antennas, not only to hopefully lower my high receiver noise level but also to reduce nearfield radiation.

Personally, I don't use earthed antennas. At the moment I'm using dipoles and a Cushcraft HF vertical with its own isolated grounding system.

Now the Paradan unit, plus a separate DC supply, connected to a remotely controlled AC socket, makes earthing and isolating my system a practical reality.

Being a US import unavoidably affects the end user price. However, set against the potential benefits and convenience, not to mention the added protection for valuable radio equipment, these items have to be a strong consideration.

I've already made my choice. All I need now to complete my installation is a, Round Tuit....hi.

My thanks to ML&S for provision of units for evaluation. The Paradan single unit retails for £115.00, the double unit for £190.00 and the Radio-On sensor for £90.00.

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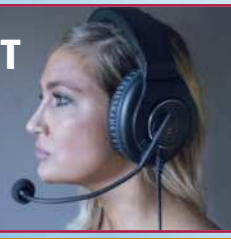

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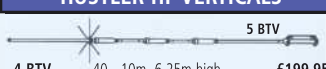

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InnovAntennas 4-Element 50MHz LFA Yagi

Our HF columnist **Steve Telenius-Lowe PJ4DX** ventures higher in frequency to try out a 50MHz beam...

As regular readers of *PW* will know, I am primarily an HF operator. The summer 6m Sporadic E (Es) 'season' coincides with the period when I usually visit family and friends in the UK and Europe and therefore, I had never paid much attention to the 6m (50MHz) band. However, Covid meant I was unable to travel during the summer of 2020 so I tried some SSB and CW on 6m, with what could best be described as 'limited' success. At the end of the year, though, I started to use FT8 on HF and, still unable to travel in May-June 2021, then also on 6m. Love it or loathe it, FT8 is where (nearly) all the DX activity is on 6m these days (even more so than on HF) and I found I was able to work as far as Cyprus, over 10,200km from Bonaire, using just a home-made wire ground plane antenna fed with some lossy RG-58 coax. Now 'hooked' on the Magic Band, I wondered just what would have been possible if I had had a 'decent' antenna?

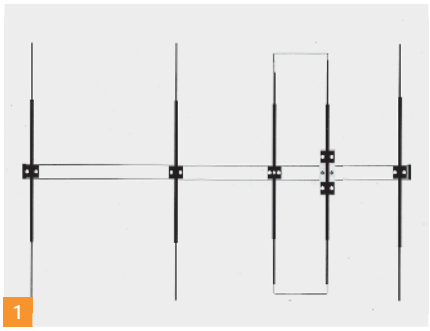
By the end of the Es season I had convinced myself that I really needed to improve my 6m antenna. Aware that InnovAntennas had built up an enviable reputation for quality and performance, I ordered a 4-element LFA Yagi from them.

At first glance this antenna may look like a 5-element beam, **Fig. 1**, but it is not. The 'LFA', meaning Loop Fed Array, in the name provides the clue: instead of a conventional gamma match, split dipole or folded dipole feed system, the driven element of this antenna is a full-wave loop. The rectangular loop is laid flat on the boom in the same plane as the reflector and directors.

According to InnovAntennas, the LFA approach has several advantages over more conventional feed systems. Having a closed loop driven element helps to reduce the reception of static and local noise; the loop with its parasitic elements provides a direct 50Ω feed with no need for any matching devices, thus leading to lower losses; and it provides a high front-to-back ratio as well as a wide bandwidth. The antenna is optimised for the 50.00 – 50.500MHz part of the 6m band. The specifications, as supplied by InnovAntennas, are given in **Table 1**.

Unboxing

Unpacking the sturdy cardboard box revealed the boom, elements and other parts to be of excellent quality, **Fig. 2**. For a fairly small antenna, there seemed to be a lot of hardware, packed in three separate numbered bags, **Fig. 3**.



1

The antenna boom is made of 1.25in square 16SWG aluminium, while the elements are 16mm in the centre and 13mm at the ends. The parasitic elements are all insulated from the boom using Stauff clamps. A boom-to-mast plate is included, which supports up to 2in (50mm) masts. All the hardware is of A4/316 marine-grade stainless steel.

InnovAntennas stress the importance of using a good quality 1:1 balun, so when I ordered the antenna I also bought the optional balun from them. The balun is rated at 2kW and is terminated in an N-type socket.

The assembly instruction manual runs to nine pages, of which three are devoted to the parts list. After checking against the list that nothing was missing it was time to start the build.

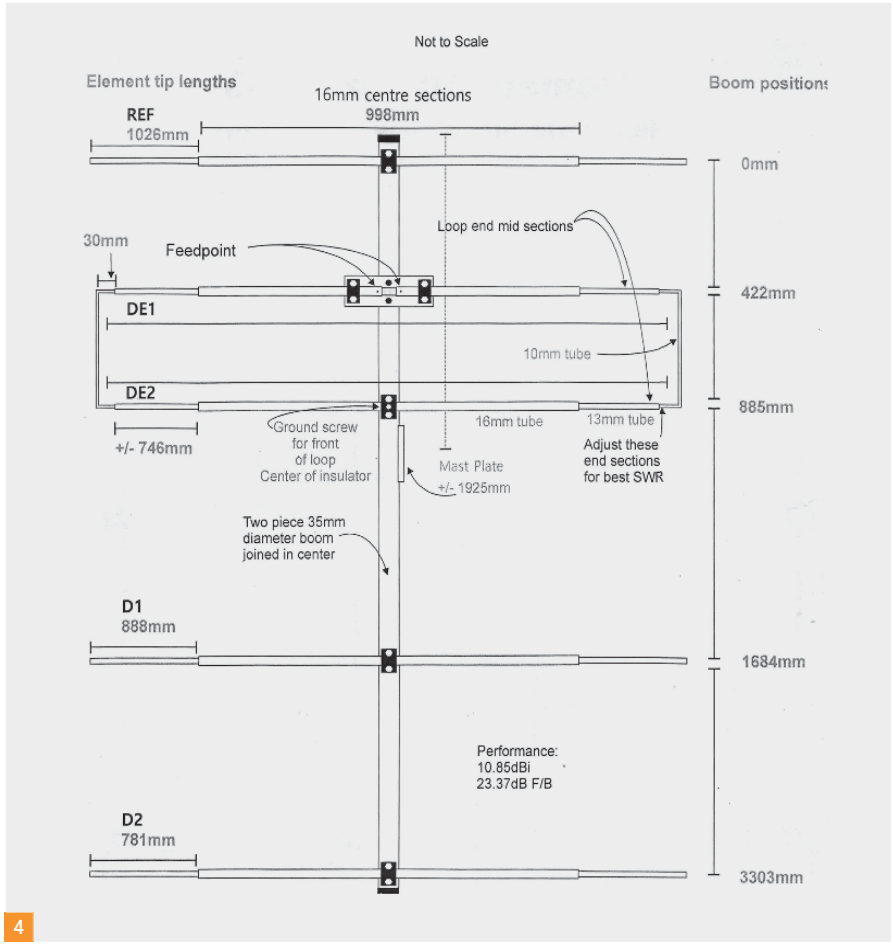
Building the Antenna

The instruction leaflet suggests starting by assembling the boom-to-mast plate. A note in the manual says that although all the stainless steel hardware is very strong and of high quality, it is possible that *'gawling'* (locking) may occur if the threads are not lubricated. I had an aerosol of lithium grease ('ideal for metal-to-metal contact') left over from a previous project so I greased all the

Fig. 1: Drawing of the InnovAntennas 4-element 50MHz LFA Yagi. Fig. 2: As it arrives, out of the box. Fig. 3: There are three bags of hardware. Fig. 4: Antenna layout plan with dimensions (from the InnovAntennas assembly manual). Fig. 5: The optional 2kW balun attached at the feedpoint. Fig. 6: SWR curve of the InnovAntennas 4-element 50MHz beam: 1.1:1 at 50.28MHz and below 2:1 from below 50MHz to 50.85MHz. Fig. 7: Azimuth plot of 4-element LFA Yagi (source: InnovAntennas website). Fig. 8: Elevation plot of 4-element LFA Yagi, 10m AGL (source: InnovAntennas website).


2

3



4

hardware before starting the assembly.

The second step is to join the two lengths that make up the boom. This is accomplished with two pre-drilled U-shaped plates and eight bolts. Everything lined up beautifully and no problems were encountered.

The final major part of the build is to attach the elements to the boom. Each of the parasitic elements comes in three lengths: a 16mm diameter centre section, which is attached to the boom with two insulating Stauff clamps, and two 13mm diameter end sections, which are held in place with hose clamps. It is important to ensure the centre sections of the elements are in fact exactly centred on the boom before tightening up the Stauff clamps. The Stauff clamps are fixed in place by Allen bolts: you need to supply your own Allen key. The manual warns against over-tightening the Allen bolts but I found that unless they were tightened adequately the elements were 'wobbly' on the boom. It's a fine balance between being tight enough and risking damage to the Stauff clamps by over-tightening.

The elements' end sections must be measured to the dimensions in the antenna layout plan, **Fig. 4**, and then fitted using a small amount of 'ConductAseal' conductive grease (supplied by InnovAntennas) on the overlapping parts of the elements before the hose clamps are tightened.

The rectangular full-wave loop driven element is different. The feedpoint with its centre insulator is already fitted in the middle of the centre section of the element, there are then two 13mm middle sections, followed by 10mm diameter U-shaped sections. The other side of the loop is grounded to the boom using a pair of aluminium clamps. The 13mm centre sections can be moved in or out, like a trombone slide, to adjust for minimum SWR.

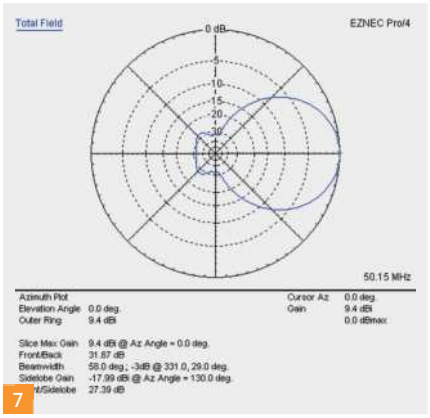
Although the hardware was greased before assembly, I added a couple of turns of tightly-wrapped self-amalgamating tape over the hose clamps as additional weather protection. This is probably completely unnecessary but it's easy to do, so why not?

5

6

Boom length:	3.4m
Weight:	3.89kg / 8.57lb
Claimed gain:	9.4dBi at 50.150MHz
Peak Gain:	9.97dBi
Gain at 10m above ground:	14.94dBi at 50.150MHz
F/B ratio:	31.87dB at 50.150MHz
Peak F/B:	32.61dB
SWR:	Below 1.2:1 from 50.00MHz to 50.500MHz

Table 1: 4-element 50MHz LFA Yagi specifications (from InnovAntennas website).



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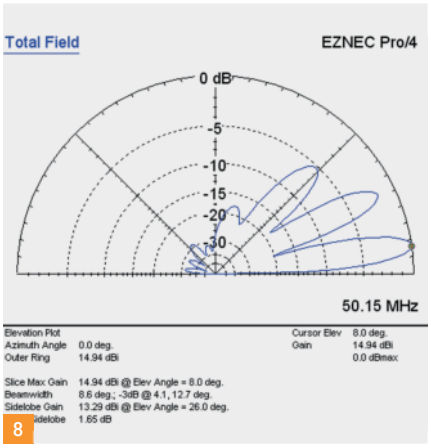

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Finally, the 1:1 balun is attached to the driven element feedpoint, **Fig. 5,** and you're good to go.

Documentation

At this point I need to say something about the assembly instruction manual supplied with the antenna. As noted above, the aluminium and stainless steel material is all of excellent quality, but unfortunately the same cannot be said for the documentation.

I found many examples where the manual said one thing but what was actually provided was quite different. I asked **Justin Johnson G0KSC**, the owner of InnovAntennas and the designer of their antennas, about this. He replied promptly saying that (in common with many businesses throughout the world) they have had major supply chain issues, which have necessitated the way the antennas are made evolving over time. The manual had simply not kept up with the various changes made.

The manual is fairly basic rather than a step-by-step construction guide but, despite its discrepancies, I had no great problems in assembling the antenna, just the occasional pause for thought. The assembly is reasonably straightforward and provided you think it through it is relatively easy to build this antenna using the antenna layout plan in the manual (Fig. 4) as your guide. If you do have any problems, Justin offers a support service by email, which, judging by his response to my queries about the documentation, will be prompt and helpful.

Performance

The antenna's SWR was measured using a NanoVNA, specifically calibrated for 50 to 51MHz. Initially, the antenna was measured close to the ground, with the reflector about 1m above ground and the antenna pointing skywards. The SWR curve was quite flat with a minimum reading of 1.1:1, but at 50.45MHz, slightly high in the band. The loop driven element was then moved out slightly, just a few millimetres, to bring the minimum SWR point down to the desired frequency of around 50.2MHz, about halfway between the main SSB/CW frequencies around 50.11MHz and the two main FT8 frequencies, 50.313 and 50.323MHz.

The SWR curve, as measured on the NanoVNA is shown in **Fig. 6.** The claimed SWR of 1.2:1 from 50 to 50.5MHz was met and the measured 2:1 SWR points were from 48.25MHz, below the bottom of the band, to 50.85MHz.

The azimuth and elevation plots, as provided by InnovAntennas on their website, are shown in **Figs. 7** and **8** respectively.

At the time of writing (early March 2022) there is little or no Sporadic E propagation on 50MHz although it is easy enough to work into parts of South America such as Argentina and Chile via Trans-Equatorial Propagation, TEP.

I am looking forward to seeing how the InnovAntennas 50MHz beam performs during the forthcoming Sporadic E season, which is expected to run from May until July.

The InnovAntennas 4-Element 50MHz LFA Yagi antenna costs £199.95, including VAT (as of March 2022), and the optional 2kW balun is an additional £49.95, again including VAT.

Tim Kirby GW4VXE
longworthtim@gmail.com

Six Metre Surprises

Tim Kirby GW4VXE reports on some intriguing propagation on the 6m band.

With increasing solar activity there have been some Trans-Equatorial openings on 50MHz from southern Europe with the occasional signal being heard at more northerly latitudes. However, on the evening of 12 March there was a good opening that reached the UK.

Mark Turner EI3KD (Co. Cork) had his beam turned north-east because of strong winds, but during the period between 1914 and 2047UTC Mark copied PP5KC (GG42), CE2SV, PP5PK (GG51), PY2EG, PY5KD (GG54), PY5CC (GG54), LU5FF, PY2XB (GG66) and PY1EME (GG76). Mark says that it's a shame he wasn't around to work them.

Jamie Ashford GW7SMV (Monmouthshire) worked PY2XB at 2016UTC during the same opening.

Not only have there been TEP openings, but longer openings have been worked as well.

Steve PJ4DX wrote with interesting 50MHz news from Bonaire. Steve writes, *"**Martin PJ4MM**, worked into New Zealand and, remarkably, even further into VK4 a couple of weeks ago. He was not using FT8 but Q65 that he reckons is even better than FT8 for really marginal paths. Martin initially felt this was by F2 propagation but with the SFI below 100 at the time, and very few sunspots about, I would doubt that. But Martin also points out that the distance involved (over 14,000km to VK4) would require too many hops for it to be multi-hop Es. So, the question remains, what mode of propagation could this have been? We have TEP into CE and LU almost daily with strong signals (I've worked nearly 6000km on the 40m dipole using FT8) but that is strictly North-South propagation. VK4 is an awfully long way to the south-west from here (and a long way west from LU/CE) so it can't have been TEP either."*

Steve and I swapped emails about this, and we are both reasonably certain that the leg from Bonaire to South America is by TEP and from then on by multi-hop Es, but of course we cannot be certain. It's fascinating.

At **John EI7GL**'s blog (below) John has been detailing some fascinating openings that have been occurring on 50MHz. For example, on 7 March, there was an opening between the Canary Islands and New Zealand on 50MHz. Interestingly, there were no reports of the ZL stations hearing any South American stations during the opening. John speculates, very reasonably, that perhaps some chordal hop propagation was going on, either at E or F2 layer where the signal


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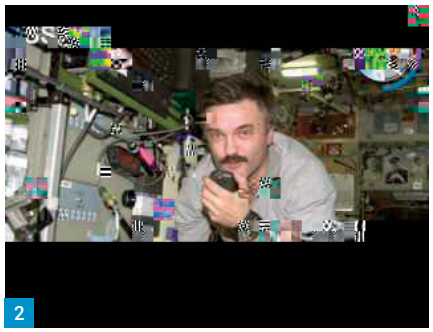
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was not hopping as normal. At the time of the opening, the Solar Flux was 118. During the opening ZL1RS and ZL1SG heard several EA8 stations over a distance approaching 18900km. ZL1RQ heard similar but also CN8YZ and even more interestingly, YS1AG in El Salvador. Is that a hint for us about the route that the signal was taking? Adding some weight to this theory, John notes that the same evening, ZL3OZ was working into Mexico. On 9 March, EA8DO worked ZL1RS. During this opening, as far as we know, no other QSOs were made. Different to the earlier opening, at the same time that ZL1RS was audible with EA8DO, so was PY5KD, so was the signal this time coming over South, rather than Central, America?

https://ei7gl.blogspot.com

On 12 March, between 0100-0400UTC there was a long path opening from South America to Japan and Taiwan, with PSK Reporter showing some interesting paths from PY2XB to stations such as JS6TWW, JS6RTJ, JD1BHA, BV3UF and BV7KL being heard and worked as well as KH6HI – the latter possibly giving us an idea about the route that the signal was taking. PT9FD worked VR2CH and BV7KL so, all in all, a very interesting opening. The distance, long path, appears to be around 21000km, although it's the sort of path where there is not much difference between the long and short paths, but it seems probable that the long path, the darkness path, was the direction that the signals were travelling. The vast majority of QSOs seem to have been made on FT8, rather than Q65.

It's fascinating to see these openings being noted and worked – once again, surely a benefit of the more intensive way that we are operating now. Many thanks to John EI7GL for his work, documenting these openings.

PW list of VHF/UHF nets

Thanks to everyone who has contributed to this list – now surely the most comprehensive listing of VHF/UHF nets in the UK. Because it now contains over 100 nets, it would take up too much space to publish it each month in the magazine, however, it is now available on the web at:

www.radioenthusiast.co.uk/articles/uk-vhf-uhf-nets

However, I thought it would be good to select some random nets to appear in the magazine each month, so here are the ones for this month (see **Table 1**).

Don't forget if your net doesn't appear in the full list shown on the website, then it's not too late to have it added – drop me an email with the details and I will be happy to add it.

As I've said before, we hope this will make it easier for you to find stations to hear and work on the VHF/UHF bands.

An introduction to Digital Voice

I recently had the pleasure of presenting a webinar in the RSGB's excellent Tonight@8 series entitled 'A Bluffers Guide to Digital Voice'. The aim was to provide an

Fig. 1: The equipment used at the Gibraltar club station, ZB2BU for the first activity from the club on the QO-100 satellite Fig. 2: One of the KG-STV images received from the International Space Station by ZB2GI Fig. 3: Tom KB5FHK operating on satellite from the grounds of the Orlando HamCation Fig. 4: Although not yet on the air, Colin G8YIG has set up his new shack in Derbyshire


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introduction to DMR, Fusion, D-STAR as well as some of the other modes such as NXDN, P25 and M17. I also covered the subject of hotspots, showing how these can help you make some interesting contacts, even if you live in a very 'antenna restricted area'. If you'd like to have a look at the presentation, you can find it at the URL below. If you're interested in digital radio, I hope you will enjoy it.

https://youtu.be/-iKjOCI2MV8

Thanks to **Jef Van Raepenbusch ON8NT** for the following two items about software

Easy QTH Locator

Easy QTH Locator, developed by a Ukrainian amateur, displays the QTH Locator, geographical coordinates and elevation or altitude obtained from the GPS system. It doesn't need internet access or a mobile network to work, so it's an ideal tool for SOTA and POTA to determine your position! It's available for free in the Apple store and Google Play *(I used it recently in the Gambia, it works well – **G3XTT**).*

KG-STV software for digital SSTV

After the experiment on the ISS, **Thierry ON2ACO** and Jef did some tests on 2m FM over a path of 20km, and found that they could go down to 4W and still copy perfect pictures! It can also be used on SSB and on HF. The software can be downloaded from:

https://tinyurl.com/2p8cv5fy

The 2m Band

Jef ON8NT (Aalter) worked MW1LCR/P (IO81) on 2m SSB on 1 February over a distance of 457km. during the RSGB UK Activity Contest as well as some closer stations. Jef runs 25W from an IC-9700 to a 5-element LPDA.

Not much to report from the **GW4VXE** (Goodwick) FT8 log – just F4FET (JO00) worked on 26 February. **Captain Yuri UT1FG/MM** was seen coming up from the Bay of Biscay and into the Channel. At the time of writing, he's in IO90 square.

The 70cm Band

During the UK 70cm Activity Contest on 8 February, Jef ON8NT worked G4CLA (IO92), G4NBS (JO02), G0XDI (IO91), G3MEH (IO91) and G4ODA (IO92).

Tony Collett G4NBS (Cambridge) writes, *"I took part in the 70cm FT8 Activity session on 9 March. I did the usual thing of operating for an hour before the RSGB session starts in order to work the PA and DL stations who get buried once the UK wakes up. There seemed to be more UK activity again, but conditions were not the best with difficult scatter across the North Sea and not so many PA stations seen.*

"So, I made 20 QSOs before the RSGB session started, followed by another 44 in RSGB and another two shortly after the end. 66 QSOs in total in 28 locators.

"I spent the best part of 15 minutes with a sked with OV3T (JO46). I could see him most of the time and managed several decodes before we finally made it but worked DG9BFE (JO33) and OZ2ND (JO46) while waiting for his signal to peak enough for him to hear me! Another highlight (and a difficult one) was EI9KP (IO54) who was only –22 and masked by a local. It took several overs before I saw his RR73. I've only ever worked that square once before back in 1986 with EI8EF on SSB when it was still VO square!

"It was nice to work DJ5AR (JN49) for the first time on 70cm but again, I had to struggle through multipath and underneath a UK station to complete but DL1KDA (JO30) and DL5EBS (JO31) were the only other DL stations and neither of them were at normal levels. Back to the UK, EI8KN, GD6ICR, GI4SNA, GM4JTJ, GM8MJV and MM0ABM (IO75) were the pick of the evening – I noticed that I worked G0CNN (IO94) who is only using a vertical collinear so proof it can be done without beams."

The 23cm Band

Peter Harston GW4JQP (Milford Haven) says that 23cm activity is growing in south west Wales and during the UKuG Lowband Contest in early March, he worked GW4HXO, GW3XJQ, MW0RLD, MW0VLO, 2W0LLJ and MW0CXH from Pembrokeshire, Carmarthenshire and Ceredigion – so it's well worth stations beaming towards the

west during contests. Further afield, Peter worked G3TCT (IO81), M0GHZ (IO81), GI6ATZ (IO74), G0DJA (IO93), G4BRK (IO91) and G4ODA (IO92), Peter's best DX was G3XDY (JO02) at 437km.

Simon Evans G6AHX (Twyning) unfortunately lost his mast on 18 February during a storm, but while he was revamping the setup he decided to put up his 36-element Dual antenna for 23cm as well as a 19-element for 70cm. Simon explains that the 23cm beam is just above the ridge of the roof and can see in all directions. He is using the IC-9700 with about 10W and has done tests with G3SQQ in Nottinghamshire. They were able to exchange signals successfully.

Day	Time (local)	Frequency	Description	Area
Sunday	1800	144.550	Bury RS	N West
Sunday	2100	145.325	Echelford ARS	Middlesex
Tuesday	1900	145.575	Fareham and District ARC	Hants
Thursday	1930	144.725	Christchurch ARS	Dorset
Thursday	1930	GB3MR	Stockport RS	N West

Table 1: This Month's Selection of 2m Nets

Satellites

Bob Houlston G4PVB wrote, *"On Sunday 20 February at 1005UTC I received a partial picture from the ISS on 437.800MHz FM. I also heard faint indistinct voices. I used a homebrew ¼-wave ground plane antenna hoisted to the apex of the loft interior"*. Bob wrote up some notes, which you can read at: http://g4pvb.eu5.net/iss.htm

Jef ON8NT monitored a schools contact from the ISS on 4 February on 145.800MHz. On 7 and 8 February, Jef received several SSTV pictures from the ISS using the 'normal' PD-120 mode. However, on 20 February, Jef monitored the KG-STV experiment, which was using the crossband repeater. Some pictures were received although there was still some voice activity on the crossband repeater, which interfered with the picture transmission.

Jef continues to be active on RS-44 using FT4 and indeed, I've noticed much more activity on this mode with more DX stations being available. Jef uses an IC-9700 and a V-2000 vertical and his best DX this month was AC9DX (EN45).

Kevin Hewitt ZB2GI says that his most notable activity this month was being active on QO-100 for the first time, **Fig. 1**. He writes, *"I operated on QO-100 from the GARS club station, this was the first time Gibraltar has been active on the satellite. I logged 228 SSB QSOs and worked 36 DXCCs. Thank you to **Antonio DL4EA** for providing the equipment, expertise and his time during a short stay on the Rock. Operating as ZB2BU we logged 147 SSB QSOs, including PY1AX, ZS4TX and 3B8FA. **John King ZB2JK** also operated and logged 84 SSB QSOs, including PR8KW, V51JP and AP2MS. The QO-100 set up comprised of a DX Patrol up-converter and power amplifier connected to a POTY feed mounted on a 60cm dish. We used an Icom IC-705 or a FT-817 as the exciter. The receiver consisted of an LNB fed via a bias tee, connected to an RTL_SDR dongle running on SDR Console with the Beacon lock feature activated"*.

Kev also monitored the KG-STV experiment and received four images, **Fig. 2**, although they were not perfect copy, owing to interference and Doppler shift. Kev says that the images were uploaded, through the crossband repeater by ON4ISS and IK1SLD. He also made a couple of QSOs, on a different occasion, through the ISS crossband repeater, working F0GFI (JO10) and ON75CRD (JO20).

Patrick Stoddard WD9EWK (Phoenix) writes, *"I was invited by ARRL to give a satellite-themed presentation, as part of their 'Hands-On Handbook' training track at the Orlando HamCation. The ARRL training tracks took place on the Thursday before the HamCation officially opened. The room was full for my track, and I was able to give a quick 'getting started' overview, along with examples of working satellites from different places and using different equipment. The audience had questions throughout my talk, and seemed interested in giving this a try with their own equipment.*

*"During the HamCation, ARRL staffers saw **Tom KB5FHK** and **Sloan N3UPS** working satellites from the parking lot* (**Fig. 3**). *Initially, ARRL sent people out to see them. Later on, KB5FHK was operating from inside the convention grounds, the Central Florida Fairgrounds in Orlando. One of Tom's demonstrations was recorded by ARRL, and posted on YouTube at:*

youtube.com/watch?v=fhyUbC_o1JM

*"Before leaving Florida, I made a quick drive toward Tampa, so I could operate from grid EL88. Orlando is in EL98, and this meant I could activate a couple of grids away from Arizona. I didn't work stations in Europe, but heard stations in the Caribbean that I never hear back in Arizona. In particular, I had a nice contact with **Bert FG8OJ** on Guadeloupe via AO-91 from a city park in EL88.*

"Not long after returning from Orlando, I drove to Tucson in southern Arizona to help the University of Arizona's radio club (K7UAZ) during an on-campus event involving many clubs and organizations at the university. The K7UAZ club had a portable HF station, and I supplied the satellite station. Even though Tucson, in grid DM42, isn't rare, I had stations from across the continental USA and Mexico calling to say 'hello' to the crowds on the AO-91 and SO-50 passes I worked.

*"A couple of days after the trip to Tucson, it was off to the Yuma Hamfest in southwestern Arizona. There was a nice crowd at the Hamfest, trying to make up for the 2021 Hamfest that was cancelled due to the COVID-19 pandemic. It was great to see **Dave AD7DB** from southern California, working FM satellites from his campsite at the Hamfest in grid DM22. One of his passes, on SO-50, can be seen in a video I posted at:*

www.youtube.com/watch?v=IT_buE0W-Zes

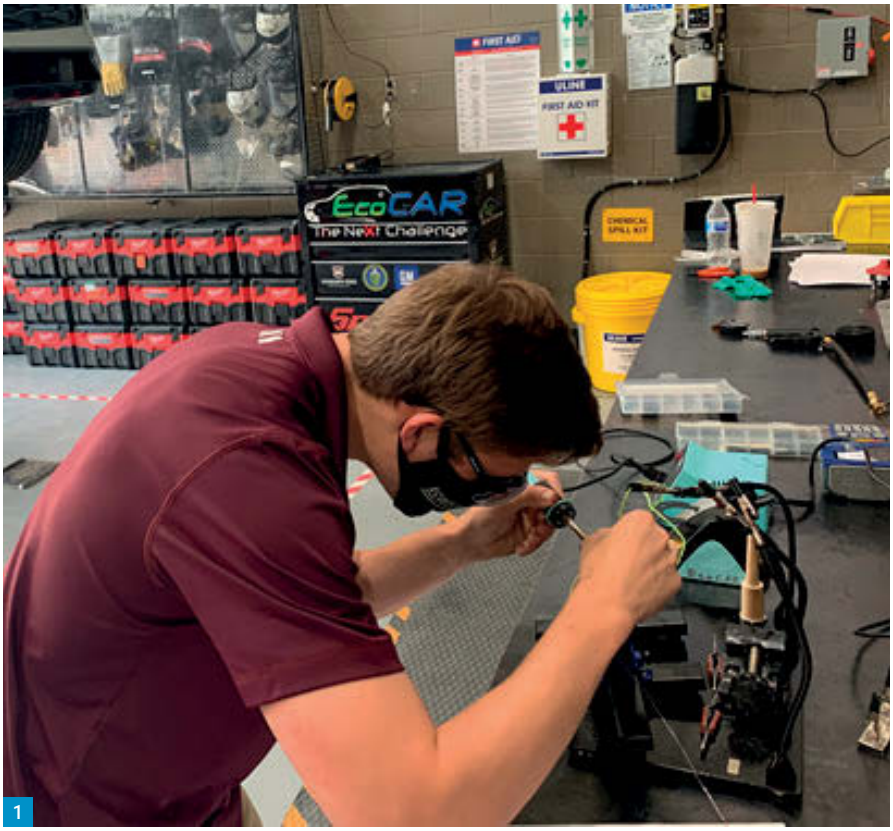
"After the Hamfest wrapped up, I drove west to the DM12/DM22 grid line, about 90 miles east of San Diego in California's Imperial Valley. I worked a few passes in FM and SSB next to the I-8 freeway, before driving home. The weather in the desert valley, at or below sea level, is different than in San Diego. In summertime, the Imperial Valley can see 50°C or higher, while San Diego would be at 25°C to 30°C due to the mountains that separate San Diego from the desert.

"In early March, I planned to make a quick trip to the DM51/DM52 grid line in southeastern Arizona. Instead, my quick trip turned into a day trip, activating two grid lines, DM51/DM52, then DM52/DM53. From the DM51/DM52 line, I worked passes in FM and SSB. DM51 hadn't been on satellites in over a year, since my last visit to this area in January 2021. I logged 99 QSOs in about five hours at this location, and then made a 90-minute drive north to the DM52/DM53 grid line. At DM52/DM53, I worked a pair of PO-101 passes, helping a few pick up either or both grids. I logged 24 QSOs from DM52/DM53 on those passes."

Here at GW4VXE I have tried to get on the low passes of AO-91 out across the sea to the west. Highlights of the log are VE1CWJ (FN85), AA1XP (FN31), W8MTB (EN72), N2FYA (FN41), VY2XU (FN86), EA8TL (IL18), N1AIA (FN42), OH6KNW (KP13), VE1CWJ/R (FN75) and N1MIW, (FN41).

That's it for this month – thank you to everyone who has been in touch with news, please keep your emails and pictures coming.

Frank M Howell PhD K4FMH
practicalwireless@warnersgroup.co.uk



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Need a Hand? Or Six?

Frank M Howell PhD K4FMH describes an Artisan Soldering Platform for Builders.

Do you ever get to use both your hands just for holding your soldering iron and the thread of solder when building something? Most don't. It's commonplace for vendors at rallies or elsewhere to have the inexpensive lightweight metal stands with two alligator clips and a magnifying glass for sale. They work. But they tip over with any heavy object and can easily break if dropped on a hard surface such as a cement floor. They don't function at all for SMD work, a growing part of kit-building and circuit board design. Surprisingly to many purchasers, you need more than a couple of extra 'hands' to get multiple parts and pieces together for connection by solder. Don't sneeze or turn on a fan as **Michael Jones GW7BBY's** article in *PW* (April 2021) suggests because your SMD parts may go flying away!

I've solved most all of those problems with an artisan-built soldering platform. It offers as many extra hands as you wish to add in practical terms. This platform is one huge heatsink that easily handles my 500W soldering iron for hotter solder jobs. It includes a wooden knitting dowel for toroid winding so the wire doesn't get away from you as you count your turns. There is a place for soldering cleaner and a simple two-wire splicing jig. It has a circuit board holder that rotates from top to bottom to check on through-hole parts. Everything is configurable on the fly as each item (except a circuit board holder) is held to a thin solid-steel sheet with feet by magnets! I've built a few of them for interested fellow hams. One of them is in use at a large university laboratory. Shown in **Fig. 1** is an Electrical Engineering graduate student using it in part of the innovative EcoCar construction at Mississippi State University [**1**].

Construction

The details of the soldering platform are illustrated in **Fig. 2**. I'll briefly go over the current set of jigs on it as shown in this illustration. Two of the simple two-wire splicing jigs are included since we all misplace one sooner or later, right? The medical clamps are mainly for temporary heatsinks. There are four 'helping hands' with alligator clips made by QuadHands.com purchased from an online vendor (Amazon for me). The wooden knitting dowel on the upper left is for winding toroids, except for the very small ones. The small staging vice has four disc magnets glued on the bottom (using epoxy cement). There is a small rectangular magnet on the upper right of the base (I'm right-handed) but it can be placed anywhere. It's mainly to hold down a round tin of soldering tip paste so that it doesn't move around, a real nuisance when you're chasing it one-handed with a hot soldering iron!

The Aven circuit board holder has some competitors but it's fairly inexpensive on Amazon, works superbly, and the rubber feet tend to have some suction to them, which holds things in place for the most part. I could have substituted magnets for the rubber feet but decided not to do that here. Other vendor's models would work, too.

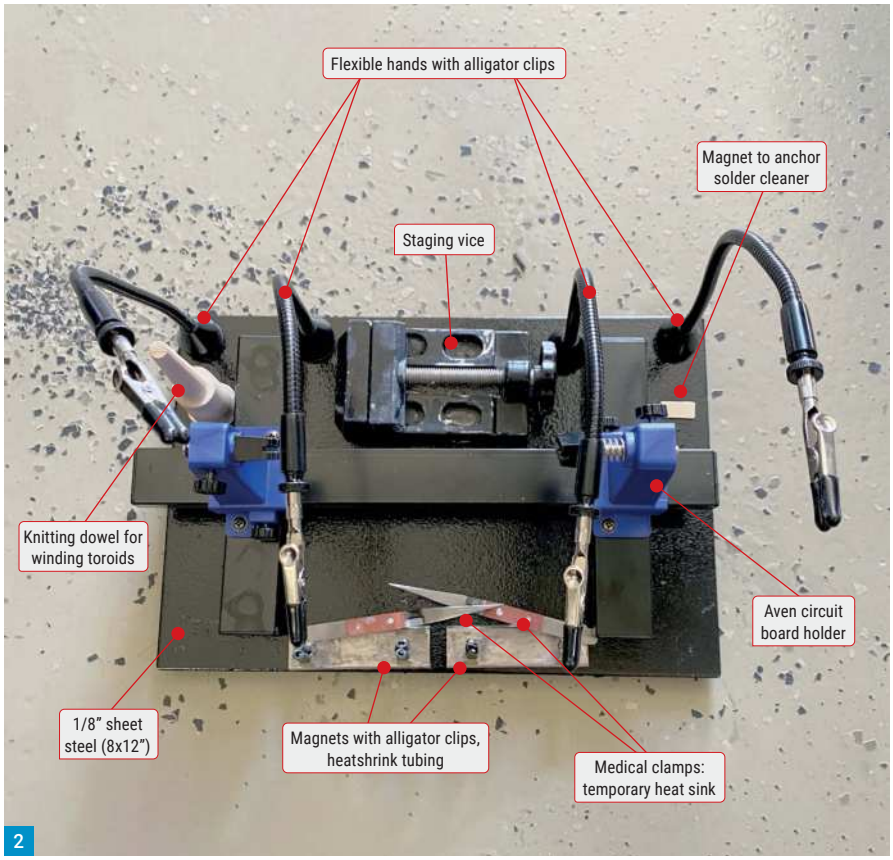
I've added a microscope and articulating part holder for surface mount work. These parts are not in Fig. 2 but I show and describe them below.

Setup and Build Steps

Here's the setup and build process. I've seen a number of other homebrew 'third hand' builds over the years so only some of this is my own invention. Perhaps the exact organisation of the aids might be but that's not anything to jump up and down about. They just reflect what I've found I can use to 'do stuff' involving a soldering iron or gun on my workbench.

The 1/8in steel base is a builder's choice 8 x 12in rectangle. I buy most of my metal materials like this from one of the many eBay vendors of stock metal. I rub any oil off it, which many sellers spray on to reduce rust. I always use a rotary tool with a grinder bit to round the corners some so they don't injure someone (me) in use. I debur the edges too [**2**]. Once this step is done, I put down a paint drop cloth (old bed sheet usually) to prevent over-spray. I use a commercial can spray

Fig. 1: Graduate student Jonah Gandy (son of Thomas N5WDG) wiring a bar connector for a new EcoCar model at Mississippi State University using the Artisan Soldering Platform (photo supplied by Jonah Gandy).
Fig. 2: Illustrated artisan soldering platform.
Fig. 3: Metal and rubber foot before removing center spike with wire cutters.
Fig. 4: Magnetic bar, alligator clip, and sheet metal screw before assembly.
Fig. 5: Addonstar microscope for SMD soldering work.
Fig. 6: Author's fabricated SMD part holder, inspired by Michael GW7BBY in April 2020 issue of PW. See SMD part under round tip rod and washer for scale comparison.



enamel paint, applying a light coat on the top, letting it dry completely, and then one on the bottom. Once both sides are dry, I use a common heat gun on the low setting to 'bake' the enamel paint on a bit before applying a second coat. Drying and another bake session completes the job. This coating I've found makes the solder drips cool almost instantly without adhering to the steel platform, wiping off much like dust after a job is completed.

At this point, I mark the four corners on the bottom for attaching round metal feet. These feet are shown in **Fig. 3**. Others can be substituted if desired. I've been using those in the picture, cutting off the metal spike (nail) that is used to attach these feet to wooden chair legs. After removing the spike, I outline the remaining rubber side that will be glued to the steel platform base. Using a rotary tool, I remove the enamel paint where the rubber side of the metal foot will attach and apply epoxy mixed on the spot of the metal. Then clamps are applied to keep the foot and base together for the epoxy to cure overnight. Rough up both the rubber on the foot and the metal circle where the epoxy will be applied for a better seal.

The soldering jigs were made from a magnet bar along with alligator clips from eBay and a sheet metal screw. The magnet bar has a shallow steel U-shaped cover for the three Neodymium Rare Earth Magnet squares inside. See **Fig. 4**. This means that they stick like heck to the steel platform! I matched a carbon steel drill to the hole in the magnet before using my drill press to bore through the steel on each end magnet. A rotary tool with a cone shaped steel grinding bit was used to debur the hole on the steel case side and to enlarge it very slightly so that the fitting end of each alligator clip would slide snugly through the hole. I screwed in a Phillips-head metal screw from the magnet side into the alligator clip so that the screw would wedge the clip into the hole without allowing it to work its way out. Then, either grinding off the screw's head so that it would be flat on the steel platform surface or using a cutting circle to just cut the head and using needle nose pliers to do the final turns (recommended). After doing that using the rotary tool's steel grinding bit, I put a bit of Duct tape over the magnet side and trimmed it with a small razor knife so that the bottom of the steel case and magnets would not chip the paint on the steel platform. Rubber caps were pushed onto the alligator teeth to keep them from cutting into insulation for wires.

I used commercial products for the helping hands and the circuit board holder. I've homebrewed several aids like this before but the commercial price point is close enough to make it just worth going with the QuadHands products since they come in models with the magnets already installed. They come in various lengths but these are the 12in versions [**3**]. The same can be said for the Aven holder.

The knitting dowel was purchased at a local art store. The disc magnet was glued on its wooden base using a glue for both metal and wood joins. I put the doughnut toroid on the top and let it find its own place on the pole. Wind your wire through by sliding the toroid up just enough to let the wire pass and then pull it taught. I've not then had the wire move very much before I measured the toroid with an LC-meter or something to see how close it was to the specification. Then I gently remove it for applying 'Q dope' (if you use that) to hold the wire in place so as to preserve the measured inductance value. The wooden dowel does not affect these inductance measurements like a metal one would.

The medical clamps were bought as a

4

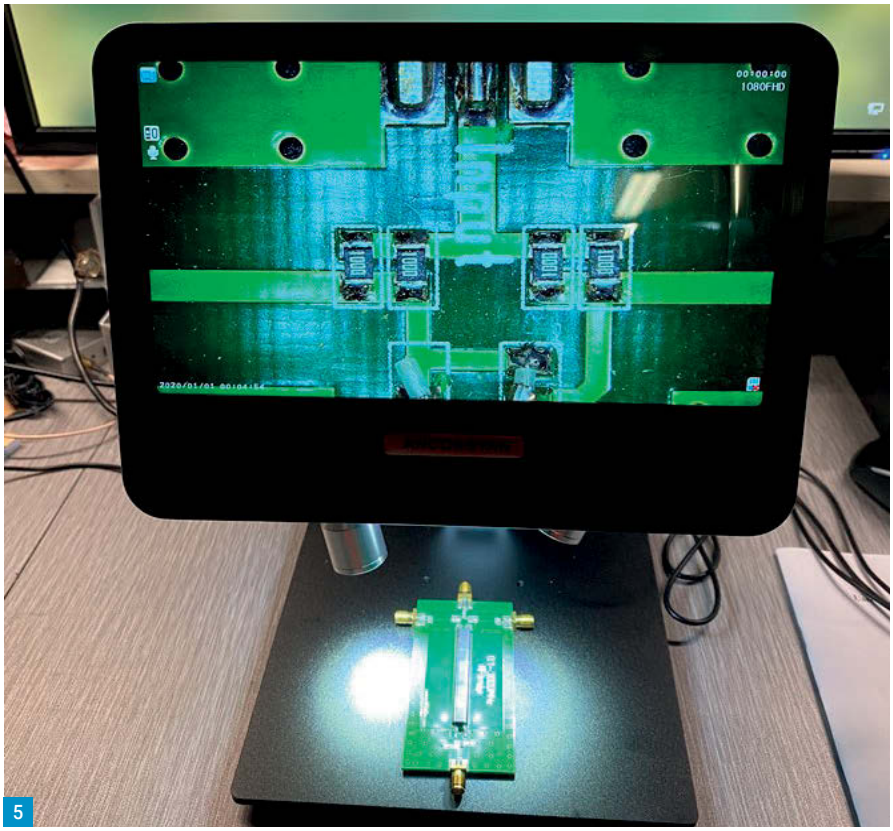
pack of 12 on eBay a few years ago. They are widely available. I've melted either insulation or plastic portions of switches so many times that I always attach one of these clamps near the solder joint so as to isolate the heat dispersal. This remedy works better than I imagined.

For the small staging vice, I got this neat little device (used) from Marlon P. Jones (website below) where I also bought various magnets used in the build. I suspect that they or others like them are available through many online vendors. They are very useful to hold various parts like copper-clad board and other pieces while soldering things to them.

www.mpja.com

I've added an inexpensive (about $150 USD) microscope that can be placed on this platform for SMD work. **Fig. 5** shows the model that I settled upon after watching numerous demonstrations and reviews on YouTube. While I have an Aven lighted magnifying glass mounted on my workbench, it simply does not do what is needed for surface mount components. This inexpensive microscope, while far from an expensive binocular model, does work well enough for my SMD work. It may well be all the reader ever needs. Or, not at all if SMD work is not anticipated.

Inspired by Michael GW7BBY's *PW* article, I used articulating mechanical arms purchased used on eBay to create a versatile SMD (or other) part holder. **Fig. 6** illustrates the metal rod with a rounded tip (again via a rotary tool) that can be placed on the SMD part then made firmly held in place by turning the large rotating know on the elbow of the mechanical arm. When the knob is loosened, this type of arm is loose like a marionette but when it is tightened, things just won't move. It is also mounted to an Earth magnet base for placement as needed for the specific project [**4**]. These articulating arms are often used in factories for quality control



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measurements or other situations where tools need to be precisely held in place.

Usage of the Soldering Platform

While I have other hand tools used in soldering, stored on a metal magnet bar underneath the shelves above my workbench, this set is what I've found to be useful. The magnets make this very versatile. I prefer them instead of mounting the helping hands via nuts-and-bolts or on a flimsy metal base. This versatility means that I actually use it every time I have some workbench soldering to do, from Power Pole installation, wire splicing, toroid winding, and through-hold and SMD circuit board work. If I ever decide that the platform needs to be larger (or smaller), all that is necessary is to prepare a new sheet metal base. As a wise person once said, every job is easier with the right tools. For me, having a bespoke soldering platform with many 'hands' fits that bill.

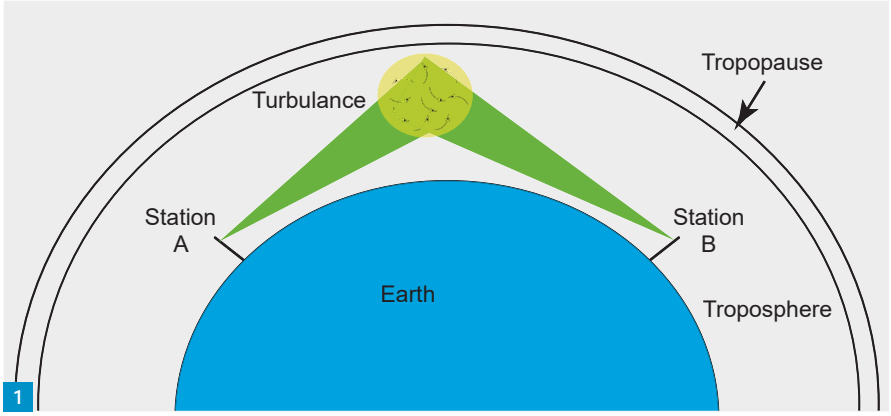
Notes

1. The EcoCar Challenge is an intercollegiate competition in the U.S. to build new generation automobiles using advanced technologies. See the website below for Mississippi State University's work in this area:
https://tinyurl.com/2p82ss52

6

2. Rotary tools have so many fittings that I use for building. The metal grinding bits come in many different sizes and grades, especially for use in jewellery making. They are highly useful for fabrication in workbench building projects.
3. In fact, I noticed when I bought these arms that Quadhands.com now actually sells a metal soldering platform with four of these helping hands for just over $50 USD.
4. The rod was made from a slingshot bolt that came bundled with one I purchased for antenna installation. I decided for safety reasons to use rubber-coated fishing weights with the slingshot.

Mike Richards G4WNC
practicalwireless@warnersgroup.co.uk



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Making the Most of Propagation

Mike Richards G4WNC describes how to use data modes to get the best results under marginal propagation.

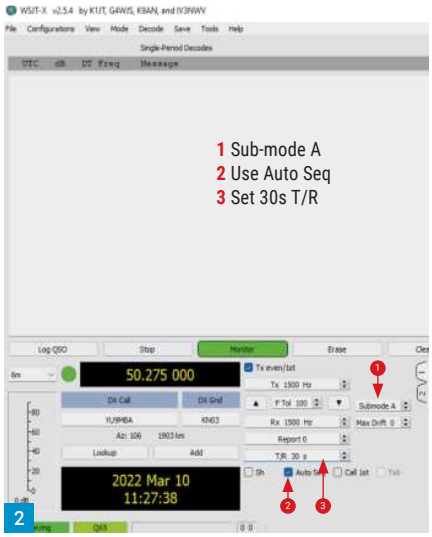
Spring is in the air, and it's time to get ready for some of the enhanced propagation conditions we will be experiencing. In this month's column, I'll be looking at how we can use specialist data modes to make the most of these conditions. Let's start by looking at a couple of propagation modes you may not have tried.

Tropospheric Scatter Propagation

Conventional radio links on the VHF and higher frequencies are usually considered effective only for line-of-sight operations. However, another propagation mode can provide reliable communications over much longer routes. That mode is tropospheric scatter or troposcatter and has often been used for long-distance UHF and microwave radio links. Let me just briefly explain how troposcatter propagation works. I've illustrated the process in **Fig. 1**. The troposphere is the first layer of the Earth's atmosphere and extends from ground level to 5-9 miles high, depending on where you are on the globe. The troposphere is the densest part of our atmosphere and is subject to all manner of turbulence or discontinuities due to weather systems, high altitude global winds, etc. This turbulence can be likened to the eddy currents you see in a river or stream. When a radio signal passes through a turbulent area, a small amount of that signal is scattered in all directions. It is this, scattered signal that is used for the long-distance radio link. Whereas some enhanced propagation effects are short-lived, Troposcatter is always available and is reliable enough for use in commercial radio links (for example, it has been heavily used to communicate from shore to North Sea oil platforms). Even when the weather is very calm, troposcatter will still be available from the boundary between the troposphere and the layer immediately above known as the tropopause. A search on the internet will reveal formulae for calculating path losses and link budgets. While Troposcatter is usable all year round, turbulence increases during the summer, so we see enhanced troposcatter propagation.

Operating Troposcatter

I'm sure you can appreciate that troposcatter signals can be weak because we're relying on a tiny amount of scattered signals, often from a relatively low-power transmitting station. Whereas a commercial link might use optimised locations, large antennas and high power, we are limited by our licence and



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location to a more modest arrangement. However, the aim is to focus as much energy as you can muster into a low radiation angle, i.e. we're aiming at the horizon! If you like to operate mobile or portable, an ideal location would be a hill with a clear take-off that slopes away at about 20° in the desired direction. Tropospheric scattering is workable on many VHF bands from 50MHz to 10GHz, but the popular bands for troposcatter operating are 50MHz, 144MHz and 432MHz with the higher bands likely to be more successful due to lower noise levels. You will generally have more success with Troposcatter in the summer months as the warm weather brings increased turbulence and thus stronger scattered signals. As our station is likely to be less than ideal, we can use modern data modes to help offset that disadvantage.

One of the best data modes for troposcatter operation is Q65 from the WSJT-X software suite. Q65 is a slow mode that uses a fixed minimal message structure similar to FT8. The mode has several sub-modes, and the popular choice for troposcatter is Q65-30A. This is configured as shown in **Fig. 2**. Begin by selecting Q65 as the mode, then set the T/R (Transmit/Receive) cycle to 30 seconds and the sub-mode to A. This slow speed combined with 65-tone frequency shift keying and error protection helps provide resilience for these communications links. While Q65 is optimised for tropospheric scatter, it only works if someone at the remote location is listening for Q65! There will doubtless be occasions where FT8 will be the most successful mode simply because of the volume of people using it.

An excellent place to spot Q65 activity is PSK Reporter (URL below), as you can filter the map results by band and mode. I would also encourage you to put out a few CQ calls, as you will probably be surprised by how many are listening! You can check the response via PSK Reporter.

https://pskreporter.info

It's important to remember that, while you may configure your station to take advantage of Troposcatter, the actual propagation

mode will likely be a combination of many that could be available at any given time.

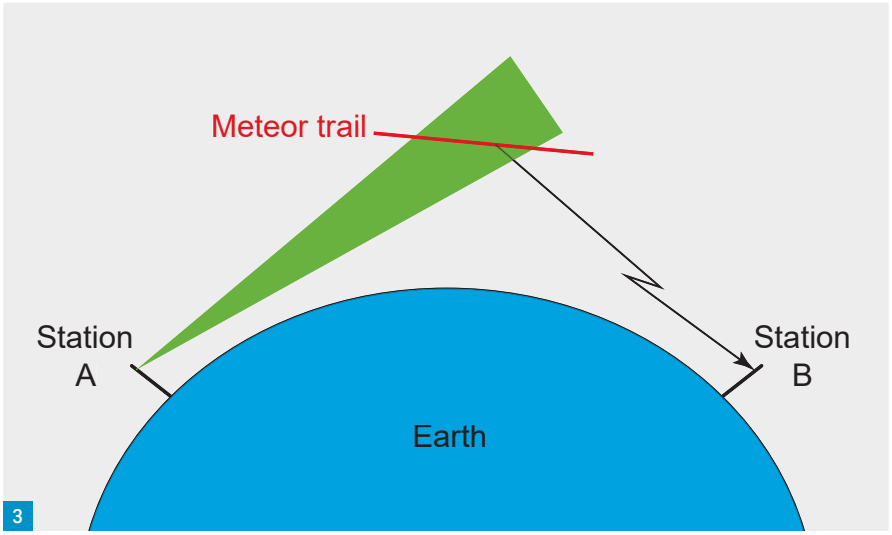
Meteor Scatter

While troposcatter is always available to a greater or lesser extent; meteor scatter is pretty much the opposite as it relies on reflections from the ionised trails of tiny meteors, **Fig. 3**. The meteors are often no bigger than a grain of sand, so the tails are often very short-lived at around 250ms and exist about 100km above the Earth's surface. As a result, we need an entirely different approach to the data mode signal. The pioneers of meteor scatter work employed high-speed Morse code (120 wpm), with modified tape recorders to slow down the received Morse for human decoding.

Thanks to the WSJT-X team, we have an ideal meteor scatter data mode in MSK144. MSK stands for minimum shift keying, and in this example, the frequency shift is restricted to half the baud rate using tones of 1kHz and 2kHz. The 144 part of the name relates to the 144-bit message frame. This combination enables a keying rate of 2000 baud, which results in an effective transmission rate of 200 characters/second. That translates to a message frame duration of just 72ms, which is fast! While each frame includes a sophisticated error correction code, the MSK144 protocol repeats each frame for the duration of the selected transmit period. The idea here is that a few of the frames will successfully hit meteor trails and be reflected to the target destination. The received frames are processed at the receiving station, and the repeated frames are compared to increase the probability of a successful decode. When listening for MSK144 transmissions, you will find them easy to spot as they sound like a very short burst of machine-gun fire.

Operating Meteor Scatter

The best and most popular band for meteor scatter work is 50MHz. This band often enables contacts with 10-30W and a small beam or vertical antenna during meteor showers. You'll need to use the MSK144 mode set to a transmit/receive period of 15s. The most popular calling frequency in Europe is 50.280MHz (±15kHz), but the Region 1 band plan recommends 50.320-50.380MHz, so it's worth keeping an eye on both while you're starting. MSK144 is easy to use, but there are a couple of settings to configure. The first is the sending cycle as that is determined by your target destination. If your transmission is directed towards the North or West, you should transmit in the 1st period, whilst all other directions use the



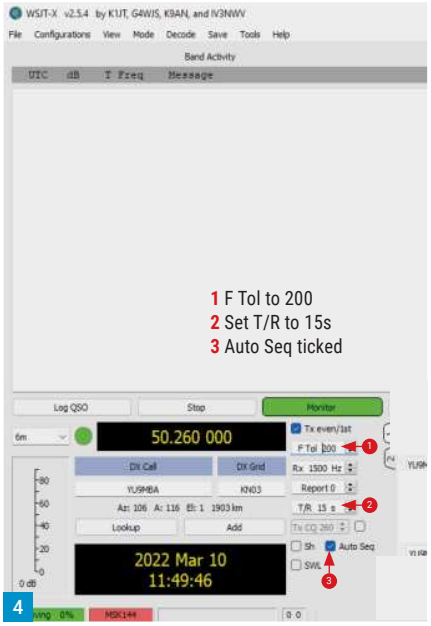
2nd period. I've shown the basic settings for WSJT-X in **Fig. 4**. PSK Reporter (URL below) is an excellent tool for spotting MSK144 activity, and it's good practice to enable uploading of your spots. To do this from WSJT-X, open the File menu and choose Settings – Reporting and under Network Services, tick the box labelled Enable PSK Reporter Spotting, **Fig. 5**. This will enable reporting for all WSJT-X modes.

https://pskreporter.info/pskmap.html

There are several significant meteor showers during the summer months, and these are the very best times to operate. However, there are always a smaller number of meteors burning up in the Earth's atmosphere, so you can often make contacts at other times with a bit of patience. Meteor trails are generally more prolific in the early morning, so that's a good time to operate. Depending on the density of meteors, QSOs can be a slow process ranging from a few minutes to up to an hour, so patience can be a virtue with this mode.

VHF/UHF Data Contests

The VHF/UHF spectrum allocated to radio amateurs is constantly under threat due to the increasing use of commercial wireless technologies. However, the best way to protect our bands is to use them. One way to do that is to participate in a few data modes contests. One of the most popular is the European VHF-UHF FT8 Activity contest (ft8activity.eu). This excellent, friendly competition runs between 1700UTC and 2100UTC on the 1st, 2nd and 3rd Wednesday of every month, which is quite civilised timing. As you can guess from the name, the only mode supported is FT8. The QSO exchange requirement is simply the callsign and four character grid location. As these form part of the standard FT8 struc-



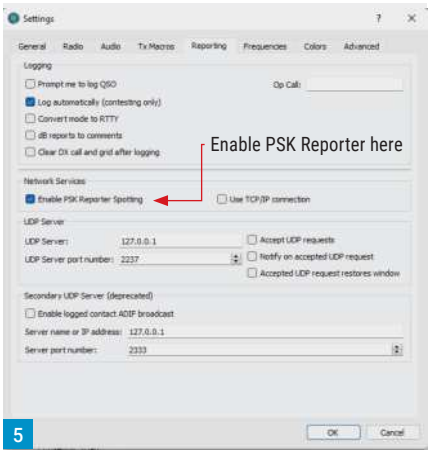


Fig. 1: Troposcatter illustration.
Fig. 2: Q65-30A configuration.
Fig. 3: Meteor scatter illustration.
Fig. 4: WSJT-X MSK144 configuration for meteor scatter. Fig. 5: Enabling PSK Reporter in WSJT-X.

tured messages, there's no requirement to add serial numbers or other customised information. Contest entry has also been made simple, and you can upload the standard wsjtx_log.adi file. This can be found in WSJT-X via the File menu, then Open log directory. Once you have located your log file, go to Upload LOG on the ft8activity website, where you enter your callsign, locator and category before uploading your log. The upload software automatically filters the log to extract valid contacts.

This contest runs every month, and I've shown the round dates and bands in **Table 2**. For more information, please refer to the ft8activity website (URL below). To further bolster activity, the RSGB VHFCC are running an FT8 AC competition on 144MHz and 432MHz using the same dates and similar format, but with a narrower timeslot of 1900-2100UTC. Full details can be found on:

www.rsgbcc.org
https://ft8activity.eu

Even if you don't want to enter the contests, the additional band activity will increase activity that often reveals enhanced propagation conditions. The QSOs for both contests use the standard message format so that you can treat the contacts the same as a regular FT8 exchange.

That's all for now, but I'll be providing some more operating guidance during the next couple of months as well as running some comparisons between WSJT-X, JTDX and MSHV to see how these programs perform with VHF/UHF data modes.

Band	Q65	MSK144	FT8
50MHz (Global)	50.275 - Q65-30A	50.280	50.313, 50.323 (DX)
50MHz (Region 1)	50.305 – Q65-30A	50.280	50.313, 50.323 (DX)
144MHz	144.12 or 144.14 – Q65-60C	144.150, 144.360	144.174

Table 1: 6m and 2m MSK144, FT8 and Q65 operating frequencies

Round	144MHz*	432MHz*	1296MHz
1	5 Jan	12 Jan	19 Jan
2	2 Feb	9 Feb	16 Feb
3	2 Mar	9 Mar	16 Mar
4	6 Apr	13 Apr	20 Apr
5	4 May	11 May	18 May
6	1 Jun	8 Jun	15 Jun
7	6 Jul	13 Jul	20 Jul
8	3 Aug	10 Aug	17 Aug
9	7 Sep	14 Sep	21 Sep
10	5 Oct	12 Oct	19 Oct
11	2 Nov	9 Nov	16 Nov
12	7 Dec	14 Dec	21 Dec

*RSGB VHFCC FT8 contest also on these dates between 1900 & 2100UTC

Table 2: FT8 Activity Rounds

1

Remote Manual HF ATU (Part II)

Ken Ginn G8NDL continues with the construction of his manual ATU.

Ken Ginn G8NDL
practicalwireless@warnersgroup.co.uk

The master unit is constructed with a commercially made case purchased from RS Components, **Figs. 1** and **2**. A supporting plate made from 1.5mm aluminium sheet was attached to the lower part of the case to support the main components in the master unit. The bias tee PCB is mounted on the rear panel, **Fig. 3**, as is the IEC mains socket with integrated switch and mains fuse. The bias tee PCB was used initially to mark out the position of the holes on the back panel for the RF sockets and mounting screws.

The bias tee PCB is mounted away from the back panel with brass threaded spacers as is the RF switch board in the remote unit.

Decoupling capacitors (C1, 2, 3 and 4) are mounted directly on the front panel potentiometer terminals of R1, 2 and 3.

The Amicus board is mounted with threaded spacers to the aluminium sheet and a daughter board (shield) made from 0.1in copper clad strip board. This is plugged into the Amicus. The additional Tune Key circuit, **Figs. 4** and **5**, if used, can be sandwiched between the Amicus board and strip board circuit. The bias tee is manufactured on a double-sided PCB for ease of construction with the two PCBs for the remote unit. The master unit's strip board construction is shown. Tracks are horizontal and are cut as shown in Fig. 4 of Part 1. Two connector pins are removed from their plastic mouldings as shown in the photo, **Fig. 6**.

Connection to the power supply, bias tee and the front panel components is made by three multi-way connectors on the strip circuit board, **Fig. 7**.

The switched mode power supply used in the prototype was shown to be a little noisy with unaccepatble QRM on the 80m band. To combat this a choke was placed between the SMPSU and the rest of the circuit. Both positive and negative 24V supply wires were wrapped around a Multicomp 33RI 25X12X15 core, available from Farnell. Five turns was sufficient. This eliminated the noise problem with the noise floor measured at below –130dBm on all HF bands. This should only be necessary should a SMPSU cause this sort of problem, a linear power supply should be quieter.

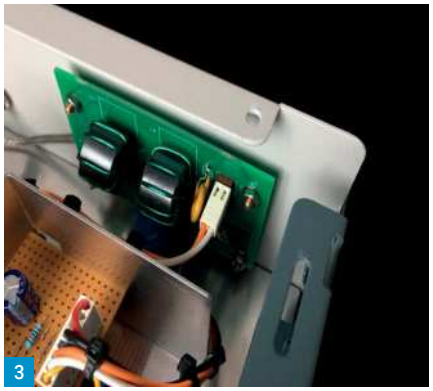
The photos, **Figs. 8** and **9**, show the component placement and wiring within the master unit.

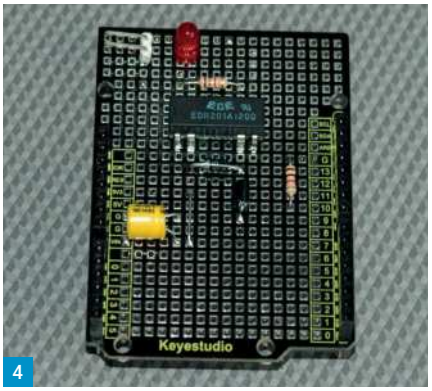
Construction – Remote Unit

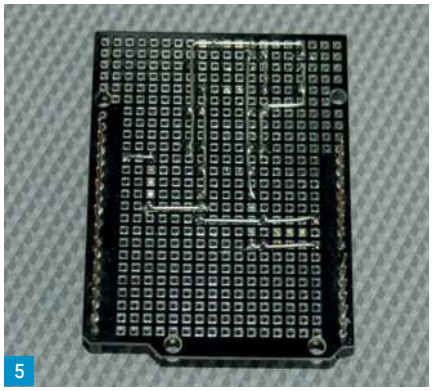
The remote unit like the master unit relies on an Amicus board to control the series of relays to match the impedance of the antenna to the feeder. The RF board and the daughter board PCB (shield) for the remote unit are manufactured on a double-sided PCB. The main RF PCB contains the relays, their drivers, the bias tee, power supply and supplementary components.

The bare relay PCB is used to mark out the position of the holes to be drilled in the diecast box that houses the circuitry. In addition, an aluminium sheet is used to mount the Amicus board. The main RF PCB with the relays is spaced off the lid of the diecast box with threaded spacers. Metal threaded spacers are again used to mount a sheet of aluminium above the RF board. This additional sheet of aluminium acts as a shield for the Amicus board, and reduces interference that may emanate from the board causing radio problems, and vice versa; interference to the Amicus board.

Fig. 10 shows the placement of components on the main relay board while **Fig. 11** shows component placement on the Amicus shield. The photos, **Figs. 12** through **17**, show how everything fits together in practice.







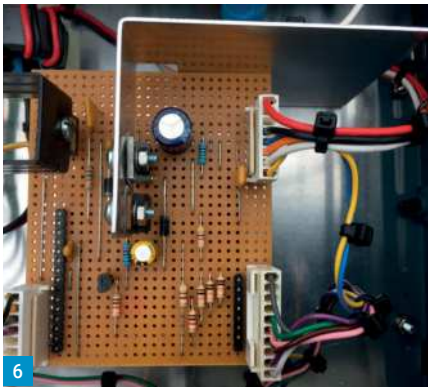
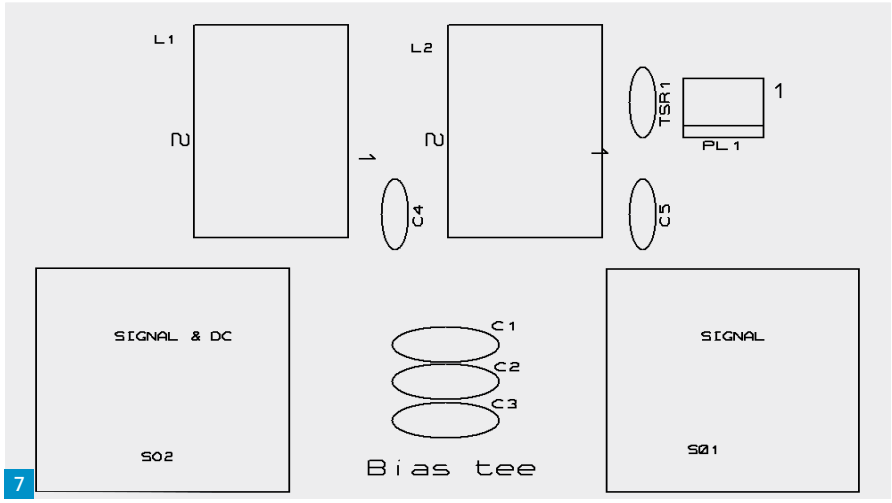
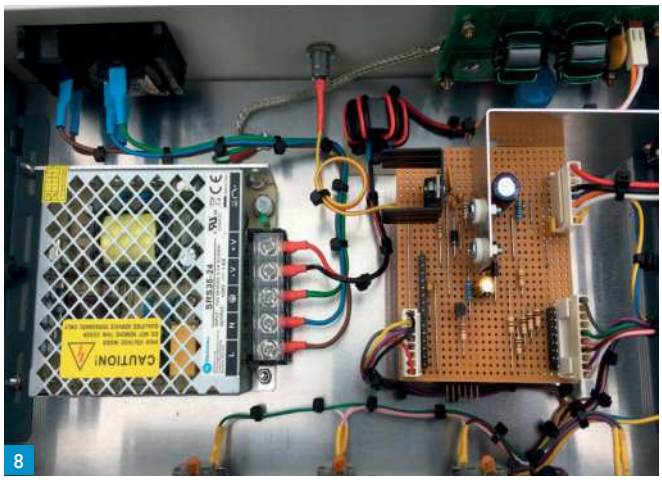


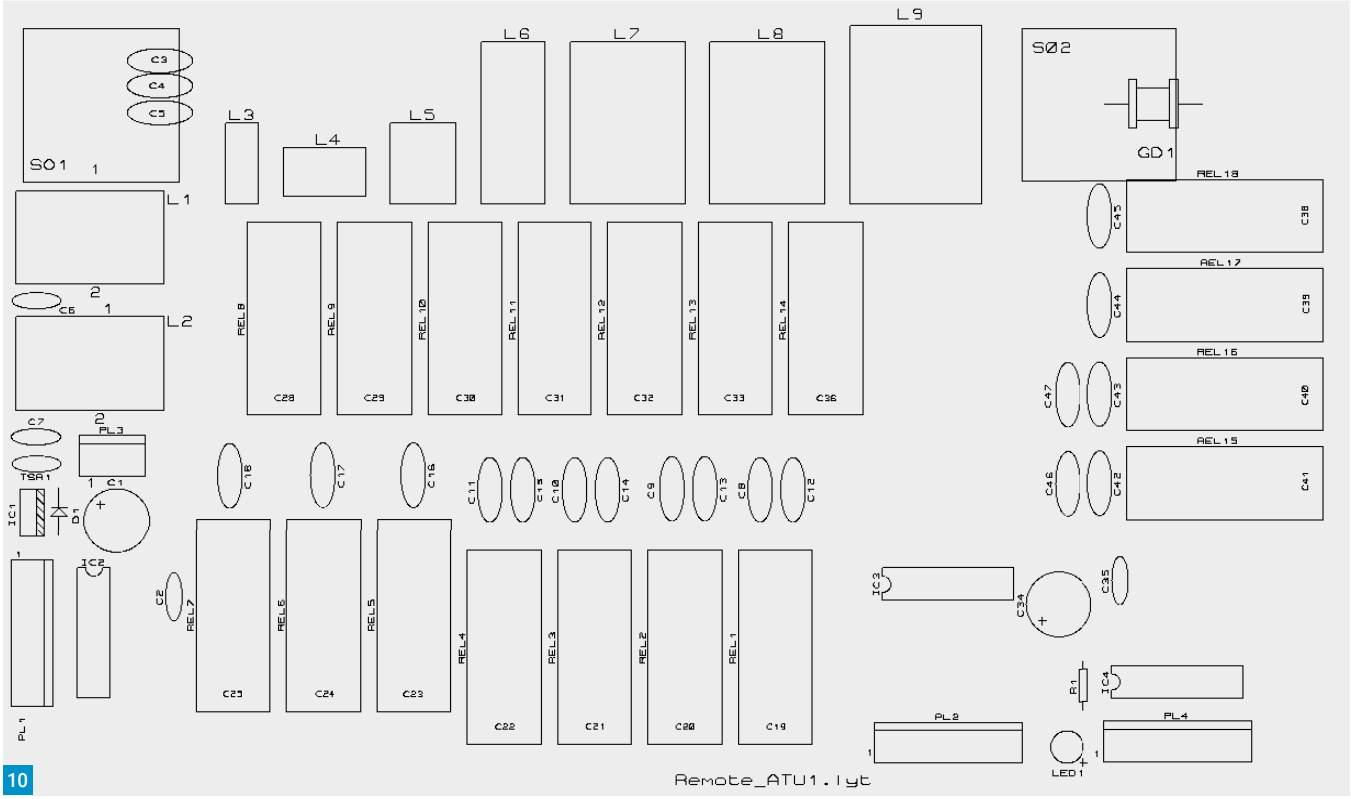
Fig. 1: Front view of master unit
Fig. 2: Rear view of master unit
Fig. 3: Bias tee. Fig. 4: Icom Tune Key circuit board top view. Fig. 5: Bottom view of tune key board. Fig. 6: Strip board construction of master unit. Fig. 7: Master unit bias tee component layout. Fig. 8: Internal view of master unit components. Fig. 9: View of front panel components, wiring. Fig. 10: Remote unit relay board component placements. Fig. 11: Amicus shield component placements. Fig. 12: Position of C40 on remote board. Fig. 13: Shield with opto coupler etc Fig. 14: Wiring of multiway connectors to shield Fig. 15: View of remote board showing inductors Fig. 16: Completed remote unit. Fig. 17: Completed and boxed remote unit.

Marking out the position of holes to be drilled on the diecast box lid is best accomplished before any components are soldered in position. The majority of components are mounted on the top of the double-side board, however there are a number of 100nF 0805 SMD capacitors soldered on the bottom track under each relay. These are best soldered in position first as this makes the subsequent building considerably easier. C48 is soldered across the input and ground connection of IC1 as shown in the photo, Fig. 6, of Part 1.

The 12V regulator (IC1) is mounted under the PCB, and secured to the case of the diecast box. This ensures efficient cooling of the regulator under high current loading.







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Winding of the Toroids

Details of the toroids used in the master unit of the ATU appear in **Table 1**. Details for the toroids L1 to L9 for the remote unit are shown in **Table 2**.

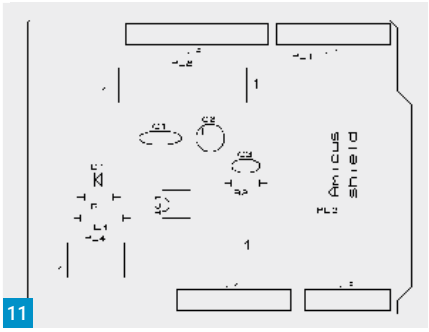
Remote Unit Wiring

The are a number of multi way cables needed to link the various boards. The inter board wiring is shown in Fig. 7 of Part 1.

Testing

To test the units connect the master only up to a current limited power supply and raise the voltage slowly to 24V. At no time should the current drawn be above 80mA in the system's quiescent state. Press each of the tuning buttons and notice the TUNE LED illuminates and when two or more buttons are selected the LED now flashes. Releasing all the push switches the LED will extinguish. If an oscilloscope is at hand, the output showing a stable 24V supply from the bias tee is interrupted when one of the tune select switches is depressed. The data stream will be evident.

Connect the remote unit to the master via a short coaxial cable. The connection of the radio or the antenna is not required at this point. Ensure that all three potentiometers are set to their anti-clockwise position. In this condition when power is applied no relay should be powered in the remote unit, minimum current will be drawn, less than



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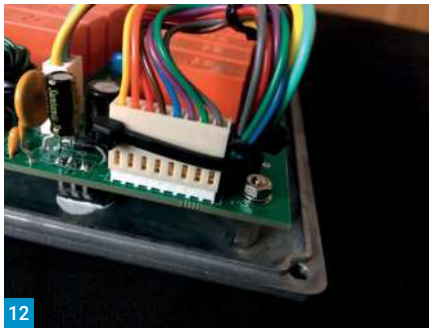
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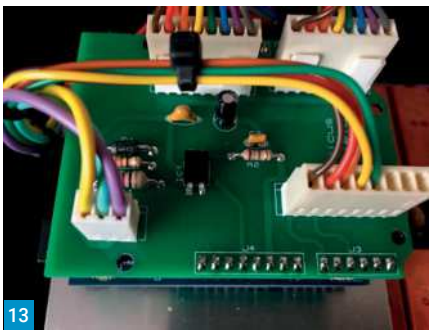
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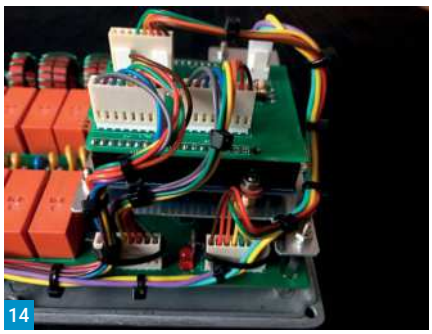
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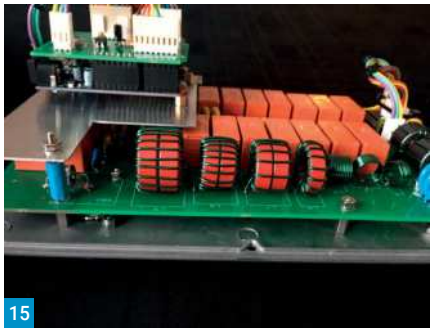
100mA. Apply power, slowly raising the voltage up to but not exceeding 24V taking note of the current drawn. The power LED on the master unit and the LED on the remote RF board should both illuminate.

Press S1 and rotate the control Ca clockwise. You will notice at this point the relays will begin to chatter as you rotate the control. As you rotate the potentiometer clockwise the value of capacitance will increase in roughly 50pF steps. Likewise with the L control the inductance will increase in 0.25µH steps until it reaches the maximum inductance. Also with Cb, but this control has only 15 steps and has coarse control. When all three controls have been selected and individually rotated fully clockwise take a note of the current drawn, this should not be higher than 800mA. Connect the mains supply to the ATU and it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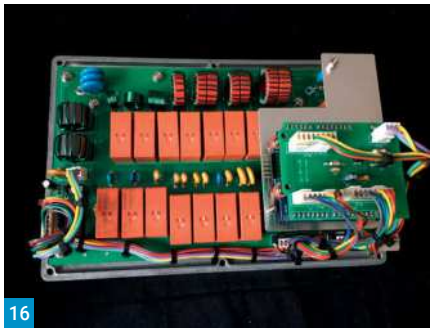
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17

Component	Turns	Diameter	Core	Wire	Comments
L1	8	NA	Wurth Electronik 74270181	0.8mm	
L2	8	NA		0.8mm	

Table 1: Master bias tee coil winding details. 0.8mm diameter enamelled copper wire is used on all coils.

Component	Turns	Diameter (internal)	Core	Wire	Comments
L1	8	NA	Wurth Electronik 74270181	0.8mm	
L2	8	NA		0.8mm	
L3	5	10mm	Air	0.8mm	Close wound
L4	7	10mm		0.8mm	
L5	10	10mm		0.8mm	
L6	13	NA	T68-2	0.8mm	Single T68-2 core
L7	17	NA	T68-2	0.8mm	Two T68-2 cores
L8	17	NA	T80-2	0.8mm	Two T80-2 cores
L9	20	NA	T80-2	0.8mm	

Table 2: RF board coil winding details. 0.8mm diameter enamelled copper wire is used on all coils.

should be good to go. Ensure there is no DC voltage at the antenna socket of the remote unit.

Using only a VNA or alternatively a VSWR meter in series with the radio, connect a 50Ω dummy load to the antenna socket of the remote unit. Power the radio and ATU, and sweep across the frequency bands of 1.0 to 55MHz. The VSWR should not rise above 1.15:1 over the whole range of frequencies. This is assuming the dummy load is less than this value over this whole range.

Check the quiescent DC supply voltage at the remote unit, adjust the power supply voltage until this reads 24V. There could be a voltage drop across the length of the feeder at the remote end that could affect the operation of the remote unit.

Use

Connect the remote unit up to the antenna, the master unit connected to the radio in the shack. Switch on and set the transceiver to tune with an output power of no more than 5W. With a VSWR meter in line, or the meter on the radio, keep an eye on the reflected power (or VSWR) adjust Ca, L and Cb controls until the VSWR on that specific frequency is at a minimum. This should achieve a VSWR of less than 2:1. Then it's available to wind up the power.

Bear in mind from initial power-up there are no instructions sent to the remote unit and no relays will be energised. Hence the connection to the antenna will pass straight through with little or no effect from the ATU. Each time the ATU is switched on the tuning process has to be activated before use.

In my particular situation I currently have a vertical helical antenna covering 80 to 6m as my primary HF antenna, and the old auto-ATU does seem to work harder than this remote ATU. As mentioned, the old auto-ATU at the bottom of the garden does have problems on occasions when I want to tune the antenna onto the higher HF bands and 6m. This manual ATU takes a little longer to tune but I have the confidence the antenna will be matched under my control.

For Icom Rigs

A good number of modern Icom radios have a facility where a pair of contacts shorted will put the radio into tune mode. A 4-pin connector is available on the rear of the radio to facilitate the tune function. An additional board (shield, the Tune Key board) has been fabricated and sits between the Amicus and the strip board shield in the master unit. This board houses a reed relay and additional components, the circuit diagram of which is shown in Fig. 2 of Part 1. The action of this relay is to short the contacts together when the tune function is initiated. However, during a faulty tune condition where the tune LED will flash, these contacts will remain open circuit.

Conclusions

How well does this ATU work against the remote auto-ATU? Using the main vertical antenna, described above, I have run comparative tests between the auto-ATUs I have. These are an SGC239 and an N7DCC design and this manual design. The manual design takes longer to achieve a good match, as would be expected. What I have found is that I have greater control over the VSWR and I have confidence that I have achieved a good match before running up the power. Tests on all bands from 80m to 6m have shown the worst VSWR across the bands was 1.5:1 on the bottom end of 10m with this design.

What Would I Have Changed?

It would have been advantageous to have an LCD display on the master unit, displaying the inductor and capacitor values.

Having used the tuner with push-buttons I would advocate the use of biased toggle switches to enable the tuning. The weight of the master unit is not sufficient to hold still the case when the push buttons are depressed.

With the use of a SMPSU to supply the 24V, it would be advantageous to incorporate a mains filter in line with the unit. I found the SMPSU seems somewhat transparent to mains borne transients and spurious signals getting through to the 24V supply. Mainly problems with the switching of the main shack radios SMPSU. A mains EMI filter, which exhibits 20dB of attenuation as low as 30kHz, would be an advantage. With an alternative to a SMPSU, the transformer in a linear power supply would act as a low pass filter to some extent and reduce any mains borne interfering signals.

Good DX.

Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

Another Good Month

Steve Telenius-Lowe PJ4DX reports another good month of DX activity, along with some important items of news.

Propagation continues to improve, albeit slowly and there have been some poor days. The sun was fairly quiet most of February with the Solar Flux Index (SFI) hovering around the 100 mark. The Sunspot Number (SN) dropped to only 23 by 25 February before picking up again. By 11 March it was 90, still down on six months ago but up on the figure for March 2021 (see **Table 1**).

Ukraine Amateur Radio Ban

Due to the invasion by Russia, the whole of Ukraine with the exception of the Donetsk and Luhansk regions was put under a state of emergency on 24 February. One of the provisions was a ban on amateur radio transmissions. The state of emergency was due to last for 30 days initially. A few Ukrainian stations remained on the air after 24 February and it seems they are located in the Donetsk and Luhansk regions.

VOA 80th Anniversary

Many radio amateurs, myself included, started their interest in radio by tuning in to shortwave international broadcast stations. Sadly, many of the stations we used to listen to – Radio Nederland, Radio Sweden, the Swiss Broadcasting Corporation and others – closed down years ago. One that is still going strong, though, is the Voice of America, which recently celebrated its 80th birthday. The anniversary was celebrated by three amateur special event stations on the air over the weekend of 19/20 February: W3V at VOA HQ in Washington DC, W8O from the VOA museum at the former Bethany relay station in Ohio and W4A at Greenville, North Carolina, a major VOA transmitter site.

Overall, they made over 3000 QSOs on SSB, CW and FT8 and those who contacted all three stations could download a certificate, **Fig. 1**. Read more about the anniversary at:
https://wc8voa.org

Readers' News

Owen Williams G0PHY also made a contact with W8O during the VOA special event, and reported that he had received an email QSL from the station. Owen said *"there was plenty of activity this month chasing the ON75 stations, all on 7MHz; I managed to work 43 of them, enough for the Diamond award. The band seems dead without the ON75 stations... There was plenty of activity on HF as well. I managed to bag TU5PCT on 14MHz before they went QRT. The French contest in February resulted in contacts with stations in FY and FG on both 21 and 14MHz and contacts in FM and FR on 14MHz. Three IOTA activations were worked this month: N3ME on NA-142. KP3RE on NA-242 and PZ5G on SA-092. The ARRL DX contest provided an opportunity to have a go at QRP operating. I started out at 200W but reduced the power to 20W on 7MHz and then down to 10W on both 14 and 21MHz. The best DX on 7MHz was K8AZ in north-eastern Ohio. The best DX on 14MHz at 10W was probably CJ3A in Ontario and the best DX on 21MHz at 10W was W9RE in Indiana and NA8V in Michigan. Although there were plenty of Ws and VEs in the contest I heard nothing from the West Coast or South Western USA... The best DX of the month was a contact with VK7ROY, my first contact with Tasmania. I happened to be randomly tuning 14MHz when I heard him calling for UK stations and I got him first shout."* This is the best way to work DX: tune around to find a DX station calling CQ and with luck you will be the only one to call him. If you only use the DX Cluster to find the DX the chances are you will have to compete against dozens of others and you may never get through as more and more stations join the pile-up.

1

Victor Brand G3JNB said *"On 17m, Turkey's national society celebration station running the call TC60TRAC was logged before my entire attention was diverted by the arrival of a very smart Eddystone EC10 MkII* (**Fig. 2**), *fulfilling a long-standing item on my 'bucket list'. From a local club member's SK sale, bidding for it was sheer nostalgia on my part but it is a most attractive and splendid working addition to my shack. I am greatly indebted to fellow Shefford club member* ***Graham Laming G4JBD*** *for his professional expertise in tracing some faults that are only to be expected in a 1970s receiver and restoring it to life. Back to business and, in need of a '4.00am cuppa', I had popped into the shack for a quick listen and was rewarded with a QSO on 40m with V31XX in Belize before an LZ blew my head off and Bill had to go to split to sort out his pile-up. On 15m* ***Chen BD8CS*** *China struggled with my suffix but got it eventually, after which I just had to work* ***Vlad SU9VB*** *Egypt with his 'VB' suffix. Later in the month, notable contacts on 17m included* ***Nev PJ2/NF9V*** *on Curacao, old friend* ***Robert 3B9FR*** *on Rodrigues, another contact with V31XX and, finally,* ***Jose KP4JRS*** *in Puerto Rico."*

Tim Kirby GW4VXE was happy to see 28MHz open so well: *"I've stuck to CW [and] just today, I was surprised to work YD2UWF around 1400UTC and within minutes, I'd worked XQ6CF – amazing! Other nice QSOs today were ZS1OIN and FM/F6BWJ. Other highlights from the log have been FY5KE, CE2ML, TZ4AM, 9Z4Y, OD5SK and NP3YL. It's been nice to see the bands open later in the evenings. Last night during the CWOps CWT session, I found 15m open to the West Coast around 1930UTC, and was amazed to make a couple of QSOs."*

Jim Bovill PA3FDR commented that *"Some time ago someone, I think from the WSJT-X group, bemoaned the lack of use of the FT4 mode apart from during contests. So, a few weeks ago when there was little of interest on FT8 I gave FT4 a try for the first time. Initially there were only a few European stations but in February the mode opened up to DX stations, and this month the majority of my report comes from that mode. I can thoroughly recommend your readers to give FT4 a try."* I would second Jim's recommendation and, particularly if you find FT8 rather slow, give FT4 a go: it's twice as fast! It is well worth giving the

Fig. 1: Certificate for contacting all three Voice of America special event stations over the weekend celebrating the VOA's 80th anniversary. Fig. 2: Smart veteran! This 1970s Eddystone EC10 MkII is alive and well, back on duty with G3JNB. Fig. 3: If you are active on FT8 or FT4 it's well worth giving the RSGB FT4 contest series a go.

RSGB FT4 contest series a try too (**Fig. 3**): the next session will be on Monday 30 May at 1900 – 2030UTC. See the link below for further details.

tinyurl.com/22dxjdkb

Reg Williams G0OOF reckoned that *"although conditions are improving, I have not worked many DX stations but am making more excursions now towards SSB operating* [from FT8 – **Ed**]. *Best DX for this mode was FY5KE on 28MHz. Not rare DX but it was good to see the band in good condition. My concentration has been working towards the WRTC championships award by working Italian stations with special callsigns. The award is available on a monthly basis from January to July. In effect you can gain an award for each month by working the same stations all over again. My log is full of Italian stations worked on FT8 and SSB. A great advantage is going to the WRTC internet site and finding what stations are on the different bands and modes in real time. I took the opportunity of lowering the Hustler 6-band vertical antenna to the ground before Storms Dudley, Eunice and Franklin came along. These events come along on a more regular basis these days."*

Etienne Vrebos OS8D *"had some nice activity this month, February, as the weather was that bad I couldn't get any ride-outs with the motorcycle... this morning minus 4°C. Nearly 450 QSOs with good conditions and propagation and I had no damage after a week of very severe wind storms here."*

However, storm Eunice so damaged the antennas at the SDR site used by beaconologist **Neil Clarke G0CAS**, that his report is only up to 17 February. *"The Israeli beacon 4X6TU on 28200 was heard every day from mid-morning onwards along with YM7TEN 28224 in Turkey, also heard every day except the 5th and 14th. Beacons in Australia, VK6RBP 28200, VK2RSY 28262, VK4RST 28266 and VK8VF 28268 were heard with the last of these being the most frequent... South and North American beacons were logged most days. The 5th was by far the best day with a total of 17 USA beacons heard, five of which made it into the log for the first time: W0WF 28204.0, N3SDO 28219.2, W8YT 28235.6, N1KON 28271.7 and K5TLL 28298.0. Mid-evening on the 2nd 4U1UN 28200 was heard, which was the only signal on the band at that time."* Neil points out that February is never a good month for Sporadic E but beacons in Italy and Spain were heard on the 3rd and those in Germany, Austria and Italy on the 13th.

2

Tony Usher G4HZW says that *"Cycle 25 is finding its feet and, with the SFI hovering around or above the 100 mark, 28MHz has been on good form... I managed some 28MHz FT8 new ones with AP2TN, EX7DY and two Sri Lankan stations in two minutes!"* Tony has been a great supporter of this column and of *PW* for many years but added: *"Looking back through my emails I see that my first list was sent to **Carl** in March 2014. As I've always done I've stuck, mainly to 28MHz, through the bottom of the sunspot cycle. In the past that's involved listening for weak beacons down in the noise and fleeting double-hop Sporadic E openings to North America. Since 2017 though, FT8 has come along and transformed the situation on 10m with JAs and KL7 possible during the summer months – unheard of in the past! Anyway, I've decided to spend less time on the radio and concentrate a lot more on my ornithological activities, so this will probably be my last contribution for the time being, although I may pop in from time to time."* Ornithology's gain is amateur radio's loss: any future reports will certainly be welcomed, Tony.

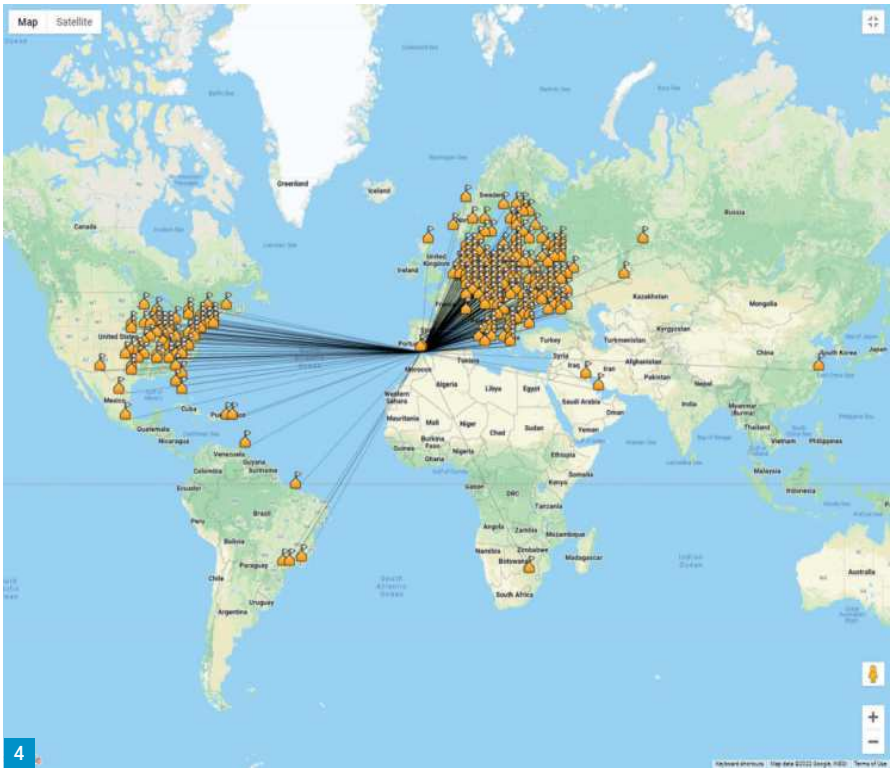
It was a pleasure for me to make not one, but two contacts with regular contributor **Kevin Hewitt ZB2GI** this month. The first was on 24MHz FT8 followed two days later by one on 28MHz SSB. Kevin noted *"The KQ2H 10m FM repeater in New York was S9+ and fully quieting on to the Rock, after we spoke to you."* No doubt Kevin surprised AA2EC, KD2ROP, KD2VQR and KD2VQX when they were called from Gibraltar through the Catskill Mountains repeater! Kevin was also very active on 28MHz FT8, as evidenced by **Fig. 4**.

Carl Gorse 2E0HPI has been

3

	Mar '22	Sep '21	Mar '21	Difference
SFI:	127	95	75	(+32)
SN:	90	124	11	(–24)

Table 1: Solar Flux Index and Sunspot Numbers on 11th of the month: this month, six months ago and one year ago. The final column shows the difference between now and the same time last year.



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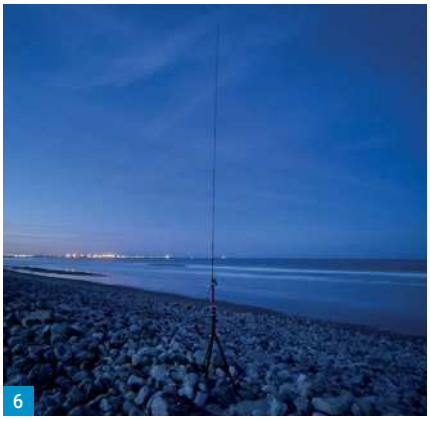
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participating in the North American Parks On The Air (POTA) programme, **Fig. 5**. He's been operating portable using a 'Slidewinder DX' vertical antenna often in the evening (**Fig. 6**), best DX being NL7V in Alaska. Carl commented, *"This afternoon's trip to G-0189 Teesmouth NNR for the Parks on the Air was to see what 17m was like. [It was] on fire this evening and it was fantastic"*, allowing Carl to put well over 100 North American stations in his log. Carl sent a follow-up report before this month's deadline, saying: *"I've sent this report now as my head will explode if I get any more DX!... The bands are certainly getting better and I have been using the Yaesu FT-891 and my latest radio, FTdx10, has been out once but I'm reluctant to take it out portable."*

Around the Bands

Owen G0PHY: 7MHz SSB: K4ZW. **14MHz SSB:** FG4KE, FM8QR, FR4KR, FY5KE, K4C, TO3Z. **18MHz SSB:** EA9URM. **21MHz SSB:** FG4KE, FY5KE, NW3Y, TO3Z, VE3EG, VY2TT.

Jim PA3FDR: 7MHz FT4: TA2EE, N1ZTB. **7MHz FT8:** 9Y4DG, EA9ACE, CO8LY, HI3A. **14MHz FT4:** 4Z4DX, 7Z3FD, A65IN, CT3IQ, EA8CVR, JF1RYU, JH7MEV, K1GG, K3VYP, K4CVL, KL7TC, KZ9DX, PY2FZ, TA7EE, VA7AQ, W6NWS. **14MHz FT8:** E25ETT, K1NKT, KE0A, KP2B, PY2VA, VE3DV. **21MHz FT4:** 4X1RU, 7X3WPL, AO8WRD, DS3CHK, JA4FKX, JA9APS, JH7RTQ, JR3VMJ, K0PLQ, K2AK, K4CVL, K5WE, KA0UNB, N3CZ, N7IVV, NN1N, OD5KU, PU1JSV, PY2FZ, R0TA, VE2CED, VE3MZD, W8KF. **21MHz FT8:** AP2TN, 5T5PA, EA9ACD, JA4FKX, JA5DIM, JE7JDL, JI3MJK, JT1BV, K1NKT, KD4YDD, KP2B, N7MDW, PY1SX, PY2ACA, TA7K, TC60TRAC, VE3DV, ZS2EZ. **28MHz FT8:** A41ZZ.

Etienne OS8D: 14MHz SSB: 4L7ZS, 8C9MGP, KP3RE, UN8LWZ, VK6ZO, VK90ABC, YB0AR. **18MHz SSB:** NP2AR. **21MHz SSB:** 6W/PE1PRB, BY1CRA, EP5CZD, FG4KH, FR5CB, HC5DX, JE1RXJ, JR4ABF, KP4PUA, PJ2/K8PGJ, PZ5G (SA-092, VP5/NN3W, XE1CQ, YB9ELS, YC3DOC, ZS6CCY. **24MHz SSB:** CX7SS, HC5DX, PZ5GE, S79/4X6TT, S79VU, TR8CA, ZC4GR. **28MHz SSB:** 4L1WW, CE7VP, LU1JHF.

Tony G4HZW: 28MHz FT8: 4L4NW, 4S6NCH, 4S7VG, 5T5PA, 7Z3FD, 9G5AR, A41ZZ, A65DF, AP2TN, BV7KL, CE8EIO, CX5ABM, DU1IVT, EX7DY, HC5DX, HI3MRV, HK3JAT, HP1AVS, HS0ZIL, J643DS, KP4GBF, UR7LK, UR8MB, US0QV, UT5GD/MM, UT7IP, UT9UM, UX3UN, UX7QV, VK2AHE, VR2UBC, WP3KW, XE2JS, XQ6MO, ZS5DCF, ZS6LKF/4.

Kevin ZB2GI: 5MHz FT8: 4X4DK. **7MHz FT8:** 4X4ZP, 5B4ALJ, 9K2OD, OD5ZF, VE2CH, W1XD, WA6YOU, WM4W. **7MHz FT4:** YL2CA. **14MHz SSB:** II3WRTC. **14MHz FT4:** YB5QZ. **18MHz SSB:** KA2ABA, ON75LLV, WD8CCC, ZS1OPB.

Fig 4: ZB2GI activity on 26 February on 28MHz FT8, using a monoband whip attached to a broom handle. Fig. 5: Activity in the Parks On The Air program by Carl 2E0HPI. Fig. 6: The 2E0HPI/P Slidewinder DX vertical antenna on the North East Coast.

21MHz SSB: AA4CS, W2CR. **21MHz FT8:** AK4R, BG0BPZ, JG3TRB, K0AY, K3GWK, KA1ERL, KA2MGE, KB9MYP, KD8GD, LU3ETM, PY5OD, VA3DX. **24MHz FT8:** AA1K, AB2E, AC4TO, K0EU, K0RS, K6ND, K8OD, KB3MXK, KD2AGW, LU4FW, N7MDW, PJ4DX, PY4LF, VA2HMD, VA3SF, VE4EA. **28MHz SSB:** K1RX, PJ4DX, N0RU, VE3EH. **28MHz FT8:** 9K2GS, 9Y4DG, A92AA, AA2T, AC5RP, AD0RW, AK1P, BA4TB, K4KL, K9RE, KB3LAN, KP4RAF, PJ2/HB3YFC, PY1IO, VA3MPG, VE1TE, VE2BR, XE1AE, XE2AFL, ZS6HON.

Carl 2E0HPI/P: 14MHz SSB: 6Y5HM, CS7AUS/P (CTFF-0733), N1RBQ (K-1707), N3WD (K-0705), NJ2DX (K-1629), NL7V, TA0S, VE2FTX (VE-0048), VE3NEP, VE5XU, VE7MH, W2SUZ, VE8GER. **18MHz SSB:** KC4JNW, KP4MK, VK2BY. **21MHz SSB:** AB8LL, KC9YDV, KP4M, KX4MI, VE3GIO, VU3NPI, WA2EAP.

Signing Off

Thanks to all contributors. Please send all input for this column to teleniuslowe@gmail.com by 11th of each month. For the July issue the deadline is 11 May. 73, Steve PJ4DX.

New Products & Special Offers

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1

The Face behind the Call

Roger Dowling G3NKH meets a Jodrell Bank astronomer whose DX was the Moon.

How do you define 'DX'? If you are a novice, operating QRP under poor conditions, a successful contact at the other end of the country might well qualify. If you're a seasoned amateur with a 400W linear, you'd be disappointed not to reach the antipodes on a good day. But, as we shall see, it's entirely possible to have a contact over 230,000 miles away – if you are **Ian Morison G0DMU** and can draw upon the resources of the mighty Jodrell Bank radio telescope.

Ian, who was brought up near Bognor Regis, had a traditional start in amateur radio, building crystal sets and in due course his first one-valve receiver. As a schoolboy, he joined the Combined Cadet Force and encountered for the first time the famous Wireless Set No. 18, the HF portable manpack radio transceiver much used by the British Army during World War II, and its VHF equivalent, No. 88.

He went on to study Physics, Maths and Astronomy at Oxford University, the latter having been the result of a childhood interest when he had made his own telescopes from lenses supplied by his friendly local optician.

By chance, while he was studying for his Finals he spotted an advertisement to study Radio Astronomy at Manchester University's Jodrell Bank Observatory in Cheshire. What better way could there be of combining his interests in both radio and astronomy? His application was successful and it led to a successful PhD project to build a computer system to control an 'aperture synthesis' radar to study the Moon's surface. This involved combining successive signals from a single telescope as the earth rotated to give results equivalent to a linear antenna some 40km long. It was a technique that later proved to be of great value to the Apollo Mission in locating a boulder-free landing site.

Ian became Assistant Lecturer in 1971, subsequently becoming a Full Lecturer followed in due course by professorial status. He retired ten years ago but still contributes to the work of the observatory as an honorary Emeritus Professor.

Radio and Astronomy Interests

Ian continued his amateur radio interests by joining the Macclesfield Radio Club and became G1GZC in 1984 followed by his full G0DMU licence three years later. He also helped fellow members with their Radio Amateur Examinations and was a keen participant in the *PW* QRP contests, with fond memories of achieving great results using a twin 9-element Tonna antenna on the hills above Macclesfield.

Ian also maintained his keen childhood interest in optical astronomy. He is a past-president of the UK Society of Popular Astronomy and was for many years a member of its council. He helped to form the Macclesfield Astronomical Society in 1990 and remains its patron. A big honour in 2007 was to be appointed to the Gresham Chair of Astronomy, the oldest chair of astronomy in the world.

Jodrell Bank Radio Telescope

When you gaze with admiration today at the Jodrell Bank Radio Telescope it's difficult to realise that it became operational fully 65 years ago. It all started in 1945 with two trailers of radar equipment and a diesel generator in the quadrangle of a Manchester University laboratory when **Bernard Lovell** – then a Physics lecturer – was trying to investigate cosmic ray echoes. He soon found that electrical noise from the adjacent tramway system was making serious measurements impossible, so he gained permission from the University to move the operation to a field at Jodrell Bank, near Goostrey in Cheshire, then used by the University's botany department.

Lovell and his team in due course erected a static 218ft diameter wire paraboloidal antenna, with the focus 126ft from the ground. However, it was not long before Lovell began to have more ambitious thoughts. What he really wanted was a fully steerable 'radio telescope' (the term was still quite new), so that his team could properly study cosmic rays, meteors and aurorae – not to mention the Moon and the planets.

Having secured the backing of the university, the next step was to secure funding, which was then in the hands of the Department of Scientific and Industrial Research (DSIR). Lovell's original cost estimate was £100,000 (some £3.5m in today's money), and £3,300 was granted so that a suitable consulting engineer could prepare a properly costed proposal.

The chosen engineer was **Henry Charles Husband**, whose Sheffield-based company Husband & Co had worked closely with various Government departments on military projects during the War. Husband's confident verdict on Lovell's ambitious project to build a fully steerable 250ft diameter radio telescope: *"It should be easy – about the same problem as throwing a swing bridge over the Thames at Westminster"*.

But it wasn't easy. Work started in earnest in 1950 and began with a stroke of luck. Husband realised that two vital and poten-


2a


3

Photo 1: Ian with a Schmidt-cassegrain optical telescope from his collection. Photo 2: With his Yaesu FT-102 and (2b) his Swedish 'massy' Morse key used for the Moonbounce QSO. Photo 3: Ian in front of the Lovell Telescope at Jodrell Bank.

tially costly items were the mountings that would enable the huge dish to be steered accurately in elevation. Lovell and Husband visited the Admiralty's Gunnery Establishment at Teddington, and were able to rescue from the breaker's yard – and at a bargain price – two complete 27ft diameter internal racks and pinions from the gun turrets of the *Royal Sovereign* and *Revenge* battleships.

However, things soon started to go wrong. One big problem was steel. The weight of the structure was coming out at 1,200 tons instead of the 1,000 tons in the original plan; it would eventually reach a figure of 1,700 tons. The situation was not helped by the rising costs of the steel itself. By 1952, the cost was already estimated to be £335,000.

Other aspects of the project also caused problems, notably the servo loop driving system. It seemed simple in theory but turned out to be a nightmare in practice.

Over the subsequent couple of years a financial crisis of such magnitude had arisen that Lovell felt himself in real danger of career ruin for having caused the university to become involved in such a financial tangle. By the time it was completed, the telescope costs had risen to some seven times the original estimate and some £50,000 still had to be found from somewhere. But from where?

Salvation came from an unexpected source. In 1957 the Russians launched the first earth satellite *Sputnik I* and the Jodrell Bank radio telescope was the only means of tracking its carrier rocket by radar. Its reputation restored, there was a telephone call from **Lord Nuffield**: *"Is that Lovell? How much money is still owing? I want to pay it off."* And the Jodrell Bank Experimental Station became the 'Nuffield Radio Astronomy Laboratories, Jodrell Bank'.


2b

CQ – the Moon!

The amateur radio transmissions involving Jodrell Bank arose from celebrations to mark the 50th anniversary of the telescope in June 1957.

"I was asked to organise an Earth-Moon-Earth (EME) system to send and receive moonbounce signals," Ian explained. At his home in Macclesfield he mounted a 19-element Tonna antenna on one of his astronomical mounts and transmitted up to the Moon in CW on 70cm, using his treasured old Swedish Morse key and a specially allocated call GB50EME. There, the signals bounced back to earth for reception by the Jodrell telescope. *"It was a great success,"* Ian recalls. *"We were later able to have skeds in CW and voice with stations in Australia, the USA, Japan and Sweden"*.

The Lovell Telescope Today

Much of the Lovell telescope's time these days is devoted to monitoring pulsars (pulsating radio sources) – highly magnetised distant stars that emit beams of electromagnetic radiation.

The telescope is also a vital part of the MERLIN programme, an array of seven linked radio telescopes spanning the UK and connected back to its headquarters at Jodrell Bank. It uses the technique of long-baseline interferometry, which gives Merlin an angular resolution comparable to that of the Hubble Space Telescope.

Ian was one of the original Merlin designers and was the project manager of a subsequent upgrade to include a 32m telescope at Cambridge. In recent years microwave links have been replaced with optical fibre links, thereby massively increasing the array's sensitivity.

Jodrell is also a member of the European VLBI (Very Long Baseline Interferometry) Network that uses similar principles to link over 20 radio telescopes across Europe and Asia.

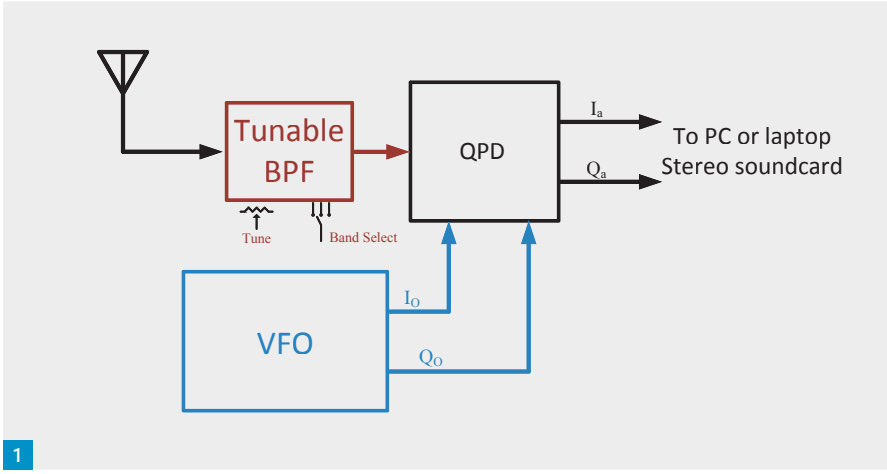
The Future of the Lovell Telescope

The Lovell Telescope, as it is now known, remains the third largest steerable radio telescope in the world and continues to play a vital role in the field of scientific research. But can it go on for ever?

In fairness, the telescope you see today is not quite the telescope that was built in the 1950s. Although, remarkably, the original turrets, racks and drive wheels remain in service, the structure itself has been substantially strengthened over the years and the dish surface has been replaced three times to ever-increasing accuracy.

Ian's encouraging verdict: *"The Telescope is better now than it has ever been in its long history. Without doubt, there are still many years of successful radio astronomy research ahead."*

Dr Samuel Ritchie EI9FZB
samuel.ritchie.8@gmail.com



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3.3 to 30MHz

Dr Samuel Ritchie EI9FZB looks at receiving across the complete range 3.3 to 30MHz.

For a number of years, I used a Drake-2B receiver with the *Q*-multiplier option. The receiver was limited to the reception of 12 band segments, each of 600kHz. These segments were selected by switching between 12 crystals.

Before you touched the tuning knob you would select the band via a bandswitch, adjust the preselector for maximum noise, then use the tuning knob to look for signals. When you heard a signal, you peaked the preselector for maximum signal.

In this fifth part I look at using the quadrature product detector (QPD) described in the January 2022 issue with a preselector and a variable frequency oscillator (VFO) to provide continuous coverage of 3.3 – 30MHz. If you have built the QPD, or are intending to do so and perhaps have been wary of building other circuits, then I trust the use of two kits might give you hope or some other ideas.

Block Diagram

This article covers two elements as shown in **Fig. 1**. The first is the tuneable bandpass filter (BPF) shown in red, which needs the band selector. The second, shown in blue, is the very wide band oscillator, the VFO. Even better, both are kits that come with the PCBs and all the components.

The Preselector or Tuneable BPF

The preselector was just another name for a variable or tuneable bandpass filter, which you tune for maximum signal level. Here I have used a kit from **Javier Solans EA3GCY** whose offering can be found at: www.qrphamradiokits.com

For about €40 you can buy kit BP-1A that is a 3 to 30MHz continuous bandpass filter. The English manual with schematic diagram is available on the website to look at before purchasing. The eight surface-mount varicap diodes (VD1 – VD8) are soldered for you, and all the other components are through-hole mounted. You need to wind six toroid cores. Javier provides 0.5mm enamelled copper wire to do this, and good instructions in the manual, with pictures.

For the bandswitch, the kit provides a toggle switch that has three positions, 'on – off – on', and this allows selection of one of three bands: 3 – 6MHz, 6 – 12MHz and 12 – 30MHz. A potentiometer is then used to adjust the bandpass with each range.

On the left-hand side of **Fig. 2**, in the red stand, is the build BPF kit (**Fig. 3** shows a close-up of the temporary front panel). The bandswitch is on the left-hand side with the switch in the middle position. Using a signal generator and watching the output of the QPD, I made a scale for the preselector indicator to give me an idea of where it needed to be pointed. I found this was necessary because if you were tuned to a strong signal, but the preselector was not set close enough, then the BPF provided so much attenuation that the wanted signal could be buried deep within the noise floor.

It is very intuitive to watch HDSDR and to adjust the BPF when tuned to a strong signal – you can make the signal disappear completely into the noise floor and then watch it soar again out of the noise as you adjust the BPF.

VFO from QRP Labs

Hans Summers G0UPL provides through his company, QRP Labs, a kit called a VFO/Signal Generator: www.qrp-labs.com/vfo.html

For about $36 you get two kits – the same frequency synthesiser board used in the ProgRock (see Part 4 of this series) and instead of a controller that allows 24 fixed frequencies you get a controller that allows continuous operation of the synthesiser from 3.5kHz to at least 200MHz.

There is also an option (€16) to place the crystal used by the synthesiser into an oven-controlled crystal oscillator, which improves the stability and accuracy of the synthesiser. There is a further option (€23) to purchase a GNSS receiver to provide a one pulse per second output, which the controller uses to discipline the frequency stability and accuracy of the synthesiser.

The construction manual with schematic diagram is available on the website to look at before purchasing. The outputs are conveniently 3.3V pk-pk, CMOS, square wave outputs, and Hans has made a provision for generating the quadrature outputs required for our QPD. However, setting the controller to provide quadrature output establishes a lower frequency limit, which is just above 3.2MHz.

The VFO is shown in the foreground of Fig. 2 just attached by a bracket to the front panel. A view of the full front panel is shown in **Fig. 4** with a power switch and the tuning knob for the VFO on the right-hand side of the panel. Most of my work ends up in this stage before I get to building everything in a proper enclosure. The open BPF was susceptible to the noise generated by all the equipment in my study.

Enclosing the BPF in a cardboard box that is fully shielded by tin foil completely eradicated any noise issues. This demonstrated that the noise was being picked up from the environment, and not

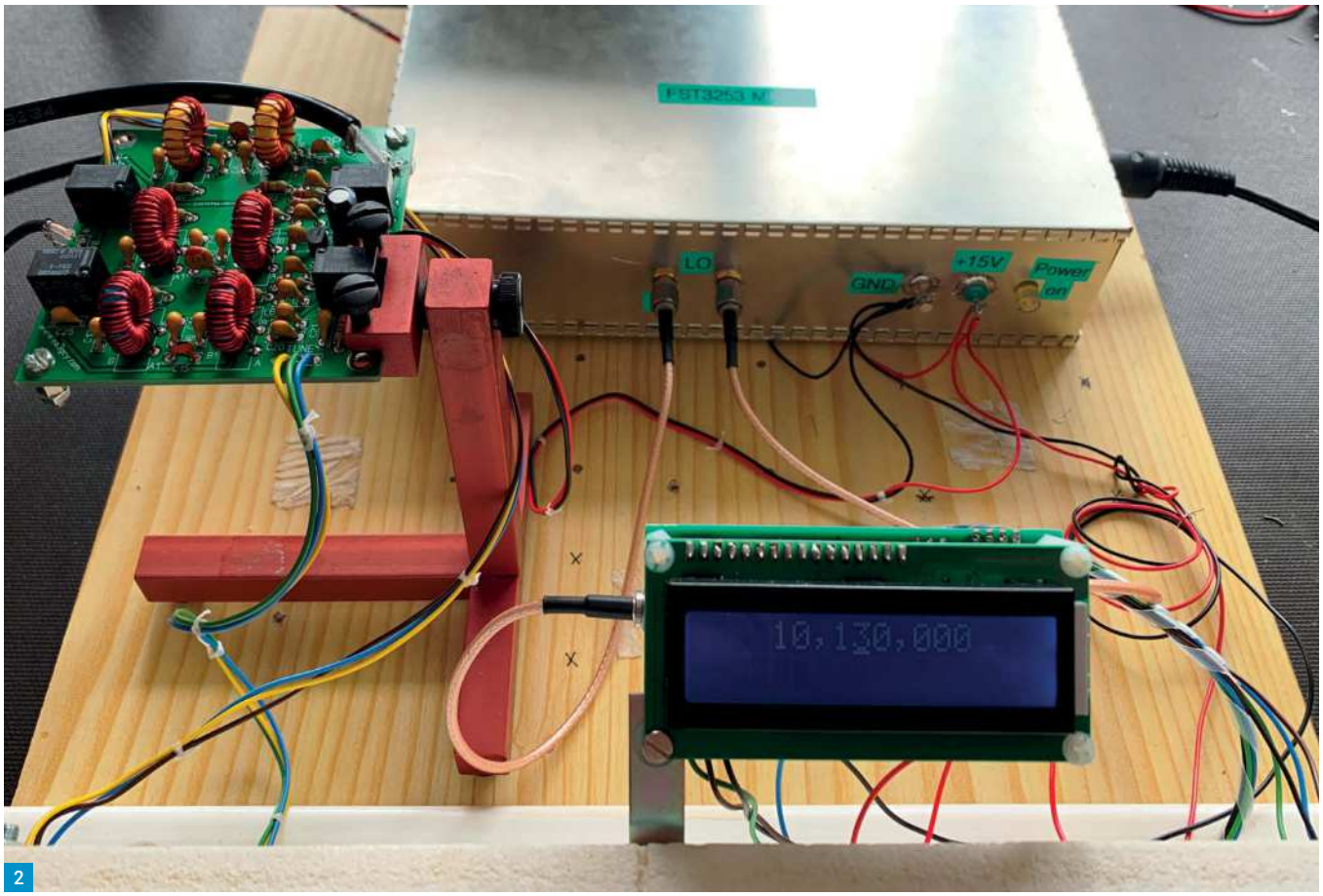

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Fig. 1: Basic block diagram.
Fig. 2: The three modules connected.
Fig. 3: Band select and Preselector.
Fig. 4: View of the front panel.

self-generated in the BPF or the VFO.

The VFO kit is very versatile, and maybe that is why I have built four of them in various guises. In order to cover the whole of the HF band, I had considered using the VFO with one output that removes the 3.2MHz lower limit, not using the quadrature feature, and then dividing that output by four while generating the quadrature signals (shown in previous articles using a D-Type flip-flop). Hans provides a multiplier function, so the output can be set 1 to 9 times what is shown on the display – setting this to 4 compensates for the divide-by-4 you need to generate the quadrature signals required for the QPD.

However, to achieve 30MHz output in this manner you need a 120MHz input clock for the flip-flops. But the 74HC74 has a maximum clock frequency of 76MHz. There are different technologies, such as the 74AHC and 74AS technology, which will manage 120MHz as long as you limit the loading capacitance and that careful layout is practised.

The price of these 74AHC and 74AS devices triple, they are not the easiest to find in through hole packages, and I am not sure my point-to-point wiring techniques will work at VHF. So, I stuck to directly generating the losc and Qosc signals from the VFO, which nearly matches the lower limit of the variable BPF.

End Notes

I have made further information available on my website at:
www.samuelritchie.com

This includes larger high-resolution pictures, the template I used for the bandpass filter dial, more details on some of the components used that are not part of the two kits, etc. Other than being a kit junkie I have no personal connection with or financial interests in qrphamradiokits.com or QRP-Labs.

In the next two instalments we are going to look at some circuits to cover the whole HF band, including the automatic switching of discrete bandpass filters.

MOONRAKER
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Moonraker (UK) Ltd, Cranfield Road, Woburn Sands, Bucks MK17 8UR

WHISTLER

TRX-1E Digital Handheld Scanner

We have worked with Whistler to customise a UK band plan for the scanners! This ensures the radios cover UK bands in the correct steps and the correct mode. The TRX-1 will receive both amateur and commercial DMR transmissions as apart from the frequency they are fundamentally the same mode. The radio is supplied with software and users can select mode when writing memories or select auto and it will work out the mode itself!
This multi-system adaptive digital trunking scanner supports Motorola P25 Phase I, X2-TDMA, Phase II and DMR.

Buy the TRX-1E for just
£419.95

WHISTLER

WS1065 Desktop Radio Scanner

The Whistler WS1065 employs cutting edge technology to bring a high level of performance and innovative features. This model clearly raises the bar in the area of advanced trunking scanners. Frequency coverage is extensive including: 25-54, 108-17, 137-174, 216-512, 764-776, 795-805, 849-869, 896-960 and 1240-1300 MHz.
1800 memories are available and may be dynamically structured to bank sizes you prefer. Plus you can store 21 virtual scanners (so that is a total of 37,800 objects).
The large backlit LCD is four lines by 16 characters. The keys are also backlit. Supported trunking systems include Motorola Analog, EDACS, LTR and Digital APCO (9600 bps).

KEY FEATURES
- Alert LED • Audible Alarms • Automatic Adaptive Digital Tracking
- Backlit Liquid Crystal Display • Data Cloning • Digital AGC
- Flexible Antenna with BNC Connector • High Speed PC Interface
- Free-Form Memory Organization • LTR Home Repeater AutoMove
- Key Lock • Lock-out Function • Memory Backup
- Menu Driven Programming with Context Sensitive Help
- Multi-System Trunking • P25 NAC Functionality

Buy the WS1065 for just
£299.95

WHISTLER

WS1025 Desktop Radio Scanner

This 300-channel scanner can be categorized into 10 separate memory banks. Plus one-touch searches of marine, air and ham Frequency Range: 29-54 VHF Low Band. 87.3-107.9. 108-137 Civil Aircraft Band Includes 833 kHz steps. 137-144 VHF. 144-148 Amateur Band 2 Meters 148-174 VHF High Band

Buy the WS1025 for just
£89.95

WHISTLER

TRX-2E Digital Desktop Scanner

Buy the TRX-2E for just
£479.95

The radios will receive both amateur and commercial DMR transmissions as apart from the frequency they are fundamentally the same mode. The radio is supplied with software and users can select mode when writing memories or select auto and it will work out the mode itself!

This multi-system adaptive digital trunking scanner supports Motorola P25 Phase I, X2-TDMA, Phase II and DMR making it capable of monitoring the following unencrypted channels/systems:
- Conventional DMR (Entered as a DMR trunked system)
- Hytera XPT
- MotoTRBO™ Capacity Plus
- MotoTRBO™ Connect Plus
- MotoTRBO™ Linked Cap Plus systems
- NXDN & DMR out of the box

KEY SPECIFICATIONS
- Frequency: 25-54MHz, 108-136.99MHz, 137-174MHz, 216-379.97MHz, 380-512MHz, 764-781MHz, 791-796MHz, 806-960MHz (excluding cellular), 1240-1300MHz
- Simple Zip Code programming
- Easy updating via Internet
- APCO P25 Digital Phase I & II
- Removable, remote magnetic head
- Scanning at up to 70 channels/second
- CTCSS and DCS subaudible decoder
- IF Discriminator Out • Store Favourites Scan List
- User upgradable CPU firmware
- Spectrum Sweeper • Clock / Calendar
- Tuning Steps: 2.5, 3.125, 5, 6.25, 7.5, 8.33, 10, 12.5 ad 25 kHz.

WHISTLER

WS1010 Handheld Scanner

This 400-channel scanner lets you listen to FM radio bands and can be categorized into 10 separate memory banks. Also, it offers the convenience of one-touch searches of marine, air and ham
Key Features/Specifcations:
200 Channel memory - plenty of memory to store all your favorite frequencies in 10 separate storage banks. Backlit Liquid Crystal Display - easy to read and program data even in low light situations.. Data Cloning - allows transfer of the programmed data to another WS1010 scanner.

Buy the WS1010 for just
£89.99

WHISTLER

WS1040 Handheld Scanner

The WS1040 scans most common trunked radio system signalling formats, including Motorola, EDACS, LTR and P25 trunked radio networks. Talk group and individual call monitoring is supported.
When monitoring P25 digital systems, the exclusive Automatic Adaptive Digital Tracking instantly adapts the digital decoder to the digital modulation format of the transmitted signal, then analyses the signal over 50 times each second and adapts to any subtle changes caused by multipath or fading. No cumbersome manual adjustments are required.

Buy the WS1040 for just
£299.95

WHISTLER

TRX-1 Leather case
Keep your traesued TRX-1 safe with this high quality leather case
£29.95

MRW-TRX3 Antenna Pack
Three compatible antennas in this great pack
£39.95

TRX SD cards
A genuine replacement for the Whistler TRX-1 SD card
£19.99

BEST SELLER

UKAFG UK Airband Frequency Guide 2022

A printed ring-bound Aviation frequency guide, Includes free UKAFG website access to frequency updates, Civil and Military call signs and Maps until the 1st of Jan 2023
- HF VHF UHF • Civil and Military
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PR781 - AR Dynamic Studio Quality Microphone

A professional quality dynamic cardioid microphone for amateur radio that is specifically designed for use with most makes of Elite transceivers. This is a truly remarkable dynamic microphone. Heil engineers were requested by ICOM to develop a very special microphone package for their iC-7800 radio.

FEATURES

- Output Connection: 3 pin XLR
- Generating Element: Dynamic
- Frequency Response: 50 Hz to 16,000 Hz
- Polar Pattern: Cardioid
- Output Level: -55 dB
- Impedance: 600 ohms balanced out , 3pin
- Diaphragm: 1 1/8" Low-mass aluminium
- Weight: 14oz.
- Finish Black: Black Satin Epoxy

All for just

£199.99

199 WATTS

BM17DYN – AR Lightweight Dual Sided Boom Set With Dynamic Element

A lightweight dual-side headset designed for Amateur Radio use. To accommodate different radio setups, the BM-17 is available with a BM-17-Dynamic element. The speakers used in the BM-17 are very sensitive and don't require much AF gain from the transceiver. The frequency response is 200 Hz – 5 kHz with very low distortion. The ear pads are replaceable acoustic foam. The microphone audio for the BM-17 series terminates into a 1/8" mono plug while the headphone terminates into a 1/8" stereo plug (1/8" to 1/4" adapter included).

The use of the AD-1 series mic adapters allows simple interface with popular transceiver inputs. The adapter cable has a 1/8" female input jack for the headset microphone while the 1/4" female that exits the adapter is the PTT (push to talk) line for the Heil foot switch or hand switch. The 1/8" or 1/4" stereo plug goes into the headphone jack on the transceiver front panel.

All for just

£119.99

119 WATTS

Proset 3 – Pro Stereo Studio Headphones

There is no better product than the Heil Pro Set 3 stereo headphones, to illustrate the fact that Bob Heil's ability to listen leads to his company, to build high quality professional sound products.

Anyone who has ever professionally recorded or monitored audio will tell you that the last thing they worry about is whether headphones look good… The fact that the Heil Pro Sound 3 looks so good is a bonus.

You get three detachable cables. A 1.8 M flexible straight cable; and a 1.8 M straight cord with mating iPhone/iPod compatible 3.5mm plug; and also, a 3 M coil cord – all twist lock terminating in a 1/8" (3.5 mm) professional gold plated screw-on 1/4" (6.3mm) adapter.

All for just

£109.95

109 WATTS

Proset Elite 6

The new Heil Pro Set Elite is the ultimate boom set designed for amateur radio operators and uses the Heil HC-6 wide response microphone element. The HC-6 is designed for full range audio or can be adjusted (with radio adjustment) for bright, articulate audio to cut through amateur radio noise and signal pileups. The Pro Set Elite offers dual side, highly efficient speakers mounted in acoustically tuned chambers which offer high rejection of outside noise. The exclusive Heil Phase Reversal feature allows the user to move the signal acoustically, which creates a spatial widening of the sound field that makes it easier to 'see' a signal inside a pileup while removing listener fatigue during prolonged use. The headphone's speakers fold up for easy storage.

The field-replaceable cushioned ear pads also come with removable cotton covers that can be easily removed for washing. The 6' coiled cable terminates in a 1/8" mono plug for the microphone, and a stereo 1/8" plug for headphone speaker connection. An 1/8" to 1/4" adapter is also supplied. The Pro Set Elite works with all Heil AD-1 adapter cables, which mate with just about every type of amateur radio transceiver.

All for just

£189.95

189 WATTS

PRO 7 - AR Industrial Headset

An aviation-style headset designed for amateur radio use in high noise environments. The specially designed foam-gel ear pads provide 26 dB outside noise reduction and provide exceptional comfort. A true dual channel, stereo headset, the Pro 7 Series feature an audio balance control which allows the user to adjust the level of the left earphone to match the right. A unique phase-reversal switch greatly helps the listener "dig out" weak signals. The latest version of the Pro 7 features a monitor jack which allows a second operator to plug in headphones and monitor audio. The flexible gooseneck mic boom on Pro 7s may be rotated for use on either the right or left ear.

All for just

£289.95

289 WATTS

PMSIC – AR Pro-Micro Single-Sided Headset

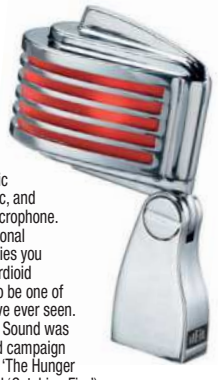
The Pro Micro is a lightweight single-side headset designed for Amateur Radio use. The Pro Micro is available with a IC electret element. The speakers used in the Pro Micro are very sensitive and don't require much AF gain from the transceiver. The frequency response is 20 Hz – 17 kHz with very low distortion. The ear pads are replaceable acoustic foam. The Pro Micro IC: contains the Heil IC electret microphone element.

All for just

£84.95

84 WATTS

FIN RED – Professional Chrome Microphone



The Fin microphone from Heil Sound was featured prominently in the ad campaign for the 2012 smash hit movie 'The Hunger Games', (as well as the sequel 'Catching Fire'), for its amazing looks. The Fin combines that "vintage mic look", with a blend of futuristic, and TIMELESS, all in one shiny microphone. However, The Fin is a professional microphone with all the qualities you could ask for in a dynamic cardioid microphone, it just happens to be one of the coolest looking mics you've ever seen. The Fin microphone from Heil Sound was featured prominently in the ad campaign for the 2012 smash hit movie 'The Hunger Games', (as well as the sequel 'Catching Fire'), for its amazing looks.

All for just

£219.95

219 WATTS

PRASEQ – AR Parametric Receive Audio System EQ

The new receiver audio processing system for ham radio and general communications. It enables you to optimise your reception for band and signal conditions as well as for your personal hearing.

Midrange frequencies are the most critical for achieving clear voice articulation in receive audio. The PRAS allows operators to have unique control over these important frequencies. First, operators can adjust the parametric midrange filter (MID FREQUENCY) from 400 Hz through 4 kHz, with the recommended sweet spot being at 2.5 kHz. In addition, operators can control the presence of these midrange frequencies plus or minus 15 dB using the MID GAIN control. Combined with a low-frequency filter (LOW) set at 160 Hz, and a high-frequency filter (HIGH) set at 6 kHz, the PRAS provides operators unparalleled control and quality of their receive audio.

All for just

£219.95

219 WATTS

PR10 PKG -AR Dynamic Microphone with LB-1 Lighted base

This microphone will bring your radio to life with full speech articulation and perfect balance. This package contains Heil's compact PR10 microphone, an LB-1 table base with an LED-backlit transmit status light, and an adjustable 8" mic boom to bring the mic up to a comfortable operating position during use. Although compact in size this microphone is built around a full 1-1/8" diameter dynamic element, just as our other. Producing full articulate sound from 85Hz to 16kHz you will be sure to be heard with every transmission.

All for just

£249.95

249 WATTS

RigExpert

AA-2000 Zoom Analyser

SPECIFICATION
- Frequency: 0.1 to 2000MHz
- Frequency entry: 1KHz resolution
- Measurement for 25, 50, 75, 100, 150, 200, 300, 450 and 600-Ohms systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range 0…2000, -2000…2000
- Dimensions: 230mm x 100mm x 55mm
- Weight:650g
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-2000 for just

£849.95

849 WATTS

RigExpert

AA-1500 Zoom Analyser

SPECIFICATION
- Frequency: 0.1 to 2000MHz
- Frequency entry: 1KHz resolution
- Measurement for 25, 50, 75, 100, 150, 200, 300, 450 and 600-Ohms systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range 0…2000, -2000…2000
- Dimensions: 230mm x 100mm x 55mm
- Weight:650g
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-1500 for just

£699.95

699 WATTS

RigExpert

AA-650 Zoom Analyser

SPECIFICATION
- Frequency: 0.1 to 650MHz
- Frequency entry: 1KHz resulotion
- Measurement for: 25, 50, 75, 100, 150, 200, 300, 450 and 600Ω systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range: 0… 2000, -2000… 2000
- Dimensions: 230mm x 100mm x 55mm
- Weight:650g
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-650 for just

£549.95

549 WATTS

RigExpert

AA-230 Zoom Analyser

This analyser is designed for measuring SWR (standing wave ratio), return loss, cable loss, as well as other parameters of cable and antenna systems in the range of 100kHz to 230MHz A built-in ZOOM capability makes graphical measurements especially effective.

SPECIFICATION
- Frequency: 0.1 to 230MHz
- Frequency entry: 1KHz resolution
- Measurement for: 25, 50, 75 and 100-Ohm systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range: 0…10000, - 10000…10000 in numerical mode /0…1000, -1000…1000 in chart mode
- Dimensions: 82mm x182mmx32mm
- Weight:236g
- Operating temperature: 0-40 C (32-104 F)

Buy the WS1010 for just

£339.95

339 WATTS

RigExpert

AA-55 Zoom Analyser

This analyser is designed for measuring SWR (standing wave ratio), return loss, cable loss, as well as other parameters of cable and antenna systems in the range of 60kHz to 55MHz A built-in ZOOM capability makes graphical measurements especially effective.

SPECIFICATION
- Frequency: 0.06 to 55MHz
- Frequency entry: 1KHz resolution
- Measurement for: 25/50/75/100/150/200 /300/450/600 ohm
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R&X range: 0…10000, - 10000…10000 in numerical mode /0…1000, -1000…1000 in chart mode
- Dimensions: 103mm x207mmx37mm
- Weight:310g (without batteries)
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-55 for just

£299.95

299 WATTS

RigExpert

AA-35 Zoom Analyser

This analyser is designed for measuring SWR (standing wave ratio), return loss, cable loss, as well as other parameters of cable and antenna systems in the range of 60kHz to 35MHz A built-in ZOOM capability makes graphical measurements especially effective.

SPECIFICATION
- Frequency: 0.06 to 35MHz
- Frequency entry: 1KHz resolution
- Measurement for: 25, 50, 75 and 100-Ohm systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in chart mode
- R & X range: 0…10000, - 10000…10000 in numerical mode /0…1000, -1000…1000 in chart mode
- Dimensions: 103mm x207mmx37mm
- Weight:310g (without batteries)
- Operating temperature: 0-40 C (32-104 F)

Buy the AA-35 for just

£209.99

209 WATTS

RigExpert

STICK PRO Antenna Analyser

SPECIFICATION
- Frequency: 0.1 to 600MHz
- Frequency input step: 1KHz
- Measurement for: 25, 50, 75, 100, 150, 200, 300, 450 and 600Ω systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in graph mode
- R&X range: 0… 2000, -2000… 2000
- Dimensions: 185mm x 40mm x 33mm
- Weight:185g with battery
- Operating temperature: 0-40 C (32-104 F)

Buy the STICK-PRO for just

£349.99

349 WATTS

RigExpert

STICK 230 Analyser

SPECIFICATION
- Frequency: 0.1 to 230MHz
- Frequency input step: 1KHz resolution
- Measurement for: 25, 50, 75, 100, 150, 200, 300, 450 and 600 Ohm systems
- SWR measurement range: 1-100 in numerical mode / 1-10 in graph mode
- R&X range: 0… 10000, -10000… 10000
- Dimensions: 185mm x40mmx33mm
- Weight: 185g
- Operating temperature: 0-40 C (32-104 F)

Buy the STICK-PRO for just

£269.95

269 WATTS

RigExpert

TI-5000 Transceiver Interface

RigExpert TI-5000 is a new and powerful USB transceiver interface based on high quality stereo codec IC, for operating phone, CW and digital modes using personal computer.
All in one through a single USB port. Ideal interface for FT8 and WSJT modes!
Transceiver audio interface: Analog audio interface is a connection to transceiver audio output (external speaker connector or line output) and transceiver audio input (microphone connector or line input). Audio interface enables operating digital modes, recording and playing voice, as well as other useful functions (such as measuring levels of a signal from the air) by using a computer. Input (two channels) and output volume levels are adjusted by potentiometers on the front panel of the device.

Buy the STICK-PRO for just

£154.99

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We have your favourite brands, ready to ship!

Seen a better deal?

We will match or beat any other UK in stock price!

SHARMAN multiCOM

AR-600XL VHF/UHF Antenna Rotator

The SHARMAN AR-600 VHF/UHF Antenna Rotator with Base Control unit and Infa red remote control is designed for use with the smaller antennas Typical suitable antennas are smaller 2m and 70cm beams or tv antennas The AR-600 has programmable antenna controller with Infra-red remote-control. AR-600 remembers up to 12 antenna directions with back up Control over all functions is either with the infra-red remote control or control unit.
The control unit displays location chosen and relative position. Rugged Light-duty rotator is built in a weather-proof one piece cast aluminium housing. Has precision metal gears and steel thrust bearings for durability. Supplied with rotator, controller, 3-device universal remote, mount clamps and hardware.

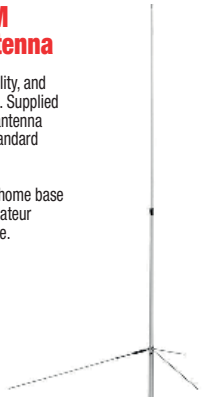
SPECIFICATIONS
- Mast size : 28 to 44 mm (1.1/8" - 1.3/4")
- Rotation time : approx. 74 sec.
- Rotation torque : 21.5 Nm
- Weight : 4.2kg
- Control unit : with digital direction indicator
- Operating Voltage 220-230VAC
- Requires 3-wire control cable (not included)

Buy the AR-600XLfor just
£199.95

199 WATTS

SHARMAN multiCOM

V-2000 6M/2M/70CM Triple Band Base Antenna



GRP fibreglass outer shell for durability, and pre-tuned for the appropriate bands. Supplied complete with mast brackets. This antenna is a two section antenna and has standard SO239 connection fitting.

A good value for money triple band home base antenna for the 50/144/430MHz amateur bands offer outstanding performance.

KEY FEATURES:
- Frequency range - 50 / 144 / 430MHz
- Max power - 150W
- Gain - 2.15dB @ 50MHz 6.2dB @ 144MHz 8.4db @ 430MHz
- Length - 2.2M
- Weight - 1.3Kg

Buy the V-2000 for just
£69.95

69 WATTS

SHARMAN multiCOM

SM-50II 50 AMP Switch Mode Power Supply Unit

Includes noise offset control to eliminate the pulse noise of the switching circuit. This patent pending function is specially designed for communication equipment use. Its effectiveness may vary depending on the frequency and mode.

KEY FEATURES/SPECIFICATIONS
- Input Voltage: 220VAC
- Output Voltage: 9-15Vadjustable
- Output Voltage regulation: less than 2%
- Output current: 50A
- Meter: Displays the supply voltage and current
- Cigarette plug terminal: 10A (max)
- Protection: Short circuit and automatic current limiting over 50A
- Dimensions:170mm (W) X 120mm (H) X 260mm (L)
- Weight: 3kg • Fuse: 8A

Buy the SM-50II for just
£129.95

129 WATTS

SHARMAN multiCOM

AV-508 – Deluxe Desktop Microphone

Suitable for most modern radios with required lead

FEATURES
High-sensitivity condensed microphone element - ensures better voice quality Runs on 2 AA batteries (Not included), Flexible goose neck supporting the microphone

Buy the AV-508 Receiver for just
£69.95

69 WATTS

SHARMAN multiCOM

AV-SW2M - 2 Way SO239 Coax Switch

KEY FEATURES/SPECIFICATIONS:
- Sockets SO239 • Power 2kW (DC-30MHz), 1kW (30-200MHz), 500W (200-500MHz), 250W (500-1000MHz)
- Range DC-1000MHz
- Insertion Loss: DC-500MHz 0.05dB, 500-1GHz 0.10dB
- Size 89 x 70 x 40mm • Weight 446g

Buy the AV-SW2M for just
£34.95

34 WATTS

SHARMAN multiCOM

STORM 100 CB Base Antenna

The Storm 100 CB base antenna is ideal when you only need local range and a compact antenna.

SPECIAL FEATURES
- Frequency - 26-28MHz
- Max Power - 30W
- Length - 1m
- Radials -3
- Gain - 0.5dB
- Bandwidth - 500kHz

Buy the STORM 100 for just
£39.95

39 WATTS

SHARMAN multiCOM

AV-600 VSWR Power Meter

Treat yourself to the Sharman AV-600 VSWR / Power Meter. It reads RMS and PEP and covers from 1.8MHz to 525MHz. It uses two sensors with five power ranges 0-5W / 20W / 200W / 400W

KEY FEATURES/SPECIFICATIONS
- 1.8-160MHz (S1) • 140-525MHz (S2)
- Two Sensors • 5W, 20W, 200W, 400W
- 13.8V DC Lamp • 155 x 63 x 103mm • Weight 720g

Buy the AV-600 for just
£74.95

74 WATTS

SHARMAN multiCOM

AV-6075NF – 75 AMP Swtch Mode Power Supply

The Sharman AV-6075NF is a lightweight, high performance, high efficiency, durable, switching power supply with highly visible back light, easy to read dual meters and audio noise cancel function.

Buy the AV-6075NF for just
£349.95

349 WATTS

MC-4MT 4M 5D-FB Cable Kit SO239 to PL259

Buy the MC-4MT for just
£17.99

17 WATTS

BM145 -PL (SO239) Large Magnetic Base

Buy the BM145-PL for just
£19.95

19 WATTS

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Richard Constantine G3UGF
practicalwireless@warnersgroup.co.uk

1

D-Star and the Next Level ID-52E

Richard Constantine G3UGF reports, "The world isn't your oyster… it's an ID-52E!"

I must confess that my first encounter with D-STAR was less than successful. At its launch, I purchased an Icom IC-7100 with the idea of installing it my new car. Replacing two separate radios and with remote mounting, it offered 160m-70cm all modes in one package, with the added benefit of the relatively new D-STAR digital system, linked to worldwide communication.

As always, I was excited to experience this new development in amateur radio, D-STAR being the first true digital voice and data system and not just digital speech on a conventional FM carrier. Designed at the end of the 1990s in conjunction with the Japan Amateur Radio League (JARL), it offered both speech and packet data, used less bandwidth and could easily link worldwide, via the internet.

Most importantly, D-STAR (Digital Smart Technologies for Amateur Radio) was designed from the outset to be 'open-architecture'. This means that it's not a turn-key system, locked to a specific manufacturer. The earliest adopter of this new technology was Icom. It has since been joined by Kenwood and lately, Flex Radio.

Once I had got my head around the handbook and failed to communicate through my local D-STAR repeater, I realised that you have to one-time register your callsign on to the system, via the internet. I was all set but still no luck. My repeater local. had gone off the air!

D-STAR Revisited

I never did install the radio in my car and didn't really follow the development of D-STAR until I re-discovered almost by accident, that my local repeater is now a dual mode device, once again with D-STAR.

If I had bothered to update my Icom software and repeater list from the Icom website, I would have discovered this much sooner!

Re-visiting the system I found that my callsign was still registered on the network. I was amazed to find how D-STAR has greatly matured. Speech quality within a repeater coverage area is excellent and the system has expanded with collectively, thousands of UK and international repeaters and access points.

While other manufacturers have diversified elsewhere, Icom has stayed with D-STAR, developing its products and software over time. Their first digital handheld ID-51 was launched as far back as 2013, followed by ID51E+ in 2015 and the ID51E+2 in 2017. Each new model representing advances in both technology and facilities.

I was delighted when Icom offered me the opportunity to evaluate at an early stage, their all-new ID-52E.

Physically and technologically somewhat different from earlier models yet similar in appearance but with cleaner lines, you can still see its pedigree. I was very curious to find if this premium product is worthy of its premium price tag.

A little taller than its predecessors at, 12.1cm high by 6.1cm wide and 3.5cm deep, right out of the box the radio feels really good to hold.

First Impressions

I've handed it to several people and their initial reaction is almost always the same as mine. Comments such as, *"This feels really good in the hand", "It's solid, not too heavy, just right"* and *"I really like this",* are what I've come to expect. There's definitely something pleasing about the feel of it that elicits an immediate response.

While some of the radio's features will be familiar to existing owners of older mod-

2

3

Photo 1: Nearby repeater on the band scope Photo 2: Simplex FM with band activity display. Photo 3: ID52E as a fixed station GPS enabled, plus optional accessories. Photo 4: Dual watch. Simplex plus, band scan and local DV repeater monitor. Photo 5: Menu icons.

els, some of the new or enhanced stuff will not. I'm pretty certain that publicity and early feedback surrounding this new model will encourage more potential users to try D-STAR. Others like me will come back, so I make no apology for diving a little deeper into what this radio can do – read on …

It's taller than its predecessors to accommodate the new, larger, 5.8 x 4.31cm 'Transflective' (easy to see outdoors, but not so easy to photograph – humph) colour screen. In addition to some coloured icons, legends and features, words and numbers can be displayed either as white on black or the other way around. Personally, I prefer black on white. It has Bluetooth installed as standard and can be used in conjunction with Icom's VS3 headset for handsfree operation.

Incidentally, I found no difficulty in connecting it to another manufacturer's headset, so it's not proprietary locked.

It's a dual-mode radio and can be operated in either FM or digital DV mode, digital voice that is. It contains two independent receivers that can be used in any combination of VHF or UHF on either band simultaneously. It's also the first version to offer DV facility on either main or sub band. Receiver sensitivity on either amateur band is good at better than 0.2µV on VHF and 0.3µV on UHF.

VHF, AM airband receive was available in the earlier models. This has now been extended to include UHF airband between, 225MHz to 374MHz. There are slight differences in the frequency coverage choices between the band A and band B. Both have multiple options when it comes to frequency step tuning rates, compatible with Air, Marine and European bandplans etc. There's no HF receive coverage.

Audio output has been increased to 750mW and I have to say it's clear, crisp, very acceptable and sounds louder than the specification suggests. Oh yes, and not forgetting it also has FM broadcast function. You can store favourite radio stations in any one of the 500 broadcast memories for easy access. Unless you're a world traveller I doubt you're going to need them all. The radio is supplied with a charger, belt clip and hand loop. There is of course, a somewhat mind blowing 74-page user manual. I suggest it's best absorbed a bit at a time as there's so much to take in and try to remember. There's an even more comprehensive full manual with ten chapters on Icom's website. It goes into everything in much greater detail. I actually found this easier to follow step by step.

I would recommend anyone to download it as it's the best way to fully understand the potential of the ID-52E – You will need a spare weekend and a good supply of coffee and biscuits, particularly if you're a first time D-STAR convert.

In common with other higher end makers the radio body is IPX 7 waterproof rated.

Its BP272 1880mAh battery is IPX4 rated i.e. splashproof from all directions. Accidentally dropping your precious ID-52E into almost a metre depth of water probably means no harm to your IPX7 radio but your charged battery could be 'toast'! However, don't despair Icom fans as most all previous accessories are compatible and the batteries from the IC-705 QRP radio are exactly the same – nice. Unfortunately, if you like speaker microphones and already own an IC-705; the right-angle plugs are the same, but they won't fully connect, due to the ID-52E's recessed sockets. Icom has three alternatives available including a waterproof version or, why not go Bluetooth and VOX instead?

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

As for current consumption, at the 5W level transmit current consumption is 2.5A approximately. There are four lower power settings that can be selected as and when appropriate, in order to prolong battery duration. In DV mode receive current runs at 450mA, with a saving of some 50mA in FM-only mode.

The standard charger takes five hours to fully recharge a completely discharged battery. I have to say that usable battery life is excellent. It hasn't been an issue so far.

The ID-52E can be operated and re-charged via the side mounted, mini USB- PC connector, in the field or in your car. During an extended hike I also ran and charged the radio from an external, portable power bank

For new owners and those with other Icom radios, the optional BC-2021P3L desk stand charger (circa £45.00) has a large footprint, making it very stable when the radio is slotted in. It might also be worth a look as it charges the standard battery in around half the time. It also re-charges larger ones in proportionally shorter times. I like stand chargers as you don't need to fiddle with a radio's water and dust repellent rubberised covers in order to plug in a charger. It's bound to make them last a little longer and seal better.

Stands used in conjunction with speaker microphones or Bluetooth make radios much more user friendly particularly in fixed locations or when connecting an external antenna, as the display is easier to see.

GPS

Crammed into this radio is a very comprehensive GPS receiver, with a potential 300 GPS memories plus the usual Positioning, Latitude & Longitude, Altitude, Course and Speed display. With an SD card fitted it will display GPS history and the log file can be exported to external mapping software.

DV message facility with fast picture transfer function from one digital user to another is among a number of other great features. It's easy to see who's active and check callsign history.

Picture transfer on simplex from one radio to another is really quite fast. The radio doesn't contain a camera. Photos previously stored on a micro-SD card (user supplied) can be edited for size, quality and resolution, using the freely downloadable ST4001a/ ST4001l software. New. jpegs can be sent to the radio's memory card by Bluetooth from an Android or IOS phone.

Voice Recording

The memory card also enables voice recording and play back.

4

A neat feature for the visually impaired is accessed by a longer press on the Quick/ SPCH button, bottom right on the front panel. A nice lady with a pleasing Japanese accent provides an audible readout of the displayed frequency.

Remote Control

The radio can be remotely controlled using Icom's RS-MS1A Android or, RS-MS1I for IOS software. Not many hand portables can do that.

While this and picture utility software is available for both, it appears that programming software CS-52 is only currently listed for Windows PCs, at the time of writing. I wonder if some manufacturers are at long last just beginning to wake up to the fact that half the world, including me, uses IOS/Apple?

If you 've already programmed another Icom radio with things like all the VHF simplex channels, or indeed anything else of interest, you can't import them directly. By first exporting data to a CSV file you can then re-introduce it into a memory bank in the ID-52E. Once done, engage the scanning display and watch it sweep across the memories looking for signals. Complete band scanning is available on demand, in VFO mode too. The scanning bandwidth is user definable.

Bandscope – a First

This radio's unique selling point is that it incorporates a bandscope, accessed from the main menu. The waterfall display shows band activity with signal traces changing colour according to signal strength. It's really useful for finding free channels as well as locating active ones. I used it to locate an interference source in my house, watching the signal trace change colour as I approached a rogue LED lamp.

Built into the system the radio can also act as a gateway or access point to the internet (see full manual. Software is needed and appears currently limited to Windows or an Android device at this time – drat).

5

Programmed and Ready to Go

Thanks to Icom UK Ltd., radios arrive fully programmed with all of the known UK FM and D-STAR repeaters, making for an positive user experience from the outset. There's nothing much worse for a tech writer and reviewer like me than having to laboriously figure out how to programme things into a product, before it can be used.

With a capacity for 1,000 memories available, four programmable call channels for quick access plus, the option to download store up to 2,500 worldwide repeaters in banks, picking UK FM or D-STAR repeaters from the directory and adding others is made easy.

Worldwide Links

The best way to enter the D-STAR system is via a repeater. Making a stand-alone local CQ call is automatic and displays your callsign to others, simply by pressing the PTT. The system can provide an echo back to confirm that you are activating the repeater. You can also select to connect to one of many reflectors/rooms anywhere on the world network or direct your call to another specific repeater chosen from a very comprehensive drop-down list.

Nearby Repeaters.

What I didn't expect and am delighted to discover is the ability to select a nearby repeater almost automatically when out of area. It's done by simply selecting the 'nearby repeater' option from the menu. This is a terrific facility that works in conjunction with the on-board GPS. For anyone that travels like me either for business or pleasure, this is just what's needed. Find a nearby repeater, select and direct your call back to your home repeater or anywhere else, with just a few button pushes.

I've said before that Icom always like to do things a little differently to other companies, it's in their DNA and the ID-52E is no exception.

Continued on page 53

Dr Bruce Taylor HB9ANY
bgtaylor@ieee.org

1

The Panda Cub

Dr Bruce Taylor HB9ANY describes a popular classic gang-tuned multiband rig.

For over 50 years, SSB has proved the dominant mode for analogue phone communication on the HF bands. So much so that young SWLs could be forgiven for believing that the 'communications speech quality' resulting from audio pre-emphasis, brick-wall sideband filters, digital dynamic pre-distortion and range compression, envelope power overshoot (and often a slightly mistuned carrier insertion oscillator) is an unavoidable shortcoming of contacts by amateur radio. SSB is undoubtedly an efficient voice mode for clocking up DXCC countries and winning phone contests in difficult conditions on crowded wavelengths. But at times when the bands are quiet and propagation is good, the richer and more natural audio quality of older AM rigs incites warmer, longer and more memorable ragchews.

Many radio amateurs first discovered the hobby when they accidentally picked up an AM QSO on a domestic radio receiver. It's unfortunate that today any receiver without a BFO would mostly deliver only 'Donald Duck' SSB audio when tuned across the amateur bands.

AM Activity

Although AM operation is a minority speciality it has many keen adherents, especially among amateurs who enjoy experimenting with their equipment. LF band AM phone is still alive, thanks to dedicated enthusiasts and the support of a community of devotees who participate in regular nets on the 80m and 40m bands. Radiating a carrier makes for efficient net conversations in which all participants know unequivocally when each operator switches from transmit to receive.

AM stations are also active on Top Band (160m), 60m, and even on 10m during sunspot years. Many AM operators are members of the lively Vintage and Military Amateur Radio Society (URL below), which is affiliated with the RSGB and based in the UK but has an international reach.
www.vmars.org.uk

Panda Cub

Today, classic commercially-built AM/CW amateur band transmitters can be acquired cheaply at hamfests and mobile rallies. Their straightforward design and relatively spacious construction mean that they are easy to restore, maintain, modify and experiment with. Unlike much modern microelectronic equipment, there is very little to go wrong with these uncomplicated rigs that can't be repaired by any amateur. When combined with a cheap SDR dongle, they provide an opportunity for a young CW operator to get on the air on five or six bands with a serious amount of RF power for very little expenditure indeed. However, some of the higher power models can be rather unwieldy to transport because of their massive mains and modulation transformers.

Designed by **Louis Varney G5RV** of multiband dipole antenna fame, and manufactured by the Panda Radio Co. near Rochdale in Greater Manchester, the Panda Cub transmitter, **Fig. 1**, is a bandswitched gang-tuned rig that covers the 10, 15, 20, 40, 80 and 160m amateur bands. First introduced at the RSGB Exhibition of November 1953, the transmitter cost £62.50 in 1955 and £65 in 1956, before being reduced to £59.50 (around £1500 in today's money) in 1957 and 1958. The Serial No. of a Panda Cub is inscribed on a small plate riveted to the right side of the PA compartment.

Described as a 'table-top' rig, the Cub tips the scales at 43kg. Even the base of the chassis has a close-fitting metal cover that weighs over 1kg, while the sturdy main steel cabinet, a product of the Loughborough metalworks of **LJ Philpott G4BI**, weighs nearly 5kg. Its higher power brother, the Panda PR-120-V, which cost £125, weighs 25kg more, while the contemporary Labgear LG300 transmitter, which cost about £200 complete, was split into separate RF and power supply/modulator cabinets with a combined weight of over 66kg. Unlike the Cub, neither of these more powerful transmitters provides coverage of Top Band.

In 1960 I purchased a well-used Panda Cub, which I operated /A at several RAF stations, albeit cursing its lack of carrying handles as I moved it from one location to another. I even installed the transmitter in the rear of a Ford Anglia 307E van and operated it /M in Scotland, England, Wales and several countries in mainland Europe. When mobile, the HT supply was generated by a heavy ex-WD rotary transformer. With youthful imprudence, no seatbelts or airbags, a boom microphone at face level and two auxiliary car batteries behind my back, I shudder to think what would have happened in the event of a frontal collision!

Fig. 1: The bandswitched gang-tuned Panda Cub transmitter is rated at up to 40W input to a single 807.
Fig. 2: The underside view of the Cub shows a neat layout with good access to all the components. The green boxes are the HT smoothing capacitors.
Fig. 3: This rear view of the Cub shows the AF stages on the left, the power supply on the right and the RF stages with the louvred PA screening compartment in the middle.
Fig. 4: Below 30MHz the adjustable Panda low pass filter *(upper)* has an insertion loss of less than 0.25dB. The ATU 150 *(lower)* has a thermocouple ammeter in each feedline.

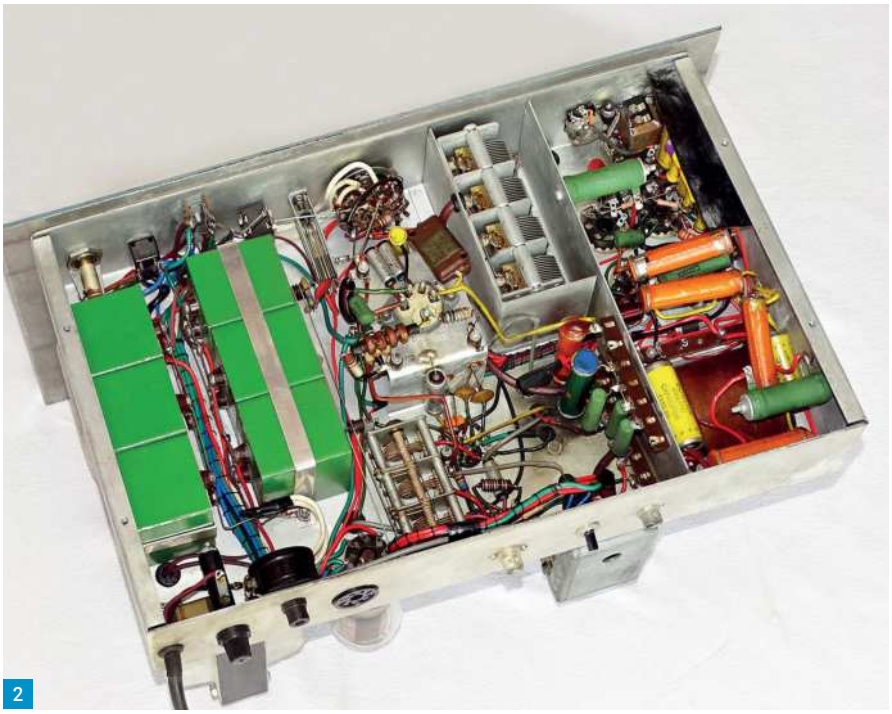
Design

I've provided the original factory circuit diagrams and documents for the Panda Cub here:
Sales brochure
https://tinyurl.com/SalesBroch
Power supply section:
https://tinyurl.com/PwrSchem
Modulator section:
https://tinyurl.com/ModSchem
RF section:
https://tinyurl.com/RfSchem
Components list:
https://tinyurl.com/CmpsList
Operating instructions:
https://tinyurl.com/OpInstns

Although the manufacturer's documentation is of mediocre quality, and suffers from errors and omissions, the construction and wiring of the transmitter itself is of a good standard, **Fig. 2**. It has eight valves (plus a 5U4G rectifier and VR150/30 neon stabiliser) and is rated for up to 40W input on CW and 25W on phone. The final PA is a single 807 with a pi-network tank circuit designed to couple to a 72Ω load.

An international octal socket on the rear panel permits the connection of a transmit/receive control relay or an external power supply. For full power operation, an HT supply of about 500V is required. Be sure to check the internal wiring to the socket before connecting it to any external equipment. That's because it appears that these sockets have been wired in different ways at origin, apart from any changes that may have been made by previous owners. For example, pins 4 and 5 may be in series with the HT supply, as shown in the power supply schematic diagram, or connected to the relay contacts of switch B2, as shown in the modulator schematic!

Produced at a time when Band I TVI was a major concern, the Cub is built in several screened compartments, **Fig. 3**, and has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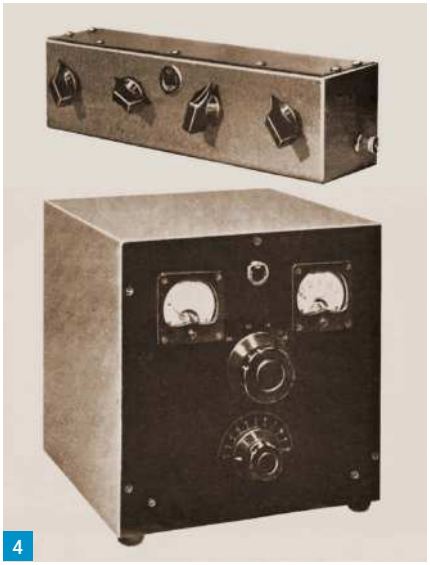
RF filters for mains input and the PA heater. But there is no tuneable harmonic trap or lowpass filter in the RF output, and contrary to the claim in Panda advertisements the transmitter could hardly be described as *"incorporating all the best TVI proofing technique"*. However, as an extra £4.90 accessory the company offered an adjustable lowpass filter that was specified to have an attenuation of 85dB at 42MHz and over 72dB throughout the TV spectrum. For £15 an 'ATU 150' was also available that employed Faraday screened links on all bands for increased protection against harmonic radiation, **Fig. 4**. Today these useful accessories are unfortunately somewhat rarer than the Cub transmitters themselves.

Modulation is by a pair of push-pull 6V6s, driven by a 6SN7 twin triode phase splitter and a 6SL7 preamplifier for a high impedance crystal microphone. These valves don't appear on the components list. The modulation transformer, a critical component for high quality audio, is a reputable Woden UM1 or equivalent, which is conservatively rated for 30W of audio and 60W of RF input.

Compared with other commercial and homebrew multiband transmitters of this vintage, the Panda Cub has very few separate switches and tuning controls. The PA is driven by an exciter that uses an ECC81 double triode and a 5763 beam tetrode in frequency multiplier service, all controlled by a band-change switch with a total of nine poles. The multiplier


3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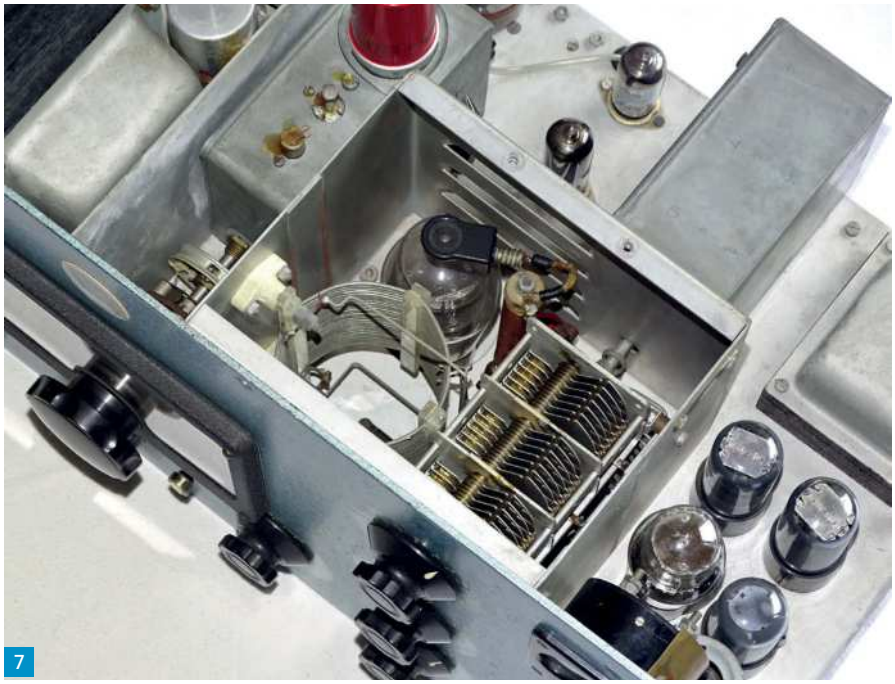
stages are tuned by a 3-gang capacitor that is coupled to the VFO tuning control by an ingenious cord drive, so that only the PA tank capacitor requires separate adjustment when changing frequency.

5



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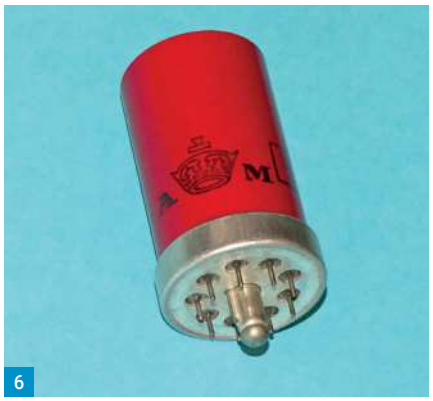

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Fig. 5: Trimmers are provided on the top of the VFO box, which nestles between the power supply and the PA compartment. The cord drive from the drum on the tuning shaft allows the exciter stages to track the VFO frequency.
Fig. 6: The revolutionary B9G pressed-glass base of the EF50 has very short electrode connections to nine chromium-iron alloy pins. The valve has an all-glass envelope covered by a spun-metal 'Jackson cap' for screening purposes.
Fig. 7: The well-screened 807 PA compartment contains the tank circuit and RF choke. A 3-wafer bandswitch under the 3-gang tuning capacitor is coupled directly to the 6-wafer switch in the diecast multiplier coilbox behind it.
Fig. 8: The exciter is tuned by nine ferrite cores; three for each of the three multiplier stages.
Fig. 9: Voltmeter probe locations for measuring the PA drive. The 4-gang PA loading capacitor is upper left, while the 3-gang exciter tuning capacitor on the right is driven by a cord from the VFO shaft.
Fig. 10: Identification of the inductor locations on the side of the diecast coilbox for the multiplier stages V2a, V2b and V3.

The VFO, **Fig. 5**, uses the classic Eddystone 598 'full vision' epicyclic ball-bearing drive. It is directly calibrated in frequency for the six bands, although scale intervals of 12.5kHz on 160m and 150kHz on 15m are more artistic than practical. The VFO is housed in a sturdy Eddystone diecast box and uses a temperature-compensated electron-coupled Clapp circuit covering 1.75-2MHz. For netting purposes a push switch activates the VFO alone.

The EF50

Immediately recognisable by the bright red metal 'Jackson cap' that shields its all-glass envelope, the VFO valve in the Panda Cub is an Air Ministry surplus EF50 high gain remote cutoff RF pentode. Often described as 'the valve that helped to win WWII', the EF50 proved a vital component in the development of effective VHF radar for the UK Chain Home Low (CHL), Airborne Interception (AI) and Anti-Surface Vessel (ASV) systems.

The EF50 was initially developed by Philips for early VHF television receivers, and six of them were used in a fixed-frequency 45MHz TRF TV receiver chassis with a bandwidth of 4MHz that was built by Pye for receiving the pre-war BBC broadcasts from Alexandra Palace. It is believed that Pye may have originated the addition of the metal shield to the valve design. This receiver unit had a very good performance, and by May 1939 scores of them had been made in an initial production run. So, when **Taffy Bowen's** group of radar boffins at Bawdsey Manor was tipped off about it by **Edward Appleton**, they immediately adopted it as an IF strip (Type 153) for VHF airborne radar use, replacing the Cossor prototype receiver that had proved completely unsatisfactory.

On 9 May 1940 a Dutch ferry docked at Harwich with a very precious cargo that had been hastily evacuated from the Philips factory at Eindhoven. On board were 25,000 EF50 valves, together with production machinery, tooling and enough of the special pressed glass valve bases to allow around 250,000 more to be manufactured. It was a close-run thing. During the crossing the ship narrowly escaped an aerial bombardment and just hours later Germany invaded the Netherlands without a declaration of war and the Philips factories and hi-tech research centre came under Nazi control. On 6 December 1942 the RAF mounted a relatively successful low-level attack on the plant, dropping over 60 tons of bombs for a loss of 15 aircraft and 62 aircrew.

The revolutionary EF50 represented an important milestone in valve development because its novel all-glass base, **Fig. 6**, greatly reduced the inter-electrode capacitance and the inductance of the electrode connections compared with conventional designs that had a glass pinch (like an incandescent light bulb). The only contemporary design with these features was the RCA Acorn type, which was much more difficult and expensive to manufacture. The original EF50 production line saved from Philips was set up in the

UK and run by its subsidiary Mullard, and to meet the huge wartime demand for the valve it was also made by Marconi-Osram and Cossor, as well as Rogers in Canada and Sylvania in the US.

In the immediate post-war period EF50 valves were very popular in amateur radio and TV designs because they were versatile and available at attractive prices on the surplus market.

As late as September 1965, when they cost about 1/6d (7.50p) each, a *Practical Wireless* article described their use in nine different circuits. The EF50 was an excellent choice for a VFO because it doesn't suffer from the interelectrode capacitance drift that afflicts valves with a pinch structure. This defect is caused by the fact that the connections of a multi-electrode valve are very close together in the pinch, and separated by glass that has a dielectric constant that is highly dependent on temperature.


8

PA

The tank circuit and the upper section of the countersunk 807 PA valve are housed in a screening box provided with ventilation louvres, **Fig. 7**. After removing the securing screws, the lid of the box can be detached by sliding it towards the rear of the chassis. The tank capacitor is a wide-spaced 80pF 3-gang component that is mounted inside the box, while the 500pF 4-gang loading capacitor is mounted underneath the chassis, **Fig. 2**. One large tapped airspaced coil supported on ceramic pillars covers the four bands from 1.8 to 14MHz, and a second smaller coil located below the tank capacitor is used for 21 and 28MHz.

A rotary switch with three ceramic wafers connects the appropriate variable capacitor sections, fixed capacitors and coil taps for the selected band. By means of a flexible shaft coupler, this switch is connected to another 6-pole rotary switch inside the multiplier coilpack that is housed in an Eddystone diecast box to the rear of it. In this way, the whole transmitter can be switched over six bands with a single front panel control.

Alignment

The basic frequency range of the VFO (up to 1.75-2MHz) is the same for all six frequency bands. If the calibration requires adjustment, this can be done by the trimmers that are readily accessible on the top of the diecast VFO box, **Fig. 5**. The exciter stages are tuned by adjusting the nine ferrite cores on the side of the multiplier coilbox, **Fig. 8**, while monitoring the PA grid current. This may be accomplished by measuring the voltage across the parallel group of three 50Ω resistors comprising R9. As shown in **Fig. 9**, a convenient tag has been provided for the attachment of the negative probe of the voltmeter and ground is available at pin 1 of the 807 base.

Table 1 indicates the inductors that are associated with the **a** and **b** sections of ECC81 V2 and 5763 V3, as well as the bands on which they should be tuned. The physical locations of the adjustable cores on the side of the multiplier coilbox are shown in **Fig. 10**, with the designations given in the schematic diagram. The tuning is quite broad and it should be possible to achieve over 3mA of grid drive (corresponding to 50mV across R9) on all bands.

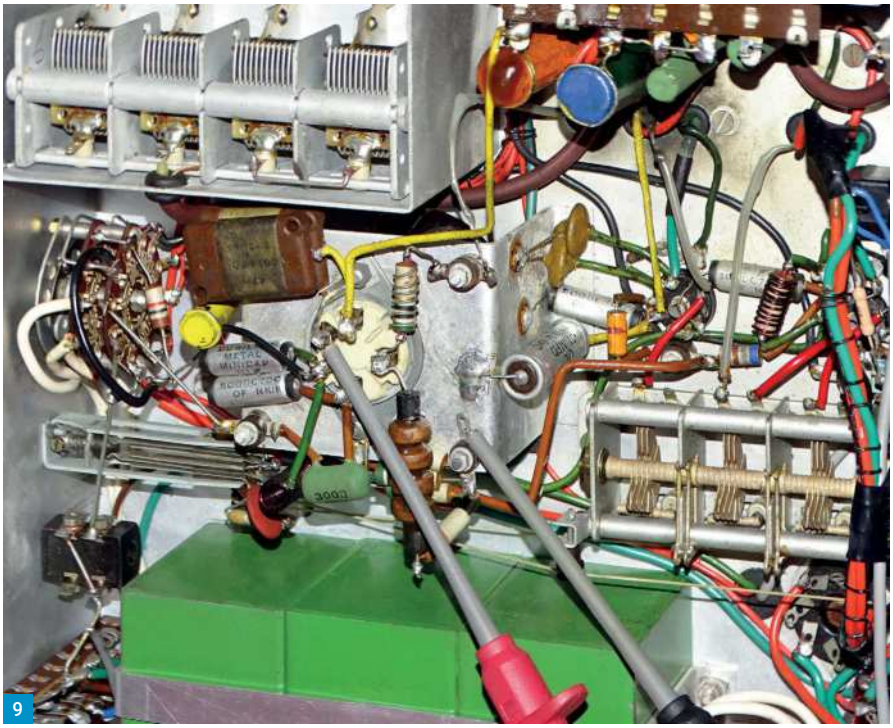
Modifications

Safety should be the first concern when working on an equipment that has AC mains input and over 1kV AC between the anodes of the HT rectifier valve. If the original rubber insulated mains cable shows any signs of ageing, it should be replaced. As the HT smoothing capacitors have low leakage and no bleed resistors they can retain a dangerous charge after power is switched off. Note that the full HT voltage is present on the terminals of the PA anode current meter, which are exposed when the lid of the cabinet is lifted, **Fig. 3.** Since cathode keying is employed, the live contact of the Morse key should be insulated. And if it has not been done already, one of the first modifications should be to fit the cabinet with four rubber feet of height at least 15mm, before the sharp lower edges of the case damage the operating table!

Since the accessible layout of the Panda Cub invites experiment, completely unmodified examples are rather uncommon. Mains hum can be reduced by adding high voltage electrolytic smoothing capacitors in parallel with the original banks of three 2µF solid-dielectric ones. When choosing the capacitors note that on key-up the HT voltage can approach 600V. If series-connected capacitors of lower rating are used, be sure to wire resistors across them to balance the voltage. In addition to this change, the modifications on my model visible in the photos include a coax socket on the rear panel for the standard bipolar input from a teleprinter, and controls on the VFO box and rear panel for selecting and adjusting the appropriate RTTY FSK shift on 3.5 and 14MHz. For compatibility with my other transmitters the front panel coax socket for the microphone has been replaced by a screened jack socket. The globe symbol above the tuning dial isn't original – it replaces the Panda logo that had become badly worn.

The modifications listed in the operating instructions should be carried out if they haven't already been applied at the factory. The 10kΩ VR150/30 feed resistor modification listed is just an omission from the schematic diagram – it will of course be present in the transmitter.

A 150mA anode current meter that is provided for tuning the PA also gives a



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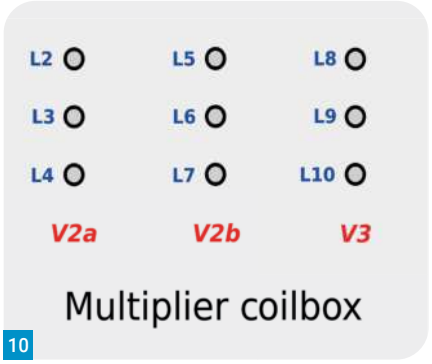
Stage	160m	80m	40m	20m	15m	10m
V2a	L2 1.8MHz		L3 3.5MHz			L4 7MHz
V2b		L5 3.5MHz	L6 7MHz			L7 14MHz
V3				L8 14MHz	L9 21MHz	L10 28MHz

Table 1: Multiplier tuning table

rough indication of modulation depth, but the grid drive is not monitored. There is room to add a grid current meter in the vacant space above the VFO tuning dial. The meter can be wired between R9 and ground and should be bypassed by a 1000pF capacitor.

A switch on the rear panel allows the power output to be reduced to the legal limit of 32W PEP in the frequency range 1.85-2MHz by transferring the reservoir capacitor of the power supply to the output side of the HT smoothing choke. Since this results in some increase in the carrier hum level, a better solution is to modify the circuit to increase the negative bias of the PA valve on this segment of Top Band. There is room in the cabinet to incorporate a small –100V power supply for this, and a potentiometer can be used to tap off the bias voltage required for any desired power level.

On other frequencies the power input can be increased and heat dissipation reduced by replacing the 5U4G rectifier by silicon diodes. An even greater increase in power is possible by providing a higher HT voltage from an external power supply. With a supply of 650V, the power input can be increased to 45W on AM and 75W on CW. The greater modulation power required can be obtained by replacing the 6V6 valves by 6L6's.



10

Many radio amateurs enjoy experimenting with transmitter electronics, but are understandably reluctant to devalue a complex expensive modern transceiver by custom modifications. A classic rig such as the Panda Cub is fun to operate, simple to maintain, and offers a convenient and inexpensive base for trying out ideas and gaining useful RF experience and practical skills. Within the many diverse facets of our hobby, twentieth century 'heavy metal' could have a worthwhile role to play for some time to come!

Continued from page 48

It seems to me that this radio does just about everything except make the proverbial tea, SSB and CW excepted. Joking aside, what this radio does it does well. I wouldn't say that it's quite as intuitive as some I've worked with but it's certainly the most sophisticated and comprehensive one to date. It feels robust, nice to handle, well made and in a class of its own. It's got to be 5 stars rated on available features alone.

However, what personally frustrates me more than just a little is that I keep forgetting that it doesn't have a touchscreen. Initially confusing but doubtless with time and constant use, I might just get the hang of it. I instinctively want to press the on screen, top-level menu icons. I have to remember to use the central pad to move around the screen, like those little tile puzzles with just one missing tile.

The often-used 'memory' icon is on page 2 of the top-level display, requiring a second button press. I just keep forgetting where the icon is!

Features and functions related to each icon are accessed on a tree menu system, with one branch leading to another. Believe me, there are lots of branches!

FinalVerdict

I said at the outset my intention was to find out why and how this radio commands a premium price. I've now had the ID-52E experience for some considerable time. It's been a mix of pleasure, head scratching and quite a learning curve, with still more to explore.

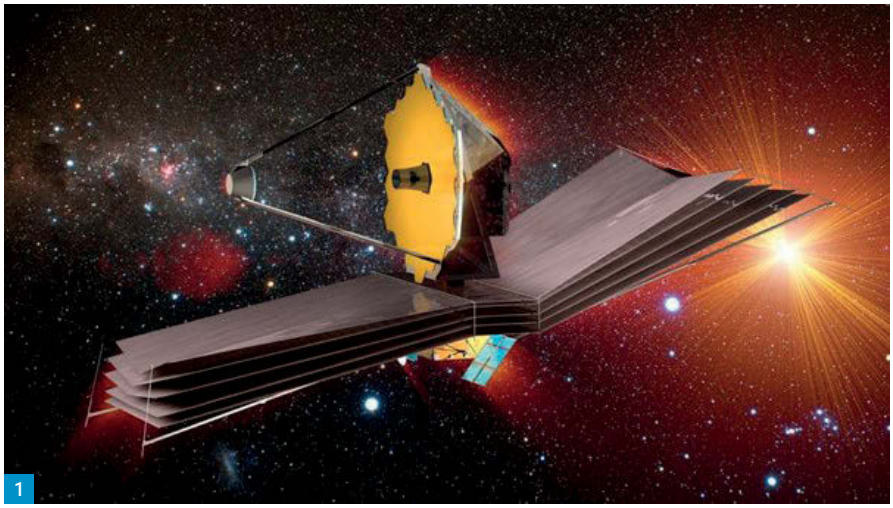
Considering its extensive facilities and taking account of the commercial/manufacturing aspects, exchange rates and ever rising import costs, I'm beginning to realise that it's more than a hand portable radio and so commands it's value. A better description might be that it's a, comprehensive, portable communications device.

Icom, if you're listening, the inclusion of a lightweight protective case, a USB cable or maybe a screen protector or two in the box as standard, might sweeten the deal.

Judging by dealer demand it's already a winner, and my initial misgivings are certainly a thing of the past. I will just have to get myself on the waiting list and start saving up.

My grateful thanks to Icom UK Ltd for the opportunity to review this item at an early stage. Available from Icom dealers circa £529.00 inc. VAT.

Ian J Dilworth G3WRT
practicalwireless@warnersgroup.co.uk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Microwave, Millimetrewave and Terahertz Antennas

Ian Dilworth turns his attention to microwave antennas.

In this 21st century introductory microwave series the centrally most important component to discuss and consider, in depth, is the antenna. As with all RF systems from gamma rays to LF HF radio, radar, submarine, and any form of radio communications, receive and transmit, the antenna governs the overall performance, hence what is possible.

A splendid, currently relevant, and extremely expensive place to start, by example, is with the recently launched James Webb 'space telescope' illustrated in **Fig. 1**. Let us call it more accurately, a large mechanically adaptable and adjustable reflector Terahertz antenna and receiver. Not exactly a *Practical Wireless* feasible project, taking 30 years to develop, several billions (~$10B), very many people, a huge powerful and highly sophisticated rocket launcher plus a wideband telemetry communications system from the special, gravity neutral, 'L2' Lagrange location, 1.5 million km in orbit (the moon is ~0.4million km from Earth). The Webb reflector antenna and receiver system very well illustrates reflector antenna design aspects that are the staple of practical earthly microwave antennas. By comparison it might seem rather relatively mundane to consider its 'K' band (18-27GHz) communications back to Earth with a fast data telemetry system. We need to examine that at some point. But in the meantime, let's look at this 'James Webb,' infra-red ~430THz system (see **Fig. 2** for the large frequency range of the receiver). The antenna and its complex multi parameter receivers are tools offering exciting possibilities, hopefully making possible a view into the beginnings of the universe we live in plus a lot more significant infra-red (IR) abled science observation. **Fig. 3** illustrates its rather modest aperture improvement (~120dBi gain) relative to the fabulously successful, smaller aperture, and science changing higher frequency optical Hubble antenna system. The successor to Hubble, aimed at improving our understanding of so called 'dark matter' is in development and is called *the 'Nancy Grace 'Roman' space telescope.'* We are fortunate to live in a time when our knowledge of the universe is going to significantly increase and soon, we hope. Our RF knowledge and technology advances are a major contribution to that advance along with the launch vehicles and mechanical engineering allowing these tools to work in the vacuum of space at cryogenic temperatures near to absolute zero (~37°C above). It is truly extraordinary in its reality and potential.

Thermal Noise Antenna Temperature

Not all microwave antennas are parabolic reflector antennas. For example, the horn antenna, which is an extended waveguide feed with partial parabolic reflector with a large aperture, **Fig. 4**, an excellent antenna that was used to discover the background noise temperature resulting from the 'big bang' 13.8 billion years ago, i.e. to the far right of Fig. 3. It was selected because it suffers little 'spillover' and is thus well suited to detect the background noise temperature where it is pointed and because of so little spillover avoids the majority of the thermal noise radiation from the Earth, **Fig. 5**. Absolute zero temperature is −273°C, which on the Kelvin scale is 0K. The Earth radiates about +290K, often rounded up to +300K. So, for example, if there is a communications satellite in orbit pointing its antennas at the Earth, it will always have a noise floor more than that produced by the 290K. In a 1Hz bandwidth that is −174dBm and in a 3kHz bandwidth that is reduced by 35dB to −140dBm. Adding unavoidable, equipment generated, noise further deteriorates the actual noise 'floor.' On Earth, with terrestrial communications, we always have ~300K entering our antennas via sidelobes if not the main lobe, as will be described in part V of this series on microwave radio propagation and illustrated in Fig. 5, so to achieve better than that, which is possible, careful antenna design is crucially important. This is the reason for the large, five layers, screens in Fig. 1, a very inconvenient, mega expensive imposition, but necessary in this spaceborne application aimed at detecting the thermal noise generated in the early universe, which is now in the infrared part of the spectrum for which the antenna frequency selective surfaces (FSS) are optimised. The thermal noise of the Webb antenna is designed to be around 35-45K by means of those screens. These comments will no doubt resonate with those trying to increase the millimetre wave distance communications records terrestrially on Earth and may also register with HF/VHF/UHF systems design as to why reducing the noise figure

THz frequency and wavelength, microns, and nm
Variable input in yellow

THz	λ microns	nano metres
10	30	30000
20	15	15000
40	8	7500
80	4	3750
160	1.88	1875
320	0.94	938
640	0.47	469
1280	0.23	234
700	Violet	400
560	Green	550
450	Red	700

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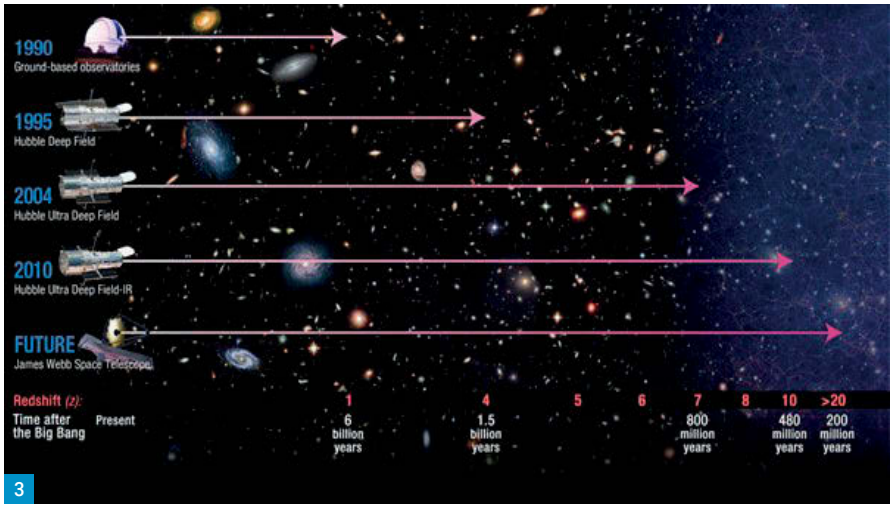

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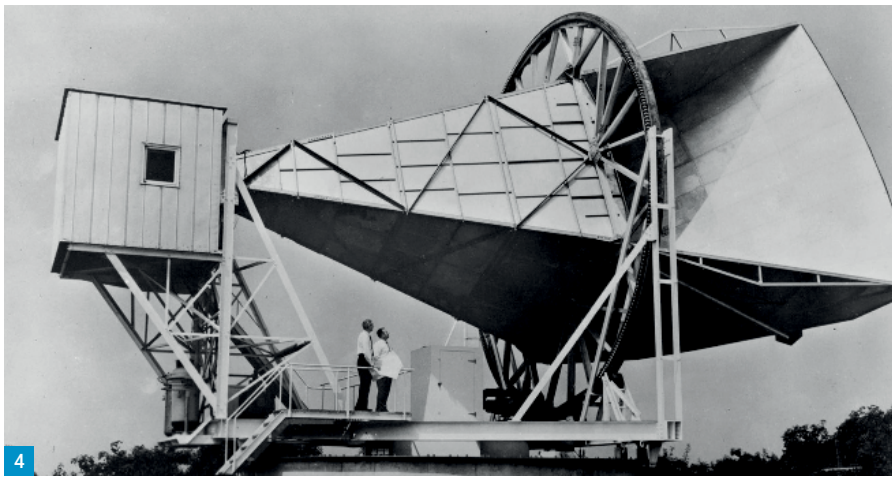

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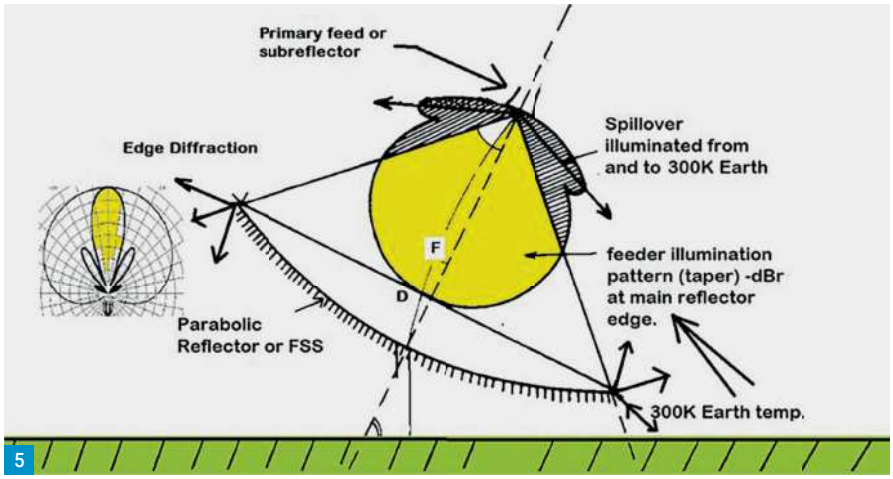

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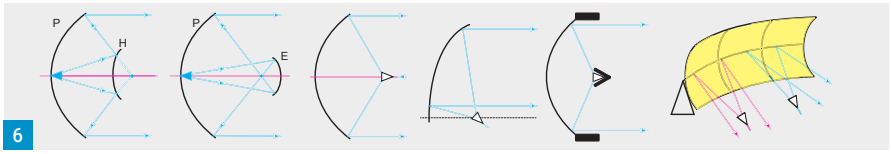
Fig. 1: The James Webb THz Cassegrain antenna, NASA. Fig. 2: One of my additional note's 'utilities' showing the Webb receiver covers the central box of the table: 10_1280 THz and the relative optical spectrum frequencies and wavelengths in the coloured bars. Fig. 3: The Webb compared to Hubble, only a few dB or a few degrees Kelvin improvement in G/T because the wavelength is no longer just optical. Just 30 years of progress and 50 years in development. 1990 to 2022. Fig. 4: A large Horn antenna. Basically, a flared waveguide with a part parabola reflector. Similar were employed on the BT tower in Tottenham, London. Fig. 5: Spillover and diffraction from a reflector antenna at a certain elevation angle. Rotate to zero and it becomes a terrestrial antenna.

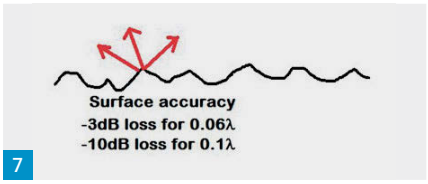
of a receiver is pointless beyond a certain measure for terrestrial communications subject to ~290K radiation from the Earth.

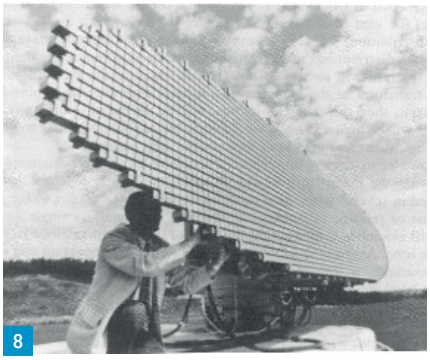
The thermal temperature radiated by the moon is of interest for moonbounce communications and radiometers as will be illustrated in Part IV of this series. It depends on the illumination from the Sun and the phase of the moon and goes from ~160 to 290K. It also depends on the antenna beamwidth illuminating the Moon. There are several EME (Excel) calculators available on the web to parametrically examine the possibilities and one I have written for my own interest. Few incorporate antenna spillover, diffraction from antenna edges and earth, 290/300K, contribution to noise floor or indeed the moon phases. None, as far as I am aware, microwave absorber material to diminish spillover and diffraction. They concentrate on gain. However, the important parameter is the G/T (linear units) as the ratio indicates, so the earth antenna spillover (temperature 'T') can be significant. The calculation to make is the main lobe contribution plus the sidelobe contribution as indicated in Fig. 5, diffraction from antenna edges/boundaries is a challenge to reduce 'T'. Marginal, small antenna, EME propagation thus requires very careful design and attention to detail, minimising spillover and edge diffraction scatter and perhaps employing microwave absorber material see **Fig. 6** on the feeder and reflector edges, and I am not aware of that being considered before in amateur circles but will likely be a useful significant advance if employed.

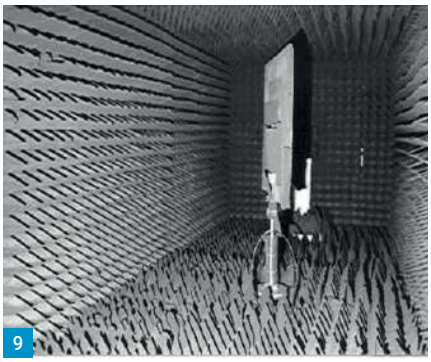
Antenna Aperture and Radiation Patterns

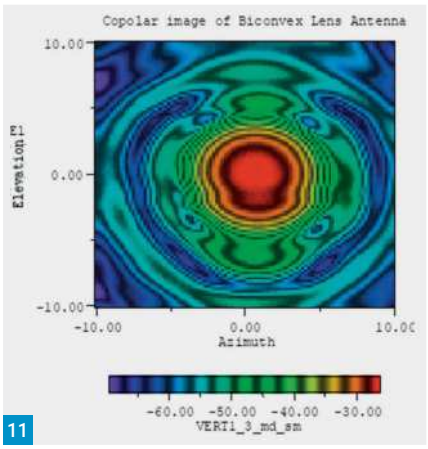
It is useful to think of any microwave antenna in terms of its 'aperture.' The Gain of an antenna can be shown to be directly related to its aperture size (A m^2) compared to the wavelength with an efficiency η less than perfect because it depends on the surface accuracy in terms of the wavelength and also the











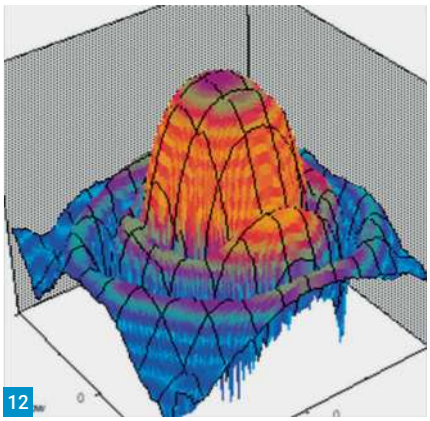


Fig. 6: From left to right, Cassegrain, Gregorian, Front fed paraboloid, Offset Paraboloid, Low sidelobe/ spillover microwave absorber employed on feed and reflector edges, dually curved toroidal antenna with multiple feeds. Fig. 7: Surface accuracy and scattering of reflector antennas. Fig. 8: Slot waveguide antenna, large aperture in azimuth, less in elevation and very heavy. Fig. 9: Anechoic chambers only work over a limited frequency range. Fig. 10: ~20-50GHz waveguide fed Horn antenna with protective radome. Fig. 11: Horn antenna pattern and sidelobes isometrically represented. Fig. 12: Measured Contour map of the Horn antenna at 38GHz, much more useful than the normal single plane cut. The distortions are due to my equipment or inadequacy or maybe they are real? Clearly, they need to be repeated.

illumination parameters. The surface accuracy required is illustrated in **Fig. 7**, and is reduced, as indicated, by scattering from imperfections. Gain G= η × (4π×A (h, v)/λ^2). As **Fig. 8** illustrates, the antenna aperture in the vertical and horizontal planes can differ. This also applies to the antenna's polarisation sensitivity, so we need to consider both Av and Ah, which will then have different gains Gv and Gh. That is quite clear terrestrially but not so clear if used on (elevated) space applications. The jagged primary reflector steerable segments of the Webb antenna are bad news for scattering if employed in a terrestrial antenna and to be avoided because of diffraction scattering and spillover.

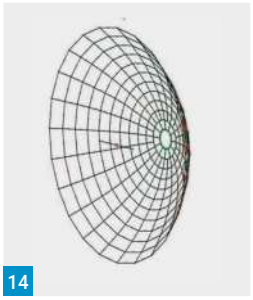
Measuring the radiation pattern of an antenna is quite feasible for the amateur provided you can get far enough away in the 'far field' of the antenna where its radiated phase front is more or less a plane wave and avoid ground reflections. Professionally, anechoic chambers can help as illustrated in **Fig. 9**.

The larger the cones the lower the frequency that the chamber can operate. On an outdoor test range in the 'far field,' the ~38GHz horn radome covered antenna shown in **Fig. 10** I measured, and **Fig. 12** shows, isometrically, the 3D radiation pattern and more usefully the same antenna in contour representation shown in **Fig. 11**, all done on my outdoor antenna test range. This large symmetric horn antenna works on all polarisations depending on the feed (waveguide) over ~20-50GHz. On the other hand, the radar antenna shown in **Fig. 13** does not.

It is narrow bandwidth in operation, because of its feed system, and narrow beamwidth in azimuth and wider beamwidth in elevation because of its different apertures.

Focal Length to Aperture Ratio and Feeder Antennas

The 'Webb' antenna has a relatively large Focal length to Aperture ratio, and since it is symmetric, we normally refer to this as a F/D ratio, D being the main reflector diameter. A large F/D means the feeder antenna needs a narrower beamwidth and hence a larger aperture than a small F/D as used in the EM modelled example of **Fig. 14**. A large F/D means the aperture blockage of the sub reflector is minimised. Fig. 6 attempts to summarise some of the many varieties of reflector antenna arrangements possible. Practically speaking the Cassegrain arrangement provides the shortest feeder, a major practical plus point, but does involve aperture blockage from the then required hyperbolic sub reflector and its supports. An offset arrangement avoids aperture blockage, particularly important for small apertures, but it then demands an asymmetric reflector arrangement. In all cases minimising the 'spillover' while maximising the illumination of the main reflector is a key design parameter and always represents a compromise. Spillover increases the thermal temperature 'T' on a terrestrial antenna because of the sidelobes introduced and scattering from edges (diffraction) as illustrated in Fig. 5. On the other hand, the gain is reduced if the reflector aperture is not fully illuminated. A 'tapered' illumination compromise is



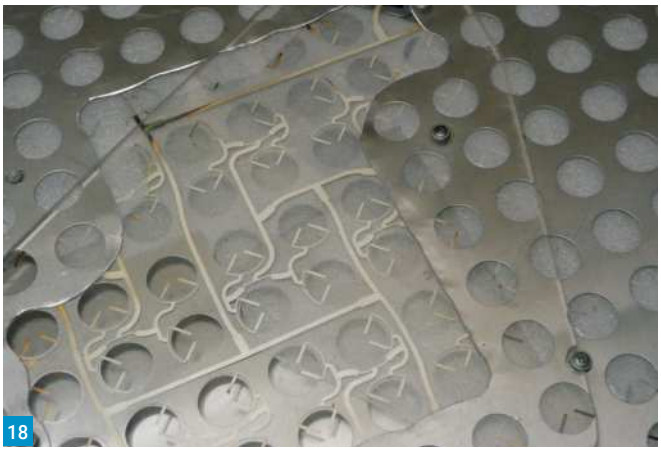


Fig. 13: 9GHz planar radar array. Broad in elevation, narrow in azimuth. Fig. 14: MoM modelled reflector antenna F/D very small and dipole feed. Fig. 15: Cassegrain with circular waveguide feed wideband ~30 to 50GHz. Note the minimisation of the metal support blockage aperture and hyperbolic subreflector. Mica weather window on the feed for protection. Fig. 16: Scalar Horn and window blown with air to remove water. This is a 3m diameter Cassegrain antenna. Note the closeness of the hyperbolic subreflector, in this particular antenna (and F/D ratio) mean the poor return loss requires a vertex plate to improve the return loss. Fig. 17: Heated radomes. Fig. 18: Printed 12GHz 'squarial' dual polarisation feeder and a cut away view. The circles and their below are the 'cavity resonators' all resulting in a narrow band operation. It is clear that this is an expensive antenna to reproduce , hence why we now employ offset front fed reflector antennas for 12GHz DBS, see Fig. 6. Much cheaper. They are elliptical to allow fitters a bit of slack in alignment because their beamwidth are greater in azimuth since the elevation angle is fixed to geostationary orbit and in the UK about 28°. The same dish would not be optimum in more southerly elevation angles to geostationary orbit.

required. In the Cassegrain arrangement then both the sub reflector and the main reflector must be considered in all these respects. Scattering and diffraction from the sub reflector and main reflector can be significant and to obtain the best G/T because 'T' needs to be minimised. In the case of the Webb antenna the five screens are designed to minimise 'T' although they also introduce diffraction scattering from the edges. The use of microwave absorbing material such as graphite loaded sponge or less effectively wood or indeed a FSS as illustrated in Fig. 6 around the feeder and the edges of the main reflector can usefully be employed to aid in this endeavour and is something that small reflector EME enthusiasts rarely, if ever, have taken advantage of for practical reasons. Because that then usually requires a protective 'radome' i.e., an RF transparent weatherproof membrane as illustrated in the Q band (~33-50GHz) horn antenna, Fig. 10. However, it does not preclude their temporary employment. A Mica window as used in the Q band Cassegrain feeder as shown in **Fig. 15** is of negligible loss. Thin Fibreglass is relatively low loss at X band. Practically speaking water (rain, snow, or Ice) on a feeder window with a radome can dilatorily change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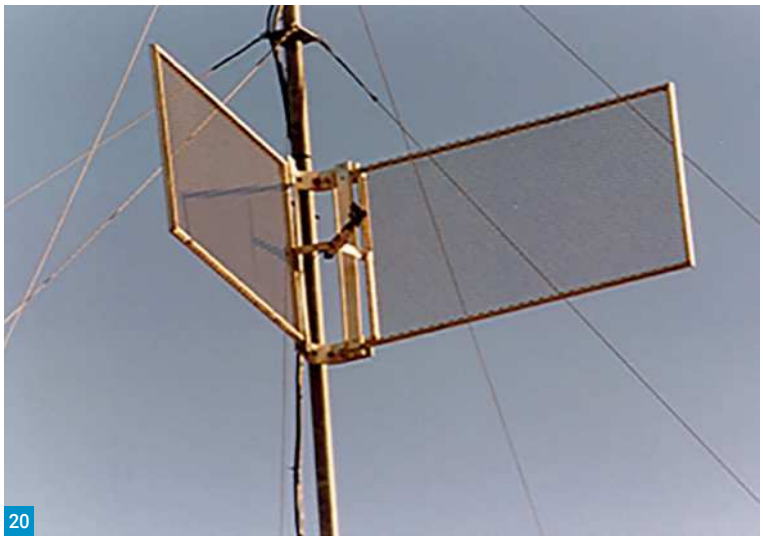
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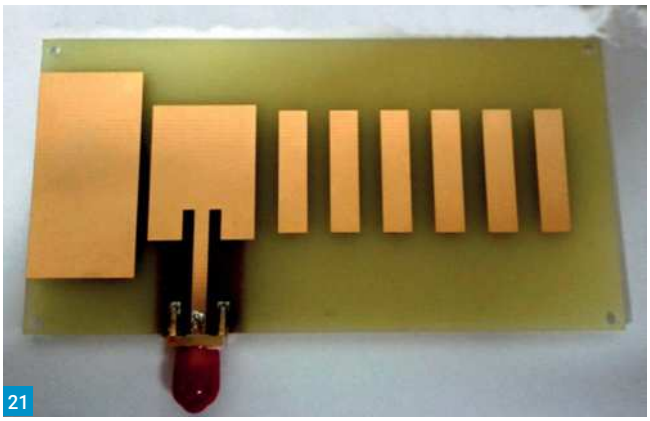
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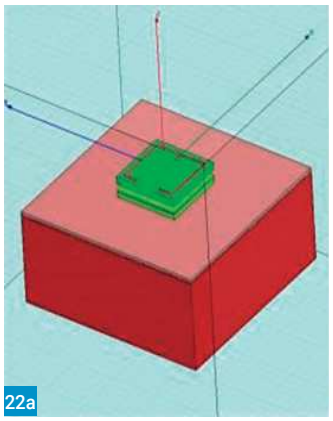
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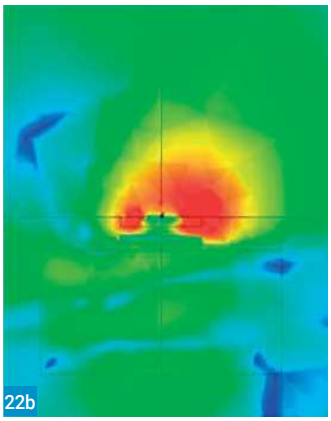
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the antenna characteristics, which may be relevant to users of the current geostationary QO100 satellite. In commercial systems warm air can be blown across the feeder window, see for example **Fig. 16**, to avoid this problem, which may not be completely effective. **Fig. 17** illustrates an alternative method, heated radome enclosures, which are much more practically effective than allowing the primary feed exposure to the elements.

Phased Arrays

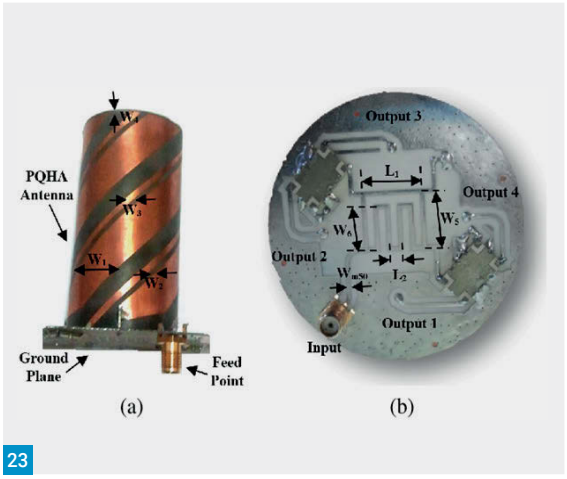
Feeding multiple apertures, in phase, can produce useful gain and, of course, the aperture increases proportionately. Efficiency is, however, compromised compared to a reflector antenna because of losses in the feeder/power divider arrangement. A printed ~9GHz phased array commercial radar antenna is illustrated in Fig. 13. The antenna works, but the main practical problem is that the feed is clearly complicated, rather long with impedance changes, resulting in bandwidth limiting and thus relatively lossy. A cut away from a dual polar silver plated 2D and 3D with the resonant cavity backing it, DBS 12GHz 'Squarial' shown in **Fig. 19**, is clearly an expensive item to mass produce. Fig. 13, also silver plated, to reduce losses, is a cost-effective compromise for a commercial mass-produced domestic boat 9GHz radar where the apertures in azimuth and elevation differ. The beamwidth in elevation is much larger than that in azimuth, thus allowing for boat roll. Of course, these are independent of polarisation apertures Av and Ah, which depend on the feed system. Waveguide slot antennas lend themselves to electrically and physically steerable phased array antennas as illustrated in **Figs**. 8 and **19**.

Printed 'patch', Yagi, and Corner Reflector Antennas

For the lower microwave bands, up to say 5GHz, a Yagi type antenna or a corner reflector, **Fig. 20**, aperture antenna works satisfactorily. These are mostly mechanically convenient but are somewhat of a compromise compared to a parabolic reflector antenna and only suitable for a single polarisation. **Fig. 21** shows a printed Yagi Antenna. This indicates the practical limitations as the wavelength decreases because the construction accuracy required (to produce 10% bandwidth at best) and good (η >50%) efficiency rapidly drops off. Note the substrate introduces loss. GPS antennas ~1.5GHz (λ = 20cm) do not require more than +3dBi directional gain and can be small bandwidth in operation but they do require to be insensitive to polarisation and operate over a large hemispherical 3D space. There are many conveniently small 2D aperture printed designs, so called patch antennas, which meet this requirement, see for example **Fig. 22**. There are also 3D antennas such as the quadrifilar helix, which have been miniaturised, **Fig. 23**. The key characteristic being to maximise their receive efficiency and quasi semi hemispheric omnidirectionality. The best depend on air or low loss dielectric supports.

Wideband Antennas

Wideband antennas are useful, and a good example is a Vivaldi antenna, also known as a tapered slot. Arrays of these can provide wideband antennas. It is attractive to employ a single such antenna as a feed for a reflector antenna or a corner reflector or as



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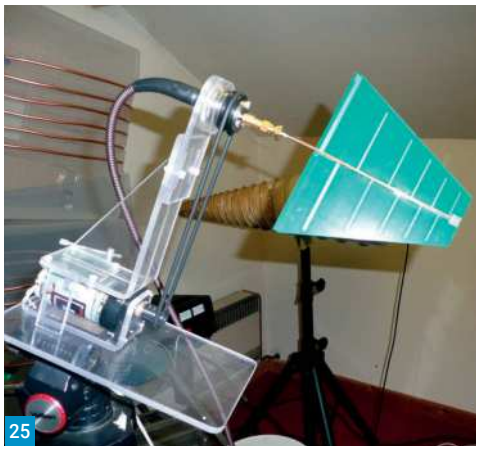
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Fig. 19: Mechanically Steerable phased array slot waveguide antenna with equal apertures and single polarisation. Fig. 20: Corner reflector and simple feed. A practical broadband antenna for portable use. Vertical (as here) or horizontally polarised. Fig. 21: Printed Yagi, a good way to learn about baluns and matching. Not a convenient or good way to experiment and rather narrow band plus the substrate is expensive if low loss. Fibreglass is microwave lossy above ~2GHz and has a non-isotropic impedance dependent on the weave. Fig. 22: Miniature (very narrow band) Patch antenna for GPS (~1.5GHz), EM modelled and the associated radiation field response. Electrically small antennas are governed by the 'Chu' limit for those interested in this aspect. Proximity effects to nearby objects (e.g., people, metalwork) are a major operational snag. Fig. 23: Quadrifilar antenna miniaturised and hence really narrow band and so expensive to reproduce. Fig 24: Broadband Vivaldi feed horn antenna here shown vertically polarised. Fig. 25: Log periodic, rotatable using plastic supports for EMC investigations. Fig. 26: Scalar horn and two port orthomode (dual polarisation) feeder.

illustrated as a horn feed, **Fig. 24**. However, a disadvantage is that the 'phase centre' of such antennas change with frequency and thus so does the focus of the feedpoint. The same applies to a log-periodic type, **Fig. 25**, which I use for EMC investigations and rotate its polarisation as its plastic mount illustrates. However, the F/D ratio of a reflector antenna is not particular sensitive to the feed phase centre location unless of very small F/D and for convenience, on a terrestrial system, represents an acceptable compromise for feeding a parabolic reflector. Plastic hardware avoids metal reflections in such arrangements.

Practical Portable Broadband Microwave Antennas

Many, amateurs including myself must go portable for terrestrial microwave operation, in my case because I am surrounded by higher land. It is part of the pain and the pleasure. Parabolic dishes are inconvenient and easily damaged in transit. A plane corner reflector, as in Fig. 20, is a single polarisation effective alternate compromise. After all we do not need the symmetry of a paraboloidal antenna for a single polarisation. I have EM modelled and measured these antennas and they can produce significant gain and good efficiency. They work and simply require sheets of aluminium or a supported wire mesh and a hinge and can sit flat in transit so are difficult to damage in 18swg aluminium. So, I think a broadband multiband log periodic, or Vivaldi fed corner reflector is possibly a very good practical terrestrial microwave, utility broadband, antenna and convenient especially for portable use. A hinged reflector goes in the car boot, is simple, rapidly deployed, and effective plus the Vivaldi or log periodic antenna feed can be short. The feed is easily optimised to account for the phase centre movement with frequency by a dielectric (plastic) adjustable mounted feed. To reduce wind load the reflector needs a mesh hole size of <0.1 λ to be effective. I have made an Excel based design for a corner reflector in my series of tools, which will be available in due course. Phasing corner reflectors together to increase gain is readily done as with Yagis. Polarisation is something that needs to be addressed. There is not much difference between V and H terrestrially, but V has the edge, yet we use H for historical reasons, see part V in this series.

Waveguide Feeds

Waveguide feeds are the low loss choice for most fixed antennas, such as horn or reflector types. Often these are required to be dual (orthogonal) polarisation because circular polarisation suffers in the troposphere so is deprecated as will be discussed in part V. Orthomode transducers are required and circular waveguide to generate orthogonal linear polarisations as illustrated in **Fig. 26**. Scalar horns and circular waveguide are often employed because they allow a controlled multi-polarisation radiation pattern.

Slot Antennas

Slot antennas are very helpful and convenient when employed in a waveguide transmission line. Some microwave beacon transmitters use slot antennas. The basic principle is that cutting a resonant hole in the wall of a waveguide allows the circulating current to radiate. Coupling slots correctly, in phase, allows a phased array to be constructed with a beam in any direction as illustrated in Fig. 19 and this can be a very efficient way of producing a directional microwave antenna albeit potentially rather heavy unless silver paint coated/copper tape plastic waveguide support is employed! Because the 'skin depth' required is so small at microwaves this is a practical method! Hereby copyrighted by G3WRT. You read it first here.

I'll complete this discussion next time with a look at antenna modelling.

Mark Tuttle G0TMT
g0tmt@theshack.org.uk

Building the Receiver Board RF Section

Mark Tuttle G0TMT starts on the receiver board, describing the RF section.

In this part I'll walk you through the RF chain of the receiver, giving my sources as I go and hopefully an explanation as to how each key 'module' works. So, as always we'll be studying the circuit diagram as we go, **Fig. 1**. By the way, the components list is for the whole receiver board, although I won't be cover the audio stages until next time.

Power Supply

In the top left is U1, a common-all-garden 8V regulator IC. The NE602/SA612 mixer chip we're going to use doesn't like a supply voltage of much more than that and it also helps to have things nice and smooth. I fitted my regulator on the receiver board.

An alternative approach would be to build a little power supply board. We're going to need 8V and 12V (or 13.8V as many power supplies output) elsewhere so it's up to you. If you do, it'll give you a smidgen more room on the receiver board but will obviously take up more room in the box elsewhere.

Bandpass Filter

The front-end design is taken from a circuit by PA2OHH called 'The Nice Rig'. Let's follow the signal path. Assuming you have a reasonable antenna into the shack you're going to pull hundreds of different radio signals into the front end of our receiver. This will include some huge broadcast stations and all manner of signals that we don't want in addition to the 40m amateur band signals we do want.

So firstly, it's a good plan to filter off everything we're not interested in. That's the function of T1 and T2 and the associated components that make up the input bandpass filter. Incidentally the two little back-to-back diodes on the input are always good practice. They will conduct any signal that exceeds 0.7V and help to protect our little rig.

RF Preamplifier and RF Gain Control

Our filtered signal is now loosely coupled (with C6) into a single transistor amplifier. The BF199 is a low noise transistor. Don't forget we're dealing with microvolts here and some of our desired signal will inevitably be lost in our bandpass filter. We don't want a noisy transistor to add to an already noisy band so I think it's worth spending a few extra pence on a low noise component here. On the emitter of the BF199 we have the RF gain control. You'll also see the input around here for the AGC control. More on that later.

The First Mixer

Now that we've boosted the input signal by a few dB we will feed it into the first mixer (U1) where it is mixed with the VFO signal we built in the last part. Now, remember what products come out of a mixer: Let's label the incoming signal f1 and our VFO signal, f2. The mixer output should contain; f1+f2, f1–f2, f1 and f2. Hopefully there won't be too much of f1 and f2 but the other two products will definitely be there.

Our VFO covers from around 2 to 2.2MHz-ish, and the incoming signals we want will be around 7MHz-ish so we should get two big signals from the mixer: 7 + 2 = 9MHz and 7 – 2 = 5MHz. I chose an intermediate frequency of 4.915MHz, because of readily available cheap computer crystals so by tweaking the VFO to run from 2.04 to 2.18MHz the receiver will actually tune from 4.915 + 2.04 = 6.955MHz to 4.915 + 2.185 = 7.095MHz. So, you can see that by changing the VFO frequency we can get the span of the receiver to cover pretty much any part of the band that the input bandpass filter allows through. This is the principle behind superhet receivers and it's pretty simple really.

The real advantage is that all the signals we want to listen to have been converted to just one manageable range of frequencies. If we wanted to use a 500Hz filter across the entire 7 – 7.1MHz range, we'd need to be able to continually change the tuned peak of the filter. This isn't easy but with the wanted signal now converted to our IF frequency we can now operate on this one frequency without the need to retune the filter.

A single signal is selected by changing the frequency of the VFO. Our crystal filter is centred on the IF frequency giving us a nice tight bandwidth of the incoming signals.

The Crystal Filter

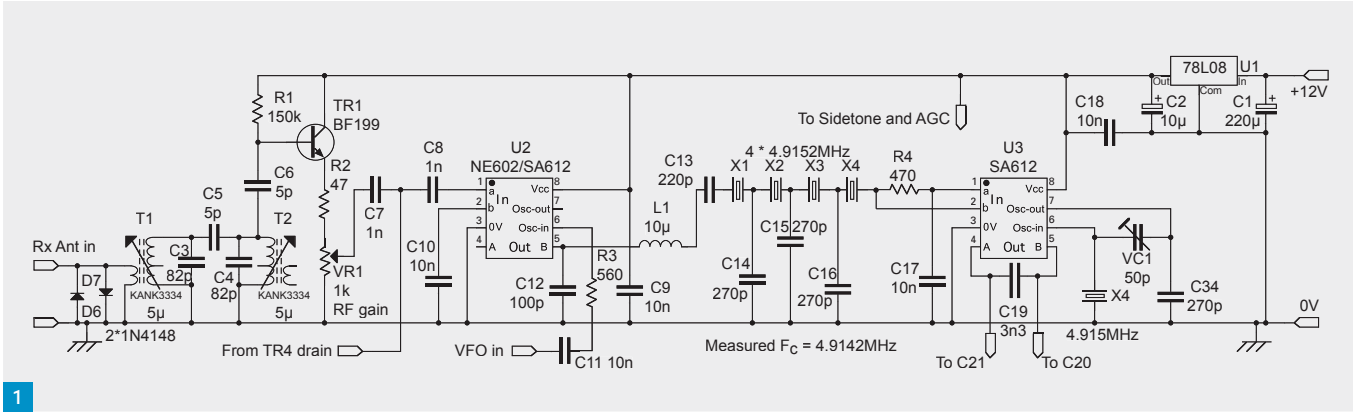
Firstly, we're going to make sure the mixer 'looks at' the right impedance so that's the job of L1 and C12. These also act as a basic lowpass filter. Next, we're going to filter off pretty much everything we don't want, and that includes the 9MHz signal the mixer also produced. X1 to X4 form a crystal filter network. By design this has a pretty narrow bandwidth. Because we're building a receiver dedicated to CW we don't need a very wide filter. An SSB signal takes between 2 and 3kHz so you need a filter that wide to hear it all but a CW signal is one frequency.

However, if our filter bandwidth is too narrow, you won't hear anyone who's not transmitting very close to our receive frequency. If it's too wide, you'll hear lots of other signals you're not actually trying to listen too. I find a bandwidth of 500Hz to be a comfortable compromise for CW. Our little filter doesn't have razor sharp edges either, so you'll still hear other signals but they shouldn't be intrusive. Keen construction enthusiasts might admonish me for not mentioning crystal matching here. I did actually test a handful of mine and picked four close ones but they didn't vary by more than 100Hz anyway. In practice, in this receiver, I'd be surprised if it would make a noticeable difference.

The Product Detector & BFO

More mixing? Oh yes. So, we have our 4.915MHz CW frequency (or thereabouts) coming out of our crystal filter. In reality,

Fig. 1: Circuit of the RF section of the receiver board. Fig. 2: Component layout.



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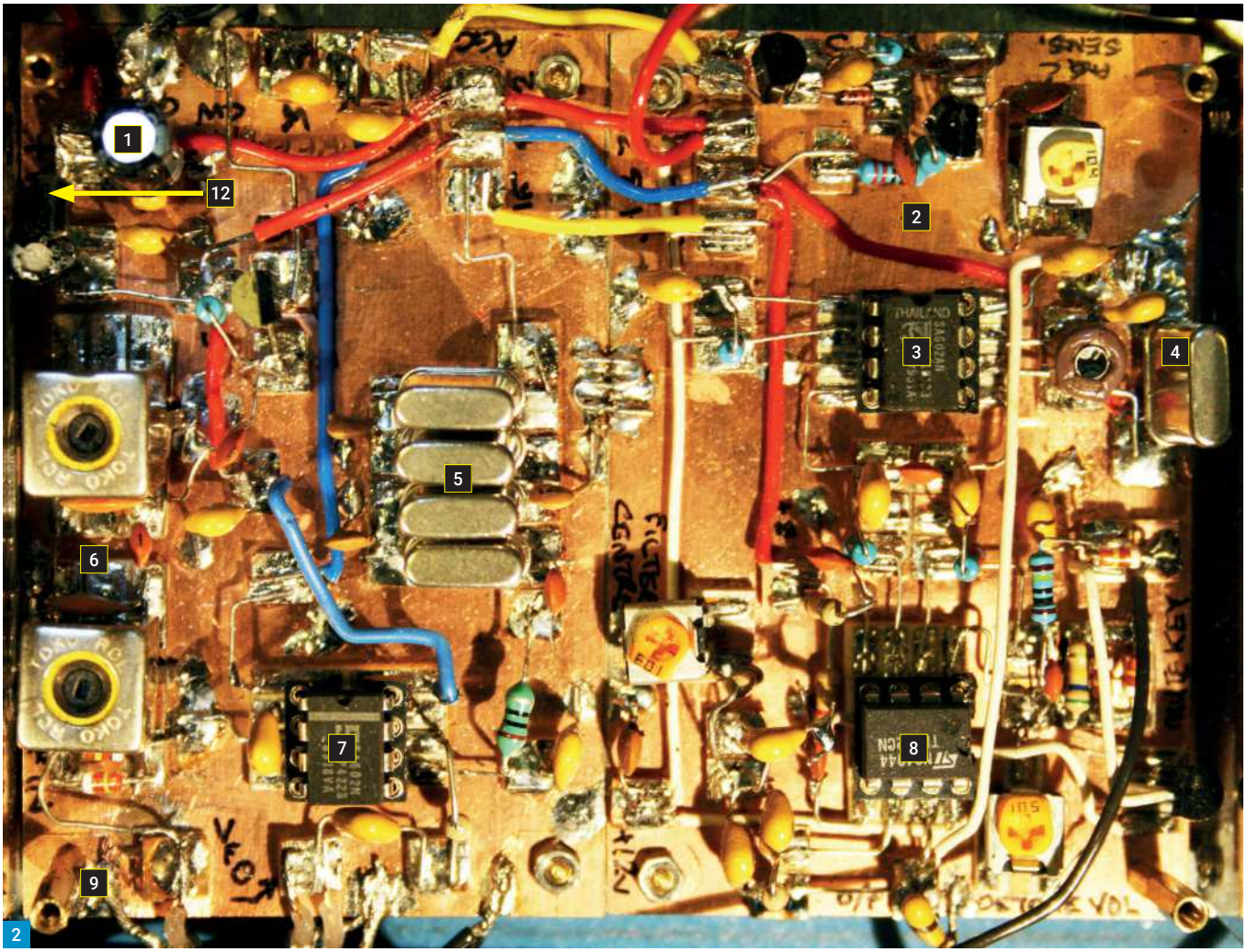


2

1. C2 2. AGC 3. U3 4. X5 5. Crystal Filter 6. Input Band Pass Filter 7. U2 8. U4 9. ANT 12. To U1.

the centre of the passband of our crystal filter won't be bang on 4.915MHz as you might expect. It is more likely to be a few hundred hertz lower. When I measured mine it was actually 4.914200MHz but for the sake of this explanation let's assume it was bang on at 4.915MHz. So, what happens if we mix that with another signal whose frequency is very close to our 4.915MHz? Let's say 4.914400MHz.

That's just 600Hz difference. That, you might notice, is an audio frequency. This operation is called 'beating' the two frequencies, so we call the oscillator part of this circuit the BFO (Beat Frequency Oscillator). As before, the mixer produces mostly two products, 4.915MHz + 4.914400MHz = 9.8294MHz, which is absolutely no use to us whatsoever, and 4.915MHz – 4.914400MHz = 600Hz. Now that is an audio tone. Bingo. Luckily for us, an NE602/SA612 can also be configured to use its own internal oscillator. So, we'll use another 4.915MHz crystal with that and then we're going to 'pull' it a little by putting in a small capacitor – VC1. We can now 'tune' our BFO to give us our desired beat note with our 4.915MHz IF signal. It doesn't matter if we beat our oscillator with the IF signal above or below it really.

Receiver Board Component List

Resistors
All Resistors are ¼ or ⅓ Watt Carbon

R1	150kΩ
R2	47Ω
R3	560Ω
R4	470Ω
R5, R6	10kΩ
R7, R8	560kΩ
R9, R16	1MΩ
R10, R14	1kΩ
R11	100kΩ
R12, R13	220kΩ
R15	22kΩ

Capacitors

C1	220µF Electrolytic
C2	10µF Electrolytic
C3, C4	82pF Disc Ceramic
C5, C6	5pF Disc Ceramic
C7, C8	1nF Multilayer Ceramic
C9, C10, C11, C17, C18, C20, C21, C29, C30, C31	10nF Multilayer Ceramic
C12	100pF Disc Ceramic
C13	220pF Disc Ceramic
C14, C15, C16, C34	270pF Disc Ceramic
C19	3.3nF Multilayer Ceramic
C22, C23	150pF Disc Ceramic
C24, C27	1µF Electrolytic or Tantalum (Observe polarity)
C25, C26, C28, C32, C33	100nF/0.1µF Multilayer Ceramic

Variable Capacitors

VC1	50pF Miniature variable capacitor

Variable Resistors

VR1	1kΩ front panel style or similar
VR2, VR3	10kΩ Miniature trimmer pot
VR4	1MΩ Miniature trimmer pot

Inductors

T1, T2	10K Style (KANK3334) 5.3µH 10mm RF transformers (Still available from Spectrum Communications who sell on eBay or from G-QRP Club Sales for members only).
L1	10µH small axial inductor
X1 ~ X5	4.915MHz Computer Crystals: I bought 100 very cheaply on eBay so if you have trouble finding them, email me. I still have plenty. If you find another value, e.g. 4.333MHz, you will need to adjust the VFO accordingly but the rest of the rig should still work fine. You will need six crystals for the complete project.

Semiconductors

TR1	BF199 low noise bipolar
TR2	2N3819 FET
TR3	BC337/2N2222A etc.
TR4	2N7000 MOSFET
D1 – D7	1N914/1N4148 small signal diode

Integrated Circuits

U1	78L08 8V Regulator
U2, U3	NE602 or SA612 Mixer
U4	TL072 Dual OpAmp

Miscellaneous
The usual for all boards
3 x 8pin DIL Sockets for ICs
Hook-up wire
Thin screened cable eg RG174 or similar
Copper clad board for ground plane and islands

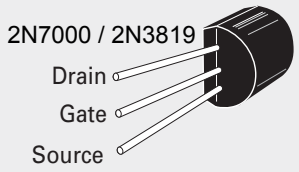
Either will produce our desired 'CW note'.

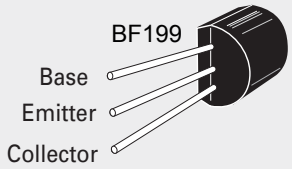
The output of our mixer can also be configured as a differential output. If you're not familiar with that term, thinking dipole versus end-fed wire might help if your antenna theory is up to scratch. The inputs of Operational Amplifiers (OpAmps) are also differential so in the next part we're going to use that differential signal to feed our first audio stage. In case you're wondering what happened to our 9.8-odd MHz signal from the mixer. Well, some of it will be suppressed by C19 and in all honesty, it's too high for the first audio stage to do anything with so it will ignore it.

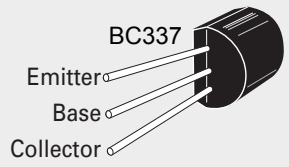
Construction

Well, that was quite a lot to take in but I hope it satisfactorily explains how the RF section of our superhet receiver works. If you run into any problems during construction and testing, it always helps to have a description of just what a circuit is supposed to do alongside the diagram.

Now we turn to converting our circuit into a working board. Take a look at my layout, **Fig. 2**. By now you should be getting the idea of how to build with the Manhattan method. You'll notice I split my receiver board into two parts. There's no need to do this. My original plan was to make all the boards the same size but I quickly abandoned that idea when I ran







out of space building this board. If you make the whole receiver on one board, you'll end up with a bit more room than I did.

I find it easier to build and test as I go. Start with the input bandpass filter. I have a nanoVNA, which is brilliant for testing filters among other uses but an RF signal generator, together with an oscilloscope, will also work well. Apply the signal at the antenna connection and keep the levels low-ish. Millivolts rather than volts. Monitor the output with the 'scope and measure where the signals peak by varying the frequency of your Sig-Gen across the 40m band. Ideally you want them to be peaked by 7MHz and stay fairly level until 7.1MHz. The main thing is that it doesn't peak too early. There could be some big broadcast stations around 6.9MHz and lower and we want to block these out.

Now you can build the RF preamplifier and test that. Then build the first mixer and apply the VFO. The output will look a proper mess but by the time you've built the filter you should see a nice signal around 4.915MHz. You can use your frequency counter to measure this and find out where it peaks. You should even be able to measure it with the little frequency display we're going to use. Once you know the peak frequency of the crystal filter you can use it to set up the IF offset of the frequency display. If you've not already downloaded the instructions for the digital display, you can find them here:

https://tinyurl.com/4yb3evm3

If it's working properly, when the frequency display is connected to the VFO it will display from around 7.000.00 as you tune up the band. When you get to the frequency you're injecting in the front end, with your RF signal generator, you should see the signal appear on your 'scope, at your IF frequency of course. If not, try and trace it backwards until you find it. It's easy to make a simple mistake that prevents a circuit from working.

Here's a few construction tips that work for me. If I'm building a complicated stage like this, I will stop after a couple of hours and do something else such as actually operating and making CW contacts. I'll usually return to it the next day or so. There's a lot to be said for 'sleeping on it'. Then I will check it all against the circuit diagram again with fresh eyes. I've found lots of simple, stupid mistakes this way. Before applying any power I will also measure the resistance from the power rail to ground. If it's a dead short or even very low, I know I've messed up somewhere.

That said, I've still blown up my share of transistors and ICs over the years. Check ICs are mounted the right way around. It's easy to get an IC plugged in a socket back to front. Check the legs of transistors are connected to what they should be as well. Ensure electrolytic and tantalum capacitors are correctly polarised. They can go pop if they aren't! The hardest component problem I ever had to trace was when a supplier sent me some transistors that didn't conform to the pinout on the datasheet. That's extremely rare and I hastily pointed it out to the supplier who was as surprised as me (after he'd checked them for himself). What a nightmare! At least it wasn't my fault that time. I very much doubt you'll come across that problem so don't worry.

In the next part we'll go over the audio stages at which point we will end up with a working receiver.

Bernard Nock G4BXD
military1944@aol.com

1

Valved Radio Repair (Part II)

Bernard Nock G4BXD discusses safety before moving on to types of valve and some basic circuits.

Carrying on from my first part about repairing old valved radios, about getting some tools together, some test equipment items and finding a nice warm, brightly lit place to work we can now look at valves and start with power supplies.

Safety

A quick reminder. Safety at all times. You may well have invested in an isolation transformer. Another useful item is an RCD. This is another device that can add a factor of safety to your workshop. Many people have plug-in units inserted in the wall socket into which they then plug their lawnmower and such and cost just a few pounds online.

A **residual-current device** (**RCD**), or **residual-current circuit breaker** (**RCCB**), is a safety device that quickly breaks an electrical circuit to protect equipment and to reduce the risk of serious harm from an ongoing electric shock. These electrical wiring devices are designed to quickly and automatically isolate a circuit when it detects that the electric current is unbalanced between the supply and return conductors of a circuit. This is another area where a bit more reading would be beneficial.

Valves

Anyone new to the hobby probably knows what valves are, **Fig. 1**, but may never have had a radio with them in, let along worked with them on the bench. Valves, though, are fairly straightforward. They have a heater, which makes them glow in the dark, and they require a higher voltage than normal to operate. This will, of course, be a very simple overview of valves and additional reading is recommended to fully appreciate the beauty of these glass tubes.

Usually, the heater is a 6.3V type but sometimes an unusual voltage as you'll see later. You have a cathode (k), one or more grids (g) and an anode (a). The cathode is usually near zero volts, grid 1 is usually slightly negative with respect to ground and the anode has the high voltage on it which in a typical receiver could be 40 to 200V or so depending on its job in the set.

The first valve you'll need to know is probably the rectifier valve. Without DC power the set is not going to work so it's usually the power supply that needs looking at first. There are many rectifier valves. Typical numbers include 5U4, 5Z4, 5Y3, 6X5, EZ80, EZ81, GZ34 but a search online will reveal many other types. Basically, though, they all work the same way. It's just the voltages and currents they handle that will change.

So, in a transformer-type PSU let's take a 5V4 circuit. This is a rectifier with a directly heated cathode and two anodes and forms a full wave circuit. The AC from the transformer is fed to the anodes, the directly heated cathode supplies the DC output, which is smoothed by the filter capacitors to power the set. You would be measuring AC volts at the anodes and DC voltage at the cathode or across the filter capacitors. It's usual to have two heater windings, one for the rectifier and another for the rest of the set.

In an AC/DC type set you might find typically U type valves used. The rectifier might be the UY41, a single diode this time as you're rectifying only the one side of the mains voltage. In a typical AC/DC set all the valve heaters are wired in series with a large dropping resistor to use up the remaining volts. Again, you measure AC volts at the anode and DC volts at the cathode.

If your valve has one grid, anode and cathode, it is a triode, **Fig. 2**, and if it has three grids it's called a pentode, **Fig. 3**. There are, of course, many other types and constructs of valves and they vary in size from small types used in receivers and even miniature types that were used in hearing aids to enormous types used for transmitters and really high-power applications. Types of valves is another ideal subject to read up on:
www.r-type.org/articles/art-001.htm

Cathode: k The cathode is heated and emits electrons into the evacuated envelope.

Control grid: g1 The control grid is commonly maintained negative with

Fig. 1: Valves.
Fig. 2: Triode valve.
Fig. 3: Pentode valve.
Fig. 4: Triode circuit.
Fig. 5: Pentode circuit.
Fig. 6: AC supply.
Fig. 7: AC/DC supply.

respect to the cathode and is used to control the flow of electrons between the cathode and anode.

Anode: a The anode or plate is operated at a high potential and it is the electrode to which electrons are ultimately drawn in the pentode or any other valve.

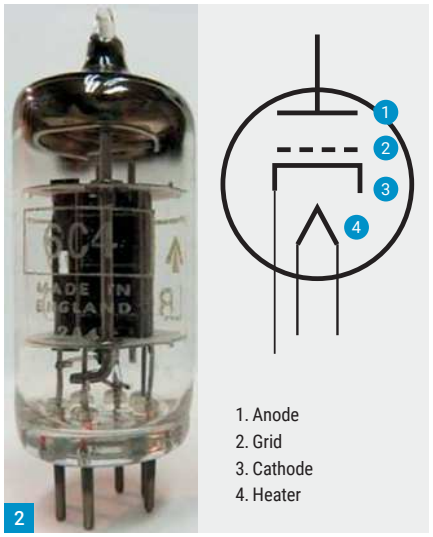
In the pentode there are two further grids, the screen and suppressor grid.

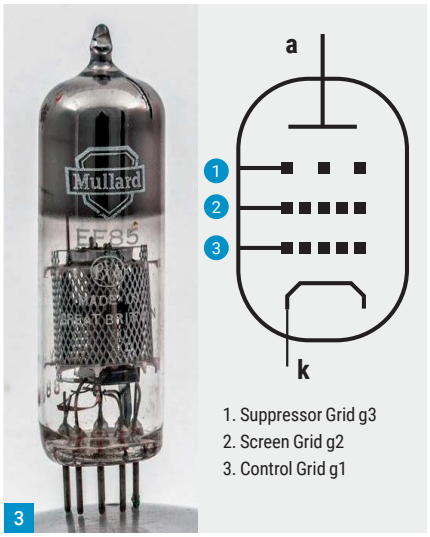
***Screen grid:* g2** The screen grid is operated at a fixed positive potential, but below that of the anode and provides screening between the anode and control grid, improving the performance. It is decoupled to ground using a capacitor to ensure that the screening is effective.

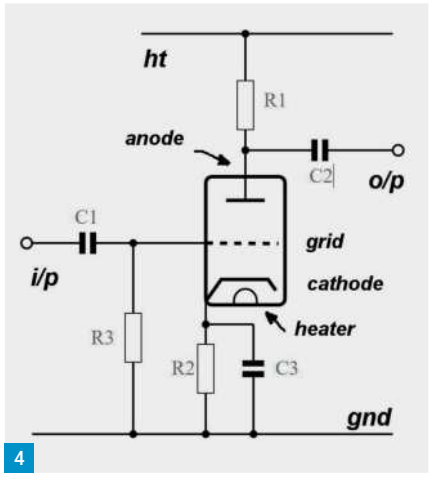
Suppressor grid: g3 In the pentode valve, the suppressor grid is generally maintained at a low voltage, often connected directly to the cathode. Its function is to create a lower voltage region between the screen grid and the anode. It suppresses the secondary emission where high energy electrons hitting the anode at high speed have a tendency to bounce off. This effect causes a kink in the response curve of tetrode valves. In this way it enables the pentode to provide a high amplification factor along with the ability to operate at high frequencies (see URL below).
https://tinyurl.com/mr2ucau8

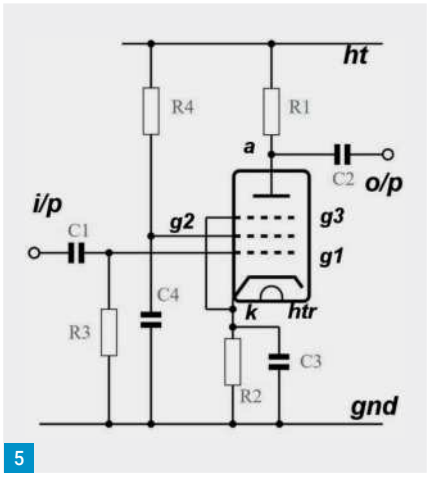
Valves work in a similar way to transistors, or rather, transistors work like triodes. A small signal in and you get a big signal out. In the triode circuit, **Fig. 4**, the input signal is fed to the grid. Between grid and ground is a resistor across which the signal is supplied. Between the anode and the HT or voltage rail is another resistor. The varying current caused by the input signal is converted to a varying voltage, which is bigger than the input signal and hence an amplifier is born. The resistors can be replaced with tuned circuits to work with radio frequencies, as intermediate amplifiers, RF amplifiers or oscillators.

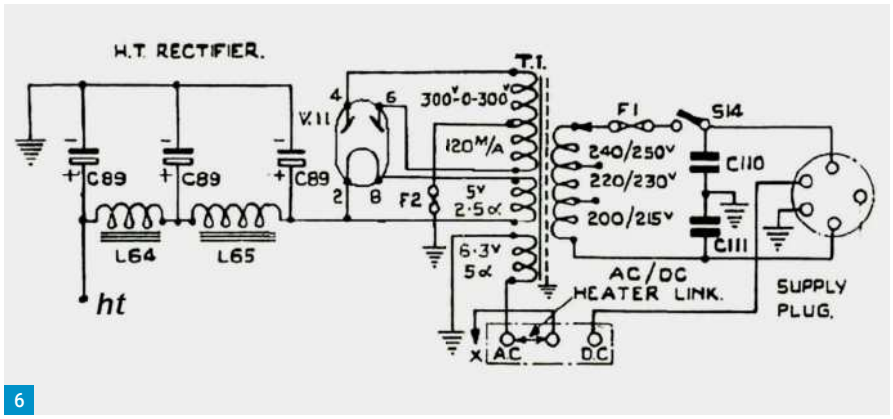
In a pentode circuit, **Fig. 5,** the input and output resistors can again be tuned circuits for RF operations. To get a better understanding of the triode and pentode valves I suggest you watch a vintage US Army film about valves (they call them tubes) on YouTube. The address is:
https://youtu.be/acGXBJv6AT4









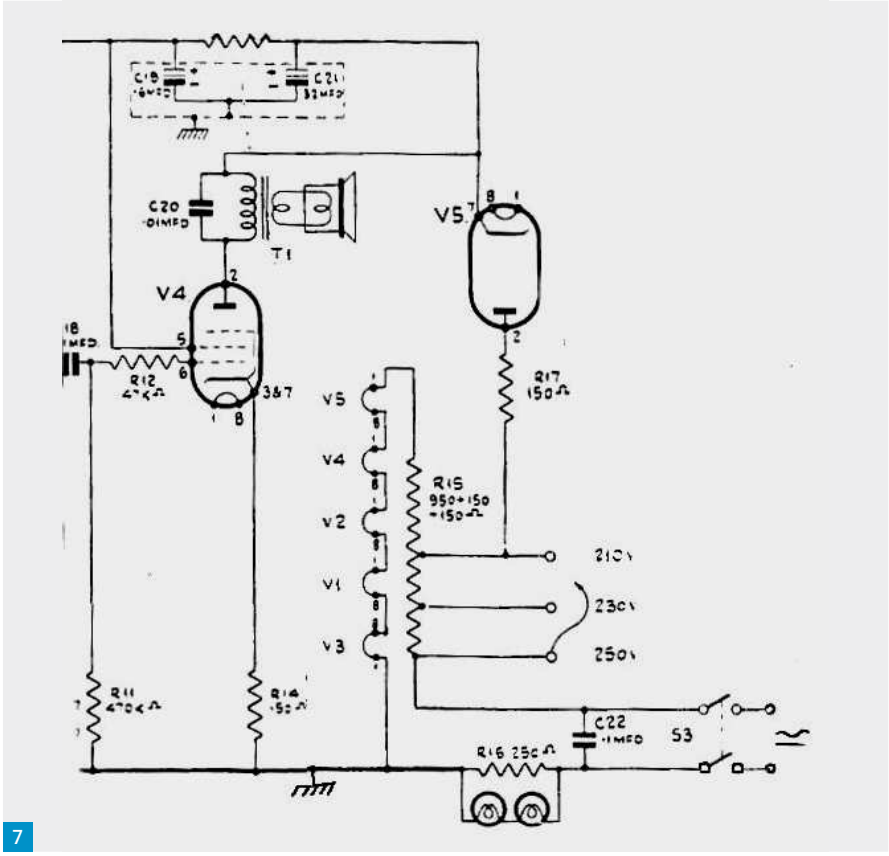


Power Supplies

The transformer type of unit converts the incoming AC mains to usually two outputs. A low voltage supply for the valve heaters (which run off AC) and a high voltage output, which for standard receivers will be around 200 to 250V or so but in transmitters can be much higher.

Let's look at a typical PSU. This one, **Fig. 6**, is that of the CR100 receiver. We can see a transformer, T1, which takes the AC mains input and in this case gives three outputs, a 6.3V heater supply, a 5V heater supply for the valve rectifier and the main HT supply of 300-0-300V, which goes to the rectifier valve, gets changed to a DC voltage and passes through L65 and L62 with filter capacitors C89 to give the 250V or so DC needed by the set.

In an AC/DC type of set, DAC90A in this case, one side of the mains, **Fig. 7**, goes to the chassis. You should ensure this goes



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to the Neutral of the mains plug used. In this set the dial lamps are fitted there and one side gets rectified for the HT or high voltage supply and also feeds the valve heaters. A neon screwdriver is a handy tool here.

In AC/DC sets the valves usually have their heaters wired in a chain, series connected and the valves used all draw the same current, in this case 100mA. The various voltages are added up. Here it's 116.6V needed for the heaters, so a dropper resistor is needed, R15 in the circuit. Assuming a 250V AC supply (will be less in reality) a resistor of 1334Ω is needed to drop the remaining 133.4V. In the set a 1250Ω with taps is used so different mains voltages can be accommodated.

Switch on

So, with a mains lead connected and the fuse checked in the plug (a 13A fuse is a NO NO, fit a 2 or 3A before you start), the back is removed and set switched on. If the valves light up, we are on to a winner. If they do not light up, we need to start measuring. Now is the time to remove the chassis from the case. On this set the control knobs are held by screws you access from two holes under the case and a long shaft screwdriver in the rear for the wave-change knob.

The black lead on my multimeter can be fitted with a croc clip on the end but both leads should have good insulated handles, any cracked or frayed leads should be thrown away. This way I can clip one on the chassis and lean back when measuring. Meter 250V AC, one lead to chassis and one to the top of the dropper or one of the clips. Check there is voltage at both ends of the dropper. If not, it's probably open circuit. If there is voltage, then one of the valve heaters might be open circuit so you will need to find the heater pins and work your way along until you find the fault.

Hopefully you will have a circuit diagram of the set you are working on so you can trace your way along, checking 240V AC in, a voltage at the end of the dropper if AC/DC, switching to DC the voltage out of the rectifier and the voltage after any smoothing resistor. Many times it's the large capacitors, 8-33µf at 400V or so in the power supply, that are bad. If you have a meter, you can measure them but I usually just change them. Measure the big resistors and replace any burnt or cracked ones.

I usually take out all the valves while I am checking the power supply so that I can get that up to specification first before tackling the signal side of the set. Next time I'll look at the audio, IF and RF stages.

Radio Round-up

WORLD QRP DAY: If you have ever wondered what your station could achieve with low power, why not give it a try on World QRP Day, 17 June? The day was designated by the IARU to promote the use of lower power and the G-QRP Club awards the Suffolk Trophy to its member with the best log of contacts made on the day. If you are not a member of the G-QRP Club, you can still turn your power down and see what you can do with 5W of CW or 10W of SSB or data.
There are CW and SSB Centres of Activity in all HF bandplans, and, with Cycle 25 on the up, there should be plenty of DX to be worked, especially on the higher bands. Higher power stations are asked to respect the internationally agreed Centres of Activity and allow the QRP operators to enjoy their chosen side of amateur radio, especially on IARU World QRP Day.
www.gqrp.com/freq.htm

ZORRO JH1AJT – SILENT KEY: Well-known Japanese amateur 'Zorro' JH1AJT died on 22 March after a long battle with cancer. Until the end, he was optimistic; cheerful; and most importantly, concerned for his fellow human beings, especially disabled children. Through his schools and his humanitarian trips in Asia and Africa he brought a better life to all of those he touched. He operated from, and led humanitarian expeditions to, places as diverse as Eritrea, Bhutan, Laos, Myanmar, Cambodia and Bangladesh.
He also contributed generously to DXpeditions and encouraged and mentored operators.

TAPR NEWSLETTER: The Winter issue #151 of TAPR's quarterly newsletter PSR is available for free download. TAPR – The Tucson Amateur Packet Radio group – was behind early packet radio developments in amateur radio, and continues to innovate with APRS (Automatic Packet Reporting System) and other packet radio based applications. Leading light Bob Bruninga WB4APR passed away in February but the organisation continues to thrive as a look at their website will demonstrate. The latest newsletter includes: President's Corner, Digital Communications Conference, 80m & 160m WSPR Transmitters. Now Available, GRCon22 on Sept. 26-30, WB4APR – SK, N1URO – SK
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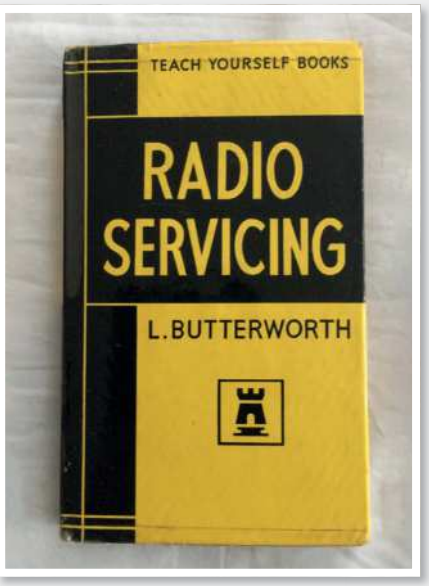
Memories of PW in the Sixties

Dear Don,
In the past few months I've greatly enjoyed reading your column on the history of *PW* through the decades. As a schoolboy in the early sixties, my pocket money often wouldn't stretch to buying magazines first-hand, but I would usually have sight of one, by various means! From about the age of 13 I listened on the household Bush radio to shortwave broadcast stations and local amateurs on topband at the edge of its medium wave coverage. I progressed to build a 90V battery-operated receiver from a *Boys Own Paper* design. I had no metalwork facilities, so the chassis and front panel were fabricated from hardboard covered with aluminium foil. Holes and cutouts were 'drilled' by punching out with a hammer and large nail. It worked! My older sister gave me a copy of *Teach Yourself Radio Servicing* (see photo) one Christmas, and from there I gained the confidence to delve into mains-operated equipment. I used to visit WH Smith when I needed a valve, so that I could browse the *PW* adverts to find what I wanted and order it. I know I wasn't the only schoolboy using WHS as a free reference library at that time! However, I began to take in radios and Dansette record players for repair, and was able to make a small profit, and of course then buy *PW*. I recall a price of 3s/9d around the mid-sixties for the magazine, which I believe was still pocket-sized then.

I recall that *PW* published a sample question for the long-hand version of the RAE each month. I used to mull these difficult questions over, and thought it would be something I would never understand fully. However, after completing 'O level' physics, and moving on to 'A level' physics, and with the help of *PW* articles and RSGB books, I passed the RAE in 1969, and then the Morse test in 1970. To my delight I received one of the last G3 callsigns at the age of 19, while studying electronic engineering at Leeds University, where there was a thriving amateur radio society.

I acquired a semi-working 19-set for £5 and also built the RSGB version of the Codar AT5. Both projects needed a lot of perseverance and help from others to become operational. I've stayed with the hobby throughout life and I'm now using weak signal data modes on many bands, especially 630m, and digital colour TV on 23cm at the other end of the spectrum. I take *RadCom*, but always look forward to the practical approach I find in *PW*. As you're aware, over the last few years I've had the privilege of writing five articles for *PW*. It's been a long journey from when I couldn't grasp the questions in the sixties! To all those starting in or returning to the hobby, I would say never be afraid to ask for or to accept help – your goals are usually achievable. Keep up the good work with the magazine – you have many devoted readers.



John Adams G3ZSE
Kettering, Northants.

QuoVadis – Amateur Radio

Dear Don,
To my mind, one of the finest hobbies one can cultivate and get involved with is amateur radio.

Licensed in 1979, my involvement grew from just an interest to a passion spanning 43 years up to the end of 2021 when I sold off all my HF/VHF and UHF equipment due to retirement village restrictions.

However, now I am embarking on a totally new 'adventure' – the abundance of software available on the internet.

I just felt, that after my 'coax was cut', why must anybody kiss the hobby goodbye. This is a problem faced by many retiring who find themselves cut off from the outside world. On the contrary – there is an abundance of networks available through which I am building up a totally new circle of friends.

The other problem facing amateur radio is the lack of control of equipment sold to Industry that does not comply with interference on the amateur bands. The level of electronic interference on most bands is now almost untenable.

Amateur radio enthusiasm is on the wane, probably due to the cost of new equipment that has gone through the ceiling. In many countries the financial rate of exchange has made the purchase of equipment just a dream.

In some countries, even Governments are getting involved into amateur radio, not as operators, but in an effort to generate an interest in the hobby. Possibly the lack of new technical and innovative developments, which so often in the past came from the shack of radio experimenters!

Historically, the vast majority of innovative and technical advancements in communication worldwide came from the bench of some

enthusiast – trying something new! This will never stop but we need to generate a new interest in this hobby.

The internet offers an open window to good communication worldwide – in a very supportive way. There are many avenues open to all licensed amateurs to communicate and share information.

HF, VHF and UHF will never die. Once propagation improves on HF, all the supportive communication done via the internet, new ideas, sharing and solving problems, will allow all of us to continue where we left off.

The popular alternative means of communication include Echolink, especially the new CQ advantage. Dude Star – a window to DMR and D-STAR communication. Allstar Link.org – opening up communications to many repeaters and networks worldwide! The Peanut, developed specifically for amateur radio with various rooms in which one can communicate in different languages and specific countries.

These are but a few internet links. The radio procedures are strictly according to the 'book' and no outsider may join to operate. Discussions often are extremely technical and with good communication and many a problem being solved.

The hobby will always continue and hopefully expand in time. Sharing information, even via Video Conferencing has in many cases resulted in a serious problem not just being solved but even improved on!

Let's make use of what is available – not just via the magnificent ease of communication but in an effort to expand the hobby and create new interest!

Francois Botha ZS4X
Bloemfontein

(***Editor's comment***: *Thanks Francois. We do indeed cover internet-connected amateur radio in the pages of* PW *and I recognise the popularity and benefits of these modes, particularly, as you say, for any of our number who are constrained in terms of antennas and so on. Let's remember, though, that there are also great benefits from being independent of the internet, whether for emergency communications, community support and the like. Horses for courses!)*

Linear Amplifiers

Dear Don,

Now, there's a thing that can get a DXer's pulse racing into overdrive, linear amplifiers.

Never being a proud owner of a linear amplifier (although I have operated them in other people's shacks) myself, for some strange perverse way after reading HB9ANY's and G4USI's compelling articles, I came over all wistful. For one fleeting moment, I felt I had to whip out the plastic and purchase one, immediately. Really. Luckily, that momentary frisson soon faded.

However, over the years, I must confess that sometimes, especially when conditions on HF have not been conducive operating wise, I began to think that maybe a linear amplifier perched on the shack bench would somehow bring more joy back into what is occasionally, an exercise in sheer futility. At least I might be heard!

Back in the late 80s and 90s, I got all excited with 2m SSB. The addiction got so bad, I nearly rushed out and bought a B.N.O.S amplifier (the one given prime position in G4USI's article). But, as **Daimon** rightly points out, why bother splashing out a bundle of cash on an amplifier when you could spend a lot less on a cheaper remedy. A Yagi antenna with heaps of gain. 'An ERP of about 2,820W', for example. Being a cheapskate, I bought the best VHF antenna instead. Wow, what a difference that made. And without a linear amplifier.

My mate **Wayne** (now an SK) had one of those Kenwood TL-922's. And what a bang you got for your buck! My commiserations to **Don** (*PW* editor) who 'loaned' his TL-922 'to a local club' where it was subsequently 'blown up by a club member'. A bitter blow.

Ray Howes G4OWY/G6AUW
Weymouth

G4UNL

Dear Don,

Regarding the enquiry about G4UNL by **Kevin G0HBL** (*Letters*, April).

I am so sorry to have to report that **Roy Charlesworth G4UNL** went silent key early in February 2013 from pneumonia following a short stay in hospital in Koronadol City, southern Philippines. He is survived by his wife **Marie G0WWZ**.

Roy was one of life's characters, he was a great organiser and touched many lives. He had been a driving instructor and ballroom dance instructor until an injury to his foot forced him to quit. He founded the Hoddesdon radio club and also a Scalextric slot car club in Edmonton, which I believe is still running.

After retiring he sold up and moved to the Philippines around 2001 where he became involved with the local Rotary club.

Still organising local charity projects and once a year on his birthday hiring two or three open-back trucks and taking all the local children and parents on a day out to the beach for a picnic (no such thing as health and safety in the Philippines), which everyone enjoyed.

He was active on IOTA with frequent pile-ups operating as DU9/G4UNL and he also regularly hosted SEANET (South East Asia Net) on the 20m band as well as regularly monitoring the

Australian emergency travellers net as he had a very good signal path to VK.

Roy and I corresponded regularly for many years by post and by audio letters on cassette when radio conditions were unfavourable. I went for a visit to his home in 2010 where I met my own wife. The picture is Roy at my wedding in Koronadol, Mindanao Island, Philippines in June 2012.

I have already been in touch with Kevin G0HBL. Possibly other readers may be interested.

Alan Crickett G4WIP
Herts.

Amateur Radio on Stamps

Dear Don,

It always gladdens my heart when I see that another country, this time Greece, has decided to celebrate amateur radio on its postage stamps (*News*, April 2022). The USA, the Pitcairn Islands (their association with **Tom Christian MBE VR6TC/VP6TC**), Israel, and many other countries have done the same thing. Unfortunately, and even though I and many other people have tried to persuade Royal Mail countless times to issue a commemorative set of stamps to honour amateur radio, our collective requests have fallen on deaf ears. Has the RSGB ever contacted Royal Mail to consider an amateur radio commemorative stamp issue?

Historically, amateur radio in the UK has been in the forefront of communications technology. And as most of us know, many amateurs played a key role during WWII acting as interceptors, etc. The list of amateur radio involvement in many sectors of RF research is a long one. Whether it be on a proverbial kitchen table, or wherever.

So, it is very galling when Royal Mail celebrates popstars, TV programmes or films on its commemorative stamps, but ignores what is and what was a vital link between the activities of amateur radio operators and the advancement of communications that benefits everyone in the UK and beyond. Even though, I should add, some forms of communication can leave a lot to be desired. Social media and such like.

As a stamp dealer (50 years and still count-

ing), among a couple of other professional pursuits, I have always collected amateur radio related stamps for my own personal enjoyment. I also sell them if I have any in stock.

A few years ago, **Rob Mannion** (the then editor of *PW*), kindly published an article of mine detailing the story of amateur radio depicted on postage stamps. Perhaps if a lot more amateur radio operators deluged Royal Mail with requests for an upcoming amateur radio commemorative stamp issue, it just might happen one day soon?

Ray Howes G4OWY/G6AUW
Weymouth

A Tale of TVs

Dear Don,

Interesting to read 'a tale of TVs' from **Chris Murphy M0HLS** in the last issue (*Letters*). I too was in the radio and TV repair trade and remember that phrase well.

I left school in 1955 and went to work with a large local company in Norwich. I have often wondered how many TV engineers could turn up at the customer's house and diagnose the faulty component without even looking at the set?

It was easy when, as soon as the front door was opened, the strong smell of selenium drifted out. The half-wave selenium rectifier had failed and in the field a silicon diode and tag strip were mounted on the rectifier for a speedy repair.

In the yard we had an incinerator to burn all our cardboard etc, and didn't know that **Mike** (now a G3) had saved up a box full of faulty rectifiers and put them in the incinerator, that was until I was cycling back to work after dinner and the smell covered the entire Norwich market place, which was a few hundred yards from our workshop.

There must be many stories like that.

Paul Burgess G3VPT
Norwich

Bad Language

Dear Don,

I was puzzled by **Peter Norris's** comments in the April *Letters* column concerning the use of bad language, particularly on 80m and so listened in to a Midlands Saturday morning net while working on a project. The language used was appalling and should have resulted in those responsible losing their licences. Unfortunately, this seems to go unmonitored these days. There is no place for this behaviour in amateur radio.

Ron Taylor G4GXO
Penrith

The Joystick

Dear Don,

Had to smile! As a professional advertising man, I did the adverts for **George Partridge's** 'Joystick' (see *PW* at 90, April)! We knew each other via the original **John Whitehead's** 'QRP Society'. I think I hired as a model the glamourous sister of **Kathy Kirby**, one of our pop stars, with the photo showing her cuddling the aerial. Worked a treat.

By the way, the Joystick did actually work if just leant against the shack wall with a few feet of feeder but, naturally as I discovered myself, 100ft of wire from shack to aerial at the top of the garden was most effective.

Victor Brand G3JNB
Shefford, Beds.

Water Treatment

Dear Don,

It was a shame **Mr Moss** (Star Letter, April 22) thought he needed to throw a bucket of water on anyone who was willing to have a go in an area of the hobby that was new to them. Having started in amateur radio at 16 with only mains powered valved equipment, the transistor had only just been invented when I started, and having very little thoughts of Health and Safety, electric isolation, fuses and the like it's amazing that after 50 odd years of messing I'm still alive apparently. I believe a good indication of the potential dangers were made apparent in my article so that anyone thinking of playing with valved gear would have understood what measures were needed. Safety yes, the Nanny state no.

Bernard Nock G4BXD
Kidderminster

Next Month

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

REVIEWED: The editor Don G3XTT evaluates a couple of interesting antennas from Moonraker, a vertical for 4m and a portable antenna for 20 through 10m. And Daimon Tilley takes a look at the latest radio from Xiegu.

A COMPACT 50-TONE CTCSS ENCODER: Many amateur radio repeaters now use Continuous Tone Coded Subaudible Squelch (CTCSS). Installing a low-cost CTCSS encoder is a simple way to restore or extend the life of legacy FM transceivers. Andrew Woodfield ZL2PD describes a solution.

AMATEUR RADIO ON A BUDGET, PART EIGHT: Daimon Tilley G4USI takes a look at the shack receiver.

LAB TUTORIAL: Jeff and Natalie discuss powers, logarithms and decibels.

VALVE AND VINTAGE: Philip Moss looks at the KW201 receiver.

There are all your other regular columns too, including HF Highlights, World of VHF, PW at 90, The Morse Mode and Data Modes.

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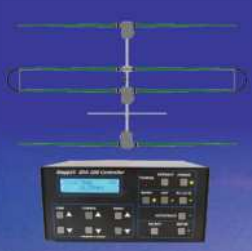

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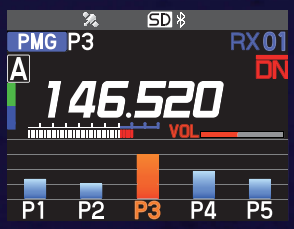

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The Battle of Britain
IN COLOUR

"Praise where due. This is the best magazine available which I have read - I am very impressed. I thoroughly enjoyed reading each chapter and it was written in such an easy style. It covered every aspect and I was saddened when I reached the end."

This 164-page special collector's edition commemorates the 80th Anniversary of the momentous Battle of Britain, making it the perfect gift for any aviation or Battle of Britain enthusiast.


THE BATTLE OF BRITAIN IN COLOUR

The Battle Looms

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

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

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

Predicted Catastrophe

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

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

BACKGROUND TO BATTLE

THE RAF FIGHTER PILOT

THE RAF FIGHTER PILOT