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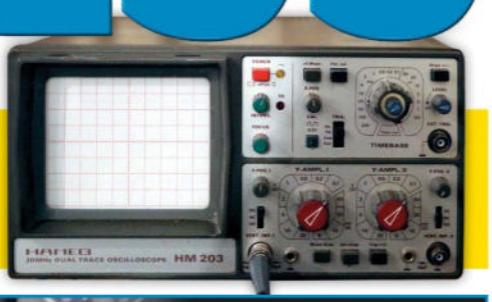

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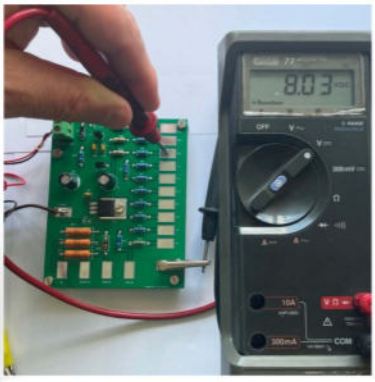

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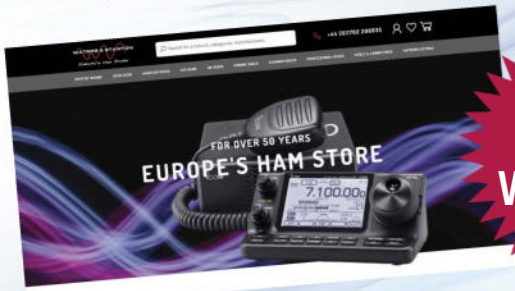

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Our new website is now operational and will be populated with some 4000 plus product entries. Take a browse through to find all kinds of useful products. Add them to your basket and we aim to ship same day for orders placed by 2pm.

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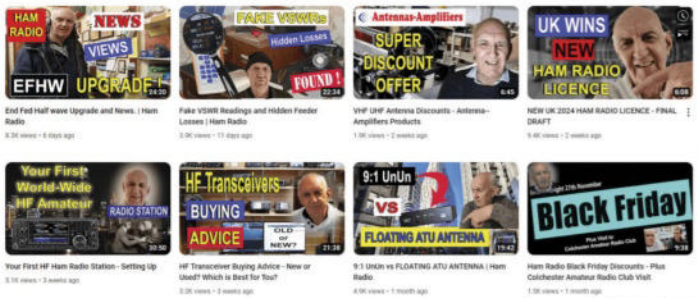

The channel is hosed by **Peter G3OJV**. It's NOT a hard selling 'you must buy from us' channel. You probably do already! Peter runs it as an informative and friendly channel devoted to giving our advice on aspects of Ham Radio. Much of the subject matter is prompted by your comments. So check it out: YouTube, 'watersstanton'

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We can supply back issues, but we only keep them for three months. If you are looking for an article or review that you missed first time around, we can still help. If we don't have the actual issue we can always supply a photocopy or PDF file of the article.

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.

Keylines

Here in Somerset at least, the weather has been pretty miserable for much of the winter. High winds blew down my 20m Spiderpole, but fortunately it survived the experience – however, I have yet to put it back up. And my SteppIR was taken down at my son's place late last year while he was doing some work close by, and hasn't gone back up yet because the ground is so waterlogged! Hopefully, all will be put right before too long but only after I get back from East Africa – I will be off in February to join **Alan G3XAQ** in Uganda for the ARRL CW Contest, and we then travel to Kenya for a 'CW Dinner' being organised by **Andy 5Z4VJ (G3AB)**. I hope to be able to report on the trip in due course.

Ofcom Consultation

As you will see in our *Letters* pages, I have been taken to task on my interpretation of the rules regarding regional secondary locators (RSLs). I apologise if I have misled you, the readers, but I still find the wording confusing! And **Steve G0FUW** has told me he has spotted a few inconsistencies and omissions in the wording of the new licence proposals, which he has pointed out to Ofcom. As the leader of the (very successful) Bath Distance Learning courses, Steve is also concerned about the timings of any changes insofar as the training they offer needs to reflect changes to the licence examinations resulting from the new regulations.

A report from India

This month we have a report from India, something a little different. I was offered this and thought it worth including in the magazine because it gives a great insight into what is happening in the hobby in that major country. Too often we can become depressed at the state of amateur radio here in the UK, with too few youngsters coming into the hobby, so it's good to be reminded that amateur radio is thriving elsewhere, especially in Asia.

And from the Balkans

There is also a report on a trip to the Balkans by a very old friend of mine, **Chris ZS6EZ (ex-ZS6BCR)**. Chris was responsible for my very first serious DXpedition when he and I operated from Walvis Bay back in 1994 (my write-up appears on Chris' website, below).

https://zs6ez.org.za/stories/Walvis94.htm

I hope you enjoy Chris's tale – as well as being a long-time radio amateur, he is also an experienced and enthusiastic pilot (having been trained for service in the South African reserve Air Force) and, more recently, has taken to some serious running (Park Runs and marathons). He was also here in the UK over the Christmas/New Year period, to add some more 'countries' to his collection of places from which he has operated radio and flown – expect his write-up on that one in a couple of months or so.

Antennas and 10m

I hope you are enjoying the monthly *Antennas* column from **Keith G4MIU**. Over the past couple of months he has described building a two-element Yagi for the 10m band, a band that should really be coming into its own over the next year or two as we reach the peak of the emerging sunspot cycle. I have always enjoyed the 10m band when it is open, with worldwide propagation possible from modest stations. I recall an author in *Short Wave Magazine* referring to 10m disparagingly as 'a gimmick band' simply because worldwide contacts can be made very easily when it's open but, to my mind, that's what makes the band so much fun. After I got married and we bought our first house, with a very limited garden, I constructed a two-element quad antenna for 10m out of garden canes – it must have cost me all of about £2.50. Being a quad, it had a very short 'wingspan' so it fitted nicely into the space available and was light enough to be mounted on top of a 20ft steel pole which I could hand rotate from ground level. It was my first 'gain' antenna and completely transformed my operating – with 100W I really could 'work the world'. I never looked back!

Rallies

Finally, do you find our *Rallies* listings helpful? We rely on being notified of upcoming events, usually by the organisers – the good news is that I have recently received notices of several rallies coming up over the summer period.

Don Field G3XTT
Editor, *Practical Wireless* Magazine

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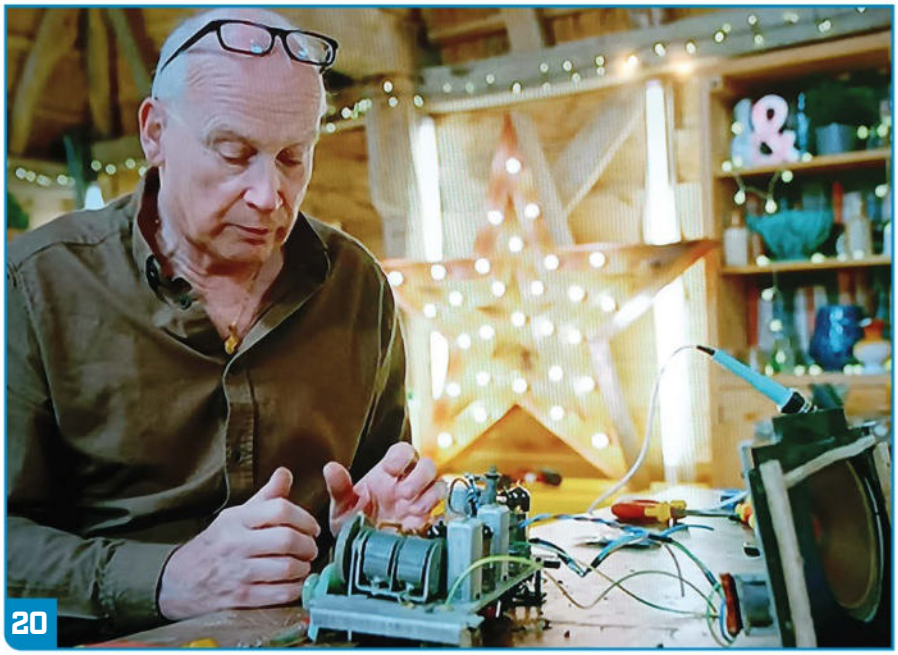
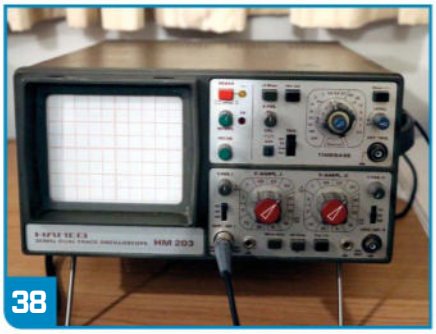




Newsdesk

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

British Amateur Radio Teledata Group (BARTG) Championship trophy 2023 presentation

The photo shows (on the left) BARTG's president **John Barber GW4SKA/GW0A** being presented with the BARTG FlexRadio trophy for winning the 2023 BARTG Championship. Presenting the trophy is **Tony Wiltshire M0TNY/ZB2TY**. Tony is the sales manager for Martin Lynch and Sons who are the UK distributor of FlexRadio. The Championship is run by BARTG and the trophy is very kindly sponsored by FlexRadio.
(Photo courtesy of Martin Lynch and Sons)
The BARTG Championship is for all SOAB (Single Operator All Band) entrants. All entries into the SOAB sections of BARTG's contests are automatically entered into the BARTG Championship. At the end of each year scores are normalised and the entrant with the highest score across all the contests wins the Championship and receives the BARTG FlexRadio trophy. We also have trophies for winners in other sections. Contest QSOs can also be used to apply for BARTG's awards.
More information is at:
www.BARTG.org.uk

PROPOSAL SUBMITTED TO ESA FOR GEOSTATIONARY MICROWAVE AMATEUR PAYLOAD: A proposal has been submitted to the European Space Agency (ESA) by AMSAT-UK, the British Amateur Television Club (BATC) and AMSAT-NA, with input from members of the UK Microwave Group, for a geostationary microwave amateur payload with planned coverage of at least part of North America. This proposal was submitted in response to a presentation at the AMSAT-UK Colloquium from Frank Zeppenfeldt PD0AP of ESA, who has secured €250,000 in funding to investigate the possibility of an amateur satellite or payload in geostationary orbit.
The proposal notes the desire for coverage of all ESA members and cooperating states, but that it is not possible for a satellite in geostationary orbit to cover the entirety of this territory, which ranges from Cyprus at approximately 34° east to western Canada at approximately 141° west and lays out example coverage from three slots: 5° west, 30° west, and 47° west. In a later section, the proposal also discusses two non-geostationary orbit options that could provide the desired coverage: a tundra orbit and a high earth orbit just below the geostationary belt.
The amateur radio and educational payload proposed consists of two 5.6GHz uplink and 10GHz downlink transponders (Mode C/x) – one 250kHz wide with 20 watts of output for narrowband modes such as SSB, CW, and narrowband digital modes and one 1MHz wide with 20 watts of output for wideband modes, including amateur television. The transponder design would include an optional SDR block for signal regeneration. Additionally, a 24GHz receiver would also function as a transponder uplink. The proposal also calls for a 47 or 74GHz multimode beacon or additional downlink transmitter, an earth-pointing camera with a still image downlink as part of the telemetry or beacon for educational outreach, and a red or near-infrared laser experiment aimed towards Western Europe. All downlink signals would be phase coherent with timing by GPS reference or a chip-scale atomic clock. The full proposal text is at:
https://tinyurl.com/5n874a3k

DRAFT REVISED SYLLABUS SECTIONS PUBLISHED: Following its consultation on proposed changes to the amateur radio licence, Ofcom has recently published the *General notice of proposal to vary amateur radio licences*. The timescale for putting the licence changes into effect means that the Examinations and Syllabus Review Group has been working on the revised syllabus, v1.6, in parallel with the Ofcom consultation. To read the full explanation and see the draft sections, go to the RSGB website (below) and choose the Trainer Information link in the righthand menu.
rsgb.org/training

SOLENT AND ISLE OF WIGHT: **Fred Dawson G1HCM** writes: *"Thought you might be interested in the Facebook group Vectis Amateur Radio. The group provides news for the Solent and Isle of Wight to promote amateur radio and to stimulate discussion. As the RSGB district representative for the Isle of Wight it helps me keep in touch with amateurs on the Isle of Wight".*

BRITISH RAILWAYS AMATEUR RADIO SOCIETY (BRARS): BRARS is delighted to announce publication of the January 2024 issue of its *Rails and Radio* magazine. In this issue **Stuart G3YPS** describes his visits to an amateur radio rally, a railway signal box and a model railway depicting the East Coast Main Line from Kings Cross to Leeds Central. **Richard G0AIH** takes us to Darlington to visit Hopetown, a substantial development based around the Head Of Steam Museum. **John G4ZTQ** (the BRARS historian) reflects on his time on the railways and **Mark G1PIE** reports on BRARS's participation in Railways On The Air operating GB1FRT. **Colin GW6HGW** takes us back to when he was eight years old and bought his first radio book. The photo on the front cover shows Jinty 47279 on Keighley and Worth Valley Railway. For more information about BRARS go to the website below or contact the membership secretary **Richard Waterman G4KRW,** 170 Station Road, Mickleover, Derby, DE3 9FJ.
membership@brars.info
www. BRARS.info

GERMAN AMATEURS GET 6-MONTH EXTENSION ON 160, 6 AND 4M: Amateurs in Germany who are using temporarily allocated frequencies on 160, 6 and 4m as well as Class E licence holders being allowed to use the 13cm and 5cm bands have been given a six-month extension from the telecommunications regulator BNetzA. The announcement was made in late December in the regulator's newsletter, which noted that the extension expires on 30 June. Until then, all licence, class, polarisation and power restrictions remain in place and use continues to be on a non-interference basis.
The extension permits the use of 1.8 to 2.0MHz on weekends for contests. It also grants continued use of 50 to 52MHz and 70.150 to 70.210MHz.

CQ MAGAZINE SUSPENDS PUBLICATION: *CQ Magazine*, which has been a resource for the active amateur radio community for seven decades, has suspended publication until sometime in 2024. The magazine is renowned for its CQ World Wide contests and operating awards and for its Hall of Fame. Editor **Richard Moseson W2VU** said *"As all of our loyal readers know, 2023 has been a very challenging year for us. We continue to pursue all options for getting things moving again. At this moment, the November and December issues are delayed but we plan to get them out to the readership as soon as circumstances permit. We appreciate everyone's patience and understanding"*. The widely read magazine, which produces both a print and digital edition, has been a staple in amateur radio shacks, starting with its first issue in January 1945.

M0PLA ACHIEVES MOUNTAIN GOAT AWARD: **Paul Athersmith M0PLA** of Telford, Shropshire, has achieved the coveted Mountain Goat award for gaining 1,000 activator points in the Summits on the Air scheme. Paul completed his mission on the summit of Pole Bank, on the Long Mynd in Shropshire. The feat took Paul just over seven years, following his debut activation in December 2016.
https://www.sota.org.uk

WIRELESS FOR THE WARRIOR: **Godfrey Manning G4GLM** offers this reminder: "A significant textbook describing military radios is *Wireless for the Warrior* by the respected authority **Louis Meulstee**, himself cited at the end of the *Portable military radio...* article (*PW* February page 58). I'm pleased to report this is back in print and sold by the producer of Practical Electronics:
www.electronpublishing.com
or 'phone 01202 880299. Anyone interested in general electronics, beyond just radio, could also consider subscribing to Practical Electronics as its subjects are complementary to (and doesn't conflict with) PW".

RSGB VIDEO HIGHLIGHTING RESULTS OF OFCOM CONSULTATION: Following Ofcom's consultation on the amateur radio licence last year, it released a statement in December 2023. The RSGB has just released a video in which RSGB General Manager **Steve Thomas M1ACB** chats to RSGB Spectrum Forum Chair **Murray Niman G6JYB**. Murray recaps some of the headline results of the Ofcom consultation, including where changes have occurred to Ofcom's proposals. They also talk about what this could mean for radio amateurs in the future. You can watch this video on the RSGB's YouTube channel or via the Society's licence review updates page at:
rsgb.org/licencereview

RSGB NATIONAL RADIO CENTRE NEEDS MORE VOLUNTEERS: There is so much happening at the RSGB National Radio Centre (NRC) that it needs to expand its team of volunteers! If you can volunteer on a Friday or Saturday, you will be particularly welcome. The NRC has a fabulous set-up, and full training on using the GB3RS radio station will be given. You should enjoy meeting people and be able to volunteer for one or two days per month as part of a friendly and dedicated team. NRC volunteers also enjoy numerous benefits associated with volunteering at Bletchley Park. For more information, please email NRC Coordinator Martyn Baker G0GMB via
nrc.support@rsgb.org.uk

RSGB PROPAGATION STUDIES COMMITTEE MEMBER GAINS PHD FOR PROPAGATION RESEARCH: **Chris Deacon G4IFX** has been awarded a PhD from Bath University after completing research on propagation. His thesis was entitled *Radio propagation through ionospheric Sporadic-E*. This part-time work over many years involved looking at Sporadic E on 6m, including making novel measurements of signal amplitude, phase (and derived doppler), polarisation and potentially time delay to discover the nature of sporadic-E propagation at VHF. The RSGB Propagation Studies Committee wishes to congratulate Chris on this fantastic achievement. More details can be found at:
http://tinyurl.com/mrjb3tfb

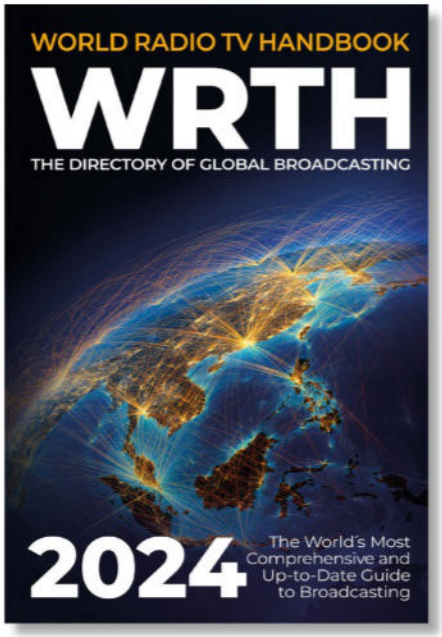
Read more radio news and reviews at www.radioenthusiast.co.uk/news

David Harris
mydogisfinn@gmail.com

WRTH and more

David Harris takes a look at several new frequency and listening guides, including the latest WRTH.

Radio Listener's Guide 2024. Edited and published by Clive Woodyear. 2023. 192 pp. pbk. £8 + £3 postage. ISBN 9781871611359
www.radioguide.co.uk



World Radio TV Handbook WRTH The Directory of Global Broadcasting 2024. Editor: Gunter Lorenz. Radio Data Center, Freising, Germany. 2023. 816 pp, pbk, £44. ISBN 9783982501710
www.wrth.org

If you are at all interested in any aspect of radio broadcasting in the UK, then *Radio Listeners Guide 2024* is a must buy. Its 162 pages are crammed with news, radio reviews, frequency listings, maps, updates on technology and much, much more.

The book begins with nine pages of radio related news. You may well have missed many of these stories. They include the switch-off of Radio 4 on 198kHz Long Wave proposed for March 2024. There is more on why **Ken Bruce** left BBC Radio 2 for Bauer's Greatest Hits Radio. The gradual switch-off of Medium Wave stations led by Absolute Radio and likely to be followed by the few remaining AM stalwarts. The move from DAB (MP2) to DAB+ (AAC) by Classic FM is surely going to be followed by the few remaining stations that cling to the old DAB format.

If Internet Radio, Smart radios, Bluetooth, multi-room systems and Smart speakers leave you confused, then RLG offers an introduction to these new devices plus some recommendation on which models to buy. The big selling point of RLG is that it is the only publication to offer independent reviews of virtually all FM/DAB radios (and Smart speakers) available in the UK today. Over 30 Smart speakers are reviewed from the highly commended IKEA Vaappeby at £13 up to the Triangle AIO Twin at £699. If it is a domestic radio you are after, then there are over 100 products reviewed with ratings from 1 star to 5 stars with prices ranging from £15 for the, not bad, Bush Big LED Alarm Clock radio to £1,299 for the Ruark 410 all-in-one system.

There are in-depth reviews of 19 new radios and speakers plus some guidelines on selecting a new radio.

RLG has comprehensive listings of all British and Irish stations by frequency and station name. There are also listings of all DAB multiplexes. There are maps of DAB transmitters, BBC stations and commercial stations. Add to this information on radio stations that broadcast on Freeview, Sky and Freesat platforms.

If you travel around the UK, RLG is a great asset and can really enhance your listening experience. If FM/MW DXing is an interest, the RLG will help you identify those distant stations. At £8 it is great value as it is a good read plus a reference guide that will be useful all the year round.

The good news is that *WRTH* is back on track after the change of ownership in 2022 and was published on schedule in mid-December 2023. *WRTH* began life in Denmark in 1947 and has been published every year. Since 2022 it has been published by the German radio consultancy, Radio Data Center. In a world where almost everything is available online or by subscription *WRTH* is a survivor of an era when almost every industry and activity had its own annual publication.

The strength of *WRTH* is that it really is the absolute, complete directory of global broadcasting. Every country in the world is covered and every terrestrial broadcasting platform from Long Wave, Medium Wave, Short Wave, FM to DAB is thoroughly catalogued. *WRTH* has something for everyone, whether you are a DXer, global traveller or radio industry employee.

WRTH 2024 kicks off with a few pages of equipment reviews. The star is the Perseus 22 SDR, which retails in Europe for 2,500 Euros. If this is out of your price range, then don't despair as *WRTH* reviews some budget RTRL-SDR dongles which sell for £35. If you prefer a real radio that does not need to be connected to a PC, then the NXP TEF6686 gets a good recommendation particularly for its FM reception and is widely available on eBay with prices ranging from £65 - £150.

If you are looking for a new world band radio, SDR or communications receiver, then *WRTH* has retained its Receiver Guide, which lists around 40 radios ranging in price from the Tecsun PL-310ET at £50 up to the AOR AR-ONE at £5,000.

"If Internet Radio, Smart radios, Bluetooth, multi-room systems and Smart speakers leave you confused, then RLG offers an introduction to these new devices."

The bulk of *WRTH 2024* (some 470 pages) is devoted to domestic broadcasting stations on all platforms in every country from Afghanistan, with two MW stations and many FM outlets, to Zimbabwe with three national channels and several private stations, all on FM. Shortwave broadcasting is far from dead with 46 pages

Continued on page 10

Rajesh Vagadia VU2EXP
vu2exp@gmail.com

1

A Report from India

Amateur Radio and Satellite Communication were promoted in the prestigious Microwave Antenna Propagation Conference (MAPCON) 2023 at Ahmedabad, Gujarat, India from 12 to 14 December 2023. **Rajesh Vagadia VU2EXP** reports.

MAPCON was an international platform for sharing of research and technologies in the field of microwaves and antennas, wherein many national/international eminent personalities shared their vision, expertise and knowledge. MAPCON-2023 carried various technical sessions, invited talks, workshops, tutorials, special sessions, student design competitions, industry sessions and a state-of-the-art exhibition. Participants included researchers and leaders of the IEEE Antenna and Microwave community, defence and space industry partners and startups, academia and eminent speakers from Government organisations like ISRO, SAC, IN-SPACe etc.

Rajesh Vagadia VU2EXP (Regional Coordinator of AMSAT-INDIA) was invited by **Shri Rajeev Jyoti Sir** (Director IN-SPACe) and MAPCON 2023 Committee for the MAPCON Exhibition to participate and promote Amateur Radio and Satellite Communication for educational purposes. Rajesh, along with team member **Shyama Vagadia VU3WHG** (B.Tech. - ICT 4th sem student of Marwadi University, Rajkot), successfully participated in the MAPCON Exhibition for three days from 12 to 14 Dec 2023. We were allocated a decent sized stand of 3x3m. It was a huge event - renowned exhibitors/leaders from different industries took part in this exhibition. We were the invited exhibitor for educational awareness on amateur radio and satellites. We properly planned and carried a range of amateur radio equipment to display from CW keys to a portable satellite communication ground station. We were aware that visitors would be from different segments such as professionals, researchers, scientists, industrialists, IIT students etc. Every person could have an interest in different amateur radio stuff or application so we exhibited the whole spectrum, including HF, VHF, UHF Radios, HTs, SDR, RTL-SDR, base station, antenna, PSU, coax, connectors, test instruments, SWR meters/RF power meter, NanoVNA, antenna tuner, diplexer, logbook, call books, QSL cards, awards, Cube satellite model etc to give a thorough idea of the equipment we use in our radio shack and out in the field.

Informative posters, banners and all our radio stuff along with a live presentation on a large TV screen on our stand gave a glimpse of our amateur radio activity. The educational approach from our team helped most visitors to satisfy their queries and gain knowledge on various topics of our fascinating hobby. IIT Students and faculties from different institutions showed a keen interest in amateur radio club activity and the student satellite programme. Many scientists, professionals and communication experts appreciated our presence to spread awareness of the way our scientific hobby keeps us engaged to learn, experiment and enjoy what were the core themes of MAPCON i.e. microwaves, antennas and propagation.

Chief Guest and former ISRO Chairman **A S Kiran Kumar Sir** visited the exhibition/our stand and spent some time understanding our amateur radio and AMSAT-INDIA activities. We were able to tell him about two amateur radio payloads collaborated by AMSAT-INDIA: HAMSAT - VO52 launched in 2005 carrying a linear transponder and the AISAT Digipeater integrated into the 4th stage of the PSLV rocket body, launched in 2019 (experimental initiative from ISRO). We also highlighted the role of The Amateur Radio Society of India (ARSI) and its activity. Shri Kiran Kumar Sir took note of our educational activities. We were delighted to welcome A S Kirankumar Sir and presented a book *The Gateway To Ham Radio* to him as a token of thanks (book credit to VU2JIM).

Also, Shri Rajeev Jyoti Sir (Director IN-SPACe) was warmly welcomed to our stall. I thanked him for supporting us and offering the stand to create awareness of our radio and satellite activity. He spared a good time at our stand, they appreciated our efforts and the range of working radio stuff we highlighted for all visitors. Sir also took good note for our small portable satellite ground station consisting of a tripod, dual-band Arrow II antenna, two HTs for RX/TX in full duplex configuration, headphone/mic, audio recorder, tracking device, with manually aiming arrangement for Azimuth, elevation and polarization. This was the least expensive yet working ground station for amateur radio (FM/LEO) satellites throughout the exhibition. Again, we presented him with the same book.

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

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We had great interaction with many exhibitors, researchers, professors from various institutions and exchanged views that a lot more radio and satellite activities/projects could be worked out for the benefit of society. We simply conveyed how common man from any walk of life can become a ham radio operator and gradually improve their skill to have digital communication, contesting, activating special callsigns and how they enjoy IOTA, Lighthouses, Hilltops, ARISS and SSTV events, tracking and working OSCAR Satellites. And all this activity is enjoyed by global amateur radio operators. This simple yet effective message appeals to most visitors.

We also had gracious presence of **Shri Hanumanth Rayappa Sir** (Director, Satcom PO, ISRO HQ), **Shri Vaibhav Sir** (ISRO), **Shri Milind Mahajan Sir** (SAC/ISRO), **Sanjeev Kulshrestha** (SAC/ISRO), **Shri Nikhil Arora Sir** (IN-SPACe), **Shri Pratik Mevada Sir** (SAC/ISRO) and **Prof. Gangaprasad Pandey** (PDEU, Gandhinagar) etc. We had good talks on various amateur satellites and projects. For specific queries, from ISRO Scientists, on our previous AMSAT-INDIA missions, I connected to **Maniji VU2WMY** and**Nitin VU3TYG** for precise explanation, I thank both of my AMSAT fellow friends.

During the exhibition we had very good 'eyeball QSOs' with other hams, including **Prof. S.P Bhatnagar Sir VU2SPF**, **Jinofar Bhujwala VU2JJJ**, **Manojbhai Suthar VU2EHY**, **VU3RGP Rakesh** and **Jayshankar VU2JAA**. I am thankful to VU2SPF and VU2JJJ for all the support they extended.

It was a great time for us to be part of this top conference for professionals yet representing amateur radio. A big thanks to the MAPCON 2023 Committee for providing us with such a platform.

I especially want to thank my niece and team member Shyama Vagadia VU3WHG for all her support and assistance from the beginning . Shyama also remains a member of the Student Satellite project team from Marwadi University and a student member of the IEEE Gujarat Chapter. For her it was also a memorable experience to meet so many living legends of the Indian space and research organisation of India (ISRO). I thank Shri B. A. Subramani Sir VU2WMY, Nitin Muttin VU3TYG and all members of AMSAT-INDIA for detailed follow up, guidance and support to make our participation notable.

I equally thank **Ramesh Kumar VU2LU** and **Krishna Kumar VU2YUU** from ARSI for their respective guidance and support.

We tried our best to cultivate the seeds (of amateur radio), hoping to get some fruitful results! Thank you all. **PW**

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Photo 1: Rajesh VU2EXP presents the ham book to A S Kirankumar Sir, chief guest & ISRO Chairman. Photo 2: Shyama Vagadia VU3WHG at the stand. Photo 3: Rajesh VU2EXP welcomes Shri Rajeev Jyoti (Director IN-SPACe)

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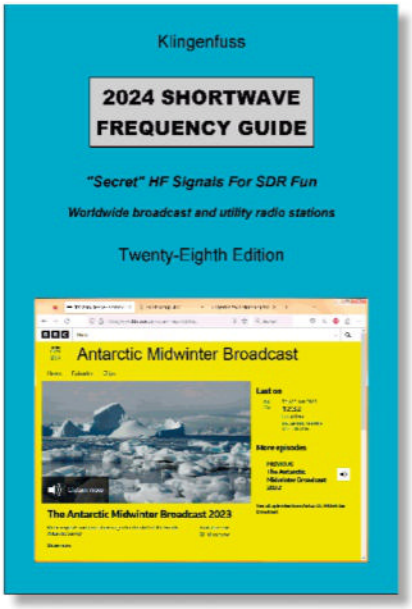

World Radio TV Handbook WRTH The Directory of Global Broadcasting 2024. Editor: Gunter Lorenz. Radio Data Center, Freising, Germany. 2023. 816 pp, pbk, £44. ISBN 9783982501710 **www.wrth.org**

given over to listing International and clandestine short-wave stations. There is no other publication that has such complete listings. *WRTH* is in a class of its own and is an essential guide for any radio enthusiast.

Other frequency guides

Klingenfuss have been the market leader in utility frequency directories for over 50 years. *Shortwave Frequency Guide 2024* gives monitors the best of both worlds with 140 pages of utility listings covering from 20kHz to 27870kHz. This is followed by 110 pages of listings of SW broadcasters from 2310kHz to 26040kHz. This one book will enable you to monitor ships, aircraft and the military as well as identity shortwave broadcasters from around the world. The book is in a very easy-to-use format with simple listings of frequency, callsign, station name, ITU and mode for utilities. For broadcast stations the listings are by frequency, station, location, ITU, start and end time of broadcasts, languages used, and target area.

Klingenfuss also publish *2024 Super Frequency List on CD* (30 Euros), which contains 37,000 entries covering both broadcast and utility stations.

Regretfully the Winter 2023/24 edition will not be published. Back copies of the Summer 2023 version are still available:
www.teakpublishing.com/books

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1

Comet CHA-250HD/ BXII Multi-Band HF Vertical

Steve Telenius-Lowe PJ4DX reviews a multi-band vertical antenna that could be the answer if you are short of space.

The Comet CHA-250HD or CHA-250BXII, **Fig. 1**, is a multi-band vertical antenna that the manufacturer says covers all frequencies from 3.5 to 57MHz continuously with a low SWR. No radials are required.

A bit of history

The Comet CHA-250 series of antennas has been around for quite a few years now. The earlier CHA-250B was replaced by the CHA-250BXII, the biggest difference being that the matching transformer at the base of the antenna is now mounted within a heatsink – of which more later. The CHA-250HD is the very latest version and is identical to the 250BXII in all respects except that the top-most section of aluminium tubing has been replaced by a flexible stainless-steel whip or 'stinger', resulting in less strain on the lower sections during windy conditions. The antenna reviewed is the 250HD, which was imported to Bonaire from the USA, but electrically it is identical to the 250BXII.

Theory of operation

So, how does the CHA-250HD/BXII manage to cover such a wide frequency range with such a low SWR? Well, unlike most amateur vertical antennas it is not a resonant quarter-wave design, which would have a feedpoint impedance of fairly close to 50Ω. It is, in effect, the equivalent of the familiar end-fed wire, but made of aluminium tubing and orientated vertically rather than horizontally. Depending on the frequency, the impedance of an end-fed antenna can be very high, typically a few thousand ohms. The transformer at the base of the antenna has the task of matching the wildly varying impedances that would be encountered across the very wide frequency range to a value close enough to allow the antenna to be matched to the 50Ω input impedance of the transceiver, and so allow the transceiver to put out full power.

On the Comet website **[1]** they state that the SWR is 1.6:1 or better across the specified frequency range and **Fig. 2** shows the SWR graph provided with the antenna. Comet does not provide any details of the matching transformer and I did not open up the heatsink in order to take a look, but I would guess that it is a 49:1 transformer wound on several ferrite cores. A 49:1 transformer would match impedances from 1532 to 3920Ω to provide a 50Ω SWR of 1.6:1.

You don't get owt for nowt, though, and on their website Comet explain the reason that the matching transformer is now encased in a heatsink: *"The transformer on the original CHA-250 had smooth sides. The current version has a heatsink to dissipate heat created inside the transformer. Yes, some of the RF that enters the power feeding section is turned into heat rather than transmitted as RF, but that is one of the compromises needed to create a broadband, low SWR, multi-band HF antenna with minimal visual impact."*

Description and assembly

The antenna consists of five sections, which simply slot together and are connected with a hose clamp and bolts with wing nuts. It is well constructed, the base section is made of 2mm aluminium tubing and includes the matching

Fig. 1: The Comet CHA-250HD antenna. Fig. 2: The antenna's claimed SWR (source: Comet). Fig. 3: The base section includes the heatsink containing the matching transformer as well as the mounting bracket and U-clamps.

transformer encased in the finned heatsink, along with the antenna's mounting bracket and two U-clamps, **Fig. 3**. No assembly is required: the transformer, heatsink, mounting bracket and lowest section of aluminium tubing are all part of the base section.

The remainder of the antenna is simplicity itself to assemble and it was put together in just a few minutes. The only tool required is a flat screwdriver to tighten the hose clamp. I would recommend smearing some conductive grease (not supplied) on all the metal-to-metal joins to allow the antenna to be more easily dissembled when required in future after a long time in the elements (pun not intended).

The completed antenna can be mounted on masts of 1.25 – 2.75in (30 – 72mm) diameter. An SO-239 socket, **Fig. 4**, is located below the matching transformer and mounting assembly and a short length of self-amalgamating tape is provided in order to waterproof the PL-259 to SO-239 connection, a nice touch.

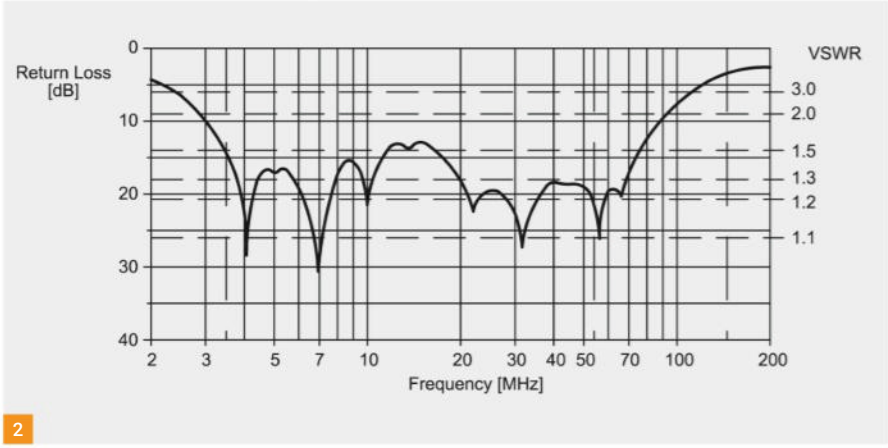
The antenna was installed at the house of newly-licensed amateur **Ish Croes PJ4ISH**. It was mounted on the wooden railings of an upstairs balcony, **Fig. 5**, rather than on a metal mast, simply because that was what was available. A 50ft (15m) length of good-quality RG-213 50Ω coax cable connected the antenna to the station.

The specifications, as supplied by Comet, are shown in **Table 1**. In the instructions of the earlier CHA-250B, Comet recommended that *"to get maximum performance from [the] antenna it must be installed at least 35 feet above the ground"*. I note that this recommendation is no longer included with the CHA-250HD: with the length of the antenna itself this would result in a structure nearly 60ft (18m) tall and I suspect very few users mounted the antenna as high as this.

Radials or no radials?

One of the perceived advantages of this sort of antenna over a conventional quarter-wave vertical is that no ground radials are required and indeed at the PJ4ISH QTH no radials were used.

However, whether or not they are actually *required*, would adding radials make any difference to the performance of the antenna? One of the UK retailers of the CHA-250BXII, Nevada **[2]**, under 'Customer feedback' states: *"Customers tell us this antenna works really well if ground mounted with two or three 5m radials, or if mounted on a pole, you use two or three sloping radials around 5 metres long. This lowers radiation angle above 7MHz and dramatically improves performance particularly below 7MHz."*



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Unfortunately, due to the particular location of the antenna on a balcony at PJ4ISH's QTH it was not possible to try adding 5m-long radials.

In practice

Before trying the antenna on the air I measured the SWR using a calibrated NanoVNA **[3]** between 2 and 58MHz, **Fig. 6**, in order to compare with the graph provided by Comet that was shown in Fig. 2. It can be seen that the SWR dip close to the 80m band is quite sharp, but above about 6MHz it is pretty flat right up to well above 50MHz. **Table 2** shows the measured SWR at spot frequencies in all the amateur bands between 3.5 and 50MHz. It did not quite meet the specification of being less than 1.6:1 from 3.5 to 57MHz, but it was pretty close. The minimum SWR close to the 80m band was actually at 3220kHz, where it was 1.4:1. It could be that the specific location on wooden railings caused the minimum SWR to be at a lower frequency than expected and it is possible that adding some radials would change this frequency. From the 7MHz to 50MHz bands the measured SWR was 1:6:1 or better – indeed it was 1.1:1 across all bands from 18MHz to 29MHz inclusive. Even on the 3.5 and 5MHz bands, where the SWR was higher than 1.6:1, the internal ATUs in most modern transceivers should be able to cope and reduce it to close to 1:1.

On air, purely by chance one of the first stations Ish worked, on 28MHz SSB, was **Mike G3SED**, of Nevada Radio, one of the retailers of the Comet antenna! Mike gave Ish a 59 report, so the antenna was clearly radiating.

For comparison purposes we also put up a 14MHz half-wave wire dipole at the PJ4ISH station. Back home, several kilometres across town, I monitored Ish's SSB transmissions on 14MHz. There was a good two S-points difference between the two antennas: on the Comet vertical Ish was S7, whereas on the dipole she was S9. The two S-units difference was the same on both horizontally-polarised and vertical receiving antennas and, as the signal was being received via ground wave, there was little or no fading involved.

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I use an Icom IC-7300 transceiver in which one S-unit is nominally 3dB, so the two S-unit difference between the two antennas is actually around 6dB. Two S-units, or –6dBd, may sound quite a lot but the reason has already been mentioned: in order to create an antenna that works on all the bands between 3.5 and 50MHz some compromises have to be made and the matching transformer causes some of the transceiver's power to be turned into heat, rather than being transmitted.

It should be noted that for short-wave broadcast listeners, the CHA-250 should be a good all-round antenna as its workable frequency range

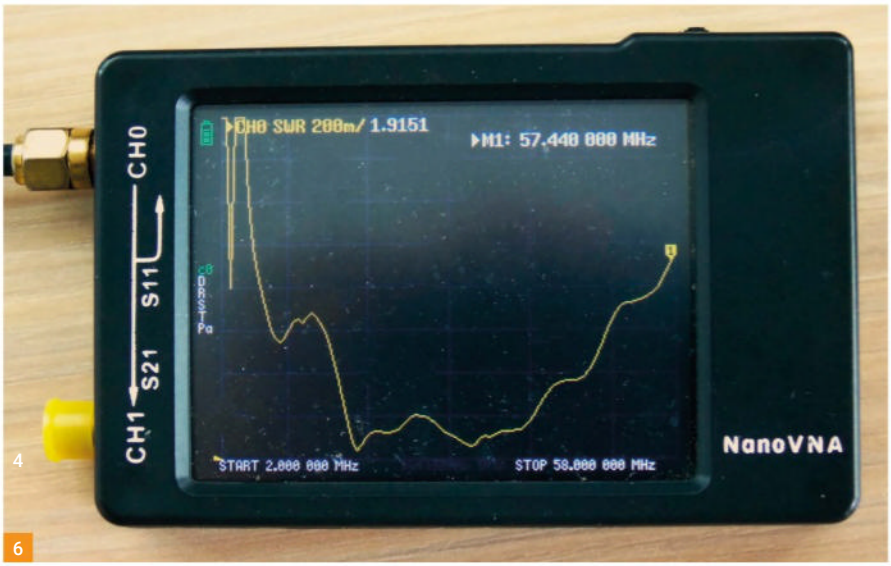

Fig. 4: The SO-239 socket is built into the base section, below the matching transformer. Fig. 5: The antenna was mounted on the wooden railings of an upstairs balcony. Fig. 6: SWR curve from 2 to 58MHz, as measured on a NanoVNA.

covers the whole of all the HF international broadcast bands. We also found that local AM airband communications, e.g. Bonaire Tower on 118.7MHz, and Curacao ATIS on 132.6MHz, were well received, despite being well outside the specified 2 – 90MHz receive frequency range.

Summing up

The Comet CHA-250HD/BXII is a compromise antenna, the manufacturers themselves are quite open about that. On their website **[1]** they state: *"If you have the space, budget and desire to erect a full-size antenna system we suggest you do so… bigger is better… however… if you live in an antenna-restricted area and must manage with antenna or space restrictions or you simply wish to operate incognito you will be forced to make significant antenna compromises. The CHA-250HD will make the most of these circumstances!"*

I would agree with this. If you have limited antenna possibilities, the Comet antenna will get you on the air in minutes on all nine HF bands plus 6m. You cannot expect signal reports to be as good as if you used full-size monoband quarter-wave verticals or half-wave dipoles (let alone a beam) – but how many people can put up antennas covering all ten frequency bands covered by the Comet vertical? If you can only put up one or maybe two antennas yet still want to operate on all of the HF bands (plus 6m), this antenna might well fit the bill. A sensible compromise may be to concentrate on one band, putting up a dedicated antenna for that band, and use the Comet to still maintain a presence on all the others. As such, it fulfils a useful purpose.

Note that the specified maximum power rating of the Comet antenna is 250W on SSB, or 75W on data modes. Its power-handling capability will be limited by the ferrite cores in the matching transformer; exceeding the specified power risks causing damage to the antenna. Using a typical 100W transceiver you will be safe on SSB but don't use a 400W linear amplifier with this antenna and if you operate the WSJT data modes such as FT8 and FT4, do remember to reduce your transceiver's power output to 75W or less. There is no listed maximum power for CW operation but 100W should be safe enough; once again, don't use a linear amplifier on CW.

If you are a CW or SSB operator you will be able to make contacts, and plenty of them, with the Comet antenna, but you should have realistic expectations: don't perhaps expect to be able to bust the pile-up on the first day of a major DXpedition! If, however, you are an FT8/FT4 aficionado this Comet vertical may well be the answer to your prayers. That's because on these data modes the absolute strength of signals is not relevant: provided your transmitted signal is above a certain threshold it will be decoded in precisely the same way as one 20 or even 30dB stronger would be.

Transmit frequency:	3.5 – 57MHz
Receive frequency:	2 – 90MHz
Maximum power:	250 watts SSB / 75W digital (FT8 etc)
Impedance:	50Ω
SWR:	1.5:1 or less
Length:	Approx 7.13m (23.4ft)
Weight:	Approx 3.2kg (7lb)
Max wind survival:	30m/sec (nominal 67MPH (107kph)
Mounting mast diameter:	30 – 72mm (1.25 – 2.75in)

Table 1: Comet CHA-250HD specifications, as supplied by Comet.

Frequency (MHz)	Measured SWR
3.500	2.2:1
5.357	2.2:1
7.100	1.6:1
10.125	1.5:1
14.200	1.6:1
18.140	1.1:1
21.200	1.1:1
24.940	1.1:1
28.000	1.1:1
29.000	1.1:1
50.313	1.6:1

Table 2: Comet CHA-250HD measured SWR at various spot frequencies using a calibrated NanoVNA.

The Comet CHA-250BXII is available from most UK amateur radio retailers for around £350 (including VAT).

References

[1] Comet website:
http://tinyurl.com/mtk2z9ne
[2] Nevada website:
www.nevadaradio.co.uk
[3] *Using the NanoVNA as an Antenna Analyser*, Steve Telenius-Lowe, PJ4DX, *PW*, April 2022. **PW**

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1

Quansheng UV-5K developments

Tim Kirby GW4VXE starts with the latest on the Quansheng UV-5K, but also has some great reports of VHF tropo activity.

Over the last few months I've been following the development of alternative firmware for these fun little Quansheng rigs. There are now so many different versions of the firmware it's getting hard to keep track of all the developments, so if you're interested, have a read around.

A new variant of the firmware 'IJV' developed in Italy includes the ability to send DSB (I've not tested this!) as well as CW! CW sending using the PTT appeared to work OK although I can see some people have made a tiny little key connected via the microphone/earphone connector. A serious use? Not really perhaps, it's all a bit of a novelty, but it is testament to the ingenuity of radio hams. Another version of the firmware appears to have the ability to send SSTV, which is fun. This is pretty limited, only having the capability to send the Martin 1 standard, but nevertheless, very clever.

Opinions vary about this rig, with some vociferous types online saying how dreadful they are at every possible opportunity – with others having lots of fun, experimenting with the different firmware versions and perhaps even trying to compile new versions themselves. The radios can be picked up for as little as £10 online from China, or if you want to buy from a UK dealer, they will cost around £25. At this price, as a basic 2m/70cm handheld they are great value. Add into the mix that, with the alternative firmware, you can receive CW/SSB on HF (with an appropriate antenna) along with airband receive etc etc – they are marvellous fun. Don't expect them, as some do, to transmit on CB, 10m, 6m, 4m etc. They will, but the output on the fundamental will be miniscule and the spurii greater than the fundamental.

There are numerous Facebook groups devoted to these radios and the firmware – as is the case with Facebook groups, some are more useful than others. It's worth keeping an eye on, though, to try and keep an eye on the new developments. A good repository of many versions of the firmware can be found at:
http://tinyurl.com/2uy9pp3z

Martyn Vincent G3UKV – Silent Key

I was deeply saddened to hear of the sudden death of **Martyn G3UKV** following a heart attack recently. Having grown up fairly close to Martyn's home ground of Shropshire, we had many contacts over the years, particularly I recall on 4m and 6m (in the early days). Martyn's interests in amateur radio were wide ranging – from slow Morse transmissions as GB2CW to microwave operation. He leaves a legacy of wonderful work in the hobby and memories of a wonderfully enthusiastic and knowledgeable man. Martyn will be much missed.

Apologies!

Gremlins got into my January column, when I managed to credit **Stewart Wilkinson G0LGS's** DX to **Stewart Cooper G4AFF**. Sorry to you both! I've known you both for over 30 years, so you'd think I'd know the difference by now. Apologies too, to **Gus Coleman G3ZEZ**, whose callsign I printed as G3ZXZ. Sorry, Gus!

Removing noise using AI

Always on the lookout for new applications and software, **Jef VanRaepenbusch ON8NT** mentions the RM-Noise application. He says he hasn't used it himself, but the videos look interesting. You can see more at:
https://ournetplace.com/rm-noise

I haven't had a chance to have a detailed look at this yet, so will be interested to see if any readers have tried it.

The 8m band

Roger Lapthorn G3XBM (Cambridge) says that the F2 openings have just about stopped for him now and finds that his 2.5W is not quite enough to make contacts. Roger hopes that better F2 conditions will return. Roger is planning, albeit somewhat reluctantly, to pay another £50 so that he can continue his transmit tests after April when his current permit expires.

The 6m band

Roger G3XBM has been continuing some QRP

Fig. 1: Aftermath of a winter storm at Steve G4AQB's. Fig. 2: G4AQB's vintage 2m transceiver. Fig. 3: Autographed picture of Kjell Lundgren received by Patrick WD9EWK.

FT8 operation and says that he found some evidence of Winter Es.

Phil Oakley G0BVD (Great Torrington) took part in the 50MHz UKAC and worked G4RRA (IO80) and 2E0VCC/P (IO70).

Andy Adams GW0KZG (Letterston) found the band open on 24 December initially with Es around Europe allowing Andy to make around 30 QSOs before propagation moved to the west when Andy worked K1TO (EL87), AC4TO (EM70), W4TAA (EL87), K4RW (EM92), NM3G (EM96), K4ESE (FM04), KD5M (EM60) and W4SO (EL98). Andy also caught an opening to the west on 27 December, working VO1CH just before 1400UTC.

Jef ON8NT worked CO7MS (FL01) on 1 December.

Steve Telenius-Lowe PJ4DX had a fairly disappointing month on 6m: *"What a difference a month makes! After last month's bumper report, 6m has been very quiet of late, although I did catch two openings. On 18 December the band opened from Bonaire to VK and ZL. ZL1RS, ZL1AKW, VK2ZQ, VK4DCM, VK2DVM, VK4ZPU and VK2EMA made it into the log. Best DX were the VK4s at about 16,400km. After hearing nothing for nearly a month, on 12 January I came into the shack at the tail end of another opening to VK and ZL but was able to catch ZL7DX on the Chatham Islands at 2040UTC for DXCC number 155 on 6m. This was followed by QSOs with VK2DVM and VK2IR and the band closed suddenly at 2050UTC. You have to be quick to catch these openings!"*

At **GW4VXE** (Goodwick) my operation on the band was confined to a nice European Es opening on 27 December.

The 2m band

Gus Coleman G3ZEZ (Clacton on Sea) found good tropo to the south on 17/18 December, with the Spanish beacons ED1YCA (IN73) on 144.444 and ED1ZAG (IN53) heard on 144.402MHz. In the evening of 17 December, Gus worked F6DBI (IN88) and F8BEC (JN19). Next morning on 18 December, Gus worked EB1A (IN53). All these contacts were on SSB.

Roger G3XBM continues to be active during the UKAC activity contests although he feels that perhaps SSB activity is decreasing. Activity in the FT8 sessions seems good though.

It's great to hear from **Tony Collett G4NBS** (Cambridge) that he has managed to reduce his noise problems on the band by installing a Dual 11/23 element Yagi for 2m and 70cm. Although the noise is still present, because the Dual Yagi is sharper than Tony's old 9-element, he's able to null the noise out a little better. Tony feels that the downward lobes are much cleaner on his new antenna, hence less pick up of his very localised noise.

Tony was pleased to work LA3EQ in the Aurora on 1 December. During the 2m AFS on 3 December, Tony made 124 QSOs, including many more SSB QSOs to the East than he had managed in a long time. During the Geminids, Tony made some nice QSOs using MSK144, including 9A1CRJ (JN95), IW2BZY (JN45), EA2DR (IN83), EA2BFM (IN83), OH6KTL (KP02), YU7KB (KN04), YU7MS (KN05), S58P (JN76), I1JTQ (JN35), IU4CHE (JN64), IV3NDC (JN65), OK8RG (JO70), 9A3ZI (JN86), E76C (JN84) and F1HQM (JN23). All the QSOs were 'random' and the majority of them moved away from 144.360. On 17 December Tony found good conditions on tropo using FT8, working SM7DTT (JO65), F4JBR (JN15), F1MPQ (JN08), F5BEG (JN07), F1JBN (JN06), F4EZJ (JN05), F8PRC (IN99), F6GLQ (IN98), F4EMM (IN97), F6BQX (IN96), F4BKV (IN95), EC2BBS (IN93), F6HRO (IN88), F8BON (IN86), EA2XR (IN83), EA1SA (IN83), EA1U (IN83), EA2DR (IN83), EA2TZ (IN83), EA1HRR (IN83), EA2T (IN83), EA1LB (IN73), EA1M (IN53), EA1DFP (IN53), EA1UR (IN53), EA1NL (IN52) and CT9/OM3RG (IM12).

During the FT8AC on 3 January, Tony's best QSOs were OV3T (JO46) and OZ1IIL (JO47) via aircraft scatter. During the lift on 11 January, Tony worked LA6GKA (JO29), OY9JD (IP62), G4FVP (IO94), G4VCJ (IO94), GM0HTT (IO89) and GM4SJB (IO88).

Ian Bontoft G4ELW (Bridgwater) enjoyed the tropo around 16/17 December and made plenty of QSOs. Some of the highlights were EA2XR (IN83), GM3SEK (IO74), EA1UR (IN53), EC2BBS (IN93), F6CIS (IN94), CT9/OM3RG (IM12), EA2BHE (IN83), EA2BFM (IN83) F1JBN (JN06), EA1U (IN83), F5DYD (JN03), F6BQX (IN96), F6GRA (N04), F2MM (IN95) and F4IAR (IN93). With the band opening to the east on 11 January, Ian worked DF7KF (JO30), OS7P (JO21), DF8PW (JO30), PC2K (JO22), DL1YDI (JO42), PA0CAN (JO22), PE1IWT (JO32) with DG6JF (JO33), DJ0PY (JO32), OV3T (JO46) all worked on the 12th. During one of the openings, Ian decided to try SSB instead of FT8 and says that he was disappointed in the level of SSB activity although he did work F6CIS (IN94). Ian uses a low 5-element Yagi.

Roger Greengrass EI8KN (Co Wicklow) worked IK2JUG (JN45) during the Perseids on 13 December. Roger found plenty in the tropo on 16/17 December with the highlights being EA1UR (IN53), DB9VE (JN39), EA1SA (IN83), EA2XR (IN83), F5DYD (JN03), EA2BFM (IN83), DL6BF (JO32), CT9/OM3RG (IM12), EA1M (IN53), EA2AGZ (IN91), F6DRO (JN03) and F1TRF (JN39). On 23 December, Roger worked UT1FG/MM (IN89). There was nice tropo to the east on 11/12 January, when the highlights of Roger's log included DL1YDI (JO42), OZ1HDF (JO55),


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DG2BCP (JO43), OZ1BEF (JO46), DG3TF (JO53), DK5IR (JN49), DH8BQA (JO73), DL2FBY (JO51), DL7UHF (JO62), DK5EW (JN48) and DL2DN (JN48). As the opening faded on 13 January, the propagation moved to southern Germany and south-western France with DL5MCG (JN58), DL3SDE (JN48), F4IAR (IN93), F5DYD (JN03), F6HRE (IN93) and F6GRA (JN04) providing some more nice QSOs.

Phil G0BVD worked MW0VKD (IO71) and 2W0JMK (IO71) on 16 December on SSB.

Steve Macdonald G4AQB (Bolton) is without antennas, following the storm just before Christmas, **Fig. 1**. Fortunately, the damage was not too severe and they can easily be repaired. Steve writes, *"I have been restoring an old 2m SSB transceiver* (**Fig. 2**) *which was given to me. It was built back in 1970 and the design came from* VHF Communications *magazine by DL6HA using all discrete components with silicon transistors and FETs. After repairing a couple of faults, the transceiver works incredibly well and I have spent some time working local stations on my 2m collinear. I used it in the 2m UKAC and received good reports from stations. The transceiver is very well built and certainly deserves restoration".*

David Johnson G4DHF (Spalding) just missed the last deadline but wrote to say that although his array suffered some damage during the strong winds in October and then all the rain, he wasn't able to make repairs until mid-November. He says that there have been some weak auroras but on 25 November, he worked several of the 'usual SMs' and was also pleased to be called by EU3AI (KO22). On 1 December the 'same suspects' were about, but the best DX was LY2R (KO15). David says that the beam headings were quite distinct. EU/LY were worked at around 30°,

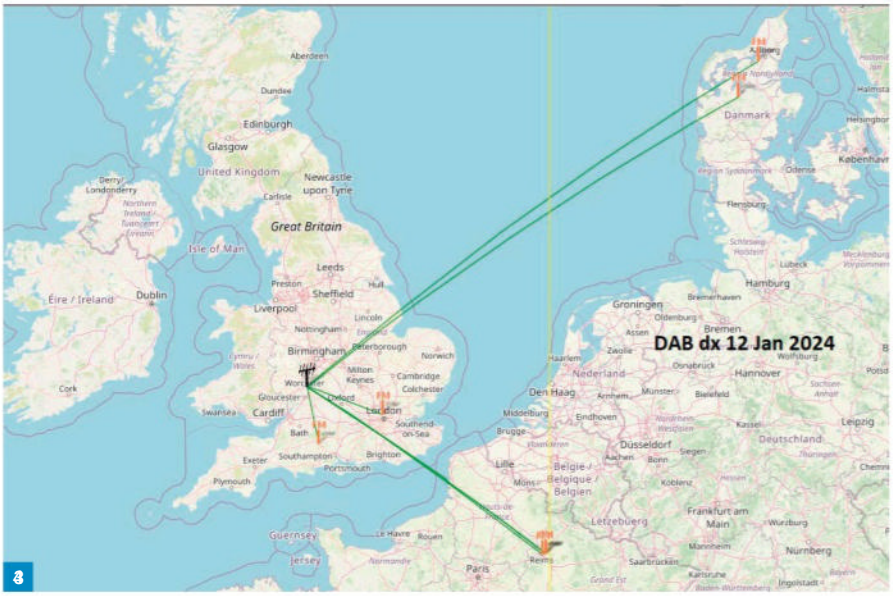


Fig. 4: DAB DX received by Simon Evans on 12 January 2024.

whereas the DL/PA stations were worked with a beam heading of around 60°. David says that activity levels are very low during these events. As he puts it, CW still rules for aurora working!

Jef ON8NT worked G8EEM (IO93) during the December FT8 Activity Contest.

Kevin Hewitt ZB2GI (Gibraltar) operated from the top of the Rock during the Geminids meteor shower on 14/15 December and managed to work G4LOH (IO70) using FSK441 mode.

Here at GW4VXE I worked UT1FG/MM (IO44), EA1UR (IN53), GM3SEK (IO74) and F6DBI (IN88) during the tropo on 16/17 December. UT1FG/MM was worked again on 23 December from the slightly less rare IN89 square.

The 70cm band

During the opening on 17/18 December, Gus G3ZEZ worked F8BEC (JN19) on the 70cm band on SSB.

In the January FT8 UKAC Roger G3XBM's 2.5W to his big-wheel omni was spotted in France and plenty of DX from the Netherlands and Germany was copied, despite using the omni.

Tony G4NBS had a preamp fail, the very first time he transmitted into it. Considering it was a straight swap for his previous one, he's rather puzzled about why it happened! Running without a preamp Tony felt that his barefoot Kuhne transverter wasn't as sensitive as it should have been. He did some checks, which suggested that the Kuhne was not meeting its 2dB noise factor spec and in fact seemed to be worse than Tony's IC-9700, which seem to indicate that something may be amiss with the transverter. During the tropo on 17 December Tony worked the following on FT8; F5NTD (JN25), F5MFO (JN19), F6HMQ (JN18), F1TWQ (JN18), F1ETW (JN06), F1JBN (JN06), F4IAA (JN05), F5DYD (JN03), F4FRG (IN98), F4FEY (IN97), F4DXX (IN97), F8DLE (IN95), EA2ZN (IN93), EA2EGM (IN93), F4HMV (IN88), F6DBI (IN88), F8BON (IN86), EA2XR (IN83), EA2T (IN83) and EA1UR (IN53). EA1UR was worked on both FT8 and SSB.

During the 70cm FT8AC on 10 January, Tony made 72 QSOs with the best being OZ2ND (JO46), OV3T (JO46), OZ1DLD (JO45), OZ6HQ (JO45) and OZ1IIL (JO47). Tony says it was nice to work GM0HBK (IO77) once again.

During the tropo on 11 January, Tony was delighted to work OY9JD on FT8 for a new country and then went on to work him on CW as well. Other QSOs made during the opening were F1RJ (JN18), G4VCJ (IO94), GM4FVM (IO85), GM0HBK (IO77), GM3SEK (IO74), GD0TEP (IO74) and EI9KP (IO54).

Roger EI8KN made some nice QSOs during the tropo events, including F4FET (JO00) on 16 December and EC2BBS (IN93) on 17 December.

The 12 January opening saw lots of DX for Roger, including DG1KDD (JO31), OZ1BP (JO55), DF1JC (JO31), GM4FVM (IO85), OV3T (JO46), PA3FXB JO33), OZ1SKY (JO56), OZ7KJ (JO46), ON8NT (JO11), OZ1JMN (KO46), OZ2ND (JO46), OZ1IIL (JO47) and GD0TEP (IO74).

The 23cm band

Roger EI8KN made some nice QSOs, including G0JJG (JO02) using Q65 on 20 December and GM4FVM (IO85) on FT8 during the tropo on 12 January.

Satellites

Patrick Stoddard WD9EWK (Phoenix) writes, *"At the end of 2023 and the start of 2024, I made some trips to two locations in southern Arizona to play radio. I had stayed close to home during the summer of 2023, the hottest on record here in Arizona, so it is now time to make up for lost time. On 30 December, I went to grid DM31 in southern Arizona, near the Mexico/USA border. Working passes in FM, SSB, and D-STAR, DM31 went into more logs from a day of operating.*

"After the DM31 trip, on New Year's Day, I made my first roving trip of 2024 to the DM32/DM42 grid line south of Phoenix. Surrounded by farms, it was fun to get on the air from another location over this long holiday weekend, and start the new year working satellites away from home.

*"Just before Christmas, I received a large envelope from NASA's Johnson Space Center marked 'PHOTOGRAPHS - DO NOT BEND'. Instead of getting this in my PO box, I had to go to the counter in the post office. I was asked if I was expecting photos. I wasn't, and it didn't hit me what could be in the envelope until I walked outside and back to my car. What I saw in the envelope was a surprise - an autographed photograph of NASA astronaut **Kjell Lindgren**, along with an Expedition 67 patch and sticker* (**Fig. 3**).

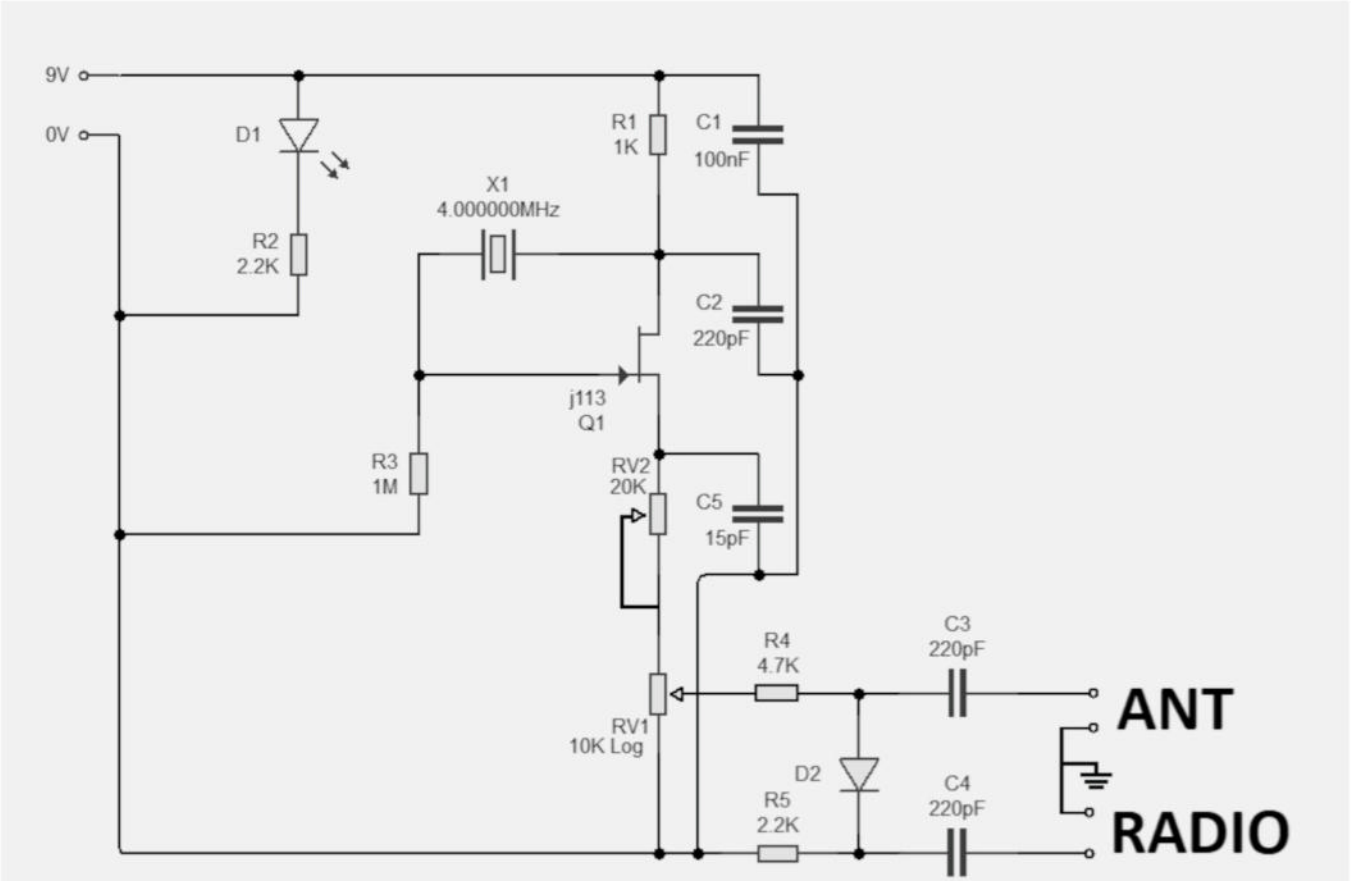
"After Kjell Lindgren completed his tour on the ISS, I sent him a short thank-you letter for his time spent on the radio, a QSL card for one of our QSOs while he was in orbit (I had already received NA1SS QSL cards from the stateside QSL manager, so I wasn't expecting another QSL card from Kjell), along with a USB memory stick. The memory stick had audio recordings from passes I heard him on, videos of some of those passes, and photos of me and my setups I used to make those NA1SS contacts. I didn't expect to receive anything in return, so getting this envelope was a surprise. The shock came when I read the personalized greeting Kjell wrote on the photo, and signing it with his personal call sign KO5MOS and the ISS callsign NA1SS".

Kev ZB2GI worked EA1PA (IN71), EA7JAM (IM77) and EA8TL (IL18) on the Tevel-3 FM satellite. Kev was also QRV on the QO-100 geostationary satellite using the GARS club station equipment. Highlights of the log include G3MXH (JO02), GB3RS (IO91), PY4LI (GG68) and R3LO (KO64).

FM and DAB

Simon Evans (Twyning) writes that over the Christmas and New Year period there has been very little of interest, but 12 January changed all of that. There was FM DX into France but most interestingly, there was some DAB DX. Simon says that he hadn't received any DAB stations on Channel 13, which is rarely used in Europe. However, Simon received DAB2N on Channel 13B from Denmark from two sites in the north of Jutland, **Fig. 4**. The path to Denmark from Simon's location is not straightforward as there is a local hill in the way.

That's it for this month. Many thanks to all the contributors for some very interesting reports. See you next time. **PW**



1

ARDF from the Offset

Billy McFarland GM6DX has another easy-to-build project, this time to help with ARDF.

Billy McFarland GM6DX
gm6dx@outlook.com

The better weather will soon be here, affording us the opportunity of some outdoor amateur radio activities such as Amateur Radio Direction Finding (ARDF), also known as fox hunting. One useful piece of equipment for use during ARDF is an Offset Attenuator. Where you have tracked down the beacon to a local area but due to the signal strength of the beacon you are unable to identify a more accurate location, then it is time to use the offset attenuator. More on the use later, let us get into the construction.

I first did some research online where I came across a few designs, but looking to keep things simple I picked and drew the schematic as seen in **Fig. 1.** This uses a 4MHz crystal and only contains 16 components. You will also need a plastic enclosure, a 9V battery with connection, two BNC chassis mount connectors, a toggle switch and a potentiometer knob. **Table 1** shows the list of components and their values. I ordered up the components and then made the decision that I was going to create a PCB for this project. One main advantage of creating a PCB is that it allows the easy assembly of components and provides reliability in projects where connection stability is crucial. As described in my previous *PW* article I got the Fritzing software out and started to lay out the components. Once all the connections were added the finished product was generated as seen in **Fig. 2.** You can download the Gerber files for my PCB design here:

https://t.ly/2MF-L

I ordered up the PCBs and two weeks later they arrived as shown in **Fig. 3.** Now it was time to fit the components. I worked my way through adding on the items until it was complete at the stage as shown in **Fig. 4.**

As this PCB will be fitted into a housing I simply used short pieces of wires for the connections to the 9V, antenna and radio connection, LED and potentiometer. I took my enclosure and installed the potentiometer and LED bezel, while just below the potentiometer knob I installed a simple toggle switch. The battery supply positive wire goes to the toggle switch and then from the toggle switch to the PCB. This allows power to the PCB to be cut if needed by the flick of a switch. I fitted the BNC connectors to the enclosure and then simply connected the wires back to the PCB. Finally, I placed the PCB into the housing and the complete project can be seen in **Fig. 5.**

In use

Fit this onto your ARDF antenna and connect it in-line between your antenna connection and transceiver connection. Now you have it installed, let's look at the use of the device. When you have traced the beacon to a small area, due to its signal strength it has saturated your receiver and you are unable to locate it further, then it is time to switch on the attenuator. Turn your transceiver to 4MHz above or below the beacon frequency. For example, if the beacon is on 144.5MHz, then tune your transceiver to 148.5MHz. Turn the potentiometer knob to increase or decrease

Fig. 1: Project schematic.
Fig. 2: The PCB design.
Fig. 3: The actual PCB on arrival.
Fig. 4: Components installed.
Fig. 5: The completed project.

Components used

Capacitors

C1 0.1µF
C2, 3, 4 220pF
C5 15pF

Resistors

R1 1kΩ
R2, 5 2.2kΩ
R3 1MΩ
R4 4.7kΩ
RV1 10kΩ log
RV2 20kΩ trimmer

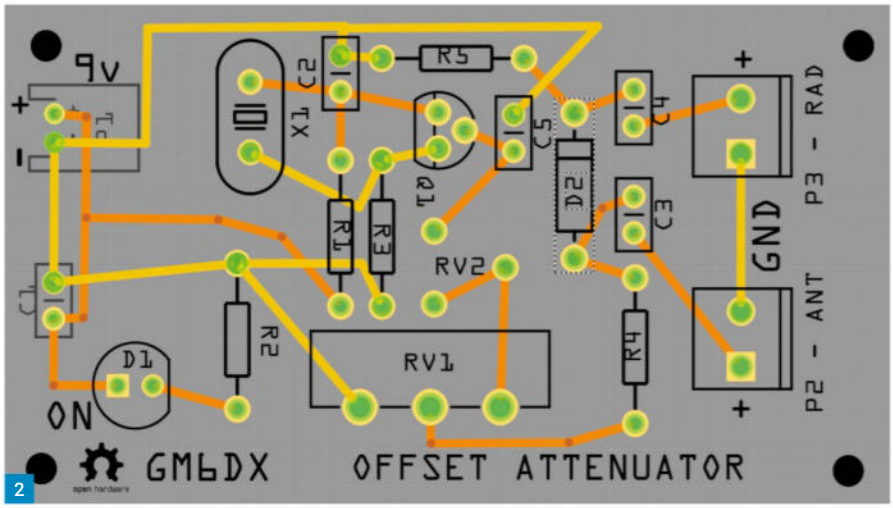
Other

D1 5mm LED
D2 1N4148
Q1 JFET J113
X1 4MHz crystal

Table 1: Components used

the 4MHz signal from the attenuator. Turn your antenna until you see the strongest peak on the S-meter. Decrease or increase the attenuator signal until the strongest direction of the beacon is found, repeat this process. To watch a video of this in practice see here: **http://tinyurl.com/5ubpma2t**

This is a very simple project but worthwhile for ARDF use. As always, any questions drop me an email at **gm6dx@outlook.com**



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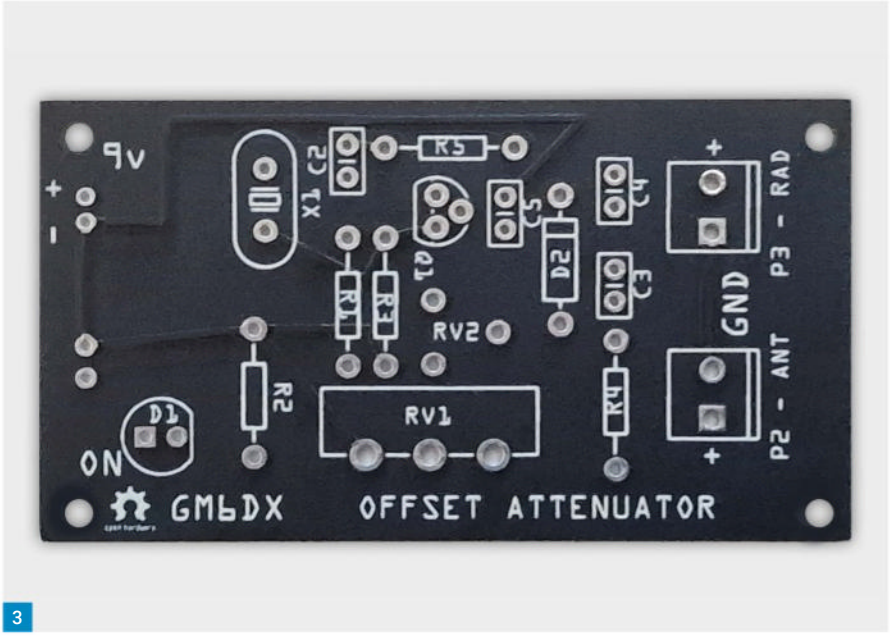

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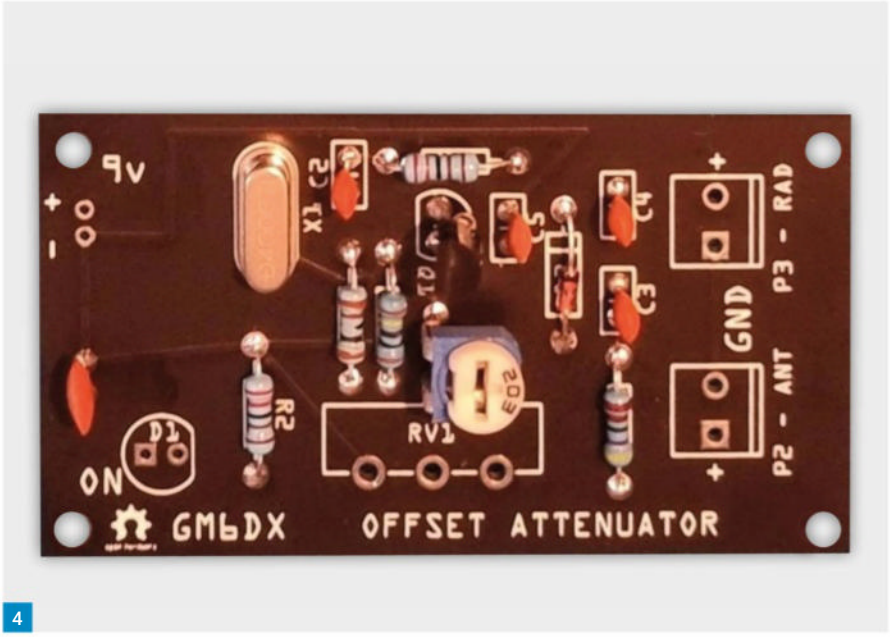

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1

Mark Stuckey G0SQK

Roger Dowling G3NKH meets a familiar face from the BBC's award-winning show *The Repair Shop*.

Roger Dowling G3NKH
practicalwireless@warnersgroup.co.uk

By their nature, radio amateurs the world over tend to be enthusiastic collectors and most shacks contain an impressive array of transceivers, tuning units, power supplies, test equipment and the like. But this month, I was delighted to meet **Mark Stuckey G0SQK**, **Fig. 1**, whose Aladdin's Cave of modern and vintage equipment was in a class of its own. It was no surprise to me that he was the obvious choice when, in 2018, the producers of the popular BBC 1 show *The Repair Shop* enlisted him as its resident electronics and electrical restoration expert.

How it all began

"It all started with my fascination with Dr Who," explained Mark. *"He seemed to know a bit about everything, and I really admired that!"*

And so started his long voyage of discovery, beginning with the dismantling of the family television set at the age of seven *("Quite easy to take apart but rather a problem to put together again"*, he found to his dismay). His father was a works foreman at Marconi, initially at St Albans and later in Luton, but numerous changes of schools made it difficult for Mark to consider further education at that stage. Instead, his father, himself mechanically-oriented, got him an engineering job in a local company at the age of 15 – but a life of milling machines and capstan lathes was not for him and he hated every minute.

But luckily he had a friend who worked in a nearby television and radio repair shop and Mark would often call in to help in the evenings. He found this fascinating and in due course was offered a job there as a trainee. Then followed a City & Guilds course in television and radio servicing, Over the course of the next few years his work broadened, at this and a later company, to include business machines such as copiers and dictating machines. This led in due course to Mark deciding to become self-employed.

The next change of career was a move to the service department of Graseby Dynamics,

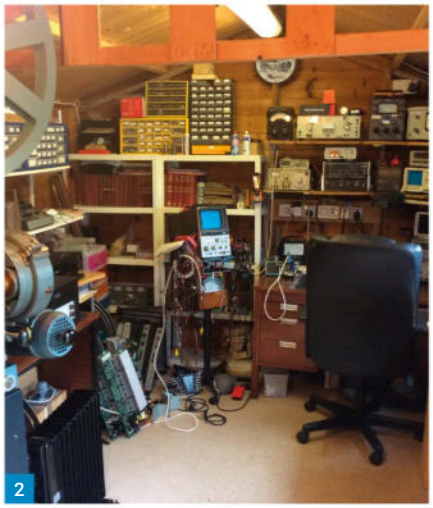

Fig. 1: Mark G0SQK in his shack in Cromer, Norfolk. Fig. 2: A separate shed houses Mark's well-equipped service workshop used for his Classic Radio Shop restoration work. Fig. 3: Mark's shack includes, at the operating position, a Yaesu FT-726R, a recently acquired Icom IC -970H, a Kenwood FT-1000MP and an Acom 1919 linear. On the shelf above are a Kenwood TS-790E, an Icom IC-746 and a Yaesu FT-102 antenna tuner. Mark's tiny Xiegu G90 transceiver sits on top of the Icom IC-746. Fig. 4: A 10-element Yagi antenna is mounted on a wind-up mini-tower. Adjacent can be seen the observatory that houses a historic Dall-Kirkham optical telescope.

part of the Pye group, in Bushey, Watford, which produced top level military equipment. Mark worked his way up there, supervising the production line and then moving into design and development. At that stage the company financed an Open University degree in Physics.

After seven years Mark decided that it was time for another change of direction. For a couple of years he worked for the instrument company Fluke, then part of the Philips group. Then, he decided to go into the television and film industry: he made contact with Pinewood Studios and worked self-employed on various film and TV projects, including the supervision of special effects and animations for the cult television comedy series *Red Dwarf* and for *Quatermass* for Channel 5.

Classic Radio Shop

After five years, it was time for a final change of career. Still living in Luton, Mark and his wife Linda visited a friend living in Aylsham in Norfolk and were so impressed by life there that they decided that they too would move to that part of the country. *"We went on the Friday, came back on the Sunday and put our house up for sale on the Monday"*, he recalled.

Mark decided to go back to working from home and this led to the setting up of his Classic Radio Shop, a successful Cromer-based company, which offers a restoration service for radios, television receivers, tape recorders and a wide range of other vintage equipment. A separate well-equipped shed houses his comprehensive range of test equipment, **Fig. 2**.

Amateur radio

Mark's interest in amateur radio dates back to his schooldays when a friend introduced him to a keen local short-wave listener who enjoyed tuning into local radio amateurs on his early Yaesu FR-50B 10-80m receiver. Fascinated by this, Mark eventually acquired his own Trio 9R-59DS. Another neighbour had a little QRP 2m AM transmitter and a 10-element Yagi, and this was enough to persuade Mark that he also wanted to gain his amateur radio licence.

Mark took his Radio Amateurs Examination at the local technical college. It presented no problem and he became the proud owner of his Class B licence as G6UTX in 1983 using a 'Slim Jim' antenna and a borrowed Icom IC-2E FM transceiver. The next challenge was the Morse test so he bought himself a BBC Acorn microcomputer and used that for self-tuition. Thanks to a 'sympathetic' examiner, Mark was achieved his 12 words a minute – and he became G0SQK in 1984.

He has fond memories of his first HF rig: a Kenwood TS-830 with matching speaker and ATU. His present-day equipment comprises a comprehensive range of transceivers, **Fig. 3**, which include a recently acquired Icom IC-970H VHF/UHF radio. Another recent addition is an Xiegu G90 20-watt HF transceiver, which impresses him greatly.

For antennas, Mark uses a 108ft 80m trap dipole and a 10-element cross Yagi on a wind-up mini-tower, which can extend up to 40ft, **Fig. 4**. He also has plans to erect a 50MHz vertical when time permits.

Mark's present principal interest is VHF and UHF and he would like to do more CW.

The Repair Shop

The Repair Shop has been one of the BBC's biggest success stories in recent years. It started life as a modest 30-minute afternoon show on BBC2, aiming to show how old discarded or damaged items could be given

a new lease of life with the help of an expert team of restorers. It soon became apparent that the stories behind some of these items were often more important than the items themselves and viewing figures rapidly soared. Today, the programme – promoted to BBC1 prime time and extended to an hour – attracts an audience of up to five million viewers.

Mark's involvement started with a telephone call from a producer at the production company Ricochet who were seeking an expert electronics, radio and electrical restorer. Since then he has become a regular member of the *Repair Shop* team.

The show is recorded from an old restored barn at the Weald and Downland Living Museum near Chichester. *"I take along all my own test equipment,"* said Mark, *"and the filming is done in real time as the work progresses and as camera teams become available. So sometimes a repair that would normally take a few hours in the workshop can take two or three days on the set."*

A typical challenge, **Fig. 5**, was a non-working 1950s Ekco radio brought along by a couple who explained that it had been a constant companion of their grandfather. They had never heard it working and it said would bring back fond memories if it could be restored. *"It was in a pretty sad state"*, said Mark, *"The first task was to replace all the ancient leaky paper capacitors, which was no mean task"*. He also noted with concern that at some stage four improvised metal legs had been screwed into the chassis – highly dangerous for an AC/DC radio with a potentially live chassis. The obvious gratitude of the radio's present owners as the radio sprang into life made the restoration well worthwhile.

Astronomy

Mark has been interested in astronomy since he was a youngster, when he noticed that a neighbour called **Horace Dall** had a really large observatory in his back garden. He did not know at that time that Dall, born in 1901, was an internationally famous astronomer, optician, mirror-maker and lens grinder.

In 1937 Dall had completed a highly original 15.5in (39cm) Cassegrain telescope – a type nowadays known as a Dall-Kirkham telescope – which he used primarily for lunar and planetary photography. After Dall's death in 1986 Mark restored the telescope and observatory with the support and assistance of the Luton Astronomical Society, and brought the telescope to Norfolk so it could again be used in the way Dall always intended. *"I had known Horace since I was just 14 and often used the telescope with him, so it is fantastic to be able to house it here at my home"*, said Mark.

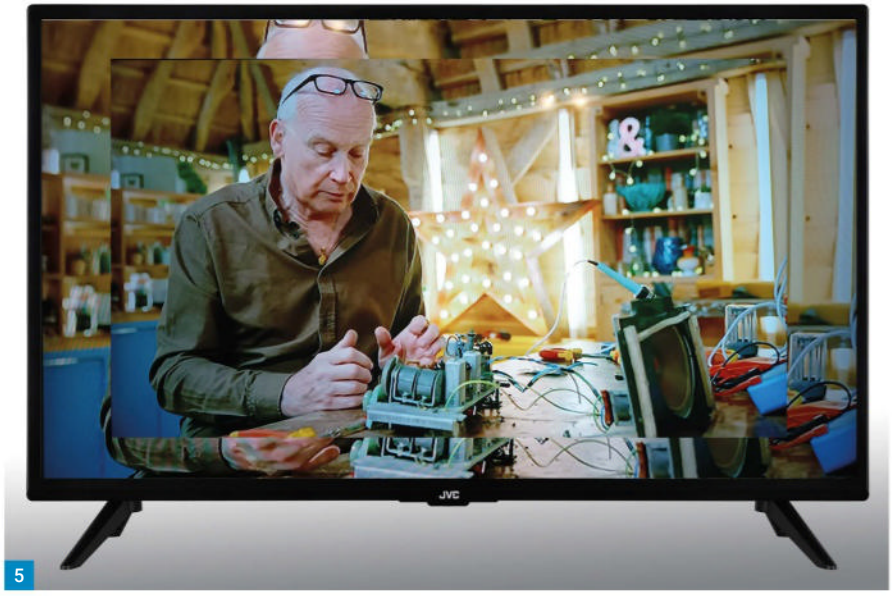

Fig. 5: Mark restores a 1950s Ekco radio on *The Repair Shop*.
Fig. 6: The historic restored Dall-Kirkham telescope. Fig. 7: Mark's 12-seat home cinema.

Home cinema

Mark has always had a deep interest in the cinema and the restoration of projectors. His home 12-seat cinema, **Fig. 7**, has a 4K video projector, and in his workshop he has a Vic-5 and Philips Kinoton 35mm projectors and an Eiki 16mm projector, all of which he plans to install in his cinema when time permits.

The future

With the success of *The Repair Shop* on television and the Classic Radio Shop in Cromer, it's good to know that there is still so much interest in vintage electronics that Mark already has enough restoration work ahead to fill the next couple of years.

So, it looks as though Mark, his wife **Linda** (Works Manager) and Norfolk Terrier **Molly** (Head of Security) are going to be kept busy for quite a while to come. **PW**

Rallies & Events

All information published here reflects the situation up to and including **23rd January 2023**. Readers are advised to always check with the organisers of any rally or event before setting out for a visit. The Radio Enthusiast website **www.radioenthusiast.co.uk** has the latest updates, please check it regularly. To get your event on this list, e-mail the full details, as early as possible, to: **practicalwireless@warnersgroup.co.uk**

3 March

EXETER RADIO AND ELECTRONICS RALLY: Open 10.00 - 13.00. America Hall, Pinhoe EX4 8PX. Details from Pete G3ZVI
Email: g3zvi@yahoo.co.uk ir tel: 07714198374

17 March

CALLINGTON RADIO AND ELECTRONICS RALLY: The Callington Radio and Electronics Rally will be held in the Town Hall, New Road, Callington, Cornwall, PL17 7BD on Sunday 17 March 2024. Doors open from 10am. Entry is £2 each with no charge for those under the age of 16. A comprehensive selection of traders, clubs and societies from the Southwest will be present along with a bring-and-buy stall and the usual excellent catering service. The venue has excellent disabled access and toilets and there is ample car parking in a nearby public car park. Some Trader tables are still available at £5 for the large size and £3 for the smaller one. Booking is essential, so please contact Alastair, MOKRR via alastair.kerrl@btinternet.com or by phone on 01503 262755 with your requirements. (CR, CS, D, SIG, TS)
www.callingtonradiosociety.org.uk

20 April

2024 YEOVIL ARC THIRTY-EIGHTH QRP CONVENTION: The Digby Hall, Sherborne, Dorset, DT9 3AA, 9.30am to 1.30pm. Admission £3. Talks, Traders, Bring and Buy, club stalls, cafe, parking. Supported by RSGB, G-QRP & Rafars. (BB, CR, CS, FP, RSGB)
http: //Yeovil-arc.com or contact M0WOB
Email: derekbowen1949@talktalk.net

5 May

LOUGH ERNE AMATEUR RADIO CLUB 40TH ANNUAL RADIO RALLY: Share Discovery Village, 221 Lisnaskea Rd, Lisnaskea, Enniskillen BT92 0JZ Usual facilities - Food and Drink, Bring & Buy Doors Open 11:00 (Traders arrive 9:00) £/Euro 5 Admission to include Draw Ticket, Usual Draw RSGB Books/ QSL Bureau, IRTS, variety of traders (BB, CR, CS, RF, RSGB, TS)
argault91@gmail.com

19 May (corrected date)

DARTMOOR SPRING RADIO RALLY: Yelverton War memorial Hall, Meavy Lane, Yelverton, Devon, PL20 6AL. Doors open 10am, Admission £2.50, Free Parking. Contact Roger:
Tel: 07854 088882
Email: 2e0rph@gmail.com

15 June

ROCHDALE & DISTRICT AMATEUR RADIO SUMMER RALLY: St Vincent de Paul's Hall, Norden, Rochdale, OL12 7QR. Doors open at 10am with entry still at only £3. Usual Traders and caterers. Plenty of free parking. Contact Dave, G3RIK – details below. Please note that all proceeds from this rally will be given to a local charity. (CR FP TS)
Email: dave@cardens.me.uk,
Tel: 01706 633400, Mbl: 0781 367 1296

23 June

NEWBURY RADIO RALLY: Newbury Showground, next to junction 13 of M4 motorway in Berkshire, RG18 9QZ This is the 35th year of The Newbury Radio Rally and is the ideal event for anyone interested in radio communications, computing and electronics. There will be a display area with an amateur radio station, exhibits, special interest groups, clubs and societies. Open to sellers at 08.00hr and visitors at 09.00hr. Free parking. On-site catering. Disabled facilities. Entry is £3 visitor, £15 sellers pitch. (CR, CS, D, FP, SIG, TS). Advance bookings (with discount):
www.nadars.org.uk/rally.asp
Email: NewburyRally@nadars.org.uk

KEY TO ACRONYMS: BA Buildathon **BB** Bring-and-Buy **CBS** Car Boot Sale **CR** Catering /Refreshments **CS** Club Stalls **D** Disabled visitors **FM** Flea Market **FP** Free Parking **L** Talks Lectures and Demos **LB** Licensed Bar **MS** Meeting Spaces **RF** Raffle **RSGB** (RSGB) Book Stall **PW** PW in attendance **SIG** Special-Interest Groups **TI** Talk-In (Channel) **TS** Trade Stalls **Wi-Fi** (Free) Wi-Fi

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Operating from the Balkans

Chris R. Burger ZS6EZ embarks on a running, flying and radio tour of the Balkans.

During 2023, I started wondering whether it was possible to run the original marathon route. The story goes that in 490 BC the Greek soldier **Phidippides** ran from a battle at Marathon to Athens to deliver a message. After passing the message, he collapsed in a heap, dead. I wasn't too keen on the traditional way. Firstly, he ran naked. I couldn't, as my feet were too soft. Secondly, I didn't fancy the idea of dying afterwards. Fortunately, I didn't have to run several times the distance the previous day, like he had.

I soon discovered that there was indeed an annual marathon on that route, in November. It is unimaginatively dubbed the Athens marathon, but I fondly renamed it the Marathon marathon. I entered and started making plans to see a few new countries while in the vicinity. I am a fan of the DX Foot Club (DXFC), run by **Stewart Cooper G4AFF**, formerly GM4AFF. The idea of DXFC is to visit countries, mark them off on the list and compare your score with others. The DX Century Club (DXCC) entities list is used as the basis. This list roughly corresponds to countries, with some notable exceptions. The leaders have incredible scores, well above 200. I had been stuck at 98 countries for four years – the second most frustrating place to be stuck. I could make some real progress, as I had seen very little of the Balkans before.

A November visit would combine well with the CQ World Wide DX Contest. I preferred CW, which happens at the end of November. I started enquiring about options in the area. Out of the blue, I was invited to join **Chris Plumblee W4WF** and friends in Andorra as C37NL. It was an amazing prospect. Unfortunately, it soon became obvious that work commitments late in the month would make it impossible. I had to go early and work the Phone contest before travelling in the area for a fortnight before the Marathon marathon. I had to decline Chris's offer with great regret.

DXFC has a second element. Apart from keeping track of countries in which you've set foot, it also keeps track of countries you have operated from. I had operated from 33 up to that point. To make use of this enticing opportunity, I would need a portable radio. I had used my Elecraft K1 to activate several countries, but it was CW only, covered only a few bands and needed an external battery. I could not find any radios locally, but **Leon Uys ZR6N** agreed to order a Xiegu X6100 with the understanding that I could borrow his radio if mine didn't arrive on time. He also helped me with an 8:1 transformer and a random wire antenna neatly wound on a small clothes hanger.

Fortunately, licensing was relatively easy. All the countries I targeted were part of CEPT. I could therefore easily operate from them with little paperwork. The one exception was Kosovo, which required a traditional licence application process. The local amateurs were helpful and I soon had an invoice. Once it was paid, the way was open to operate from there too.

My long-time radio friend (and *PW* editor) **Don G3XTT** had operated from Greece in 2015 (see *PW* February 2016). He highly recommended the Radio Amateur Association of Western Greece, who operate as SZ1A in most of the major contests. They, in the persons of **Vasilis Kontothanasis SV1DPJ** and **Costas Stamatis SV1DPI**, welcomed my enquiry with open arms. The show was on! I would operate the contest with them, then travel through Greece and the Balkans for a fortnight before tackling the Marathon marathon. I would then immediately return home. I also set up some meetings regarding aviation, with a view to doing a European pilot licence one day.

I had recently completed four semesters of Koine Greek at university. I was thoroughly familiar with the alphabet and could read with help from a dictionary. About two months before

Photo 1: One of the towers at SZ1A, with the Greek and South African flags.
Photo 2: The Koutloumousiou monastery, where Iakovos SV2RSG is supposed to be. Photo 3: Some of the towers at the YT1AD/YT5A station. Photo 4: K1ZZ and YT1AD touring the station with the Dog, X-ray. Photo 5: Looking out over Herceg Novi, with the 4O3A peninsula in the background.

the trip, I started doing daily Greek exercises on Duolingo. I was hoping to at least make some progress toward conversational ability.

En route

I travelled via Istanbul. I would have liked to have spent some time there, but time was limited. My paddle and a roll of insulation tape caused a lot of excitement while passing through security. I arrived in Athens the day before CQWW Phone. Vasilis picked me up at the airport for the three-hour drive to Agrinio. After lunch in the village, we tackled the steep roads to the station. I was thrilled to see a South African flag on the tower, along with the Greek flag. Not long after our arrival there, other operators started arriving. Apart from SV1DPI and SV1DPJ, the crew included SV1CIB, SV1CQG, SV1CQK, SV1DKD, SV1HKH, SV1JG, SV1SN and SV8PMM. Some work had to be done to get everything ready, but the work did not preclude a hearty meal. To my disappointment, I understood virtually nothing. It is no wonder that the saying is *"it's Greek to me"*, as opposed to Italian or German or Japanese, all of which I've had some success with, with far less effort. Fortunately, most of the crew spoke enough English to get by, much like I do.

Our entry would be in the Multi-Operator Single-Transmitter category (Multi-Single). We were allowed to have one signal on the air at all times, with a second station looking for multipliers. There are some limitations on how often you may change bands. At SZ1A, there is also a third station that operates in the running station's band, looking for other contacts and multipliers. These two stations are interlocked to ensure that only one of them can transmit at a time.

I hadn't been active for more than a decade. In this period, I did a few contests from offshore locations and some limited portable operations from foreign countries. I wondered to what extent my abilities would still be intact. I certainly didn't want to be the weakest link!

The CQWW contest

The entire contest was divided into four-hour slots. I was rostered to operate for five slots, for a total of 20 hours. Some slots were on the running station, while others were on the secondary station. In general, the secondary sessions consisted of half multiplier and half in-band operation.

The running station and the multiplier station were well within my realm of experience. The in-band station was not. There is some technique to operating the in-band station effectively, both for the in-band operator and for the running operator. It is relatively difficult to work stations in-band without disrupting the run station's rhythm.

Obviously, as the run station's rate increases, it may not make sense to try and work other stations on the band at all, except maybe for multipliers.

Multi-operator contesting has its attractions. I remember some contests where I suffered extreme fatigue, even to the point of hallucinations. Multi-operator contesting provides the opportunity to get some rest. I even managed to do a 20km run in the mountains. I was intrigued to notice an almost total absence of animals, even birds. Perhaps the numerous shotgun shells had something to do with it. I especially enjoyed some of the local tales, including the support this club had provided to **Monk Apollo SV2ASP**, a local Agrinio boy who became a legend in amateur radio as the sole operator from Mount Athos for decades.

I had lots of fun in the contest. I managed to make many contacts in German, Spanish, French, Japanese, Italian, Dutch and – to my surprise – even in Afrikaans. The only time when I was caught off-guard is when I was called by Greek stations in Greek…

I kept my eyes open the whole weekend, looking for tips to employ when I commission my own multi-operator station in the coming years. I definitely gathered numerous station engineering and operating tips that should stand me in good stead.

Back on the tourist trail

On Monday, after the conclusion of the contest, Vasilis dropped me off in the outskirts of Athens. I caught a train to the tourist spots and walked a lot. Around sunset, I made my way to the airport for a rental car. I got bad news: No rental car company would permit their cars to cross Greek borders. I needed a car for my aviation appointment the following day, a seven-hour drive away. However, I suddenly needed to find a way to cross borders. I could not find an affordable one-way rental either, so I would have to park the rental car while I was travelling in other Balkan countries.

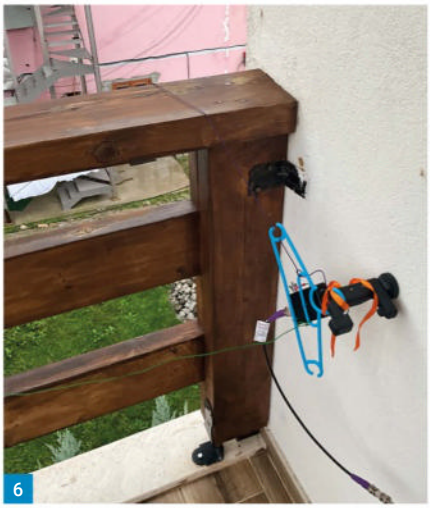
As soon as my friend **Alet** landed, we set off toward Kavala in the northeast (SV2). After an overnight stop where we had to sleep on the porch as the landlady was nowhere to be found, we arrived at the flying school. After a long business meeting, I flew a Diamond DA40 with an instructor. During this flight, I managed to get some nice pictures of the Mount Athos peninsula from this unusual angle. The instructor pointed out the remains of Philippi, now covered by the modern town of Lydia. Those who know the New Testament will recognise the city and the name. Later research revealed that Paul had landed at Kavala and spent much time in the area. Inadvertently, the Pauline connection became a theme in our Greek travels. We visited many related destinations during the rest of our trip.

For the moment, though, my target was Mount Athos. This peninsula has enjoyed almost full autonomy for about 900 years. Only men are allowed – even cows and hens are prohibited. Many orthodox Christians make the pilgrimage. Only ten unbelievers (including all non-orthodox Christians) are allowed daily. Access is controlled by the Diamonitirion, for which I had applied before departure. I had to face a brusque interrogation and pay before obtaining the precious permit. Soon I was on the ferry. Passing the Docheiariou monastery, I spotted the green-painted Yagi that I had been told about, still there four years after Apollo's death. The paint was an effort to avoid unwelcome attention.

Once the ferry had docked in Dafni, and I had logged my 100th country on DXFC, I wanted to walk to Karies. It was soon obvious that this project would not fly. The terrain is very steep and the road surface is too rough for my carry-on suitcase's wheels. The bus driver short-changed me, making the trip very expensive. Once at Karies, I tackled the walk to Koutloumousiou monastery, where Apollo's successor **Iakovos SV2RSG** is supposed to be. The situation was very confusing. Road signs are in ancient Greek script, using abbreviations that I didn't recognise. I soon noticed that there were Koutloumousiou signs everywhere, some pointing in opposite directions and some in the direction I had come from. After a two-hour search, I finally found the monastery. It turns out that some of the signs pointed to sketes, small communes associated with the main monastery. I was given curt instructions: *"Church at 16, eat at 17, room at 18"*. My questions were met with a blank stare.

The church service was a new experience. The Orthodox way is very different to what I am accustomed to. The meal was wholesome but spartan, accompanied by reading from a prepared text. After 18:00, I found myself in a double-storey building outside the monastery, sharing a room with about six other pilgrims. I found myself in a grotesque situation. Here I was in Mount Athos, in the Top 20 on the Most Wanted List on both Phone and CW, with a radio and an antenna and a valid Greek licence, unsupervised, yet unable to operate.

The next morning, I found my way back to Karies and then to Dafni for the ferry. I wanted to get back to Ourianopoli as soon as possible, as I had found a company in Sofia, Bulgaria that seemed to offer rental cars that can travel. Unfortunately, the early ferry was full. By the time I was back in Ourianopoli, it was too late. We set off to Pella for the night. Using a sloper from the balcony, I worked some stations as SV2/ZS6EZ after figuring out how to operate the radio. We enjoyed the museum in the morning, before finding exorbitantly expensive parking in Thessaloniki and catching a bus to Sofia.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When I added Mount Athos to my DXFC, I noticed that ZS4BS had just added Serbia. My suspicion that there must have been an IARU event was quickly confirmed. I resolved to try and arrive in Serbia in time to stop by at the IARU Region 1 conference in Zlatibor.

That night, I repeated the radio performance as LZ/ZS6EZ. In the morning, we obtained the rental car and headed for Romania. We arrived in Pristol in the far southwest around sunset. I draped a wire over a tile roof and made some QSOs as YO/ZS6EZ. The following morning, after a 90-minute run and a swim in the Blue Danube, we set off for Serbia. The tiny border post had never seen a South African passport. I spent half an hour with a probe in my mouth and waiting for a machine to analyse the probe before being declared drug-free and being allowed to enter Serbia.

We were just too late to meet most of the conference attendees. When we got to his house, **Hrane Milosevic YT1AD** had just arrived back from Zlatibor. Hrane took us to a restaurant with local food before allowing me to use his superstation for a while. YU/ZS6EZ ran a string of Europeans and North Americans using the

Photo 6: The antenna feedpoint at ZA/ZS6EZ. The 20m wire ran down into the parking lot, providing a great quarter-wave sloper on 80m.
Photo 7: A tired radio ham wearing a fancy medal. Photo 8: Vlado Z31TU being a gracious host to a foreigner.

monster beam on 20m SSB. It beats having to string wires in the cold and bleating your heart out! I especially enjoyed chatting to AA6AA and NQ4I for the first time in decades. The following morning, Hrane took us to a local flying club from where we flew over Hrane's station and took some pictures. We stopped at a wine farm before returning home. **Dave Sumner K1ZZ** and **Linda** had just arrived. I hadn't seen Dave in a decade. We spent several hours visiting at Hrane's station before another delightful Serbian meal nearby.

Having missed several days due to the rental car, time was tight. Hrane recommended that we avoid Sarajevo. We spent a night in Visegrad, from where I was able to get on the air as E7/ZS6EZ. Visegrad is the site of a bridge that became the topic of a Nobel Prize-winning book about the Balkans: *The Bridge on the Drina*, by **Ivo Andrić**. It is recommended as the best source for understanding the ongoing Balkan conflicts.

The following morning, we drove to Montenegro, where we had a delightful lunch with **Ranko Boca 4O3A** and **Dragan Djordjevic 4O4A**, before visiting Ranko's 4O3A.com factory. I enjoyed operating as 4O/ZS6EZ and seeing all their contest toys. One day when I'm big…

And so to Albania

We could not spend a night in Montenegro, proceeding instead to Albania. After a harrowing night-time drive on narrow, winding, bumpy and potholed roads through the Accursed Mountains, we spent the night at Peshkopi on the eastern border. My sloper from the third storey worked exceptionally well, including to G3PJT on 80m. Operating as ZA/ZS6EZ was an intense experience. In my youth, Albania was the Most Wanted DXCC country. My role models lacked only Albania at one point. Only with ZA1A in 1991 did the situation change. And here I was, operating from ZA with CEPT paperwork!

After more driving through those mountains, we arrived in Skopje in the late afternoon. Our accommodation was decidedly seedy. We walked to **Vlado Shutevski Z31TU's** nearby apartment. Vlado welcomed us with open arms. Using Z3/ZS6EZ from his rooftop station, I worked Europeans and Americans on 17m CW for a while. I was happy to contact **Vlado Karamitrov N3CZ**, who had introduced me to the local Vlado.

The following morning, I flew out of a local airport for a while before driving to the nearby Kosovo border. The rental car was not allowed to enter Kosovo, so we left it at the border post and walked to nearby Elez Han for lunch. Unfortunately, I could not operate, as I was unable to pay the invoice for the licence, despite attempts from three countries. Alet attracted considerable attention, as she was initially the only woman in the restaurant.

Our 10-minute stop at the Sofia bus station to buy tickets resulted in a clamped wheel and a hefty fine. I had apparently violated a prohibition published on a sign about 80m away, in Bulgarian. After returning the rental car and a night's sleep, we caught the bus back to Thessaloniki to recover the other rental car.

The radio portion of the trip had now come to an end. I had visited ten new DXCC entities, operating in eight of them. My DXFC score had grown to 108, comfortably above the century mark and the first place in the southern hemisphere. My QRV score was now 41. The two southern hemisphere callsigns that show higher scores are both Europeans in disguise. I feel a little cheated…

Marathon time

The focus now shifted onto the Marathon marathon. We took a trip via Berea, Corinth and Mars Hill to Athens, where I collected my race number. The Sunday was spent on a leisurely jog from Marathon to Athens along with 23,000 friends. I was ill-prepared and without insurance cover, so I took it very easy to minimise the risk of a mishap. We finished in the Panathanaic Stadium, built around 330 BC and revamped into its all-marble current shape in 144 AD. It was the venue for the first modern Olympics in 1896. After finishing in the stadium, I walked to the metro station and returned to our apartment to sleep the sleep of the dead.

The following day, we drove the marathon route and took some pictures before catching the flight home.

This trip was a great opportunity to relive the fascination of radio. I have been inactive for more than a decade. Having the opportunity to operate from SZ1A was a great privilege. There is something to be said for operating a contest with great hospitality, without having to stay awake for 48 hours and without having to do several days of paperwork afterwards. There is also a great fascination in operating with a piece of wire and a portable radio that fits in the palm of your hand. It really is all magic! **PW**

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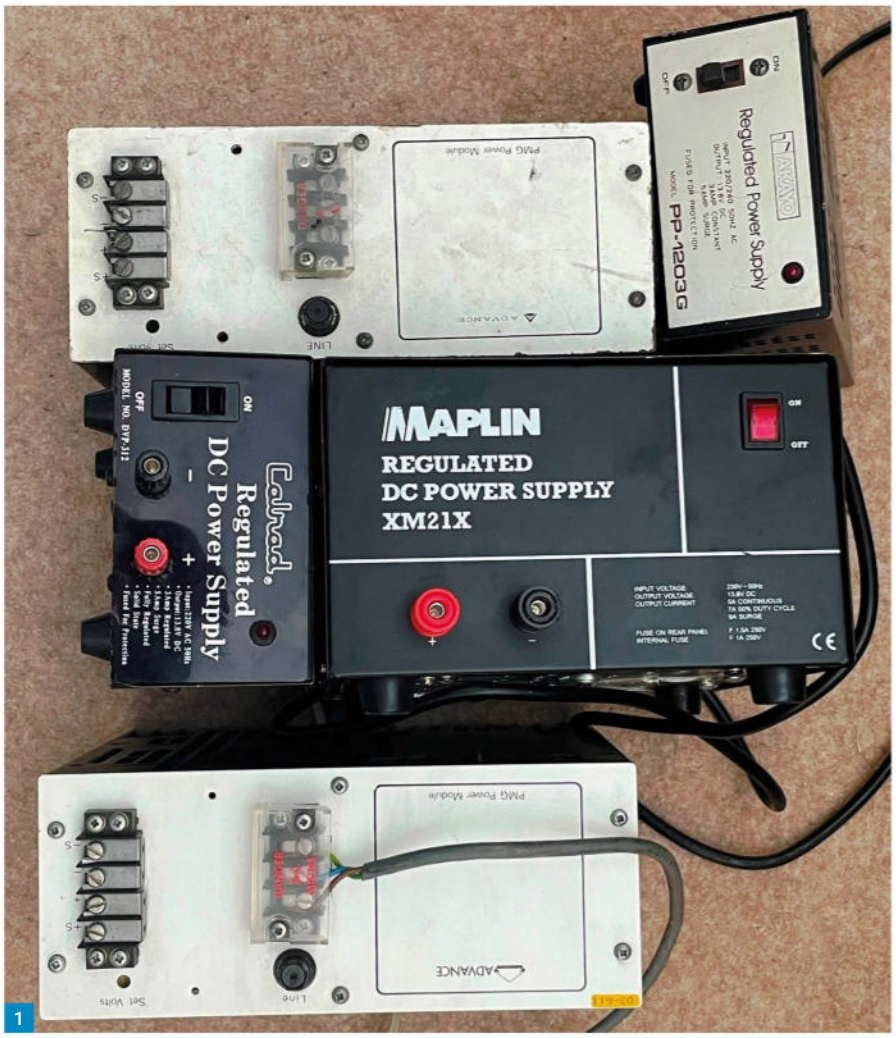

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Using those fixed power supplies (Pt I)

Dr Samuel Ritchie EI9FZB has, over the years, accumulated a number of fixed power supplies. In a set of three articles he looks at maximising the utility of these types of supplies.

Over the years I have accumulated a number of fixed power supplies of which some examples I will mention are shown in **Fig. 1**. The advantage of using these fixed supplies is that you do not have to fear coming into contact with, or working around, 220V AC mains voltage. There are no transformers, rectifiers or high value electrolytic capacitors to worry about as all the dangers and complexity are handled within these fixed power supplies. We do not have to worry about peak-to-peak, RMS or any other AC voltage measurements. We are going to use the rectified and smoothed DC voltage on their outputs to generate different fixed voltages and even make a variable voltage power supply in a later article. In this article I will look at how the smaller fixed power supplies perform and build a circuit that will allow you to test and gain confidence in using your multimeter as you build circuits.

The amateur power supply

This power supply, which I call the amateur power supply, is typical of the many power supplies that can be purchased at hamfests and on eBay. They weigh in at around 1.7 to 2kg and come in a metal box with dimensions of about 180 × 120 × 70mm. The specifications are a fixed output voltage of 13.8V DC with a maximum continuous current supply of 3A and a surge current capacity of 5A. I ran a number of 2m and 70 cm rigs off these supplies for many years and fondly remember the constant hum coming from the transformer and how the hum dramatically increases in amplitude as the output is loaded, when going from receive to transmit. One of my first jobs as an apprentice was learning about and repairing these type of devices as they were used on many machines and pieces of equipment in the large factory as well as by the many radio amateurs who worked in that company.

These power supplies are kept simple in order to minimise manufacturing costs and do not incorporate any integrated circuits but rather rely on simple circuits with transistors and in some cases Zener diodes. Some examples only have a rudimentary voltage reference with no short-circuit protection, or current fold-back but rather rely on the fuse burning out if there is a problem with the load. The symptoms representative of these lower quality power supplies are listed here with typical results I have measured:

The output voltage varies depending on the load – having set the output voltage at 13.8V with no load connected the output falls to 13.4V as a 3A load is connected. Trying to set a higher no-load voltage (as high as 14.2V) does not help as the output voltage varies as the load varies;

The output voltage slowly falls as the semiconductor junctions heat up – typically when running with a 3A load the voltage falls as low as 13.2V after 15 minutes;

The heatsink gets very hot – with a 3A load and after 15 minutes the heatsink temperature has risen from 23°C to 82°C, that is blisteringly hot; and

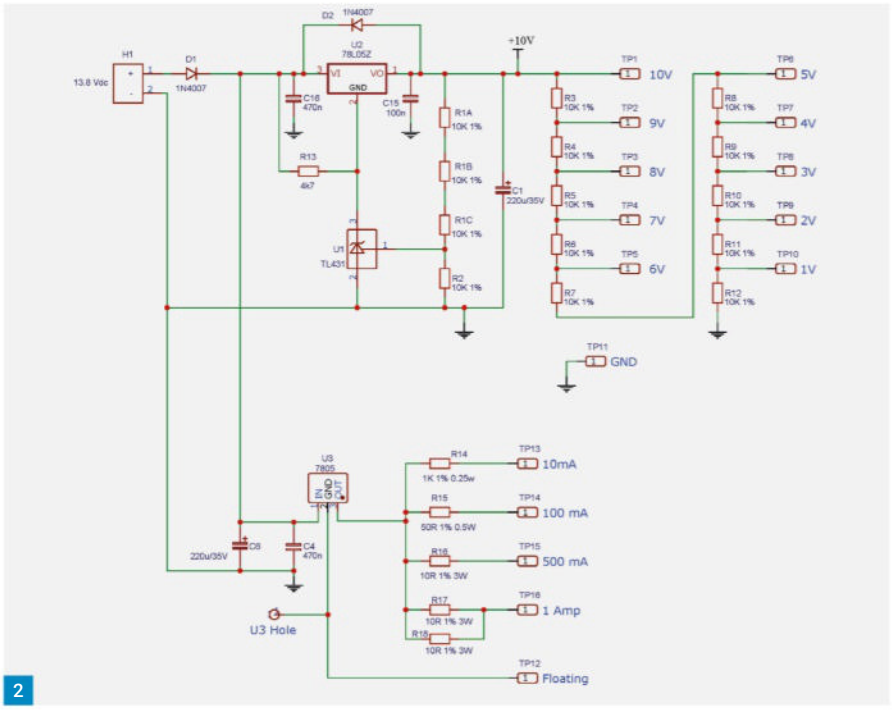
The 100Hz ripple on the output rises from a respectable 10mV pk-pk when the load is only 0.5A to 60mV pk-pk under a 3A load.

The higher quality versions have better voltage references (usually a Zener diode) but as these also vary as the temperature changes there is still some variation as the output load increases. The higher quality versions also have current fold-back protection and can recover from a short circuit on the output without blowing the fuse. However, relying on the same small heatsinks the temperature increase of the heatsink is still excessive.

Direct voltage and current measurements

To work on these power supply projects we will need access to equipment to measure DC

Fig. 1: My pile of power.
Fig. 2: Schematic of circuit to test multimeter.



voltage and current. I am going to discuss how to check if your multimeter is accurate and how to use a multimeter to measure Direct Current (DC) voltage and current.

To test your multimeter we need a circuit that does not require any form of calibration, because I am assuming that we only have a multimeter as test equipment and we do not know if our multimeter is accurate. For this purpose I developed the circuit shown in **Fig. 2**.

We connect one of our fixed power supplies (we assume it has an output around 13.8 V DC) to the input. D1 protects the circuit in case we get our positive and negative input wires crossed. U1, U2, R1A, R1B, R1C and R2 set an output voltage on U2 of 10V DC. No calibration is necessary. You do need to buy a bag of 10kΩ resistors that are at least 1% tolerance to ensure repeatable results without having to measure and select between resistors. If you have a 30kΩ 1% resistor, you can insert it in place of R1A and short out R1B and R1C. I use a 680µF electrolytic for C1 as I have a large bag full and you could get away with leaving this component out or using something smaller like 220µF. Resistors R3 to R12 form a multi-tap voltage divider network to give an output voltage from 10V to 1V in 1V steps.

U3 is configured as a constant current supply and resistors R14 – R18 set four values of constant current. Note that these resistors also need to be 1% tolerance devices and that their power ratings increase as the value of current increases. There are a few tricks here which I will explain later as we need to compensate for the current used by U3 when measuring low current values.

The PCB I designed is shown fully populated in **Fig. 3** and you can see that U2 is a small TO-92 package as we are not consuming any significant current when making voltage measurements. However, U3 is a TO-220 package that is attached to the PCB as we will be drawing 1A current for short periods of time. The middle leg of U3 (pin 2) does not connect to ground but rather to a pad called 'floating', which will be explained later. Two components, D2 and C5, are found on the PCB but not in the schematic. After testing my design I decided that neither component is required and does not need to be inserted.

In Fig. 3 you can see that on TP11 (GND) I have soldered a crocodile clip directly onto the PCB to make connections to probes or leads easy. On TP12 (marked floating) I have soldered a short piece of brown wire (about 4.5in) that goes to a yellow crocodile clip.

I am going to use my trusty Fluke 77 multimeter for these measurements – I acquired the original version of this model in about 1986 and I see that version 4 is the current model on sale. As shown in **Fig. 4** the PCB is connected to one of the fixed power supplies using the red and black banana plugs. To measure DC voltage we connect the multimeter's negative (black) test lead to the COM terminal of the multimeter and connect the black probe to the unshielded crocodile clip attached to TP11. The positive (red) multimeter test lead connects to the V terminal of the multimeter and the red probe is held in the hand. Nothing is connected to the yellow croc clip. Set your multimeter to measure DC volts and now you can now touch the red probe to any of TP1 to TP10, measure the voltage on that test point and see how accurate your multimeter is.

You may be old school using an analogue multimeter and then you need to know that the input impedance of these meters may need to be taken into account. The input resistance of the Fluke 77 is in the range of 10MΩ no matter what voltage range is selected. However, many analogue multimeters, such as the famous Simpson 260 (version 8 is the current model on sale), only have an input resistance of 20kΩ per volt. What this means is that if the 1V scale (yes, the Simpson 260-8 has a 1V scale) is selected, then the input resistance of the meter is only 20kΩ. The 2.5V scale has an input resistance of 50kΩ, the 10V range has an input resistance is 200kΩ and so on. **Fig. 5** helps to explain why it matters and why it needs to be taken into account when using an analogue multimeter.

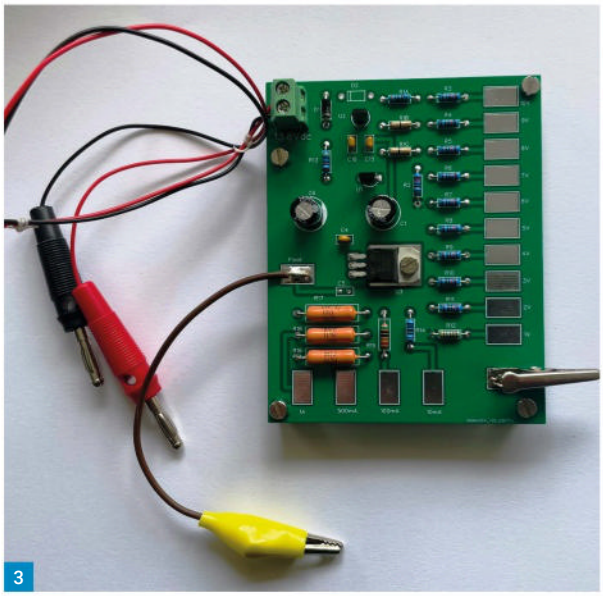
The output resistance of the 78L05 (U2) is in the range of 0.02Ω. It is in series to ground with R1A, R1B, R1C and R2, which make up 40kΩ, and in parallel we have 100kΩ made up from R3 to R12. At each tap you place the multimeter in parallel with all or a portion of that 100kΩ. In block A of Fig. 5 we have the digital multimeter, with an input impedance of 10MΩ, measuring at TP1 (where we expect 10V) and in block C of Fig. 5 measuring at TP10 (where we expect 1V). In both cases the high input impedance of the digital multimeter does not affect the circuit it is coupled to and for all practical purposes measures 10V at TP1 and 1V at TP10.

In block B of Fig. 5 we are using the analogue multimeter on the 10V range and as its input impedance specification is 20kΩ per volt, the actual input impedance on the 10V range is 200kΩ. This impedance is high enough not to adversely affect the circuit and measures 10V at TP1. However, in block D of Fig. 5 the analogue multimeter on the 1V range only has an input impedance of 20kΩ. This low impedance adversely affects the circuit and only measures 0.7V at TP1, an error of 30%.

The format that *PW* magazine uses is not great for showing equations so I will place a document on my website showing these calculations in full and the equation used so you can determine the likely error based on your circumstances.

If you do have an analogue meter that has a low ohms/V specification, then consider replacing R3 - R12 with 100Ω 1% resistors. On the 1V scale this will reduce your error to less than 0.5%. Again, this is shown in that online document.

Now turning our attention to measuring current. The principle of the constant current circuit is that U3 is configured to maintain 5V across R14, or R15 or R16 or across the parallel network of R17 with R18. The constant current is then I =



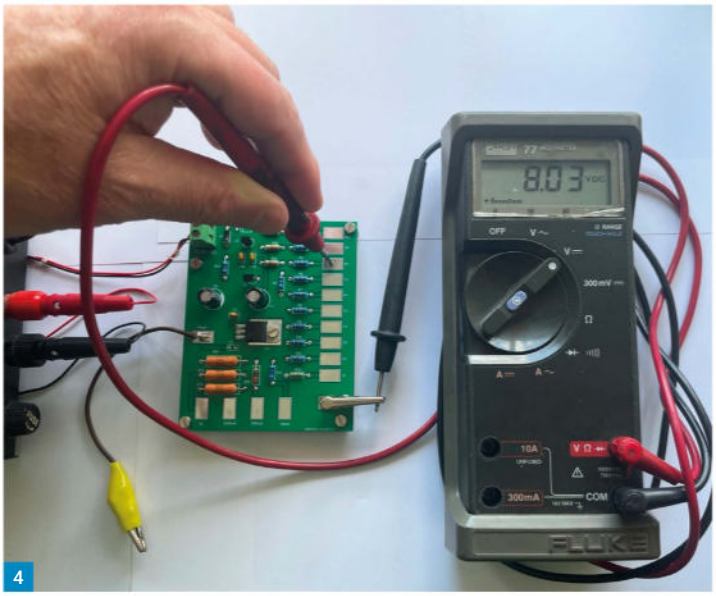
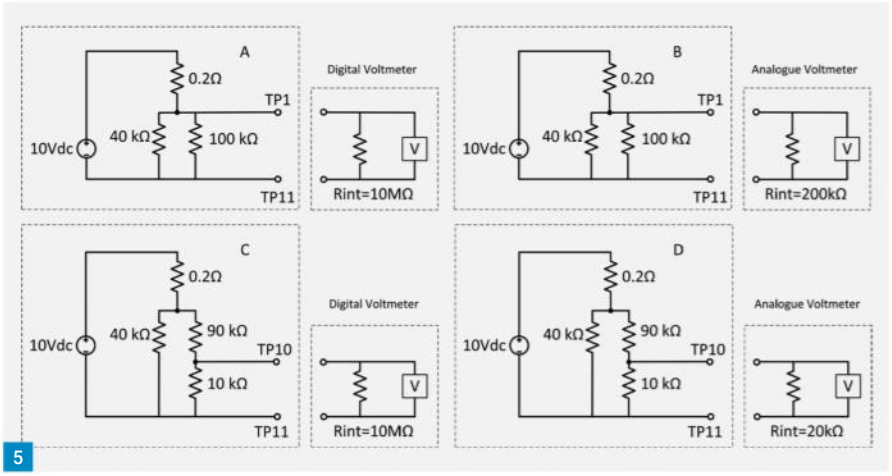


Fig. 3: Fully assembled PCB.
Fig. 4: Measuring voltage at the 8V test point.
Fig. 5: Be aware of different multimeter input resistances.
Fig. 6: Measuring current at the 10mA test point

V/R. For example, to generate 500mA we use R = V/I = 5V/0.5 = 10Ω.

As shown in **Fig. 6** the PCB is again connected to one of the fixed power supplies. To measure DC current we connect the negative (black) test lead to the COM terminal of the multimeter and connect the black probe to the unshielded crocodile clip as we did before. The positive (red) test lead connects to the 300mA terminal of the multimeter, the yellow crocodile clip connects to the red probe tip and the red probe is held in the hand. Set your multimeter to measure DC amps and now you can touch the red probe to TP13 or TP14 and measure the current flowing through the multimeter to ground. I have a 4A fuse in my multimeter so if I touch TP15 or TP16 while in the 300mA scale, the meter simply reads as off-the-scale. Switching the red lead to the 10A terminal on the meter allows me to measure the current at TP15 (500 mA) and TP16 (1A).

The astute reader will point out that R14, to set the current to 10mA, should be R=V/I=5V/0.01A= 500Ω and not 1kΩ. However, also passing through the resistor that sets the current is a small amount of current that U3 needs to operate. For the device I used (made by Texas Instruments) the specification sheets tells me that the typical bias current required is nominally 4.2mA and the maximum is 8mA. When measuring 100mA, 500mA or 1A this 'quiescent current' of 4.2mA is a small percentage of the constant current value and not noticed for all practical measurements. This is not the case when measuring 10mA when 5mA will skew the reading by 50%. To solve this I set the current using a 1kΩ resistor (R14) so that measuring 10.4mA is only an error of 4%.



Do not forget to connect the yellow crocodile clip to the test lead or else you will get spurious results. If you want to box the enclosure, then you can replace the yellow crocodile clip with a 4-way switch arrangement.

Learning about Watts and feeling the heat

Set up to measure current as detailed above. Place a finger tightly against U3 or against R17/R18 and then place your probe (with yellow crocodile clip attached) on TP16. Within 10 to 15 seconds, U3 or R17/R18 will become too hot to touch. Any longer and R17/R18 will start to smoke and burn out so be careful with how long you take to read the result and remove the probe. U3 has a thermal shutdown mechanism so should survive an extended overload but as the threshold for shutdown appears to be above 100°C the PCB will take some damage until R17/R18 have burnt out.

U3 and R17/R18 dissipate excess power as heat which is measured in Watts. For U3 it must drop the difference between the input voltage and the output voltage multiplied by the current and dissipate this as heat. So 13.8V - 5V= 8.8V needs to be dropped. When drawing 1A, P= V×I = 8.8 × 1 = 8.8 watts of heat needs to be dissipated. Now we can feel what 8.8 watts feels like. For R17/R18 each resistor shares the current so that is 0.5A passing through each resistor. P = I×I×R = 0.5 × 0.5 × 10 = 2.5 watts, hence the reason 3W resistors are used here and why these resistors get hot. As a further example for R15 a 0.5W resistor is used as P = I×I×R = 0.1 × 0.1 × 50 = 0.5 watts.

Measuring resistance

If you are building the circuit, then you will acquire a small range of 1% tolerance resistors to practise measuring with your multimeter and learning about its accuracy. Fortuitously you will have some high values (10kΩ), mid-range values (1kΩ) and a few low value ranges (50Ω and 10Ω) that you can measure before assembling the PCB. Then once the PCB is assembled and

noting that R17 and R18 are in parallel, you can make sure the total resistance is 5Ω. Probing between TP13 to TP16 (with no power applied to the circuit) allows you to measure a range of resistors in series.

Keep in mind that a 10kΩ resistor with a 1% tolerance can be as low as 9900Ω and as high as 10100Ω and still be within specification. As a practical example, for a batch of twenty 10kΩ 1%, metal film resistors made by Stackpole and supplied from Mouser, the lowest resistance was 992XΩ and the highest was 1001XΩ. The use of X reflects that with my measurement setup there is uncertainty about the least significant digit. Assuming the worst case for X, the lowest resistance value is 0.8% away from 10kΩ and the highest resistance value was only 0.2% away from 10kΩ.

Endnote

Have a look at my website (URL below) where there is a link to access the schematic and PCB design on EasyEda if you want to modify what I have done, just have some identical boards made or use it as a starting point for your ideas. As usual there are higher resolution pictures, details on some of the components and that note which complements Fig. 5.

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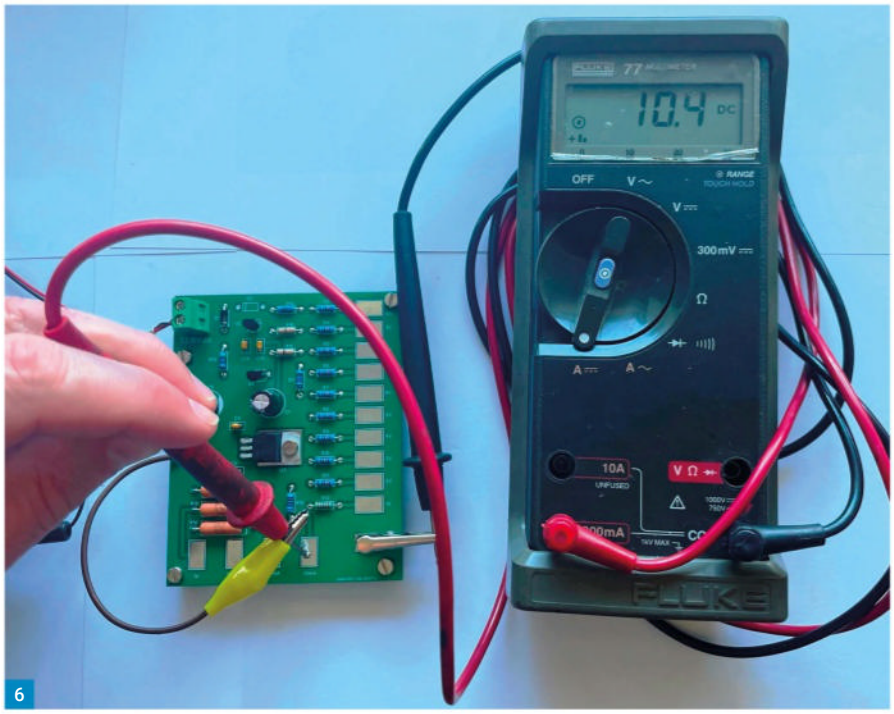

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I have no financial interest in Mouser, EasyEDA, Texas instruments or Stackpole. **PW**

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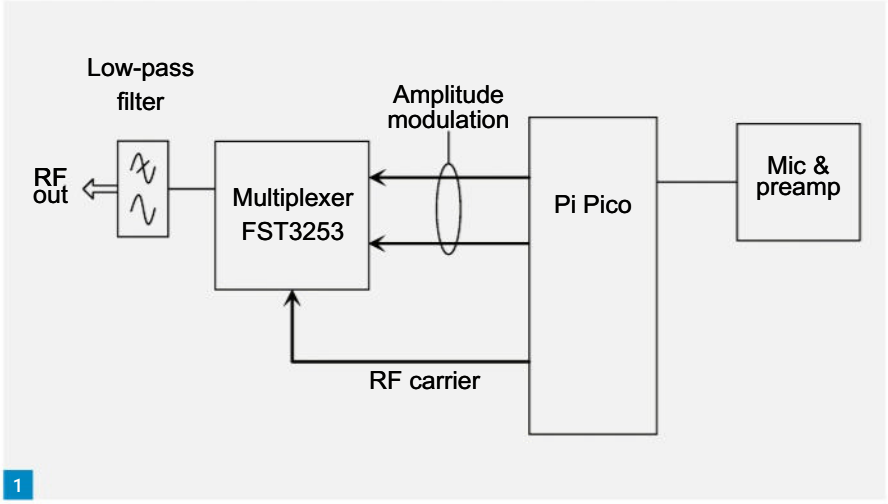

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More on Pi and VarAC

This month **Mike Richards G4WNC** has a packed column with a diverse range of topics, including a Pico HF transmitter, Pi NVMe Drive, data modes tip for newbies and a VarAC install guide!

I've just spotted an exciting new design for a low-cost HF transmitter using the Raspberry Pi Pico (£4) microcontroller board. The design has been developed by **Bryan Cockfield** and published on the popular HACKADAY site: **http://tinyurl.com/4w8wxupd**

One of the features that sets the Pico apart from many other microcontrollers is its programmable I/O pins. These can be programmed to operate independently of the central processor core using their four dedicated state machines. These state machines are ideal for handling repetitive tasks such as generating an RF carrier for a transmitter. Bryan's design has taken full advantage of the Pico I/O pins. I've shown a simplified block diagram in **Fig. 1**. It uses one programmable I/O for the RF carrier and a second to generate a PWM (Pulse Width Modulation) signal to control amplitude modulation (AM & SSB). This PWM signal is mixed with the RF carrier using an analogue multiplexer. A modulating signal (speech or data modes) can either be fed to a third PIO via a preamplifier or supplied via USB. The output from the transmitter is a square wave of just a few milliwatts but that is easy to filter and amplify. I shall build one of these over the coming weeks as it has great potential to make a low-cost HF data modes transmitter.

Raspberry Pi NVME drive

One of the many exciting new features in the Pi 5 is the provision of a PCIe (Peripheral Component Interconnect Express) connector, **Fig. 2**. For those unfamiliar with PCIe, it is the communication interface commonly used for plug-in boards on your PC. For example, a dedicated graphics card in your PC will almost certainly use a PCIe slot to connect with the processor. PCIe slots are incredibly versatile and have become the industry standard for connecting high-speed devices. The PCIe connector on the Pi 5 is a first and provides a high-speed lane to the processor. The Pi 5 PCIe connector is located on the top of the PCB directly above the µSD card slot. One of the most obvious applications of a PCIe port is to connect a fast NVMe (Non-Volatile Memory Express) solid-state drive. These drives offer high-speed data transfer in a very compact form factor. NVMe drives are becoming common in desktop and laptop PCs, driving the price down. For my Pi 5, I used a Samsung 980 256GB NVMe drive (just £36 from Scan Computers).

Installing the NVMe drive

You will need an add-on interface board to use an NVMe drive with the Pi. In addition to providing a mounting location for the drive, the interface board configures the data lines to link NVMe with PCIe. Although the Raspberry Pi team are developing an official NVMe board, Pimoroni seems to be the first to market, and it's their board I'll cover here. It's called the NVMe BASE and costs just £13.50, or £54 complete with a 500GB fast SSD, which makes it an attractive package. The board is supplied with the ribbon cable and all the fixings and sits neatly underneath the Pi 5, leaving the topside GPIO pins clear for other HATs and peripherals. The hardest part of the installation was attaching the small ribbon cable that links the NVMe BASE with the Pi 5 PCIe connector. I recommend following the Pimoroni video guide and connecting the ribbon cable before mounting the board beneath the Pi.

Configuring the Pi

Start your Pi 5 with a µSD card with the latest 64-bit Pi operating system installed. A few configuration steps are required to get the most from the NVMe drive. The first is to ensure your Pi is using the latest firmware. You can do this by opening a terminal session and entering the following command:

sudo rpi-eeprom-update

This will list the current and the latest firmware release details. If you don't have the newest firmware, use the following command in a terminal session to run the Pi configuration:

sudo raspi-config

Once raspi-config opens, select Advanced – A5 Bootloader Options – E1 Latest.

Reboot the Pi, and you begin the next stage of configuration. For the fastest disk speeds, it's worth activating PCIe generation 3. Here are the steps:

Open a terminal session and enter: **sudo nano /boot/config.txt**

This will open the config.txt file for editing. Use the arrow keys to scroll to the bottom, past the section marked [all]

Add the following new line: **dtparam=pciex1_gen=3**

Press Ctl-X followed by Y then Enter to close and save the file.

That completes the basic configuration, but you are still operating from the µSD card. The next step is to format the NVMe drive and clone the µSD card to the NVMe drive. The Pi SD card copier is the simplest way to do this. You will find this via the Raspberry Pi menu in Accessories. Using the SD card copier, you copy from /dev/mmcblk0 to /dev/nmve0.

Once the copy is complete, you must change the boot order, so the Pi uses the NVMe drive as the first choice. Here are the steps:

Open a new Terminal session

Enter the following: **sudo raspi-config**

Select - 6 Advanced Options then - A4 Boot Order then – B2 NVMe/USB boot

You can now reboot the Pi with the µSD card removed. It's worth running a few speed tests to ensure all is well. Disk benchmarking is a science on its own, but there are a few simple tests you can use.

Fig. 1: Pico transmitter block diagram.
Fig. 2: Pi 5 PCIe connector.
Fig. 3: NVMe typical write speed test result.
Fig. 4: NVMe typical read speed test result.

Speed testing

The Linux built-in **dd** (disk duplicator) doubles as a useful indicator of disk speed. To measure the write speed, open a terminal session and enter the following command:

dd if=/dev/zero of=/tmp/tempfile bs=1M count=1024 conv=fdatasync

This will produce an output similar to that shown in **Fig. 3**. The speed calculation measures the time to write one million blocks containing 1MB of data and converts the result to Mb/s.

To check the read speed, we need to enter two commands. The first clears the disk cache, and the second takes the measurement. Here are the commands:

sudo sh -c "/usr/bin/echo 3 > /proc/sys/vm/drop_caches"

dd if=/tmp/tempfile of=/dev/null bs=1M count=1024

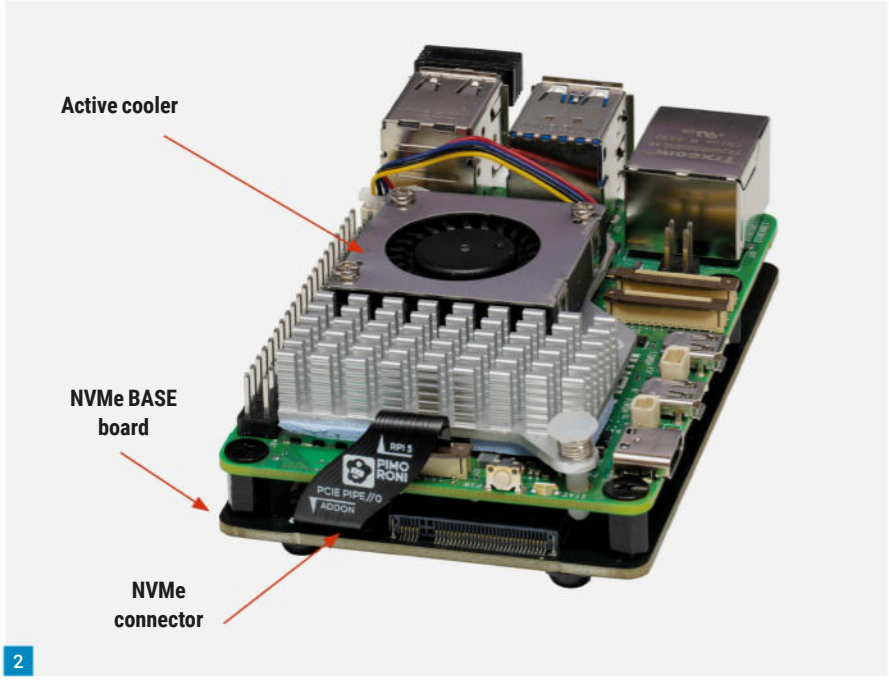
The output from these commands should resemble **Fig. 4**.

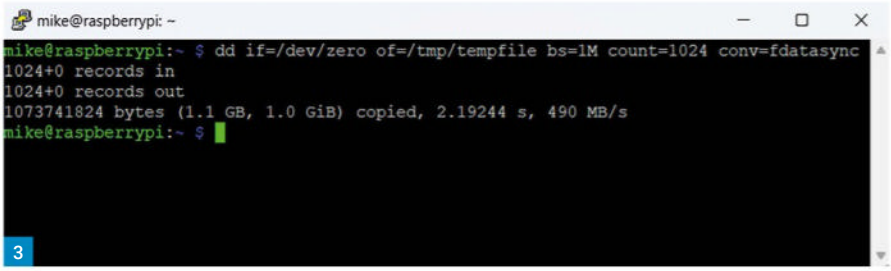
On my Pi 5 with 8GB RAM and the Samsung 980 256GB NVMe drive, I measured a write speed of around 500MB/s and a read speed of just over 800MB/s. The boot time to the logon screen was about 20 seconds.

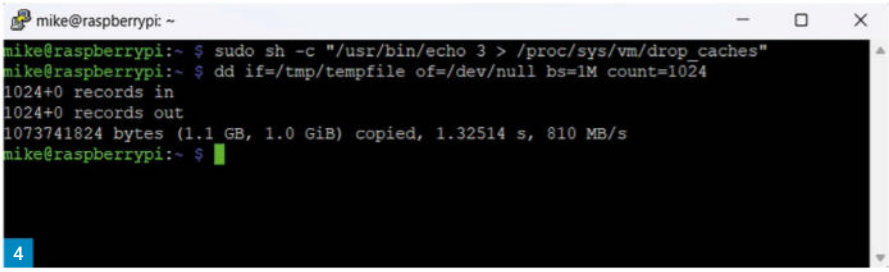
Data Modes Top-Tip

The most common data modes question goes like this: *"I've set up my software, checked all the settings and can receive perfectly, but when I transmit the rig PTT operates, but there's no output; I don't understand"*. The solution is to set the rig to the correct transmit mode. Let me briefly explain the problem. When your rig is in USB (or LSB) mode the audio input comes from the Microphone socket. This signal usually passes via a preamplifier and speech processor before being used to drive the transmitter. However, when using data modes, we present the audio either through an Aux socket on the rear panel or via the USB soundcard built into modern rigs. Because the audio path is entirely different, you must tell the rig which path to use. The rig can only use the data mode input if the mode is set to digital and NOT USB. The digital mode varies between manufacturers, but a quick check of the user manual should provide the answer. Alternatively, Google is your friend and a search for data modes and your rig will usually help. The mode selection problem doesn't affect the received audio because most rigs permanently supply a fixed-level audio feed to the USB soundcard, Aux socket, and internal audio amplifier. That's why data mode receive usually works.

Many popular data modes programs include a method to force the rig into data mode. WSJT-X users will find this facility in File – Settings – Radio with the Data/Pkt button forcing the correct digital mode, **Fig. 5**.







VarAC update

As part of my continuing campaign to encourage more use of keyboard QSOs, I gave a talk to the Norfolk Amateur Radio Club (NARC) on 10 January 2024. This proved to be very popular with plenty of questions and positive comments. This month I'm looking at the latest release of VarAC which is now at version 8.4.4 and offering a few operating tips.

Installing the new version has been simplified and there's no longer any need to copy files. For first time installers, there is also a prompt that will take you to the VARA modem site so you can install the essential HF modem.

To help new users, I've prepared the following installation guide.

Begin by navigating to the VarAV site and following instructions to download the latest VarAC. This should download an .exe file into your Downloads folder.

The next step is to double-click the downloaded file. You will probably see a Windows warning saying Windows has protected your computer. Click More Info followed by Run Anyway to start the installer.

The following prompt will ask you to choose components, and you should leave all the boxes ticked.

You will then be asked to confirm the install folder as C:\VarAC. This is the correct location so there's no need to make any changes.

Fig. 5: WSJT-X digital mode selection.
Fig. 6: VarAC configuration panel.

As the installation proceeds, you will be diverted to the Vara download site to download the latest Vara modem. This will open a Mega download page where you click Download to get the zip file.

Once the download completes, open your Windows Downloads folder and double-click on the downloaded zip file to open it.

Choose Extract All and then double-click on the extracted Varasetup file. This will also hit the Windows protection, where you can click More Info, then Run Anyway to proceed.

Accept the default location for the Vara modem to complete the installation.

The Vara-HF modem should open, and you can choose Soundcard and then select your computer's Soundcard.

The next step is to run VarAC and complete the My Info settings.

That completes the basic installation, so you should now configure rig control to get the most from VarAC. Here's a guide for configuration, **Fig. 6**.

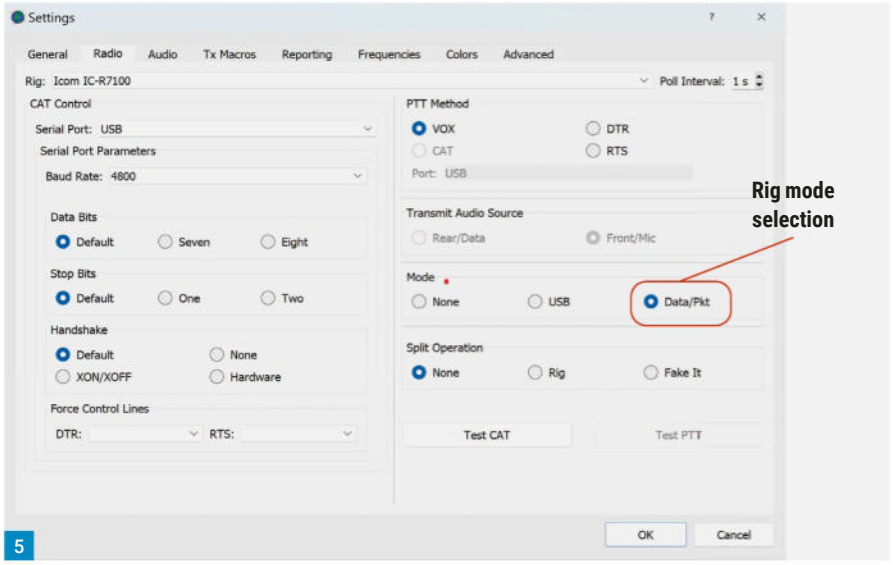
In VarAC go to the Settings menu and choose Rig Control and VARA Settings

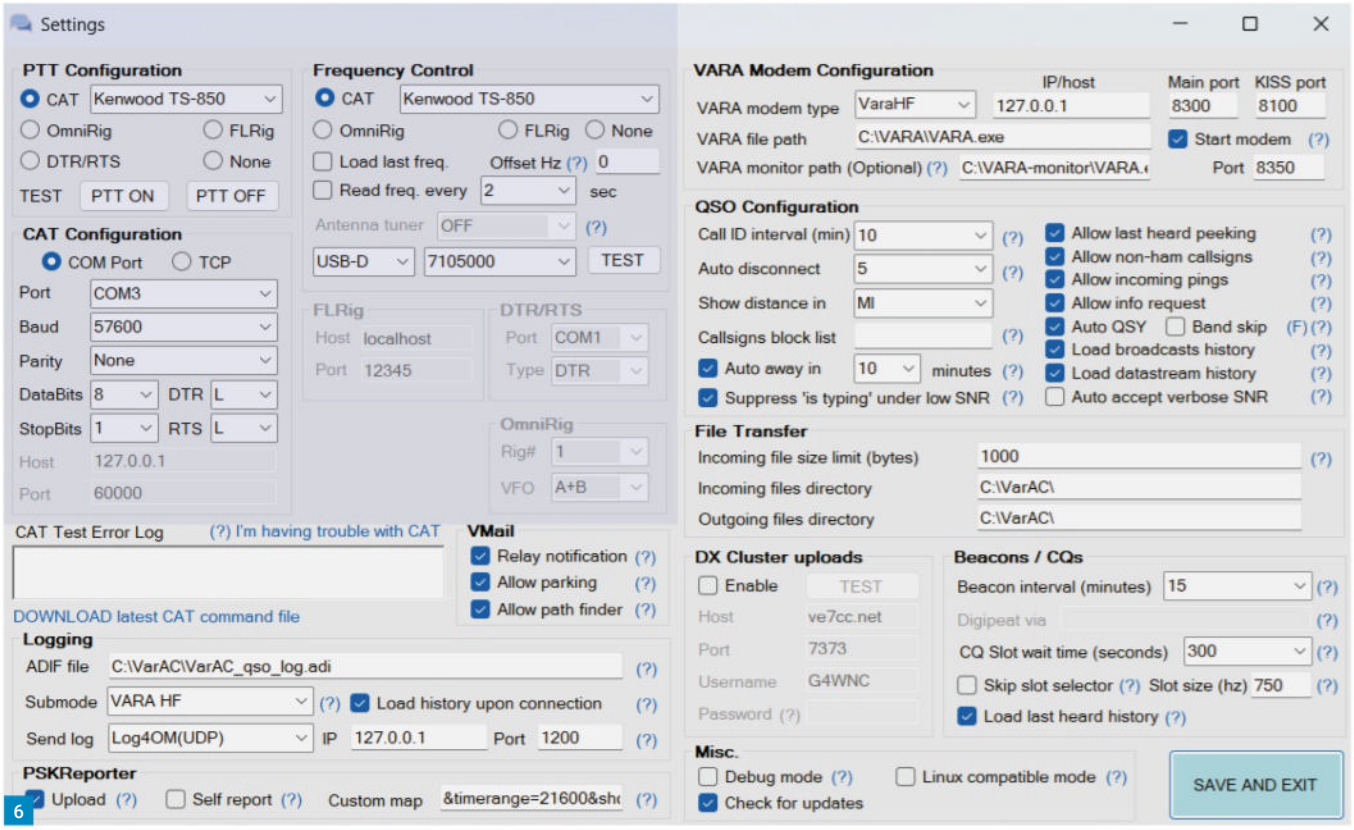
This panel looks a bit intimidating, but only a few boxes need to be configured.

Start at the top left and choose the rig control method. If you're using a direct cable, choose CAT.

A little further down on the left, you will see CAT configuration. This is where you enter details of the COM port, speeds, and associated information. You may have to check Windows Device Manager and your rig's manual to find the required info. If you have data modes software installed, you can probably get all you need by opening the configuration panel of one of the programs. VarAC includes facilities to check that CAT control is working. The first test is to try the PTT controls. In the top left of the configuration panel, you will have two buttons: PTT ON and PTT OFF. Clicking these should trigger the PTT on your rig if all is well. The second test checks that frequency control is working and is located under the Frequency Control section of the Configuration. One box lets you set the mode, whilst the other lets you enter the frequency. Enter values in these boxes and click the TEST button to check the operation. Your rig should switch to the selected frequency and mode. If all is well, you are ready to go.

Before you go on air, you should test and adjust your transmit power. Most operators find that 20-30 watts is plenty for reliable HF communications, but you should always reduce power if you get positive SNR reports. **PW**





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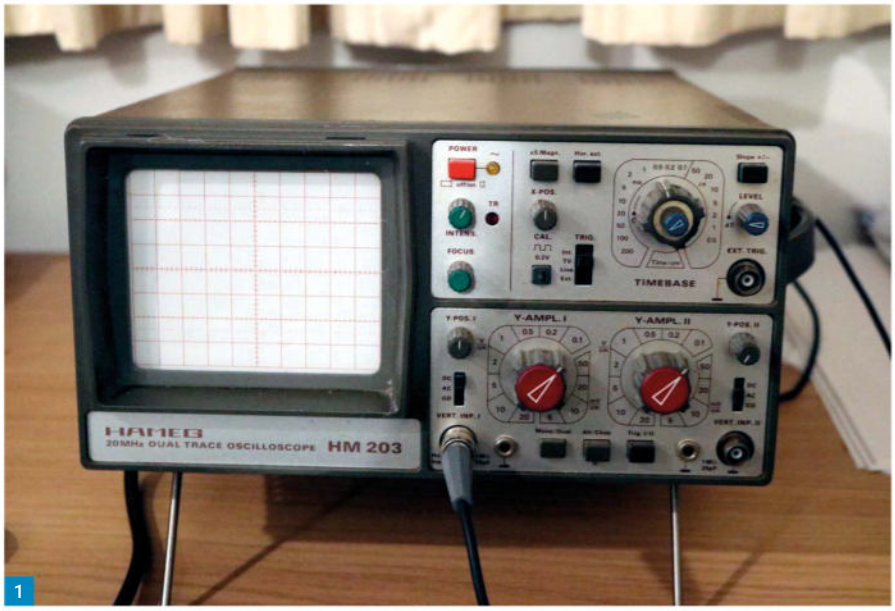


1

How to use a basic oscilloscope

Chris Murphy M0HLS focuses on one of the most useful pieces of test equipment in the homebrewer's workshop.

While measuring voltages and currents in a circuit can tell us a lot about what is going on, an oscilloscope can provide a visual image of the voltage or more rarely, the current that we're interested in. This article is intended to provide someone who has never used an oscilloscope with an introduction to the controls found on a basic single- or double-beam oscilloscope and how to make some basic measurements. Oscilloscopes are available with a wide range of capabilities and performance – reflected by the price. Modern oscilloscopes tend to have LCD displays and may have four or more traces. They are usually also able to carry out certain mathematical operations on the waveforms.

Here though we will assume that you're using one of the older analogue oscilloscopes. Basic oscilloscopes can be picked up quite cheaply at radio rallies and at online auctions etc. The one shown in **Fig. 1**, a Hameg HM-203, cost me the princely sum of £5 at a radio rally. There are also simple instruments that can be purchased new – often in kit form online. **Fig. 2** shows a DS 150, which is available for around £35. An audio frequency signal generator will also be useful. Again, simple kits can be obtained quite cheaply from various websites and will provide a useful addition to the shack or workshop.

The specification of an oscilloscope will most likely mention bandwidth. Because of the internal impedances, the amplifiers in an oscilloscope do not amplify all frequencies equally. The range of frequencies that are amplified to within three decibels (3dB) is called the bandwidth. This should be stated in the instruction manual. Signals with frequencies outside of the bandwidth can still be displayed but you need to be aware that any measurements made may not be the true values.

In order to get a signal into the oscilloscope you will need some sort of probe. In many cases, flying leads with crocodile clips will suffice but ideally, a proper probe should be used. Oscilloscope probes are available in many forms but the most useful for the home experimenter are the X1 and X1/X10 types.

Using a X1 probe, when measuring a voltage of say 2V, an oscilloscope with a Y axis set to 1V/cm will show a trace with a deflection of 2cm. A X10 probe will attenuate the input voltage by a factor of 10, so the Y axis would need to be set to 0.1V/cm to achieve a deflection of 2cm. Many oscilloscope probes have a small trimmer capacitor present in the probe body, which should be adjusted so that the impedance of the probe matches that of the oscilloscope. This will be illustrated later.

Before you start

Before you switch on for the first time there are a few checks that are worth making – especially if the instrument is second-hand. Ideally it should have a full Portable Appliance Test (PAT) and inspection carried out. If you know a local friendly electrician, you may be able to get this done cheaply or there are companies that can be found on the internet that will carry out the test.

If, however, neither option is viable, you can carry out some basic checks yourself. Be aware, though, that these do not constitute a proper test and inspection.

1. If the instrument has a mains input voltage selector, **Fig. 3**, check that it is set to a voltage that suits the UK mains voltage 230/240V and not the US standard of 110/115V. A different rating of fuse may also be required.

2. Check the instrument for any signs, both visual and smell of burning. If a burning smell is present, someone has probably already switched on with the voltage selector incorrectly set. Ideally this test should have been done before parting with your money if at all possible. It will probably mean that the mains transformer is burnt out and replacements can be hard to find.

3. Check that the casing is in good condition and secure and that the screen isn't cracked or broken.

4. Check that the mains lead is in good condition and free from damage such as cuts and burns.

5. Check that the mains plug is in good condition and correctly wired. Some older instruments may have mains leads with the cores being coloured red, black and green. It may be worth considering replacing this. If not, check that the red core goes to the live pin on the plug, the black core to neutral, and green to earth.

6. Check that a fuse of suitable rating is fitted. A 3A fuse will suffice.

7. With a multimeter set to a low Ohms range check the continuity between the earth pin on the mains plug and the metal casing. Assuming that the mains lead is no more than about one metre long, the resistance should be less than one Ohm.

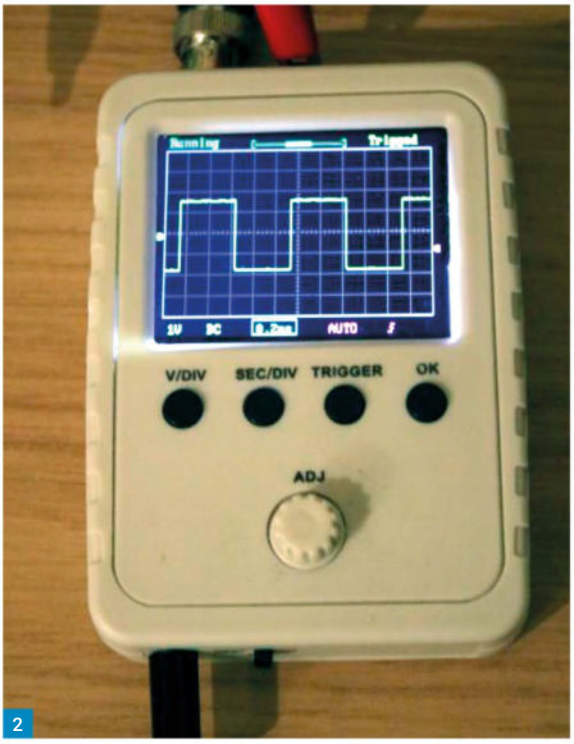
8. Measure the resistance between the earth terminal on the mains plug and the live pin. Repeat for between earth and neutral. The resistance should not be less than 1MΩ.

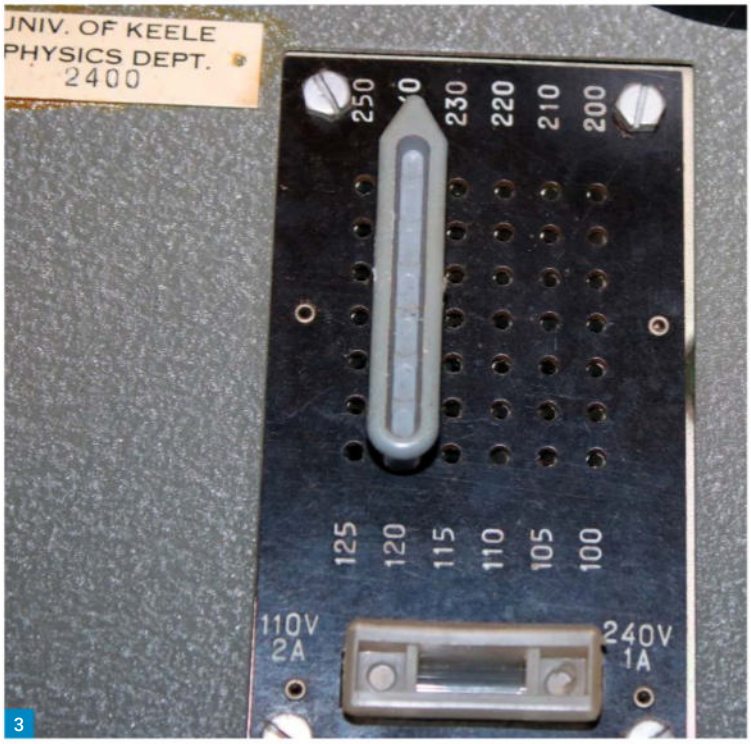
Steps 7 and 8 above DO NOT represent a formal electrical safety test – step 8 for example should be carried out at a voltage of 500V but if readings higher than (step 7) or lower than (step 8) are obtained, further investigation is required.

So, let's have a quick canter around the controls that you are likely to find on a simple oscilloscope.

On/Off switch. This switch is often combined with the brightness control. The brightness of the trace should be set as low as practical to be able to see the trace. Don't leave the brightness control turned up too high for a long time or leave a bright spot on the screen as this will burn the phosphor coating of the screen.

Focus. The focus control should be adjusted to





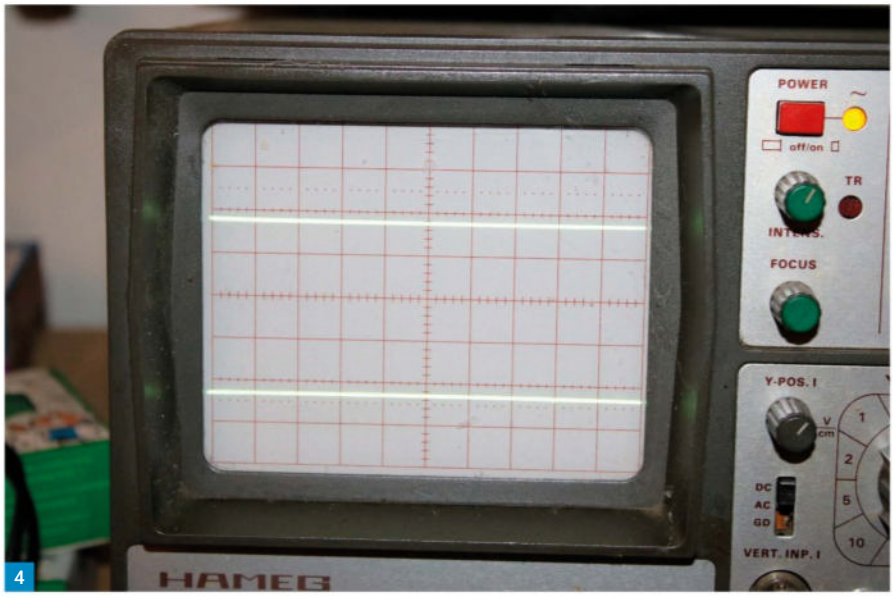


Fig. 1: The author's Hameg oscilloscope. Fig. 2: The DS 150 scope, available for around £35. Fig. 3: Ensure the mains voltage is set correctly. Fig. 4: On a dual-beam scope, set the traces equidistant about the centre line.

obtain as sharp a trace as possible. A thick or fuzzy trace will lead to inaccurate measurements.

Vertical (Y) amplifier/attenuator. This is usually a multirange rotary switch with the ranges marked as volts per centimetre (V/cm). This control determines what input voltage will result in a vertical deflection of 1cm. To start with set this to something like 0.5V/cm. There will also most likely be a variable control. Set this to the CAL position, which is usually at one end of the travel of the control.

Vertical Position. This control positions vertical position of the trace on the screen. Set it so that the trace is at the centre of the screen.

AC/DC switch. With this switch in the DC position the input is directly coupled through the vertical amplifier stages. This will mean that an AC signal that is superimposed on a DC voltage – such as may appear at say the collector of a common emitter transistor amplifier – will be deflected due to the DC voltage. By moving the switch to the AC position a capacitor is inserted into the input circuitry, which blocks the DC such that the AC signal can be observed without any vertical deflection due to the DC voltage. For measuring DC voltages, however, the switch should be in the DC position. If it is set to AC, you will see the trace deflect vertically for a short time but return to zero as the capacitor charges. Some oscilloscopes also have a GROUND position, which shorts the vertical input to ground enabling the trace to be accurately positioned without being affected by noise, etc. Useful on the more sensitive input ranges.

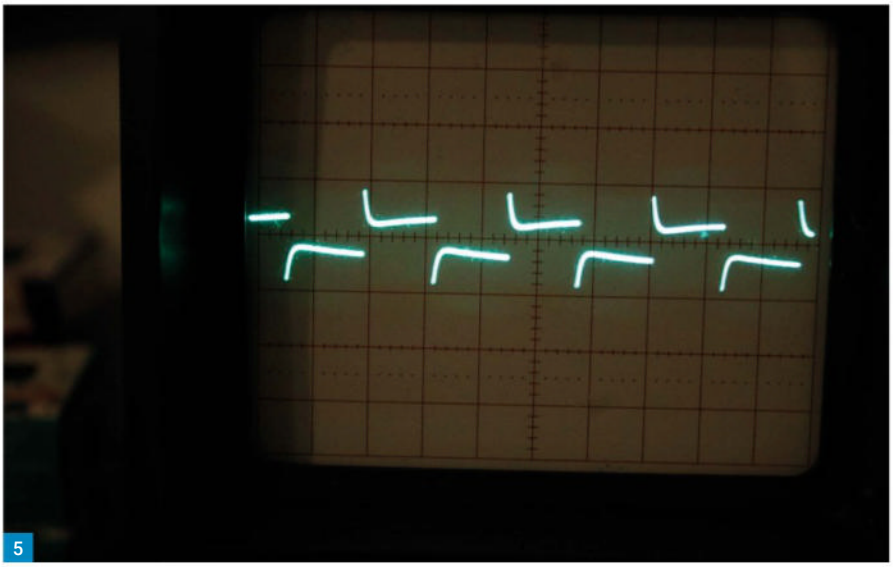
Horizontal (X), timebase speed selector. This sets the speed of the timebase – the speed at which the trace scans the screen from left to right. It normally takes the form of a multirange rotary switch with the ranges marked in terms of seconds, milli seconds, and microseconds per centimetre (e.g. ms/cm.) Like the Vertical input selector there is usually a variable control that for most cases should be set to the CAL position.

Horizontal Position. Positions the trace on the horizontal axis. Useful for, say, lining up the zero crossing of a waveform with a vertical graticule to enable a time period to be measured.

Trigger level. This determines the point at which a waveform starts to commence the sweep across the horizontal axis. The source by which the trigger point is set can be selected. Most oscilloscopes have an AUTO trigger selection. With AUTO selected, with no input signal a trace will be present that will be automatically triggered once an input signal is applied.

Trigger source. This control determines the source from which the waveform is triggered. Sources internal to the instrument include a signal from the 50Hz mains supply or a signal from the vertical amplifier. Most instruments also have provision for a source external to the instrument to be used. Some older oscilloscopes have provision

Fig. 5: An incorrectly adjusted probe with overshoot present. Fig. 6: Result of checking a DC voltage - a flat line offset from the centre axis. Fig. 7: An AC waveform - the frequency can be determined from the number of centimetres representing one cycle. Fig. 8: Measuring frequency and amplitude.



for triggering to be sourced from the line and field timebases on televisions back in the days when they used cathode ray tubes.

Trigger Slope. Sets whether the triggering starts on the positive going or negative going edge of the signal.

Stability. Adjusts the timebase so that a stable trace to be obtained.

Chop/Alternate (Dual trace oscilloscopes) This control determines how the two input signals are displayed on the two traces. In the chopped mode a portion of input A is displayed on one trace followed by a portion of input B on the second trace. The process repeats for the full-time duration of the sweep. In the alternate sweep, a complete sweep of input A is completed followed by a complete sweep of input B. As the sweeps are carried out at a fast rate the two sweeps appear to be continuous in either mode.

When using a dual-trace oscilloscope it is useful to position the traces so that there is a trace in each of the top and bottom halves of the screen, **Fig. 4**.

Other controls that you may find include:

Trace rotation. This should be adjusted so that the trace aligns with one of the horizontal graticules on the screen. Preferably the centre one.

Astigmatism. Ideally, the spot on the screen should be circular. In practice, however, the spot is more likely to be elliptical. The Astigmatism control should be adjusted to make the spot as round as possible as this improves the focus of the trace.

In Fig. 1, the Vertical, Y input channels can be seen at the bottom right with the timebase section above them.

Assuming that all is well we can go ahead and power up the instrument. Older models that use valves will take a minute or two to warm up and during the wait you can take the opportunity to set the various controls to positions that will hopefully result in a trace appearing on the screen. The important controls and their settings are shown in **Table 1**.

After switching on, and waiting a couple of minutes if you're using an oscilloscope that uses valves, adjust the brightness and focus controls to get a trace on the screen. You may also have to adjust the Trigger level and Stability controls to obtain a trace. Adjust the vertical position control so that the trace is on the centre of the vertical graticule.

So, now that you hopefully have a trace on the screen the next recommended step is to check the calibration. Most oscilloscopes have a calibration signal that is generated internally. This will often be a square wave with an amplitude off 0.5V or 1.0V and a frequency of 50Hz, 100Hz or 1kHz. Connect the oscilloscope probe to the 'Cal' signal output and adjust the trigger and stability controls to obtain a stable, steady trace. Check that the oscilloscope is displaying the correct amplitude and time duration for the signal. If not, some instruments have a control, often requiring a screwdriver to operate it, so that the gain of the Y amplifier can be adjusted to calibrate the instrument. On other instruments, the control will be internal, and a service manual will be required in order to carry out the calibration.

As an additional point, many oscilloscope probes have a built-in trimmer control that allows the capacitance of the probe to be matched to the oscilloscope to prevent distortion of signals. Adjust the trimmer to obtain a good square wave with no overshoot or undershoot. **Fig. 5** shows an incorrectly adjusted probe with overshoot present. A correctly adjusted probe is shown on the trace in Fig. 2.

Starting to make measurements

So, now that we have an oscilloscope that is calibrated, let's have a look at a few basic measurements, starting with DC measurements. For the experiments that follow, a simple X1 probe or even simple leads with crocodile clips will suffice.

Obtain a DC source of some kind, a simple battery will do. Set the vertical amplifier to say 2V/cm (If you're using a 9V battery set it to 5V/cm and the AC/DC selector to AC). Connect the probe/leads across the supply terminals and watch what happens. The trace will deflect vertically and then return to the centre of the screen. That is because the capacitor that is inserted into the input when AC is selected is doing what capacitors do – blocking DC.

Now change the selector switch to DC and repeat the experiment. The trace should deflect either up or down depending upon which way round you've connected the leads. Read off the vertical displacement in centimetres and multiply by the vertical input setting. Let's say that the deflection is two point four centimetres, **Fig. 6**, and the vertical input setting is 2V/cm, then the voltage is 4.8V. Now reverse the test leads and observe what happens. The trace should deflect by the same

Control	Purpose	Initial setting
Brightness	Sets the brightness of the trace	Set mid point
Focus	Sets the sharpness of the trace	Set mid point
Timebase rotary switch	Sets the speed that the spot on the CRT scans the screen	5ms/cm or 10ms/cm
Timebase variable control	Variable control for above	To Cal
Horizontal (X) position	Controls the position of the X axis trace on the screen	Set to mid position
Input amplifier (Y) rotary switch	Sets the sensitivity of the input amplifier	Set to 0.5V/cm or 1V/cm
Input amplifier variable control	Variable control for above	To Cal

Table 1: Main controls and their settings.

amount but in the opposite direction. For a 9V battery and 5V/cm the deflection should be just under 2cm.

Now, let's look at what happens with AC. An audio signal generator will be required if you wish to conduct this experiment. If you don't have one, just try to follow the text to understand what is happening. Another option is to use the Cal output signal if there is one, although this will most likely be a square wave rather than a sine wave, but you'll get an understanding of how to measure time periods and peak-to-peak voltages.

Adjust the Y position control so that the trace is on the centre of the screen graticule. Set the audio frequency signal generator to give an output of a sine wave at a frequency of 1kHz and an amplitude of one volt. Set the timebase to something like 500µS/cm and the Y amplifier to 0.5V/cm. Adjust the trigger level and stability controls to get a stable trace on the oscilloscope. Next, adjust the horizontal position control so that the point where the sine wave transitions through zero volts align with one of the vertical lines on the graticule. Now count the number of centimetres on the graticule for the waveform to complete one complete cycle, **Fig. 7**. Then multiply by the timebase setting to find the time taken for one complete cycle.

With the setup described above, one complete cycle will occupy two centimetres on the horizontal, X axis and the height, or amplitude of the trace will also be two centimetres, symmetrical around the centre of the graticule.

So, what can we deduce from the information that we're looking at? Taking the X axis first, we can see that one complete cycle takes two centimetres. The timebase is set to 500µS/cm so two centimetres will represent a time period of 1ms.

The time period is given by t = 1/f, which we can manipulate to give f = 1/t. So, for what we're looking at: f = 1/0.001 = 1000Hz, or 1kHz.

Likewise, the vertical deflection is also two centimetres and with the Y amplifier control set to 0.5V/cm this represents a voltage of 0.5 x 2 = 1V.

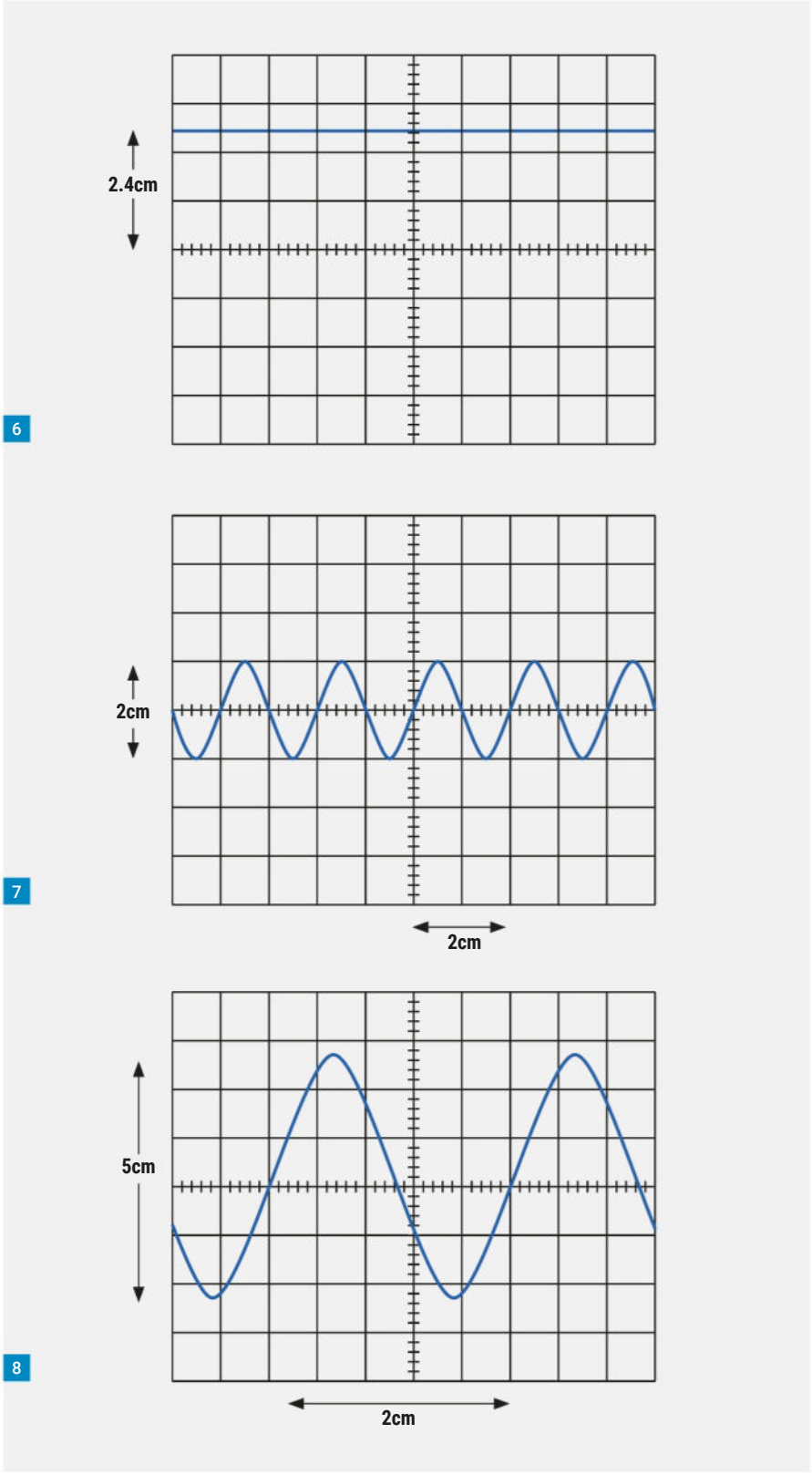
Now, let's alter the control settings. Keep the input signal the same but set the timebase control to 200µs/cm and the Y input to 0.2V/cm. You should be able to see that one complete cycle now takes five centimetres. From this we can calculate that the time period is 5 x 200µs = 1ms – the same as before. The vertical deflection will also be five centimetres so we have an amplitude of 5 x 0.2V/cm = 1V, **Fig. 8**. To measure the amplitude you may find it useful to adjust the Y position control so that the peaks of the signal aligns with one of the horizontal graticule lines.

Have a play around with the amplitude and frequency of the input signal and determine the frequency and amplitude from the oscilloscope trace.

Unless you've got a very sophisticated instrument you won't be able to carry out measurements on high frequency signals very accurately, but by looking at the output of an oscillator, say, you will at least be able to see whether it's working or not.

I hope that you have found this brief introduction to how to use an oscilloscope useful. If you do a lot of project building or experimental work, it's worth scouring the radio rallies etc for oscilloscopes, signal generators and similar that can be picked up for a bargain.

And finally, one last experiment. Connect a microphone to the input, set the Y amplifier control to its lowest setting and let the kids and grandkids have a look at what their voice looks like. **PW**



Steve Telenius-Lowe PJ4DX
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Looking forward to March

March usually brings an upturn in HF conditions and **Steve Telenius-Lowe PJ4DX** has news of what to expect.

My interest in radio started as a short-wave broadcast bands listener in the late 1960s. One of the stations that was very popular back in those days was Radio Nederland. 55 years ago, in March 1969, Radio Nederland opened its first overseas relay station on Bonaire, in what was then the Netherlands Antilles. As a keen listener (and lapsed philatelist – radio had taken over from stamp collecting as my main interest) I applied to Radio Nederland for the commemorative first day cover shown in **Fig. 1**. Little did I know then, as a 13-year old SWL, that decades later I would spend ten wonderful years living on Bonaire!

However, all good things come to an end and, after nearly 20 years abroad, **Eva PJ4EVA** and I have decided to return to the UK in March. I have made around 135,000 QSOs as PJ4DX and many thousands more as one of the operators at the PJ4G, PJ4K, PJ4Q and PJ4V multi-operator contest stations. I have mainly been on SSB but I have also made thousands of QSOs on CW and on FT8 and FT4. Eva, meanwhile, has made around 25,000 QSOs, almost all on FT8 or FT4, since becoming active at the end of 2020. We have both made numerous on-air and real-life friends during our time on Bonaire.

The English-language service of Radio Netherlands (as it was by then called) ceased broadcasting in 2012 and, later the same year, the Bonaire relay station was completely dismantled, just a few months before we visited the island for the first time. I therefore never got to see the station myself, although the resident amateurs here regaled me with stories of getting permission to use the Radio Netherlands 21dBd-gain curtain antenna arrays (during the periods the station was off the air!) when celebrating Bonaire's status as a new DXCC entity in 2010.

I will be continuing to compile the *HF Highlights* column every month (but from glorious Devon) so please continue to send in contributions to **teleniuslowe@gmail.com.** A reminder that photos of your station, antennas or you in the 'shack' are always welcome.

The month on the air

Krish W4VKU made over 52,000 QSOs as VU7A from the Lakshadweep Islands between 4 and 13 December (with more than 51,000 of them on FT8). Krish then moved on to the Andaman Islands from where he was active as VU4N from 16 to 27 December. Unfortunately, high levels of noise and other issues meant he made far fewer contacts from here. His signals were also much weaker than from VU7 and I only managed one QSO, on 7MHz FT8.

The Rebel DX Group was active as T32TT from Eastern Kiribati between 5 December and 7 January. This was another predominantly FT8/FT4 operation: the group stated it would be a *"90% digital activity"* with 12 digi stations plus two on CW and one on SSB.

Two Italians operated as 3B9AT from Rodrigues Island in the Indian Ocean from 27 December to 5 January, making over 10,000 QSOs.

The largest solar flare of Cycle 25 (so far!), an X5 event, took place on New Year's Eve, resulting in an almost complete radio blackout on the daylight side of the world, mainly the Pacific area. For those interested in the mechanics behind HF radio propagation, it is well worth following the Space Weather website at:
https://spaceweather.com

In order to celebrate the 150th anniversary of the birth year of **Guglielmo Marconi**, the 'World Wide Award', **Fig. 2**, was running the whole of the month of January, with numerous special event stations active from around the world. GB2WWA, GB4WWA, GB6WWA and GB8WWA were on the air from England, Scotland, Wales and Northern Ireland respectively. For full details see the QRZ.com pages of any of the WWA special event stations.

What to look for in March

One of the rarer Pacific DXCC entities is the Japanese island of Minami Torishima, **Fig. 3**, located 1000 nautical miles south-east of Tokyo. It is most frequently activated by **Take JG8NQJ** who works at the meteorological station on the island. He signs JG8NQJ/JD1 on CW and FT8 and is expected to be active from mid-January until mid-April.

Also active for three months from mid-January, W2APF will be signing VP2MDX from Montserrat. He uses SSB, CW, FT8 and FM on 3.5 to 50MHz.

The new dates for the H40WA DXpedition from Temotu are 22 February to 7 March. This operation was postponed from October last year.

Six German operators will be flying to Christmas Island, **Fig. 4**, to activate T32EU between 13 and 27 March on all bands 1.8 to 50MHz using SSB, CW, RTTY and probably FT8.

The CDXC 'LF Challenge', covering the 1.8, 3.5 and 7MHz bands, takes place the whole of March. The idea is to work as many DXCC entities as you can on these three bands during the month, and to upload your log to Club Log. I took part last year and ended up in second place on 40m, **Fig. 5**. You don't need to be a member of CDXC to participate, although prizes (trophies, salvers and certificates) are only awarded to CDXC members. Full details are at:
clublog.org/lfchallenge.php

There are several contests of interest in March. The first is the ARRL DX Phone Contest for the 48 hours of 2/3 March (the CW leg is on 17/18 February). Work stations in the USA and Canada only and send a report and your power, e.g. 59 100; they will reply with a report and their State or Province. The rules are at:
www.arrl.org/arrl-dx

If you are a CW operator, have a go in the RSGB's Commonwealth Contest, one of the oldest in the contesting calendar, having been around since 1931. Still often referred to as 'BERU' (the British Empire Radio Union), this year's event runs for 24 hours from 1000UTC on 9 March. If you are in the UK, Channel Islands or Isle of Man, you should only work stations in other Commonwealth countries. The full rules are at:
rsgbcc.org/hf/rules/2024/rcwc.shtml

The CQ WPX SSB contest is held on 30/31

Fig. 1: 1969 First Day Cover commemorating Radio Nederland's Bonaire relay station. Fig. 2: The World Wide Award special event stations were active the whole of January. Fig. 3: An old photo of Minami Torishima. At the top, left of centre, can just be seen the 411m-high former LORAN-C antenna (dismantled in 1985). Fig. 4: Coming in to land at Christmas Island. Fig. 5: The CDXC LF Challenge runs the whole of March.

March this year. This is a work-anyone-anywhere contest; participants send a report and a serial number. The full rules can be found at: **cqwpx.com/rules.htm**

Readers' news

First up this time is **Owen Williams G0PHY**, who reports *"a relatively quiet end to the year, but activity has picked up since the start of the New Year with all the special event stations for the World Wide Award celebrating Marconi. It seems to be a Eurocentric event with the majority of stations I've worked being Italian but I have managed to work N1W on three bands."*

Martin Burch VK4CG has been busy with work and other things so has not been too active of late. However, he says: *"I got a nice Christmas present with a new 10m multimode transceiver, an Anytone 555nii* (**Fig. 6**). *I aim to be updating the shack this year and getting a new Icom IC-7300 plus Icom external speaker."*

Unfortunately, **Etienne Vrebos OS8D** lost his voice and, as an almost 100% SSB operator, this meant he too was not very active! *"With CW or FT8 you don't need your voice and continue working all the way long. I would say 'no comment'... I finished 2023 with 232 activated castles (8000 QSOs), first place in Belgium and also 300 Belgian castles worked (I can not pick up for myself the activated castles), 300 English castles worked (honour roll) and 600 German castles worked. It seems I love castles..."*

Jim Bovill PA3FDR wrote: *"This month I have managed a respectable number of DX QSOs but nothing spectacular and no new DXCC entities. However, one QSO confirmed for me just how efficient WSJT-X is at decoding weak signals. From past experience I am reluctant to respond to CQ calls with a signal strength less than about –17dB as my experience is that the likelihood of a contact is very low. However, during my first session of the month, with very little activity from either DX or European stations, I answered a CQ call from BG8AMG on 21MHz FT8, with a signal strength of only –25dB, and to my surprise and delight got an immediate response followed by RR73 with my received signal strength also of –25dB. In future I will not dismiss stations with a very low signal strength."* Jim is absolutely right not to: I use the JTDX program and regularly decode FT8 stations as weak as –26dB. Whether a two-way contact then results is very much dependent upon the relative power outputs and the amount of local noise at either end of the path.

Carl Mason GW0VSW sent in a 'QRPp report': *"I decided to operate in the GQRP Winter Sports after Christmas and restricted myself to 1W CW and 5W SSB. Although I made a few SSB QSOs running 5W I forgot to 'up the power' after operating some CW and was amazed in the conditions how many stations I worked with QRPp so stayed with that power."* Altogether Carl made 93 QSOs, 13 were two-way QRP, with 23 DXCC entities on CW and no fewer than 22 on SSB. Overall, he worked 32 entities using his Xiegu G90 and 'inverted G5RV'. On 21MHz CW Carl worked N1W, a special event station for the 'World Wide Award', operated by **John NN1SS**: *"he had quite a pile-up but very good ears,"* Carl said.

Kev Hewitt ZB2GI reported that **John King ZB2JK** has been operating from Thailand as HS0ZIQ. They contacted each other on 10m and

15m SSB on 26 and 27 December while Kev was operating portable from the top of the Rock and using John's home-made Moxon beam, **Fig. 7**. Kev added: *"The annual Polar Bear Swim took place at Catalan Bay on Boxing Day. The collective gasp of two thousand people running into the cold water at midday was audible from my operating position at the top of the Rock!"*

Tim Kirby GW4VXE operating as **GW4MM** wrote that it seemed to be a quieter month, with little in the way of DXpedition activity. However, Tim was particularly pleased to work JD1BMH from Ogasawara for an 'ATNO' (All-Time New One). He commented: *"When I was first licensed in 1983, my first HF rig was a solid-state one. As a youngster, I considered valve rigs rather 'old hat'! Views change with age, of course, and in recent years I have had a nagging desire to get a valve radio into the shack to play with. This came to pass this month, with the chance to acquire a Trio TS-530SP,* **Fig. 8**, *which was in beautiful*

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*condition and had been used primarily as a receiver by its previous two owners. Perhaps the valves have gone a little soft, but there is still 70 or 80W to play with. As a primarily CW operator, the first challenge was to find a keyer which could cope with the negative voltage on the key line. I remembered I had a 1990s vintage AEA Morse Machine in the cupboard and was delighted to find that it still worked and better still, would key the TS-530SP. Not before, I might add, I had my first straight-key Morse contact in around 39 years, with **Ini EA6EJ** on 80m. I've been particularly impressed with the crisp CW filter on the rig, which has made CW QSOs on 80 and 40m very enjoyable. I have had to contemplate a modest amount of 'drift' during more lengthy QSOs. All in all, it's a delight to enjoy trying operating a little differently. When it comes to weak DX on the higher bands, though, the modern rigs definitely have the edge."*

28MHz beacons

The 28MHz beacon report for December by **Neil Clarke G0CAS** starts with news of the return of two beacons belonging to the world-wide beacon network on 28200. RR9O returned on the 2nd and YV5B on the 21st. Paths to North America were good: 4U1UN 28200 was heard every day although W6WX was heard only on eight days. On the 4th, 6th and 22nd all ten of the W call areas were logged. LU2DT 28193 and PY4MAB in South America were heard on 28 and 25 days respectively. Looking towards Australia, VK6RBP 28200 was heard on 24 days and VK8VF on 14 days.

Neil also reported on the most frequently heard beacons in 2023. In Europe SV5TEN was heard on 191 days while SV2RSS 28265 and SV6DBG 28269 were close behind at 189 days. In the Middle East, 4X6TU 28200 was logged on 302 days with 5B4CY 28219 on 193 days. In Australia VK6RBP 28200 was heard on 133 days and VK8VF 28268 on 71 days. ZS6DN 28200 in South Africa was heard on 210 days. In North America 4U1UN 28200 was logged on 161 days, while in Canada VA3KAH 28168 was logged on 141 days. Lastly to South America, where LU4AA 28200 was heard on 301 days and LU2DT 28193 was logged on 328, making it the most-heard beacon in 2023.

Band highlights

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

Owen Williams G0PHY (HS): 14MHz SSB: N1W, VE7AV, WJ0W. **21MHz SSB:** N1W. **28MHz SSB:** N1W, W1AW/1.

Etienne OS8D (HB): 14MHz SSB: 4L5P, JW/M0PLX, YB0AR. **21MHz SSB:** XE1CQ, ZD7/DG1PM. **24MHz SSB:** EX0DX, J8TT, PJ2ND, TI5CDA. **28MHz SSB:** CO2OQ, FM4TI, FM8QR, HI8AT, KP4DZ, PJ2ND, PU2TDY, PY3PDR, TO2FY (=FY), VP8LP, VR2VRC, XE1XR.

Jim PA3FDR (MS): 7MHz FT8: VO1CH, XV9T. **10MHz FT8:** 7X2RF, CO7MTL, ZL4KX, ZS6NL. **14MHz FT4:** JA9BFN, RU9S, VE5SF, W7CT. **14MHz FT8**: HI6M, N8DP, RV9DD, ZS6AF. **18MHz FT4:** WE9V. **18MHz FT8:** JA5AFW, JA8IZP, K0BLT, TA3BD, VE6WQ, ZL2BX. **21MHz FT4:** AI6NS, JA6VQA, JH1RGG, KB7RUG, PW8BR, RA9LL, VE3YOUTH, VP8FLY. **21MHz FT8:** BD5CAM, BG8AMG, DS5TUK, HC1DAZ, HL2VA, JH1ODD, JH6QIL, K6AFW, PY4HGM, UA0AV, UN7CL, YB1HR. **24MHz FT4:** RW0AE. **24MHz FT8:** 7Z1IS, CE4WJK, DS4FWI, EK/RX3DPK, JT1BV, N7LD, PY2XU, UN8PC, VE4YH. **28MHz FT4:** 4L8A, BU2FF, P4/WE9V, VR2XMT. **28MHz FT8:** BA7LUI, BG0CAB, HL2EO, HZ1BHR, JG4AKL, N4BP, UA0AV, UK8GG, UN9LEI, V31DL, VK6DW.

Carl GW0VSW (QS): 1.8MHz CW: SP1D. **3.5MHz CW:** DK4AN (2 x QRP), S524PMC. **3.5MHz SSB:** TM23YOTA. **5MHz CW:** GW0FJT. **7MHz CW:** E7I. **7MHz SSB:** 9A3BWP, LZ5R. **10MHz CW:** TM100GE. **14MHz CW:** CT3MD, OH3GZ. **14MHz SSB:** HB0/DK3RN/P, IQ3AZ, TK4TH, RW1F. **18MHz CW:** OE40WO, SA6AUT. **21MHz CW:** N1W. **24MHz CW:** SV5BYR. **24MHz SSB:** II9WWA. **28MHz CW:** EG8WWA.

Kev ZB2GI (MS / MB): 5MHz FT8: AA1V + EU. **21MHz SSB:** HS0ZIQ (AS-053), W5ZR. **21MHz SSTV:** W5ZR. **28MHz SSB:** HS0ZIQ, SV9JI + many EU. **28MHz FT8:** AB7LQ, CX3DDO, J66BF, K6AFW, KP4ZZ, NP3DM, PS7KM + many USA.

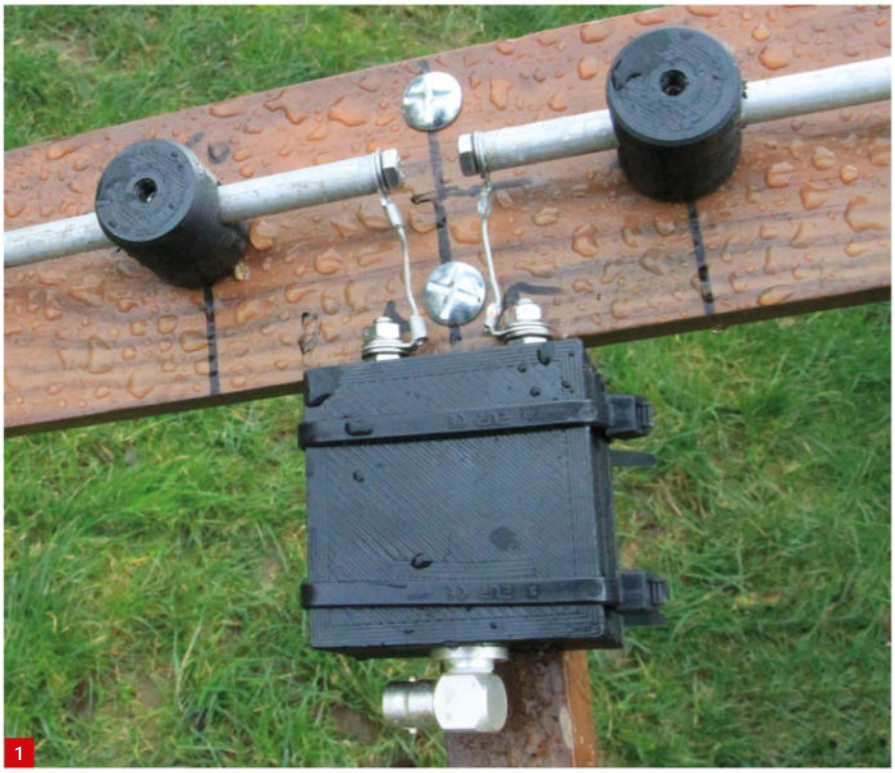
Tim Kirby GW4VXE/GW4MM (MS): 3.5MHz CW: AA3B, VP9/DK7PE. **7MHz CW:** VK2GR, VP9/DK7PE. **10MHz CW:** BY8DX, VP9/DK7PE, ZL2AGY. **14MHz CW:** VP9/DK7PE. **18MHz CW:** FM/F8AAV, JD1BMH, KK7N (OR), KP4DX, OX3XR, PJ2ND. **21MHz CW:** A47RS, KP4DX, TI5/N3KS. **24MHz CW:** 9J2REK, TZ4AM, V44KAI. **28MHz CW:** CE2SV, CO8ZZ, HC5CW, HK1MW, KP4TF, OX3XR, PJ2ND, R120RAEM, TI5/VA3RA, XE1XR.

Fig. 6: New 10m multimode transceiver at the station of Martin VK4CG. Fig. 7: ZB2JK's home-made 10m Moxon at the top of the Rock of Gibraltar. Fig. 8: GW4VXE's 'new' old TS-530SP.

Signing off

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

Keith Rawlings G4MIU
keith.g4miu@gmail.com



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A simple light weight two-element beam for 10m (PtII)

Keith Rawlings G4MIU completes the construction and testing of his new 10m Yagi, and tries out an over-the-top antenna for his Quansheng!

Last month I started to describe the construction of a lightweight two-element Yagi for use on the 10m band (loosely) based on the W6SAI model in the *Beam Antenna Handbook*. To recap; the antenna had to be as light as possible because it was my intention to mount it on my LMA-33 telescopic mast. I decided on a reflector and driven element configuration and for simplicity a feedpoint close to 50Ω was desirable. Also wanted was a good VSWR bandwidth to cover as much of the band as possible. It needed to be constructed from materials that I had to hand. I had some 24x24mm timber for the boom, 65x10mm for the elements support and 8mm dia thick wall aluminium tube for the elements themselves. I would 3D print the element standoff spacers and use a 1:1 balun from the junk box.

For a two-element beam an element spacing of around 0.16λ will provide a 50Ω feedpoint impedance and also give a favourable front-to-back (F/B) ratio but at the expense of lower forward gain. My target frequency for the design was 28.4MHz.

To get some ballpark dimensions I used the formula of reflector length in metres = 150/f and driven element length in metres = 138/f with an element spacing of 0.16λ. This gave me a total length of 5.281m for the reflector and 4.859m for the driven element with a spacing of 1.689m.

As the aluminium tubes I have are in 4m lengths and therefore too short overall to make complete elements, four lengths were used with individual elements being cut to size. The reflector was made to one complete length using a coupler and the driven element split in two different parts and fed as a dipole. The design was then modelled in AN-SOF where the computed results looked promising.

That said, even though AN-SOF simulations have proved to be surprisingly accurate I was not expecting the simulation to be exact in this case. This was because the physical design would be very close to nearby buildings and only be a few feet above the apex of my garage roof. Many publications tell us that Yagis, especially at HF, can have their radiation properties altered by nearby objects.

Assembly

The wooden supports for the elements were initially screwed into place on the boom using woodscrews. This gave me the option to be able to easily reposition the elements along the boom. Once the dimensions were finalised I would use M6 bolts to fix these in place. The support for the driven element was placed at the front end of the boom and I measured 1.690m away from this point to locate the centre of the reflector support. The element standoffs were loosely bolted to the supports and the elements were guided through these. Once into position the standoff bolts were tightened to the support and the elements themselves tightened into the standoffs. I then affixed the balun to the feedpoint, **Fig. 1**.

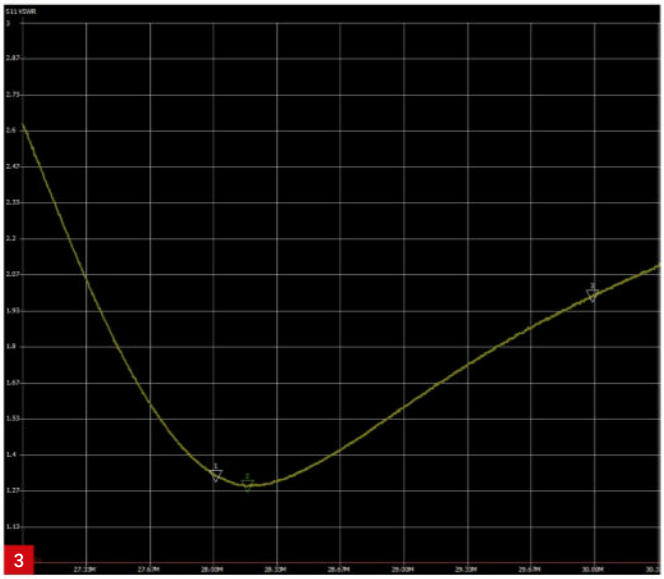
The next job was to fix a wooden block into place on the boom to take the mast clamps, **Fig. 2**.

To allow for tuning, the elements were cut deliberately long, the reflector being 5.375 m and the driven element 4.920m. Adjustment of a Yagi can be quite a time-consuming task if best performance is to be obtained. It really needs to be at its operating position when adjustments are being undertaken. As this is often not possible a mast that can be easily lowered and then raised is the best solution.

In my case, unfortunately, where the LMA mast was located meant that the antenna would foul the garage roof if it was at a height where I could reach it. Consequently, I settled for mounting the beam on a portable mast in the middle of the garden at around 10ft and then climbing step ladders to reach the elements for trimming.

The method of adjusting the Yagi to resonance that I (attempted) to use was to trim the elements while monitoring a dip in the trace of an antenna analyser, in this case the Chelegance VNA-3G. A single loop of wire was placed across the feedpoint and another on the input to the analyser. The idea being that the elements were adjusted to the wanted frequency while watching the response on the analyser.

This worked for the driven element but not for the one-piece reflector. There was clearly not enough coupling. I decided to try a tip written about by **Peter Dodd G3LDO** where he used a coat hanger connected to a GDO. This formed a large 'coil' in the form of a loop, which is placed alongside the element to check resonance and was a technique I had used once before but using an MFJ269 analyser. It was tried with an



equivalent sized loop of wire with the VNA-3G analyser but without luck. I dug out the MFJ and similarly I could detect no dip on the meter.

Being keen to get the beam up and out of the way and also because the weather was starting to get a bit more wintery I decided to use a different approach. I used the analyser and the single turn loop to adjust the resonance of the driven element and used a simple calculation in a spreadsheet cell to give me the length of the reflector, in respect to the measured trimmed length of the driven element. The reflector was then cut 'reflect' (!) this dimension. The aim was to keep the 5% ratio between the two.

On first check the beam was resonant just below 28MHz. Clearly the elements were too long for the 28.4MHz target. But I also had to take in account that the resonant frequency would likely rise as the beam was placed into a higher position above ground. What I couldn't account for was what difference the proximity to the garage roof would make, if any. I carefully trimmed a few mm off the driven element while going back and checking the analyser. Dimensions were taken from the driven element, put into the spreadsheet and the reflector trimmed accordingly.

To cut the tube while balancing on stepladders I used a plumber's pipe cutter. It took a bit of work as the aluminium was a bit tacky and the wall thickness of the tube didn't help. However, it was better than trying to hold what are quite thin elements in one hand while hacksawing away with the other.

After repeated trimming I came to the point as seen in **Fig. 3** where, when checked, the VSWR had reached 1.27:1 at 28.250MHz. Not knowing exactly what would happen when the beam was put up at height I stopped here with the driven element at a length of 4.876m and the reflector 5.300m.

The beam was mounted on the LMA mast, **Fig. 4**, and to make an initial performance assessment during an extended period of bad weather I sheltered in the garage doorway with my FT-817 and reached out into the rain to turn the pole manually. Although difficult to assess by using the FT817's LCD S-meter I estimated that the antenna has a F/B ratio of a couple of S-points at the very least, probably a bit more. The VSWR minimum though had dropped to 28.050MHz. This is attributed to the antenna only being a few feet away from the wet garage roof tiles and the frequency rose slightly as I gingerly raised the antenna higher in strong winds.

Forward gain was also difficult to assess in these tests as there was nothing to compare to. However, Front-to-Side ratio was quite impressive where signals of some S4-6 could be reduced to being no more than around S1. For example, I noted that pointing the beam towards 325° brought in some nice fat signals from North America while turning the beam side on reduced them markedly and the reverse was noted with European signals. Another encouraging feature I have noticed is that the annoying S6 'white noise' here that blights the 10m band when using wire antennas is no more than S2 and can be completely removed by turning the beam side on to the North or South.

With the beam presently at 5m and fixed pointing at North America and while still using the FT-817, but now from the warmth of the shack, results have been good. I have worked a string of W's along the North East coast of the USA and a number of VE's while running less than 5 watts, although this is not difficult to do on days the band has been open, admittedly.

Fig. 1: Feedpoint with balun. Fig. 2: Mounting block and bracket. Fig. 3: VSWR plot of beam while on portable mast. Markers at 28 and 30MHz plus minimum VSWR. Fig. 4: The beam mounted on the LMA mast.

Fig. 5: The Abbree sitting on Quansheng folded over. Fig. 6: The Abbree extended to full length.

The dimensions of the model I ran in AN-SOF look as though they will be very close to the finished antenna by the time it is up at around the planned 8m and even the bandwidth predicted in the simulation looks to be fine too.

The beam will be retracted when not in use, in consideration for the mast as well as the light construction method used.

Still to do will be to reinforce the boom, adjust the element spacing to see if I can get below the presently near 1.3:1 VSWR, try a choke balun, attempt to plot the beam's polar diagram and rig up a rotator.

This was intended to be a cheap project to replicate my old W6SAI beam and get on 10m with a noticeable performance improvement over a dipole and while not completely the 'finished item' it seems to have worked. If any of you construct or have constructed a simple beam like this (for any of the bands), please let me know how you get on.

Somewhat over the top

While researching my purchase of the Quansheng UV-K5(8) I noticed that some users were using an Abbree 'Tactical Antenna' with them. This is a flat tape-like antenna that folds over on itself and is available in various lengths. Being me, I decided I had to have one to play with!

Going onto aliexpress I found and ordered what I thought was a 33cm model fitted with a female SMA connector for £3.25 inclusive. The antenna arrived a few days later and I found that when unfolded it was a whopping 124cm long. Checking my order confirmed I had clicked on the wrong model! In its packaging it had been folded over on itself twice and was still some 47cm long. It has what I assume is a loading coil at the base some 70mm long and when fitted to the UV-K5(8) while folded it looked a tad oversized although still comfy in the hand, **Fig. 5**. Unfolding it once to 88cm long it looked odd and to the full 124cm outrageous, **Fig. 6**!

Fortunately, the antenna is reasonably light and the base fits firmly to the UV-K5(8). It looks as though the element is formed using pieces of tape measure material placed face-to-face, one piece of which runs full length while there are three other sections placed to form gaps where the element folds. The whole element is wrapped in heavy duty heatshrink sleeving and has an M6 thread on the bottom to screw into the loading coil. The antenna seems well made but I wonder how many times the single section of tape will fold before cracks in the metal occur. A Velcro strap is provided to hold the elements in place when folded.

I mounted the antenna on the VNA-3G and swept it from 100-500MHz with the antenna fully folded at its shortest length, with it folded in the 'mid' position and a full length. In its 'short' and 'mid' configurations it looked as though the VSWR may be suitable for transmit on 70cm but that's it. As a receiving antenna it seems to work well enough on civilian air band despite the match being poor and also on Mil air band where the match is much better.

In the 'mid' configuration the reception in the UHF PMR section from 70cm to the digital TV allocation seemed quite respectable. It seems to work adequately well on Mil air and if UHF SATCOM (VHF?) pirates are your thing, then reception around 255MHz seems pretty good too. Over the last Christmas period one transponder on 255.560MHz was clearly heard on the Quansheng playing a continuous loop of 'Jingle Bells'!

At full length the antenna was OK listening around on 10m. Using the full 124cm it feels as though it puts quite a bit of strain on the radio so I think I will go and order one that is a bit shorter this time! However, if you want a cheap antenna for just under four quid that will get you some odd looks, I can recommend the 124cm Abbree Tactical Antenna! A Google of Abbree Tactical Antenna will bring up a wealth of sources.

Other news

With the sad passing of **Marcel ON5AU**, American amateur **Lonney K1LH** has made a copy of the antenna data by **Cebik**, which was held on Marcel's website. This has been done so that this useful resource remains online for everyone in case the content on Marcel's website is eventually lost. The address of Lonney's website can be found here:

www.antenna2.net/cebik

Another sad loss is that of **Andrew Ikin** of Wellbrook Communications who passed away last October after a brief illness. Andrew closed Wellbrook Communications at the end of April 2023 for retirement. The qualities of his products were first class, and Wellbrook loops are arguably the best in the business. I have an ALA1530LN loop myself and also reviewed the FLX1530LN loop amplifier in *RadioUser*, finding both of them excellent performers. In fact, I have long regretted not buying the latter after the review period ended. Andrew and his products will be sorely missed. **PW**

1

Birth of the superhet

Dr Bruce Taylor HB9ANY describes the early development of one of the most important inventions in the history of radio.

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The invention of the superheterodyne receiver, **Fig. 1**, was a major milestone in the evolution of radio technology. History tells us that the theoretical basis of a development is often derived long before its practical applications flourish. For example, **George Boole** published his *Mathematical Analysis of Logic* in 1847, but it was only with the arrival of the digital age in the 20th century that his binary logic was applied extensively. And **James Clerk Maxwell** had formulated the classical theoretical foundation for the understanding of electromagnetic radiation as early as 1865, but only in 1888 did **Heinrich Hertz** confirm the existence of radio waves and measure their properties. Even Hertz thought that his work had no practical use, and it was a further nine years before **Guglielmo Marconi** and others began to pursue the application of these discoveries to the first practical systems of wireless communication.

The phenomenon of beats between audio tones of slightly different frequencies had probably been known since antiquity, and the sum and product identities of trigonometry were worked out in the early 16th century by the Swiss clockmaker **Joost Bürgi**. Until the invention of logarithms in 1614, the prosthaphaeresis algorithm that was derived from these equations in the 1580s by **Johannes Werner** was used extensively to simplify the tedious calculations that were required to compile navigational ephemerides. But it was not until 1901 that the prolific Canadian-born inventor **Reginald Fessenden (1XS/VP9)**, **Fig. 2**, began to apply the principle to the reception of wireless signals. He named the technique heterodyning, from the Greek roots *hetero-* (different) and *-dyne* (power).

Heterodyning

Despite Maxwell's seminal work, the radiation of electromagnetic waves wasn't well understood by many early experimenters. Fessenden was one of the first pioneers to understand that efficient radio communication required the generation of continuous waves, whereas even reputable scientists such as **Ambrose Fleming**, who was retained as scientific advisor by Marconi, postulated in his 1906 book that the impulse produced by a spark discharge (the so-called 'whip-crack effect') was essential to cause radiation. This erroneous argument became progressively muted in later editions.

From 1903, Fessenden financed the development of a high-speed alternator by **Ernst Alexanderson** at General Electric, and he improved its design until it could generate frequencies up to 100kHz. It was with a carbon microphone connected in series with the antenna of an alternator that in 1906 the first transatlantic voice transmission was achieved, from Brant Rock in Massachusetts to Machrihanish in Scotland. Several Alexanderson alternators remained in service until well after WWII and the 200kW transmitter at Grimeton in southern Sweden is still run every year on 'Alexanderson Day' (the nearest Sunday to 2 July) and on Christmas Eve with callsign SAC. Although the theory of alternators was well established, designing these machines was a challenging task in view of the speed at which they had to be run, and the hysteresis losses at high frequency. Initially there was such fear that the fast-spinning rotors of Alexanderson alternators would fly apart that they were tested in a sandbagged bunker. This contrasted with the arc transmitter developed by **Valdemar Poulsen**, which was straightforward to build, but whose CW output had a large harmonic content that was difficult to filter out. It was also difficult to scale and optimise because the physics of the arc plasma was not well understood.

But the reception of signals from these early CW transmitters posed a new problem. The RF output from a spark transmitter was modulated by the spark discharges, producing a buzzing tone in the receiver, or a more musical note in

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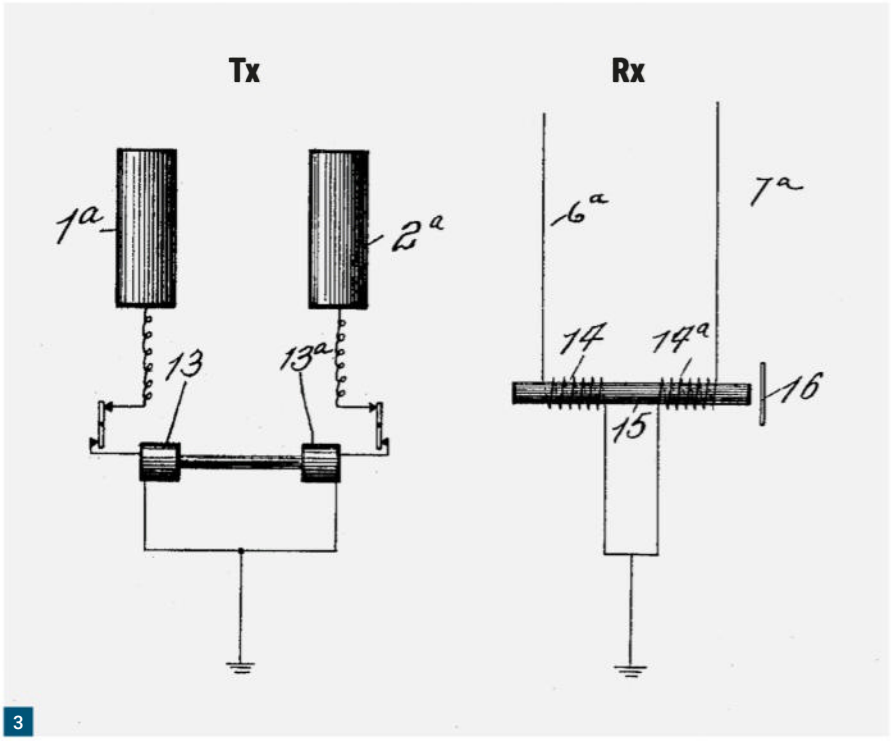

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the case of a rotary synchronous spark gap. An unmodulated CW carrier, on the other hand, produced no sound except for key clicks. To solve this problem, Fessenden first proposed to transmit two carriers separated by an audio frequency. His 1902 patent, **Fig. 3**, shows the carriers being generated by alternators *13* and *13ª* and radiated by antennas *1ª* and *2ª*. At the receiver, the signals picked up by the tuned antennas *6ª* and *7ª* are routed through coils *14* and *14ª* that are wound on core *15* of a telephone receiver, causing the diaphragm *16* to reproduce the audible beat frequency between them. He then realised that there was no need to transmit one of the carriers, as it could be generated at much lower power locally, and the concept of the heterodyne oscillator was born. In view of the difficulty of making a stable and low noise oscillator, the idea was several years ahead of its time. However, despite the rather broad spectrum of the Poulsen arc, Fessenden used it successfully as the local oscillator (LO) in a direct conversion receiver that was adopted by the US Navy.

Thermionic valves

The next major milestone along the road to the development of the superhet was the invention by **Lee de Forest** of the triode version of his Audion thermionic valve, **Fig. 4**, which he patented in 1907, although at the time he had little idea of how it functioned.

For about five years little was done to improve the erratic behaviour of the original gas-filled Audions, and the invention wasn't recognised as the forerunner of a new technology that would influence every sphere of human activity from entertainment, education and medicine to industry, commerce and world war. Despite the claims in his patent, de Forest was unable to obtain satisfactory amplification with the Audion, and it was just used as a detector. In 1912 he and his associates were even charged with defrauding the public by selling shares in a company whose only assets were patents for *"a strange device called an Audion, which had proven to be worthless and was not even a good lamp"*. It was only after **Irving Lamuir** and others at General Electric and AT&T carried out a more scientific study of the valve that they developed high vacuum triodes that were stable and sensitive, and these were also manufactured by Edison-Swan and **Henry Round** of Marconi.

Regeneration

The technique of obtaining greatly increased gain from a valve amplifier by applying regeneration (positive feedback) was discovered by **Edwin Armstrong, Fig. 5**, while he was still a student at Columbia University. As an impoverished student he didn't possess the $125 required to file a patent application for his invention. His father failed to appreciate its potential value, thought that it was a diversion

Fig. 1: A 1927 7-valve superhet. The large dial on the left controls the local oscillator, while the one on the right tunes the RF input. Fig. 2: Reginald Fessenden invented the heterodyne technique in 1901. Fig. 3: Heterodyne reception in Fessenden's patent of 12 August 1902. The alternators *13* and *13ª* generate carriers of slightly different frequency, which are received by the tuned antennas *6ª* and *7ª*. *15* is the core and *16* the diaphragm of a telephone receiver. Fig. 4: 1908 Audion triode valve. The connections for the dual filament (now burned out) are on the left and for the grid and anode on the right. (Photo Gregory F Maxwell GFDL-1.2)

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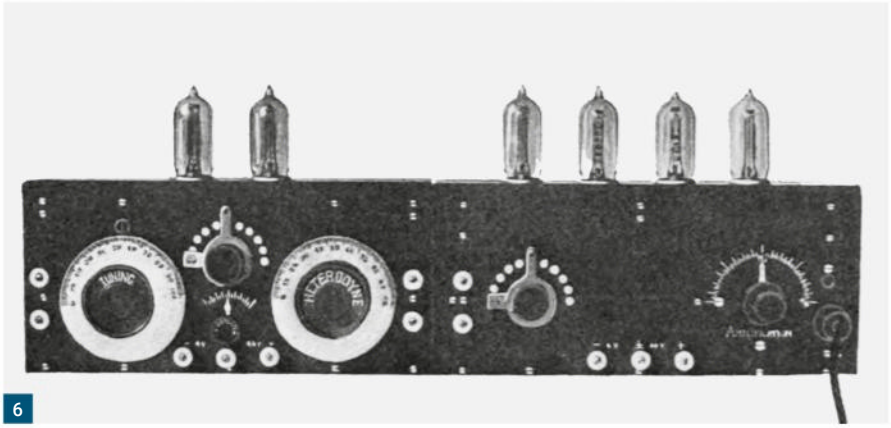

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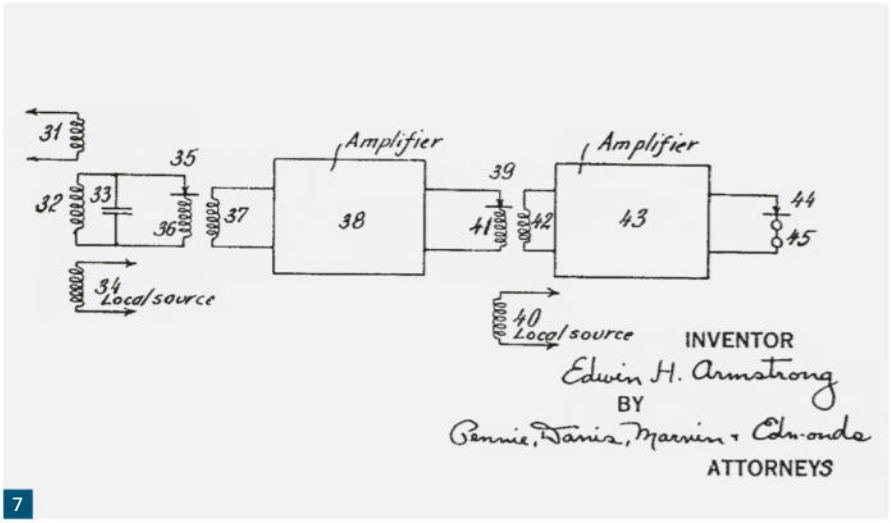

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Fig. 5: Edwin Armstrong invented the superhet while serving with the US Army in France. Fig. 6: The 6-valve superhet built by Armstrong and Houck in Paris in 1918. Fig. 7: Armstrong's 1920 US patent included the schema of a double conversion superhet. Fig. 8: Armstrong's wedding gift to Marion was the world's first portable superhet. Fig. 9: Harry Houk poses with the very successful 1924 RCA AR-812 6-valve superhet. Fig. 10: The RT Micro-Bigril frequency changer has two coaxial spiral control grids.

from his studies, and refused to advance him the money before he had graduated. Fortunately, his uncle, while declining to pay for a patent, advised him to have his circuit diagram witnessed and notarized in a small real estate office in January 1913 for 25 cents. This evidence of the date of conception was to prove crucial when later that year Langmuir filed a patent application for the invention on the same day as Armstrong. The historic US Patent No. 1113149 that was finally awarded to him on 6 October 1914 was to become worth millions of dollars.

On 18 December 1913, a few weeks after the first patent application, Armstrong filed another for the use of the regenerative circuit as an oscillator. While Lee de Forest had observed oscillations in his Audion circuits as early as August 1912, he didn't understand the significance of the phenomenon and tried to eliminate it. After he heard of Armstrong's work, he belatedly applied for patents on the oscillator on 20 March 1914, and on the feedback circuit on 23 September 1915. The competing de Forest and Armstrong patents were to become the most bitterly contested in the entire history of radio technology, and the subsequent acrimonious litigation was to continue for 20 years and cost one and a half million dollars in lawyers' fees.

Although large industrial companies were slow to exploit Armstrong's inventions, radio amateurs were soon using regenerative receivers and valve oscillators, which enabled them to extend their communication ranges by hundreds of kilometres. American Marconi finally purchased a licence under Armstrong's patent in April 1916, and other companies began to follow soon afterwards.

Paris

On the outbreak of WWI, hundreds of radio amateurs turned their skills to military work. Armstrong responded to Woodrow Wilson's call to arms, was commissioned as a captain, and at the age of 27 sailed to England in October 1917. While in London he met **Henry Round** at Marconi House on the Strand. Round showed him his valve designs and the 14-stage RF amplifier that had been used successfully to track the movements of the German fleet while stationed in Heligoland. He explained that there was a need for a sensitive receiver to detect signals at frequencies up to 3MHz, which it was thought (incorrectly, as it turned out) were being used by the enemy for secret field communications. With the triode valves and straight Tuned Radio Frequency (TRF) circuits of the time, it was difficult to achieve stable gain above about 1.2MHz. This triggered a chain of thought that was eventually to lead to Armstrong's second revolutionary invention.

Armstrong was soon in Paris, working with other military wireless experts in a development laboratory at 140 Boulevard Montparnasse. He was joined by a keen young sergeant, **Harry Houck**, who had built his first amateur radio station at the age of 14. Armstrong was amused when on Houck's arrival, he excitedly sketched for him a regenerative circuit, which he said he had seen in a *Wireless World* article written by someone with the same name as his captain! Houck became one of Armstrong's closest associates, and in the years to come contributed in no small way to his successful discoveries.

One night in early 1918, Armstrong was walking back to his apartment in Paris in thoughtful mood. He had just been watching the unsuccessful attempts of French anti-aircraft guns to bring down any of the German bombers that had been carrying out a raid on the French capital. He was turning over in his


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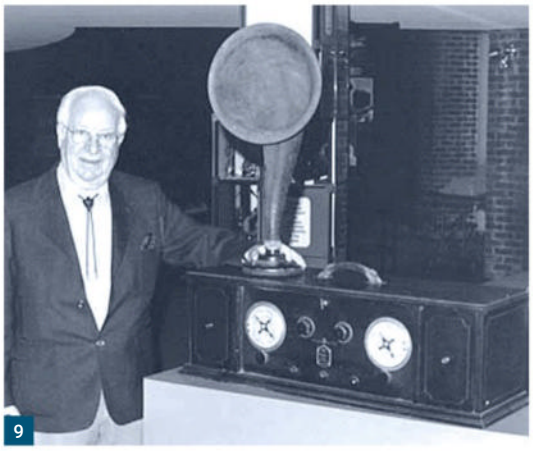
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mind the idea that it might be possible to direct the AA fire more accurately if the guns were linked to a radio direction finder that picked up the high frequency ignition noise radiated from the engines of the enemy planes.

It was while pondering the challenge of detecting these weak signals that Armstrong suddenly conceived the solution to the HF amplification problem. Since existing triode valves tended to be unstable at high frequencies, why not use a tuneable local oscillator to heterodyne the received signals down to a fixed lower intermediate frequency, at which they could provide the required gain and selectivity? In spite of other pressing work on tank radio, Armstrong, Houck and others worked on this super(sonic)heterodyne principle throughout the summer of 1918, and produced a prototype superhet receiver that was almost ready for trial at the front line when the Compiègne Armistice was signed on 11 November. The receiver, **Fig. 6**, comprised one unit with two valves for the local oscillator and mixer, directly connected to a second unit containing a 3-valve IF amplifier and a single valve detector. An 8-valve version added two AF amplifier stages.

Armstrong applied for a patent in France on 30 December 1918, then in the US on 8 February 1919, and US Patent No. 1342885 was issued on 8 June 1920. In that landmark patent, he even included an example of a double-conversion superhet, **Fig. 7**, in which a 10MHz input signal *31* is heterodyned with 11MHz LO *34* and amplified by 1MHz first IF stage *38*, before being heterodyned with 1.1MHz LO *40*, and amplified by 100kHz second IF stage *43,* which drives detector *44* and headphones *45*. Armstrong was promoted to major, and awarded the French *Chevalier de la Légion d'honneur* for eminent services to the nation. In the US he was awarded the first *Medal of Honor* of the IRE (now the IEEE), but trouble with rival patent claims was already brewing.

Patent wars

Armstrong wasn't able to return to the US until September 1919, by which time several experimenters had claimed prior invention of the superhet principle. These included **Walter Schottky** of Siemens, who had certainly developed it independently, and **Lucien Lévy**, whom Armstrong had met in France. During an acrimonious debate in 1925, Lévy accused Armstrong of having stolen his idea. However, it then emerged that the superhet principle had first been described in February 1917 in an internal report by **Paul Laüt**, a member of the same Eiffel Tower team as Lévy, but it had been patented by Lévy while Laüt was hospitalized with tuberculosis. In 1926, Schottky generously acknowledged that while he had filed a German patent application on 18 June 1918, six months before Armstrong, his theoretical 'word' was less important in the field than the 'deed' of Armstrong in making the superhet a practical technology.

Lévy's American patent application was bought by AT&T for $20,000, and found to be in interference with Armstrong's patent in the US. A few months later General Electric purchased American Marconi, the Radio Corporation of America came into being, and the radiotelephony interests of AT&T were brought into the conglomerate. Outside this circle of complex interlocking agreements among powerful corporations, Armstrong was an individual experimenter with limited resources, but whose first two key inventions were vital for the future development of radio.

Surprisingly, the first move to acquire Armstrong's patents was not made by this mammoth new organisation but by Westinghouse Electric, which had gained control of Fessenden's patents and wanted to catch up with RCA. Westinghouse had been inspired by the success of the first regular broadcasts by local radio amateur **Frank Conrad 8XK**, and set up station KDKA at the company's plant in East Pittsburgh using a transmitter with six 50W valves. Armstrong's funds were at a low ebb, and in October 1920 he agreed to sign over his regeneration and superhet patents to Westinghouse for $335,000, payable over ten years.

The Roaring Twenties

In June 1921, Westinghouse was taken into RCA's group to manufacture 40% of the radio receivers, the remaining 60% being allocated to GE, while the transmitters were to be made by AT&T. But GE and Westinghouse struggled to develop a satisfactory superhet design until Armstrong and Houck themselves came to their rescue and perfected the 6-valve 'second harmonic' Radiola AR-812, **Fig. 9**, that was eventually launched in March 1924. In this

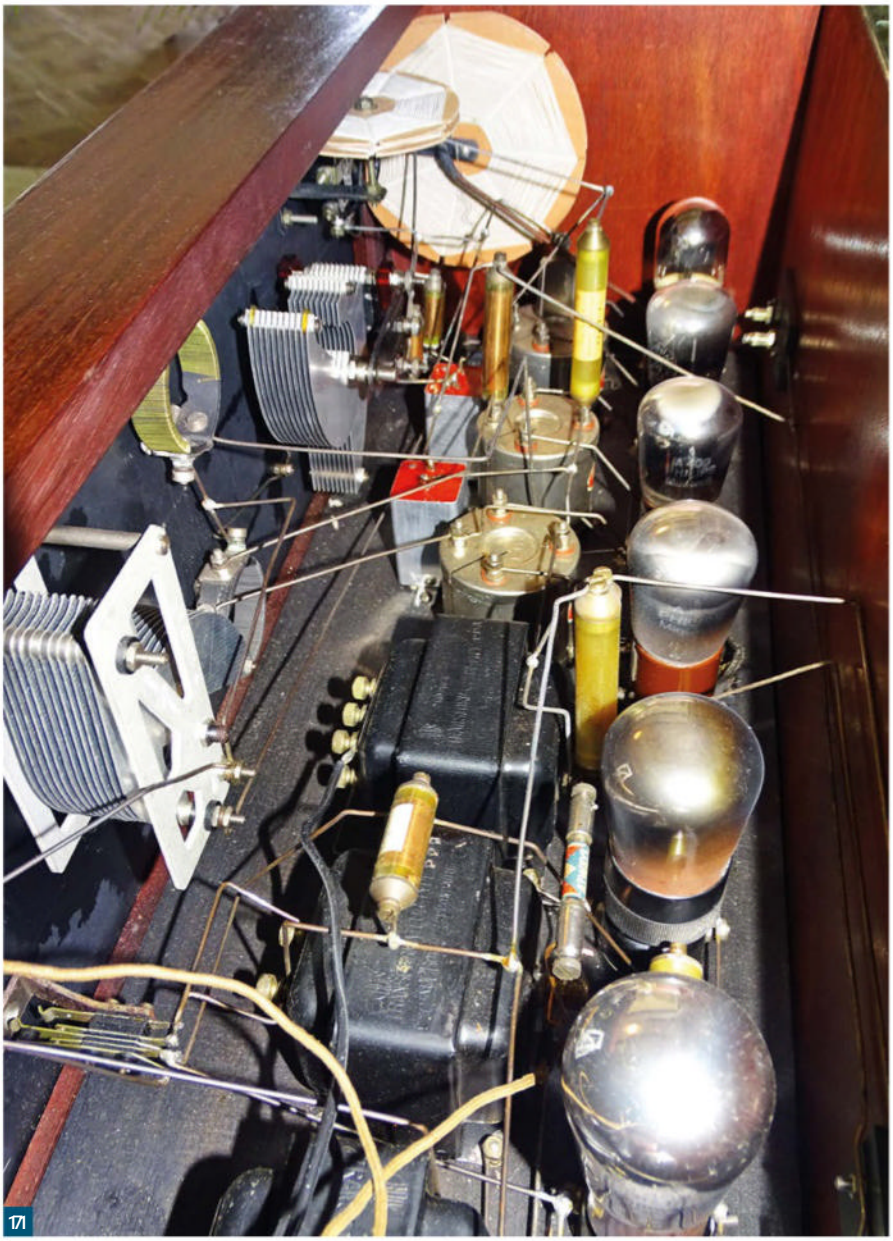
Fig. 11: This dual-range 1927 superhet has seven valves, three IF and three AF transformers. The two spiderweb coils are for the LO. Fig. 12: Loudspeakers by SG Brown have a diaphragm adjuster that allows the sound reproduction to be optimised.
Fig. 13: Early SG Brown Type F headphones have potentially hazardous exposed terminals. The cord connects the two 2000Ω earpieces in series. Fig. 14: With a 500pF tuning capacitor this frame aerial covers 170kHz to 1240kHz in two ranges.

ingenious reflex set the first valve performs as both an RF and an IF amplifier, while the second valve is the LO and the first detector. The set proved a winner that dominated the market for several years; the total production of 148,300 superhets making more money for RCA than anything up to the introduction of mains-powered receivers in 1927-28. For this, Armstrong was rewarded with a further 18,900 RCA shares, bringing his holding to almost 80,000 – worth over $3 million at the time, and about $50 million in today's money. His frequent visits to RCA also enriched his personal life, for in 1923 he started courting David Sarnoff's secretary **Marion MacInnis**, an attractive 25-year-old Scottish girl, and they were married in December of that year. Armstrong's wedding gift to Marion, **Fig. 8**, could be described as the world's first portable superhet.

With very few exceptions, RCA maintained high prices by refusing to license its superhet patents to other companies until it was forced to do so by an antitrust suit in July 1930. The corporation tried to hinder the activities of pirate manufacturers by restricting the sale of valves except to radio amateurs and as replacements for legal sets, creating a market for valves with burned out filaments. As with de Forest's agreement with AT&T concerning the Audion, Armstrong had wisely retained the rights to his patents for non-commercial and experimental use.

At that time most large corporations thought that these rights were of no importance, for they saw wireless only in terms of point-to-point commercial communications, and entirely failed to foresee the meteoric rise of public interest in radio.

By 1922 radio had taken off, chaos reigned in the industry and on the air, the corporations were engaged in bitter in-fighting, and their agreements were in shreds. Hundreds of individuals and small independent manufacturers were making radio equipment, AT&T had lost control of the transmitter business, and Armstrong was receiving $10,000 a month in royalties from the licensing of his feedback circuit for non-commercial use.



Transition

As valves were initially very expensive, crystal sets and TRF receivers with one, two or three valves remained popular and multi-valve superhets were restricted to the upper end of the market. But as the tumultuous decade rolled on, the number of radio stations began to rise rapidly and the higher selectivity and sensitivity of the superhet became valuable assets. To reduce costs and avoid patent-infringement suits by RCA, many manufacturers sold kits of parts for the home assembly of superhets and some of these were provided with very comprehensive multilingual blueprints, as in this example:

https://tinyurl.com/SuperhetPlan

Predrilled and engraved front panels were often included in the kits, while the valves and the cabinet were usually procured separately. Different IF transformers could be supplied to suit valves of different dynamic resistance. Less scrupulous manufacturers supplied 'kits' that were almost complete receivers, because the majority of the components were preassembled in a sealed unit.

Initially, the functions of LO and mixer were often performed by an autodyne circuit or by separate valves, but in 1924 special valves such as the Radiotechnique Micro-Bigril, **Fig. 10**, were developed to perform both operations. This rare dual-grid tetrode was a forerunner of the heptode frequency changer, later superseded by the ubiquitous triode-hexode valve that was introduced in England by Lissen and other suppliers in 1934. A high-end mid-1920s superhet, **Fig. 11**, typically had two or three stages of amplification at an IF in the range 40-180kHz and a transformer-coupled AF amplifier, followed by a push-pull

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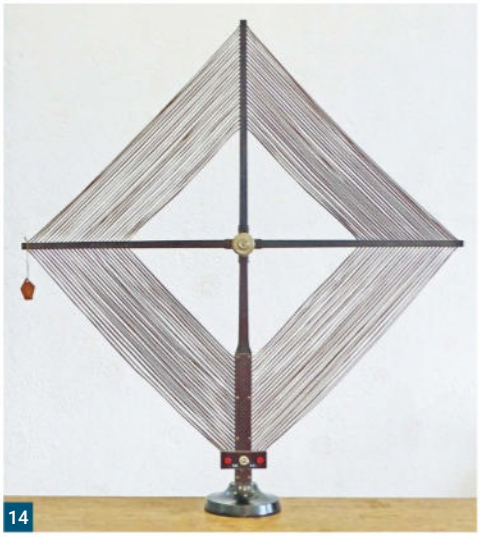
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output stage that could drive a loudspeaker. It cost about £50 (today £2600). In the case of single-ended audio output, it wasn't unusual for the exposed headphone or loudspeaker terminals to be connected to the HT supply. The front panel could be quite busy. Before the advent of ganged components, separate variable capacitors were required for the local oscillator and the RF tuning, calibration charts being provided to convert the tuning dial readings to wavelength. Rheostats were usually provided to control the filament voltages of groups of valves, or even each valve individually. To increase the gain, it wasn't unusual to provide an IF stage with adjustable regeneration and one 1922 superhet had six tuning dials and 17 other controls.

A receiver of this period also required several auxiliary items, usually including a low tension 2V or 4V accumulator for the valve filaments as well as high tension and grid bias batteries. In the UK, a large range of horn loudspeakers, **Fig. 12**, was made by the company that was founded by **Sidney George Brown** in 1903 and that produced gyro compasses during WWI. SG Brown's headphones were also very popular and the Type F 'featherweight' economy model, **Fig. 13**, that was introduced in 1922 at a price of £1.25 (today £60) was advertised regularly in amateur radio publications, even after the company was sold to De Havilland in 1960. Compared with today's padded over-ear headsets they were quite uncomfortable to wear for long periods.

Many superhets were designed to operate with an external frame aerial, **Fig. 14**, which had useful directional properties. Some frame aerials had multiple windings to cover several wavebands, while others had to be used in conjunction with additional coils for the lower frequencies. Without a separate RF amplifier stage, the tuned frame aerial provided the only image rejection for the receiver. The BFO required for CW reception, consisting of a single-valve oscillator very loosely coupled to the detector, was often housed in a separate case outside the main set.

Conclusion

Since Armstrong had filed his superhet patent six months later than Lévy, most of his claims were eventually transferred to Lévy, in a patent issued to AT&T in November 1929. By that date all the patents were in the same pool, so this transfer is not widely known as it had no effect on the industry. In spite of the valid claims of prior invention by several others, Armstrong is generally recognised as having done most to make the superhet a practical reality. It was a tragedy that at the age of only 63 this brilliant engineer was driven to despair and suicide by years of conflict with RCA over the adoption of another of his revolutionary inventions, wideband FM broadcasting.

By the end of the 1920s the superhet had come of age. In the years to follow, the technology would mature and spawn many derivatives, while refinements in radio components and the arrival of the microelectronics revolution would transform its implementation and vastly improve its performance. But the basic concept that was born over 100 years ago has stood the test of time. Only a few of the inventions of the early wireless pioneers have endured, and still play a vital role in modern radio. The superheterodyne is an outstanding example, and it is fitting that we remember the talented individuals, many of them radio amateurs, who gave it birth. **PW**

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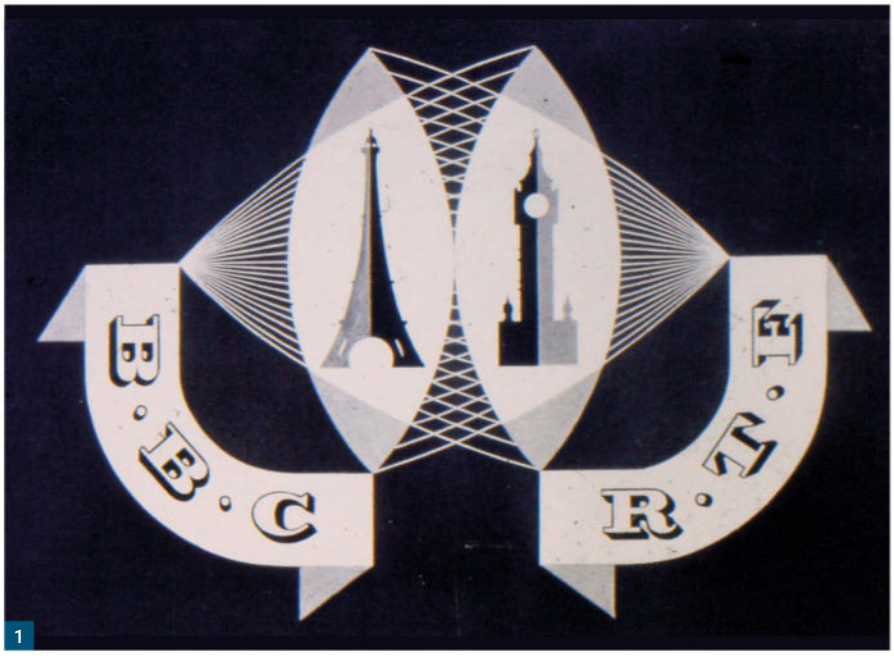

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BBC coronations Pt XI

Keith Hamer and **Garry Smith** ccontinue the special series looking back at the BBC's coverage of Coronations since 1937. There is also a Coronation vintage television advertisement from the archives plus the first instalment of a two-part series describing the Ekco company. There are more unique details about Roland Pièce, the pioneer of Swiss radio broadcasts, from family archives supplied by Pierre Yves-Pièce. The series charting the rise and fall of BBC 198kHz transmissions focuses on the BBC's decision to transfer the 5GB Long-Wave Station from Brookman's Park, near London, to Droitwich. We also continue our series about the development of Swiss Radio and Television since 1922.

For the non-English speaking world, the BBC's *External Services* reported the Coronation on 2June 1953, in no fewer than 41 different languages. Europe was served during the day by 'live' commentaries broadcast over five networks in 15 languages. Recorded commentaries and studio reconstructions of the day's events were given in a further ten languages. The pattern of multi-language broadcasting for the Middle and Far East, and for Latin America, was similar.

Some months before the Coronation, requests were received from France, Western Germany and the Netherlands for facilities to relay the BBC's television broadcast of the event. The possibility of such a relay had been demonstrated by the BBC a year earlier when it successfully transmitted a number of programmes over a temporary television link established between Paris and London, **Fig. 1**. The new project, though technically more complex, was regarded as practicable and the BBC worked hard to bring it about in co-operation with the television services of the three countries concerned.

The actual operation was carried out without any serious technical problems. Radio links took the BBC television signal in stages from London to Paris, where it was converted to the French *RTF* 819-line and 441-line standards. The signal passed via Belgium to Breda, in the Netherlands, for conversion to the Dutch *NTS* 625-line standard. The signal was then relayed to Wuppertal, in Germany, where it was fed into the German *NWDR* television network. For the sound accompaniment, the whole of the Coronation Service and sound effects from the processional route were transmitted by line to all three countries. In France, television viewers shared with radio listeners the sound commentary provided by French-speaking commentators in the Abbey and elsewhere. In Germany and the Netherlands, viewers heard separate commentaries in their own language. These were not broadcast with the television signals from London, but were given by carefully briefed commentators as they watched the television pictures in their own countries.

The relay was carried by 12 European transmitters in all to an estimated 1.5-million viewers. Its success was largely responsible for the subsequent move to establish a European network for the exchange of television programmes.

Vintage coronation television equipment

This month's rummage through vintage copies of unkempt newspapers and magazines has unveiled an advertisement by **E K Cole Limited** for their 15-inch television receiver. The advertisement was carefully timed to appear with just five weeks remaining until the 1953 Coronation, **Fig. 2**. The advertisement dates from 24 April 1953. The text has been left in its original format to reflect the spelling, grammar and punctuation of the time. This is the full description of the *15" Ekcovision Table Cabinet T164*.

"LUXURY VIEWING
at moderate price!
THIS receiver has a 15" aluminised tube plus 'Spot-wobble', an Ekcovision feature which gives pictures of photographic quality. It has a tinted screen for viewing in any light, the mechanical perfection of the famous 'Triple-link' chassis and, to cap it all, a superbly designed walnut cabinet.
£86
EKCOVISION 15" Table Cabinet T164
**Only 5 weeks to the Coronation - ask your Ekcovision Dealer to demonstrate today.*
E. K. Cole Ltd., Southend-on-Sea, Essex."

The 15in *aluminised* tube referred to in the advertisement was an attempt to improve the overall brightness of the picture and also to reduce ion burns within the cathode-ray tube. In those days, there was a tendency for a small, very dark spot to develop in the middle of the screen, which could be very distracting for the viewer.

Ekco fitted *spot-wobble* circuitry to several of their television sets in the 1950s. The additional circuitry was designed to slightly elongate the scanning beam in a vertical direction. Radiation from the oscillator circuit into the IF could cause patterning. A trimmer was provided for the viewer in the form of a toggle switch mounted on the receiver's back cover. Although the system worked well technically, most viewers never complained

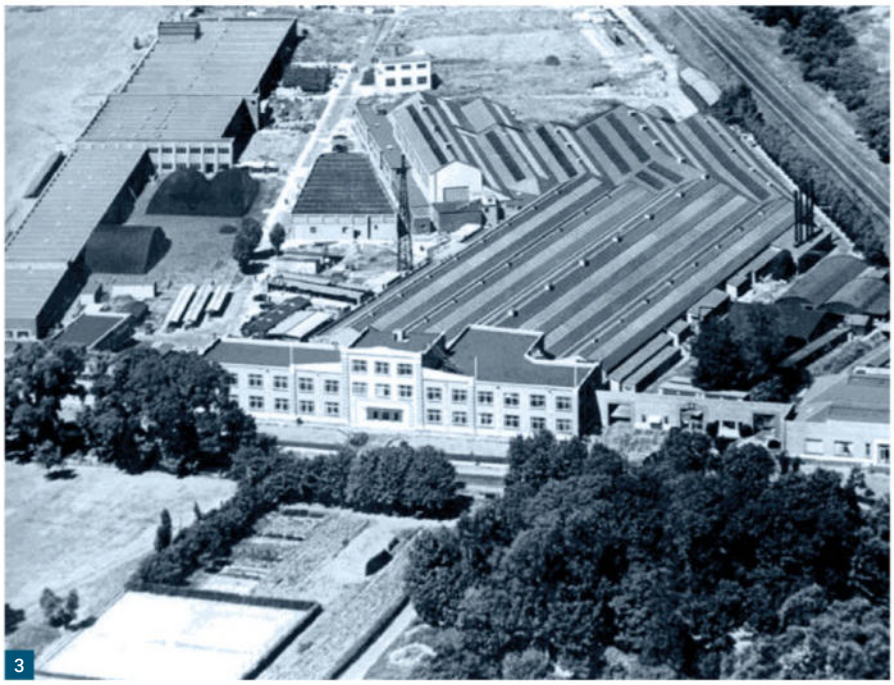


Fig. 1: A temporary television link was established between London and Paris ahead of the 1953 Coronation. Fig. 2: An advertisement by E K Cole Ltd for their 15in television receiver. This appeared on 24 April, five weeks before the Coronation. Fig. 3: Ekco's spacious factory located at Priory Crescent, Southend-on-Sea.

about the line structure with 405-line pictures, even on 21in models, and often couldn't see any difference whether the spot-wobble was switched on or off. In fact, some viewers complained that the picture became slightly fuzzy when the circuit was switched on. The Ekco *triple-link chassis* featured circuitry to negate timebase problems.

The Ekco story, Part I

This two-part series gives a detailed account of the rise and fall of the famous British company, **Ekco.**

Eric Kirkham Cole was born on 4 July 1901, in Rochford, three miles north of the city of Southend-on-Sea in Essex, often referred to simply as Southend. He was the only son of **Henry** and **Alice Laura Cole** who lived at 2, Beedell Avenue in Westcliff-on-Sea (Southend). It is thought that *Kirkham* was his mother's maiden name.

After leaving school, he attended *Southend Technical College*. At the age of 19, he joined his father's business as an electrical engineer. At that time, the UK was still in the process of installing electricity in domestic properties. In 1920, he began experimenting with radio using his father's garden shed. In 1924, Eric began to make radio receivers, together with his future wife, **Muriel Bradshaw**. He established a business called the *E.K. Cole Receiver Company*.

He happened to read an article in a local newspaper by schoolmaster and freelance journalist **William Streatfield Verrells** who enquired whether it would be possible to power a radio set using the public electricity supply rather than batteries. At that time, most radio sets were battery powered due to the wide variation in voltages encountered with the public electricity supply. The *National Grid* supply at 240V AC was not agreed until 1926 and DC mains was still commonplace. At that time, Southend used 230V DC.

Intrigued by the challenge, Eric Cole designed and manufactured such a radio system, which he called his *Battery Eliminator*. Initially, he encountered technical problems reducing the DC mains sufficiently to operate his 6V wireless. Apart from the potential danger of causing a fire, the reception suffered from severe interference. However, later that evening in his workshop, he experimented by connecting a series of lamps between the wireless receiver and the mains. This reduced the voltage to the required 6V. Although the wireless worked, the hum was totally unacceptable. To counteract this, he fitted a high-capacity smoothing condenser, which reduced the hum to a satisfactory level. Even so, a high-tension battery was still required.

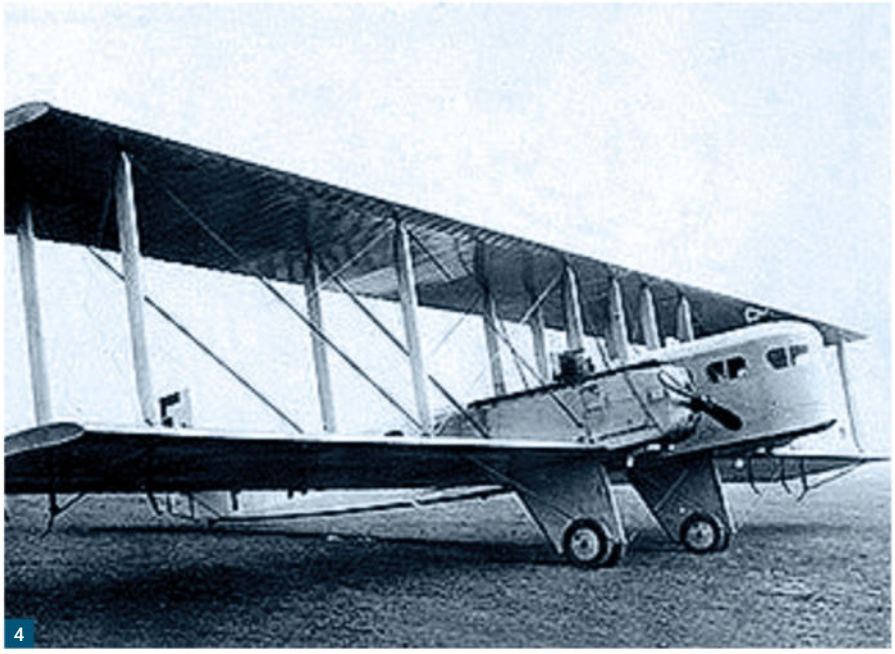
In addition, the glare and heat from the electric lamps certainly caused problems. Following further experimentation, he changed the electric lamps for a large resistor. This became very hot and required a metal shroud to avoid the risk of a fire. He eventually succeeded in incorporating a device that supplied the high-tension current that previously required an HT battery.

He demonstrated it to William Verrells who was so impressed by the receiver that they formed a business partnership. They began selling the battery eliminators to the public. The equipment soon became very popular and the two entrepreneurs formed a private company called *E.K. Cole Limited*. Capital for the new company was provided by a local milkman, a builder, and the owner of *Peter Pan's Playground*, located on Southend's seafront. In 1926, when E.K. Cole Limited was formally incorporated and floated on the stock exchange with a working capital of £2,500, the business moved to larger premises at 505 London Road, Southend.

A little later, the company transferred to 513 London Road. Unfortunately for the company, most of England was quickly upgrading to AC mains and sales were limited to those areas still on DC. It soon became apparent that the *Ekco Battery Eliminator* would have to be modified to operate on AC. Meanwhile, sales of their DC devices flourished in the Southend area and one year later, in 1927, the company's profits enabled a new factory to be established at 1135 London Road in Leigh-on-Sea.

The company went from strength to strength

Fig. 4: A Goliath aircraft was used in the 1920s for flights between Lausanne and Paris.
Fig. 5: Brookman's Park was the world's first high-power long-wave transmitter.
Fig. 6: The Eurovision emblem in the Fifties heralding an exchange of programmes from Swiss television.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resulting in it becoming a *Public Limited Company* in 1930. A new spacious factory was built on a greenfield site (actually a cabbage patch) in Priory Crescent, Southend, **Fig. 3**. This location remained the main headquarters and manufacturing site for the rest of the company's existence. Production concentrated on mains-powered radio sets rather than the earlier battery eliminator receivers, which were becoming obsolete. Business was certainly booming and ten assembly lines were built using the 'conveyor-belt' technique. This was another innovation unique to Ekco and the system allowed six models to be produced simultaneously.

The company's future looked assured, until a devastating fire raged through the research and development laboratories. The blaze destroyed most of the design work for the company's new range of receivers.

Undaunted by this major setback, Ekco recovered sufficiently enough to be able to launch their first car radio at the *1934 Radiolympia Exhibition* in London. The company was also among the first manufacturers to use Bakelite cabinets for their wireless sets. Bakelite cabinets were already being produced in Germany for *Telefunken* by *Allgemeine Elektricitäts Gesellschaft AG* (*AEG*). An agreement was signed with AEG for the supply of similar enclosures to Ekco. However, in 1931, high import duties were imposed on the cabinets, which forced Ekco to establish their own Bakelite moulding shop adjacent to the Southend factory. The moulding presses were supplied by AEG for which Ekco paid an annual fee and a royalty.

The company employed famous British architects, such as Russian-born **Serge Ivan Chermayeff** and Japanese-born **Wells Wintemute Coates OBE**, to design their Bakelite radio cabinets. Ekco also produced matching loudspeakers housed in Bakelite enclosures. The loudspeakers were always separate from the receivers because the early types of valves were *microphonic*. This phenomenon resulted in distorted reception due to vibrations generated by the loudspeakers.

Bakelite was the major form of 'designer plastic' from the 1930s until the 1950s. It was developed in 1907 by Belgian-born **Leo Hendrik Baekeland** in New York and was the first hard, infusible, and chemically resistant plastic. He patented it on 7 December 1909. The thermosetting resin was based on a chemical combination of phenol and formaldehyde – two compounds derived from coal tar and wood alcohol (methanol). Thermosetting meant that, once formed, it could not be melted or changed by heating. The plastic was unaffected by high temperatures, solvents or acid, and was electrically resistant and shatterproof. In addition, Bakelite did not crack or discolour when exposed to sunlight.

In 1936, Ekco began experimenting with television and made a substantial investment in a company called *Scophony Limited*. This company developed the ingenious Scophony projection television system. In 1938, the mechanical scanning system was successfully demonstrated at the annual *Radiolympia Exhibition*. The first set to go on sale was the *Ekco-Scophony Model ES104*. There were actually three types that produced 405-line pictures. One was a domestic receiver in a cabinet that produced a picture approximately 24in by 22in. The other two were of similar construction, but without cabinets. They were intended to be used in theatres and cinemas. One produced a 6ft by 5ft image and the other a 9 by 12ft picture. Although the three systems showed great promise, development was permanently halted by the Second World War. In 1937, Ekco introduced their own conventional CRT-based domestic television receiver, the *Model TC101*, which had a built-in radio. It sold for £84, whereas their *Model TC102,* without a radio, cost £47.5.0 (£47 and 5 shillings).

In the late 1930s, Ekco began producing their own radio valves at the Southend factory. The business was ultimately abandoned and sold to *Mullard Limited*. The factory was converted to manufacture lamps. In 1943, Ekco acquired *Ensign Lamps*, based in Preston. In 1950, Ekco sold 51% of its lighting subsidiary, *Ekco-Ensign Electric Limited,* to *Thorn Electrical Industries*.

Shortly before the official declaration of war on 3 September 1939, the government decided to disperse certain production to locations away from obvious bombing targets. This resulted in a secret Ekco factory being set up at *Cowbridge House*, Malmesbury, in Wiltshire. Other secret factories were established by Ekco at Preston, Rutherglen, Woking, and Aylesbury. The Southend factory was evacuated except for the Bakelite moulding shop because the large presses could not be easily moved. The wartime headquarters of Ekco was based at *Aston Clinton House* in Buckinghamshire. Less than a year later, the empty factory was re-equipped to make wiring looms for military aircraft such as the *Avro Lancaster*.

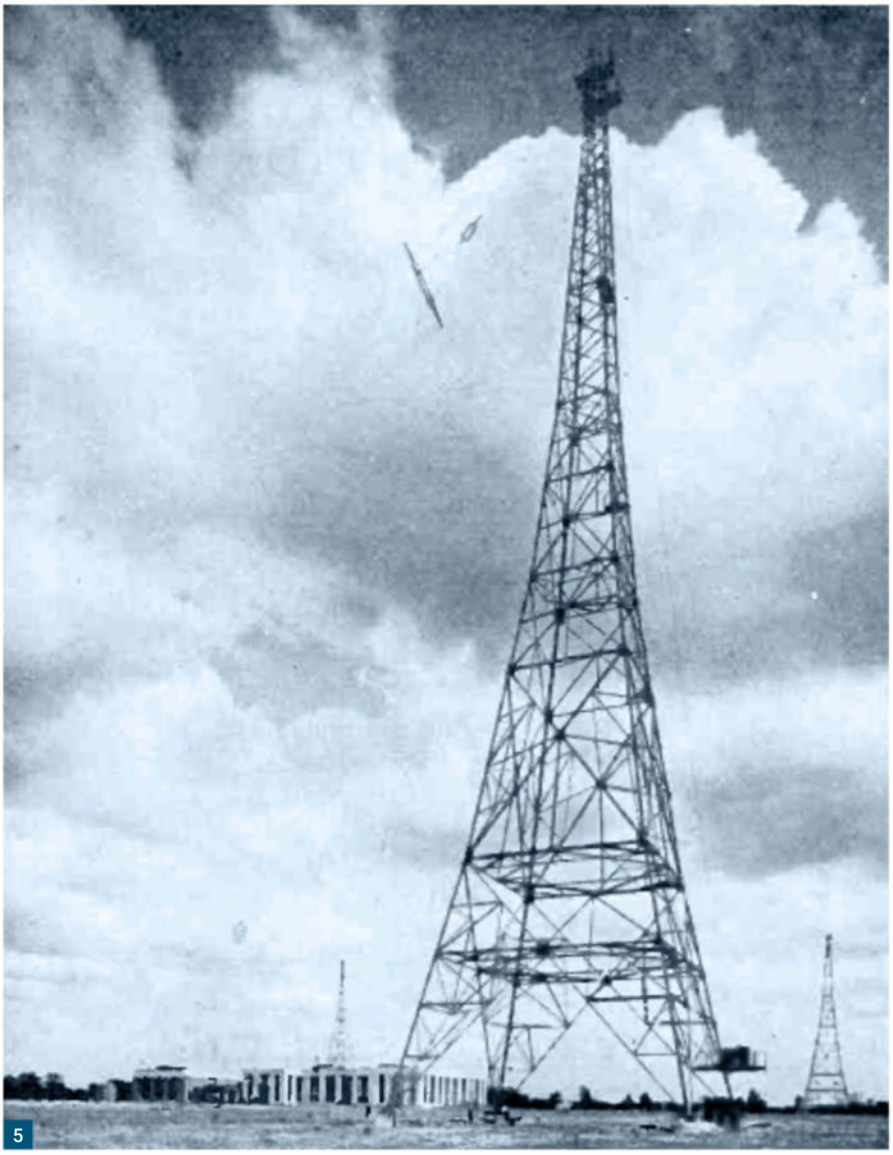
The Ekco factory at Malmesbury specialised in the top-secret development and production of new radar systems as part of the *Western Development Unit*. Equipment produced at Malmesbury during the war included the *AI Mk. IV* and *AI Mk. VIII* air-interception radars, and the ASV Mk.II air-to-surface-vessel radar system.

Roland Pièce archives: part V

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

At a meeting on 11 November 1921, the Lausanne municipal council decided to develop the *Place de la Blécherette* area in order to create a radio station and to build the hangars needed to house the *Goliath* aeroplane. The council sent **Professor Paul-Louis Mercanton** to the *International Air Navigation Congress* in Paris to liaise with other technical delegates. Goliath aircraft were used for civil and military purposes by several European countries in the 1920s, **Fig. 4**.

On 14 February 1922, the council awarded a grant of SFr. 250,000 for the transformation of the Blécherette airfield and for the construction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of the Champ-de-l'Air radio station. A month later, on 14 March 1922, the Lausanne municipality issued the following, somewhat terse, statement: *"Despite the inaccuracies of the French government with regard to the operating guarantees for the Paris-Lausanne airline, we will place an order with the Société indépendante de télégraphie sans fil in Paris for the station to be installed at Champ-de-l'Air."*

The Champ-de-l'Air site was chosen because of its unobstructed position on the heights of Lausanne, its immediate proximity to the *Vaud Meteorological Service*, directed by Paul-Louis Mercanton, and the fact that the Canton of Vaud was making premises available to the city of Lausanne. Discussions took place between 6 and 15 June 1922, to assess whether there were any objections to the site being used for the installation of the wireless telegraphy station. There were no adverse comments and installation work began.

The installation of the transmitter was entrusted to Roland Pièce, with the exception of the two 50m masts supporting the 70m aerial. On 26 September 1922, the *Lausanne Works Department* announced that tests at the Champ-de-l'Air wireless telegraphy station had been successful.

The installation used a wavelength of 900m for radio telephony (communication with the aircraft) and 1400m for wireless telegraphy (connection with the airfields). The Lausanne municipality asked Roland Pièce if he would be the engineer in charge of the transmitter, a role which he willingly accepted.

The rise and fall of 198kHz: part IV

Several months after the opening of the Droitwich long-wave transmitter, another installation was transferred to the same location. This was the *Midland Regional Transmitter*, often referred to as *5GB*, which had previously been at Daventry. Originally, this transmitter was built to carry out experiments, which would lead to the adoption of a design for all the new regional stations such as

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Brookman's Park and *Moorside Edge*. Brookman's Park was the BBC's *London Regional Transmitter*. It was also the world's first high-power long-wave transmitter, **Fig. 5**. After successful tests, the transmitter, still in its experimental form, was used to supply the regional programme to the Midland Region. It initially operated on 25kW, which was about half of that used by other regional stations.

The original location at Daventry, some 38 miles from Birmingham, was not thought to be an ideal site for a regional medium-wave transmitter in relation to the densely populated region that it served. BBC engineers regarded the move to the new site at Droitwich as a distinct advantage.

Service information: Switzerland: part XIII

In 1954, eight European television services collaborated to form *Eurovision,* which was operated by the *European Broadcasting Union* (*EBU*), based in Brussels. The organisation was designed to promote the exchange of television programmes internationally. SRG was heavily involved with Eurovision from the start, **Fig. 6**. The international exchange of radio programmes was provided by the EBU's *Euroradio* service.

In 1956, Lugano hosted the inaugural *Eurovision Song Contest*. The event represented a watershed moment for television entertainment, as well as a Swiss national triumph as local performer **Lys Assia** won the first *Eurovision Grand Prix* with her song, *Refrain*.

In 1960, the *Schweizerische Rundspruchgesellschaft* changed their name to the *Schweizerische Radio- und Fernsehgesellschaft* (*Swiss Radio and Television Corporation*). The change reflected its move into television broadcasting, which began with experimental broadcasts in 1953 and culminated in the beginning of regular broadcasts on 1 January 1958. The organisation continued to use the abbreviation *SRG* and still remains registered as an *Association* under Swiss law.

Stay tuned!

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

Graham Caldwell
practicalwireless@warnersgroup.co.uk

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Portable military radio communications of WWII

Graham Caldwell continues with his series of articles on WWII portable radio equipment, including their collecting potential. This issue covers the German Wehrmacht.

Between the wars, Germany continued to secretly improve its wireless technology by experimenting with new frequency bands, such as HF (high frequency) and VHF (very high frequency), which allowed for less interference and more compact antennas, despite the restrictions imposed by the Treaty of Versailles. The embryo armed forces of the 1930s, or *Wehrmacht*, were particularly advanced in portable radio design, supplying the infantry with a series of man-portable radios designated as *Tornister Funkgerrät* (Torn.fu, later also TFuG) meaning 'back-pack radio equipment', followed by a lower-case letter for the model: e.g. 'Torn.fu.b1'. On a much smaller scale were the Field Radio Transceivers designated *Feldfunksprecher* (Feldfu), which were small, two-way voice radios supplied in different lettered models that had a range of up to ¾ mile. These early 'walkie-talkies' became standardised for the infantry and as the war progressed further versions were developed, allowing direct communication with *Panzer* and *Sturmgeschütz* VHF radios.

Army and Waffen SS Infantry

Torn.Fu.d2. Introduced in 1936, the set is a small, very-high-frequency transceiver, consisting of a three-stage transmitter and six-tube superheterodyne receiver, which could receive and transmit by CW (Morse) or WT (voice). It became the standard portable radio set used by the Wehrmacht and Waffen SS infantry, with four sets per battalion to communicate with the companies. It required at least two men to operate and set up. When on the march, the man in front carried the 16kg set, while the soldier walking behind carried the 17kg battery case and operated the radio, using a Kmf.b throat microphone and standard Dfh.a headphones. The set has a range of 2.5 miles using 0.4W output for voice, or six miles with 1W output using Morse on a frequency of 33.3-38MHz, employing a 1.8m six-rod aerial. However, when operating at a distance under cover, a remote antenna allowed the operator to be up to 3.7m away from the radio station. For power, two 90V anode batteries are used, or for filament, a 2V storage cell. Sized 31.7 x 36.5 x 19.0cm, a crystal calibrator in the battery box allowed the frequency of both the receiver and transmitter to be calibrated. Currently for sale on German eBay (eBay.de) is a Torn.Fu.d2 transmitter/receiver for €2,200 (£1,900).

Feldfu.b1 is a portable, compact, two-way, handheld, voice radiotelephone, or 'walkie-talkie', with the option to be carried on the back; the b model was introduced in 1941 and the b1 in 1944. Experience during the Polish and French campaigns revealed that several improvements were necessary to replace the pre-war Fuspr.a.1 for tactical communication between infantry units, which among other issues, had a weak aluminium case and a short battery life. By the war's end, the series of Feldfu's comprised b/b1/b2, c, f/f1 and h. The major difference between each was the frequency range, the b's working on a frequency of 90-110MHz, with a range of up to one mile employing a 2ft rod aerial. The volume control and receiver fine tuning were fitted to a remote-control unit that could be plugged into the radio or worn on the belt. Power was provided by a 2.4NC28 battery (2.4V Nickel Cadmium 28Ah) within the b1's Bakelite container, while the accessories compartment contained the headphones, throat microphone, remote control cable and spare sectional antennas. An advertised Feldfu.b1 radio in a Feldfu.b case, but with an HLS radio lid, colloquially called a 'Frankenstein' (i.e. elements from different versions mixed up) recently sold for €3,750 (£3,230) prompting the need to always check details with the seller.

Army and Waffen SS Panzergrenadiers

Torn.Fu.g. Tanks operating independently require their own motorised infantry for support

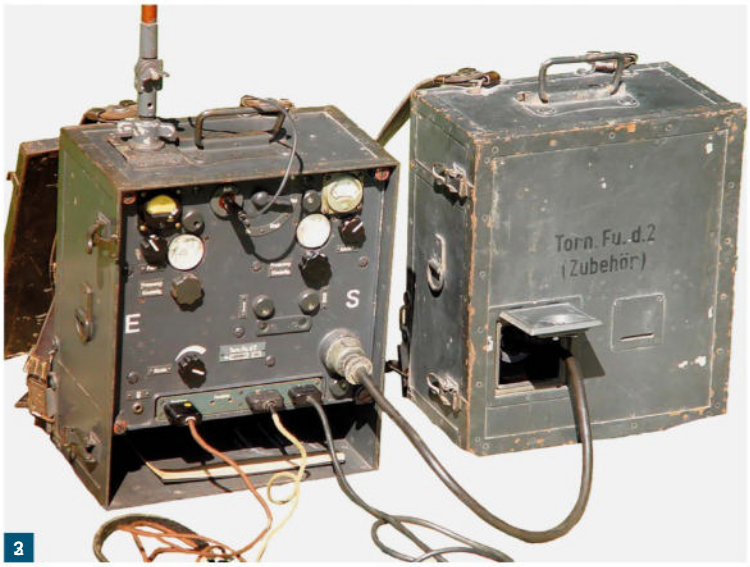

Fig. 1: The Torn.Fu.d2 VHF (duel Morse and voice) transceiver became the standard portable radio set used by the infantry of the Wehrmacht and Waffen SS at regimental, battalion and company levels. ***(laud.no/ww2)*** **Fig. 2: Operational setup of the Torn.Fu.d2 VHF Transceiver. On the right is the *Zubehör* (Accessories Box), which housed the batteries, seen here plugged-in. The vertical six-rod antenna could extend to 1.8m.** ***(funksammlermilitaria.com)*** **Fig. 3: When the Torn.fu.d2 was operated on the march, one signalman carried the set, while the signalman walking behind carried the battery/accessories case, whilst controlling the radio using headphones and a throat microphone.** ***(funksammlermilitaria.com)***
Fig. 4: Feldfu.b1 is a portable, compact, 2-way, hand-held, voice radiotelephone. A remote control unit, worn on the belt, adjusted the volume and fine tuning. ***(funksammlermilitaria.com)***
Fig. 5: The Torn.Fu.g is a backpack transceiver designed to operate on all Panzer divisions' medium-wave command network, allowing Panzergrenadiers to communicate directly with the Fu.8 sets installed in command tanks. ***(funksammlermilitaria.com)*** **Fig. 6: Panzergrenadiers on the Eastern Front 1941. The signalman carries an 18kg Torn.fu.g backpack transceiver, which also contains the battery pack and sectional antenna. Fig. 7: A free online copy of the 17-page WWII US manual on the evaluation and operation of the Torn.Fu.g radio, with added helpful illustrations, can be found at kriegsfunker.com.**

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

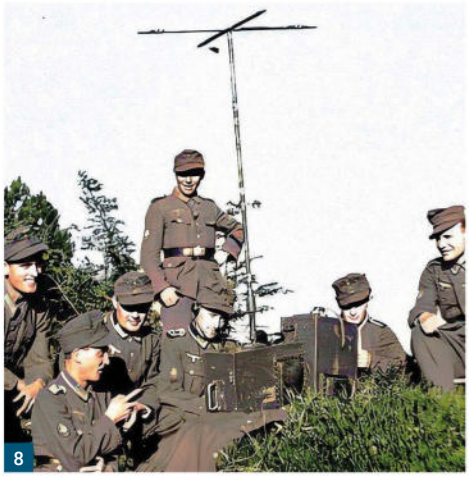

Fig. 8: The vertical rod antenna, with four top rods in the typical WWII cross configuration, is clearly illustrated in the set-up of this Tornfu.f transceiver by German mountain troops. *(laud.no.ww2).* Fig. 9: This Eineits-Pkw Type-40 4WD signals car, belonging to the 17th Panzer Division, is equipped with a Tornfu.b1 set, which only differs from the f variant in the frequency range of the transmitter. *(laud.no/ww2)* Fig. 10: The operating face of the portable Torn.fu.f transmitter, used by forward artillery observers to call down artillery fire onto enemy positions in support of the infantry. *(laud.no/ww2)* Fig. 11: Tornfu.f transceiver, battery container, accessories, speaker and antenna base. The *Fernbesprechung* (remote unit) separated the radio from the observation post. The green reel with the receiver was taken forward by the observation team. *(funksammlermilitaria.com)*

and to neutralise enemy anti-tank weapons. The term *Panzergrenadier* was introduced in 1942 and applied equally to the Waffen SS. The Torn. Fu.g was a backpack transceiver designed to operate on all Panzer divisions' medium-wave command network, allowing Panzergrenadiers to communicate directly with Fu.8 sets installed in command tanks and Sd.Kfz.251 halftracks. The steel radio container also contained the battery pack and the sectional antenna, with some additional accessories carried in a cloth pouch attached to the back of the radio. Unlike the infantry Torn.Fu's, the Torn.Fu.g was a one-man operation with a range of 15 miles using Morse, or half that using voice, on a frequency of 2.5-3.5MHz employing a 1.5m stab pole-antenna. A tuning coil was used to adapt the short antenna for medium wavelengths. Power came from a 2.4V rechargeable battery, plus a vibrating power supply with an output of 2W. Sized 39.0 x 33.7 x 18.0cm, the set weighed 18kg. Currently on eBay is an incomplete Torn. Fu.g for US$1,900 (£1,500) advertised as an excellent starter kit for a collector to add the missing parts. However, finding an original case and all its accessories will be a tall order.

Army artillery forward observers

Torn.fu.f transceiver dates from 1936. In combined arms attacks, the artillery forward observer, often the battery commander himself accompanied by a radio operator, is considered the best friend of the infantry. His responsibility is to call down artillery fire originating from rear echelon guns on to the enemy positions of resistance, or alternatively as covering fire, thus allowing the infantry to progress past enemy defences and on to the next assault. The transmitter operates on a frequency of 4.5-6.6MHz, while the receiver operates on 3.0-6.6MHz. Its range was 7.5 miles on voice and 15.5 miles using Morse, employing a rod antenna in a vertical orientation, with the top four rods placed in a cross configuration as a

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top load, or alternatively, a 45ft wire could be used from the set fixed to a mast or tree. The power source was a rechargeable filament battery 2B38 and two 90V anode batteries. A remote voice control system allowed the radio to be placed up to 100m behind the hidden observation post. All components were housed in an armoured wood case weighing 20kg, the equally sized battery case weighing almost the same. Consequently, sets were transported by two-man teams, but could not be operated on the move. An identical looking, but electronically modernised, TFuG.k version replaced the Torn.Fu.f from 1942. A good condition 1940 Torn.fu.d2 is currently offered for €1,950 (£1,670) by lmcsmilitaria.com.

Fallschirmjäger: airborne operations

Fusprech.a1. Most people are familiar with the iconic WWII picture of a US serviceman speaking on a handie-talkie, such as the SCR-536 developed in 1940, but less commonly known is that German technology developed the concept first. The *Feldfunksprecher* (Fusprech) radiotelephone is a compact portable transceiver, complete in a single carrying case, designed for voice operation only. It is a small, portable, two-way radio that can convey a spoken message over ¾ mile and began limited production as the 'Funksprecher a' in 1936; shortly followed by the Fusprech.a.1. Sized 35.2 x 12.0 x 33cm, it was designed with backpack straps, but in this position, it required two men to operate it on the move as the send/receive switching had to be performed on the radio itself. Consequently, if carried on the chest, it became a one-man operation. The bottom compartment held a 2B19 filament battery, while the top compartment held the standard 90V anode battery. Frequency is 120-156MHz transmitting 0.1W using a 60cm two section antenna. At only 10.9kg in weight, it was ideal for the Luftwaffe parachute arm and there is evidence that drop-containers, each holding six sets, were used in the Norwegian campaign. When the improved Feldfunksprecher models b and c were introduced in 1941, the Fusp.a.1 became almost obsolete, thus its early wartime manufacture in low numbers makes it one

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Fig. 12: Feldfunksprecher.a1 radiotelephone two-way voice transceiver weighs only 10.9kg, making it ideal for the Luftwaffe parachute arm, until it was superseded by the b and c models from 1941. *(funksammlermilitaria.com)* Fig. 13: The Feldfernsprecher FF33 battery operated field telephone provided maximum portability for communication on the battlefield by infantry and airborne units. Working originals are plentiful from around £100+. Fig. 14: Two Luftwaffe Fallschirmjäger operating an FF33 field telephone, which incorporates its own battery. The FF33 was particularly ideal for airborne operations due to its small size and weight.


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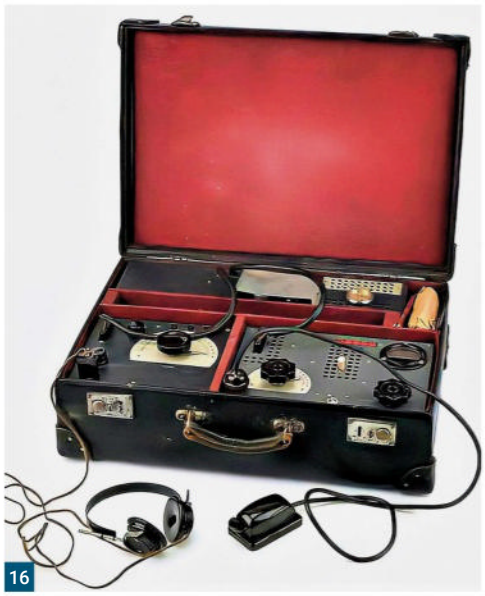
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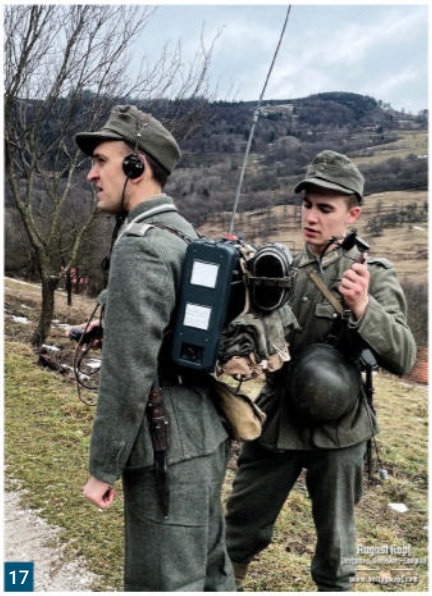
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Fig. 15: Feldfu 2-way radiotelephones have a common tuning element for transmitting and receiving, but on a different frequencies. Illustrated is the Feldfu.c (note green dot) which was allocated exclusively to Pioneer (technical) troops. ***(funksammlermilitaria.com)*** **Fig. 16: SE90/40 suitcase spy radios were issued by German Intelligence (Abwehr) to their overseas agents. The model illustrated belonged to Ib Arnason Riis; codenamed Cobweb after being turned by the British Double Cross System.** ***(iwm.org.uk)*** **Fig. 17: This reenactor, who is carrying a functioning reproduction Feldfu.c backpack and additional kit, demonstrates the portability of this two-way radio.** ***(verlagkopf.com)***

the rarest of the Feldfunksprecher variants to come onto today's open market. However, the standard Dfh.a headphones and Kmf.b throat mic were used with the Fusp.a.1 and on eBay an original condition working pair of headphones and microphone are currently on sale for US$540 (£430).

Feldfernsprecher FF33 field telephone. While not a radio, it draws power from its own battery. They provided maximum portability due to their small size and weight, becoming the most frequently used piece of German communication equipment on the WWII battlefield, including by airborne troops. Genuine sets are plentiful from £100-£250. Imcsmilitaria.com currently have one in working order for US$99 (£78).

Army Pioneers: engineers and technical troops

Feldfu.c. Army Pioneer battalions, each with a strength of approximately 700 men, were trained specialists in demolition, house-to-house fighting and explosives. These formations were used extensively during the first half of the war, particularly at Stalingrad in November 1942, but because Pioneer troops fought in close proximity to the infantry, it was important that they were allocated a separate radio frequency to operate on. The series of Feldfu radios (a1, b, b1 c, f and h) are portable, compact, two-way radiotelephones that have a common tuning element for transmitting and receiving, but each operates on a different frequency, thus model c was allocated exclusively to the Pioneer Branch with a frequency of 130-158MHz, providing a range of about ½ mile. The container had special fittings so that it could be carried on the back and operated while on the move. The unit's weight is 10.9kg, sized 35.2 x 12.0 x 33cm, with internal compartments to hold the transmitter-receiver, 60cm sectional whip antenna, the 2.4 NC 2B battery (with 1.2W power output) and a throat microphone. Because the role of Pioneer units changed somewhat after 1943, the Feldfu.c model was thereafter no longer produced. The h model was used to communicate with the FU5 radios of assault gun units. Flakweasel.com currently have a slightly modified Feldfu.h for sale without its antenna for US$3,000 (£2,380).

Abwehr: military counter-intelligence

SE90/40 is a clandestine spy radio hidden in an unassuming suitcase. It was developed for the German Intelligence Service (Abwehr) in 1939 for issue to Abwehr agents secretly operating overseas. It essentially consisted of three units: S.89/40 SW transmitter, E90 receiver and a GISE-90 AC mains power supply. Frequency coverage was 3.5-8.5MHz and 5.3-9.3MHz; RF output 40W; VFO and RF power amplifier with CW Morse only. The suitcase measures 48.5 x 39.0 x 13.0cm, including a rear compartment for accessories and spares. Ingeniously, the lettering for volume, on/off, tuning etc. was in English to put off any snooping landlady from believing her lodger might be a German, instead of a British spy! The model illustrated was used by the German undercover agent **Ib Arnason Riis**, who was turned and codenamed Cobweb within the British Double Cross deception strategy. During the war, he transmitted over 500 messages of false or misleading information. The Germans continued to believe Cobweb, resulting in Riis being awarded both the Iron Cross 2nd and 1st Class. A complete SE90/40 with its suitcase (but inoperable) was offered at auction in Germany recently with a guide price of €4,500 (£3,860) but in response to enquiries for this article, the auction house advised that it failed to reach its reserve.

Collecting WWII German radio accessories and spare parts

Each radio originally came with many accessories, e.g. antenna, battery boxes, carrying straps, frequency calibrator etc. Today these are considerably rarer than the radio and often command higher prices than the radios themselves. Unfortunately, this desirability is also driving an increasing level of faking, thus potential collectors should study the market thoroughly before taking the plunge. Radio sets complete with all their correct accessories are extremely rare, thus collectors face a long and expensive search to complete their radio sets. The best place to start looking for those items needed to restore your German military radio is with specialist WWII equipment suppliers. For example, lux-military-antiques.com currently have genuine headphones from €285 (£245), original microphones from €225 (£195) and a Panzer 1943 Morse key for €325

(£280). Another supplier worth contacting is Funksammlermilitaria.com of Normandy, France, which has a good variety of German and Allied items, currently including a fully working WWII British No.18 Mk.III radio complete with accessories for €1,990 (£1,700) and on eBay.de there are five WWII unused RE074 tubes marked 'RLM' in their original boxes for €125 (£110). Newcomers are recommended to join the WWII German Signals Equipment forum to gain a free exchange of knowledge with fellow radio collectors at facebook.com/groups/397758290343662.

Acknowledgement

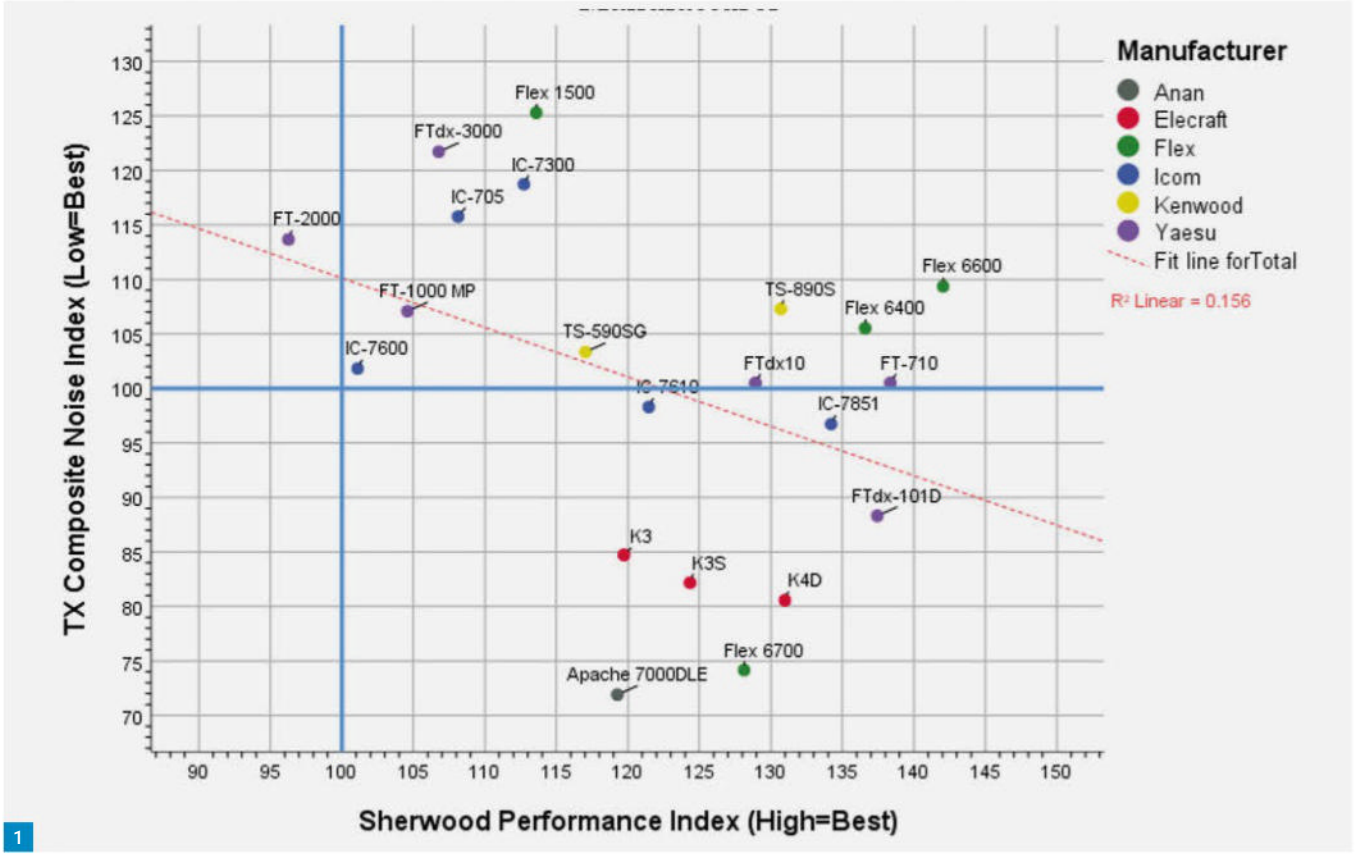
Thanks are due to **Remco Caspers**, owner of Radio-Collector-Militaria at Normandy, France (URL below), for images and his valuable technical information.

www.funksammlermilitaria.com

Prices and availability of sets mentioned were current in late 2023. **PW**

Fig. 18: This is only part of the large German WWII radio collection that can be viewed at Radio-Collector-Militaria. *(funksammlermilitaria@gmail.com)* Fig. 19: Top: standard pair of Dfh.a headphones. Bottom: Kmf.b throat microphone. Both are used with most of the sets featured in this article. A similar original Dfh.a/Kmf.b pair are on sale on eBay for US$540 (£430). *(image: feldfunker-la7sna com)* Fig. 20: This 1943 German Panzer vehicle E325 Morse telegraph key is on sale for €325 (£280) from lux-military-antiques.com. Fig. 21: These five unused German RE074 tubes marked 'RLM', still in their original boxes, will cost you €125 (£110) on eBay.de (German eBay).Fig. 22: Authentic reproduction, fully functional Feldfu 2-way backpack radio, available in models b, b1 c, f and h series, comes complete with microphone, headphones and battery for €199 (£170). Visit Verlagkopf.com Fig. 23: Detail of the working-replica Feldfu.b1 radio distributed by Verlagkopf.com. Left: microphone, volume and remote control unit inputs. Centre: Frequency tuning dial. Right: authentic serial plate. *(Verlagkopf.com)*

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



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Frank M. Howell, PhD K4FMH
k4fmh@arrl.net

Transmit Quality Among Modern Transceivers (Pt II)

Frank M. Howell K4FMH discusses linking transmit noise to receiver performance, price and satisfaction

In Part I, I described new data on HF transmit noise that I compiled from public sources. These data covered many modern HF transceivers appearing in the famous Sherwood Table of receive performance and in my previous articles (Howell 2021a,b). The finding was that many modern HF transceivers, some of which would be considered among the best available today, vary considerably in the noise they put into their transmitted signals. These differences were perhaps surprising to the reader, partly because they represent new data in a consolidated, compiled form. But how do these HF transceivers compare on measured receive performance? Can money buy a 'cleaner' HF transceiver? Altogether, how well does the amateur say they like these 'cleaner' transceivers?

In Part II, I analyse these questions using visual charts and a few statistical tools to summarise what the reader is seeing in the figures. I encourage readers to have read the Part I article to better understand the data and measurements used in the analysis below.

Receive performance and transmit noise

If one buys a transceiver that has low transmit composite noise, how well does it receive? In **Fig. 1**, a scatter plot of transmit noise and the Sherwood Receive Performance Index (SPI) is shown with a linear fit to the data to see how well they correlate. The manufacturer of each transceiver is shown in different colours. The median values for each variable shown through a blue reference line give the reader a demarcation of the best characteristics: the lower right-hand quadrant of radios (best receive performance and lowest transmit noise).

There *is* a modest relationship of better receive performance and lower transmit noise (R^2 is about 16% so the correlation is 0.4). But there is *not a single transceiver* with the top values on both variables. The Apache 7000DLE, for instance, has the lowest composite noise but it is not at the top of the receive performance index. Not by a long shot or, more specifically, it is 1.5 standard deviations below the top score. That radio at the top would be the Flex 6600 but, alas, it also has a higher than median value for composite noise. The Flex 6700, the Elecraft K4D, and FTdx101D are possible choices to maximise both lower transmit noise and receive performance. Note that Elecraft radios have a continuous progression of both lower composite noise with receiver improvements in the sequential release of the K3, K3S and K4D transceivers. One would surmise that the Elecraft design team, focusing on a single desktop radio series, has continued to make progress in lowering the composite transmit noise, unlike the other manufacturers in this set of radios.

Transmit noise, market-entry price, and satisfaction

But what does lower transmit composite noise cost in this set of modern transceivers? Do we observe what **Jim K9YC** (2014) did, that money buys 'dirty' transmitters? **Fig. 2** addresses this issue, at least

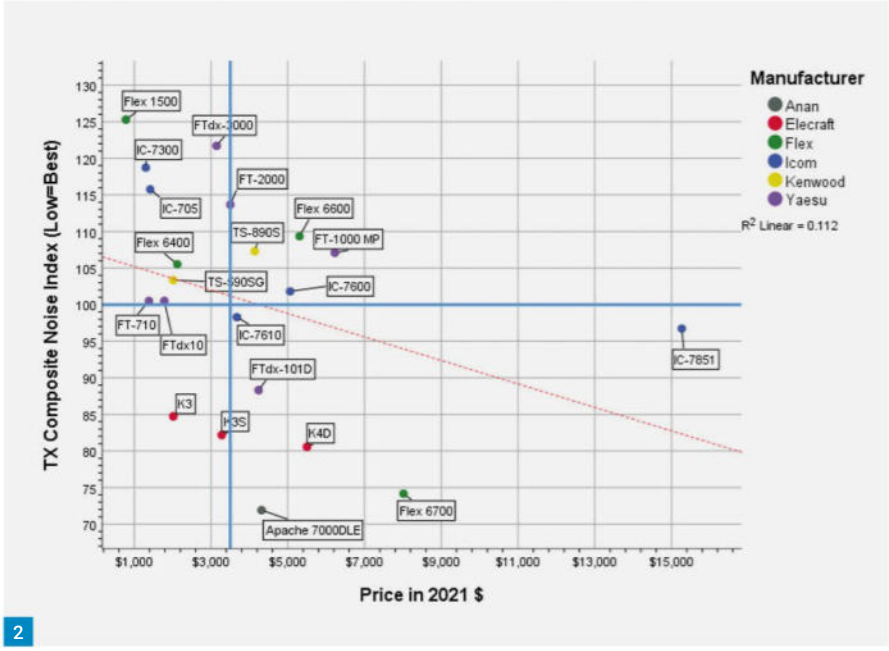
Fig. 1: Scatter plot of TX Composite Noise Index and Sherwood Performance Index by manufacturer. Fig. 2: Scatter plot of TX Composite Noise Index by market-entry price by manufacturer. Fig. 3: Dot plot of RX SPI-to-TX Composite Noise (upper) and Scatter Plot of RX Performance-to-TX Composite Noise Index by price in 2021 by manufacturer (lower). Note: the blue reference lines are set at the median values. Manufacturers are denoted by colour circles

for this set of transceivers. The scatter plot is of composite transmit noise by market-entry price in 2021. The blue reference lines frame the lower left quadrant as the desirable set of transceivers (lowest noise for price).

There are clearly very few optimal transceivers in this quadrant. The Elecraft K3 and K3S have the lowest noise below the median transceiver price in this group of radios. If a few hundred dollars are available for the buy, the Apache 7000DLE captures almost one standard deviation of lower composite noise. If one goes a thousand dollars more, the K4D comes into range as a lower transmit composite noise transceiver. If a buyer doubles the cost over the K3S, the Flex 6700 is second to the Apache in lowest transmit composite noise. If knobs are more desirable than a computer-control interface, the FTdx101D might be an acceptable trade-off at a similar price-point to the Apache SDR.

This chart also illustrates how costly the Icom IC-7851 is for the transmit composite noise performance: *it's up to four times more expensive* than even its predecessor, the IC-7610, for the same composite noise metric. (There may be other aspects of the IC-7851 that a given buyer might be compelled toward the higher price.) These results do not provide much evidence that price *per se* results in 'dirtier' transmit noise (Brown 2014). In fact, the modest association (R^2 = .112) is negative: a higher price is related to lower, not higher, composite noise. Even the highest priced transceiver (IC-7851) has a noise figure below the median reference line, although this is a smaller and more recent set of radios than Brown studied.

To further help readers see these patterns, I've computed the *ratio* of the Sherwood Performance Index (SPI) to the composite transmit noise index. They have the same T-Score metric (mean of 100, standard deviation of 15) so this ratio produces a *direct comparison* of both measures. Note that it is a higher ratio that is desirable since we want to identify the highest receive performance relative to the lowest composite transmit noise. **Fig. 3** contains an ordered dot plot of this ratio (upper panel) and a scatter plot of the ratio by market-entry price (lower panel) so that this 'optimal' transceiver ratio can be evaluated against what it costs. A vertical reference line in the dot plot at a ratio of 1.0 (see blue vertical line) reflects both receive and transmit at their median values. This ordered dot plot



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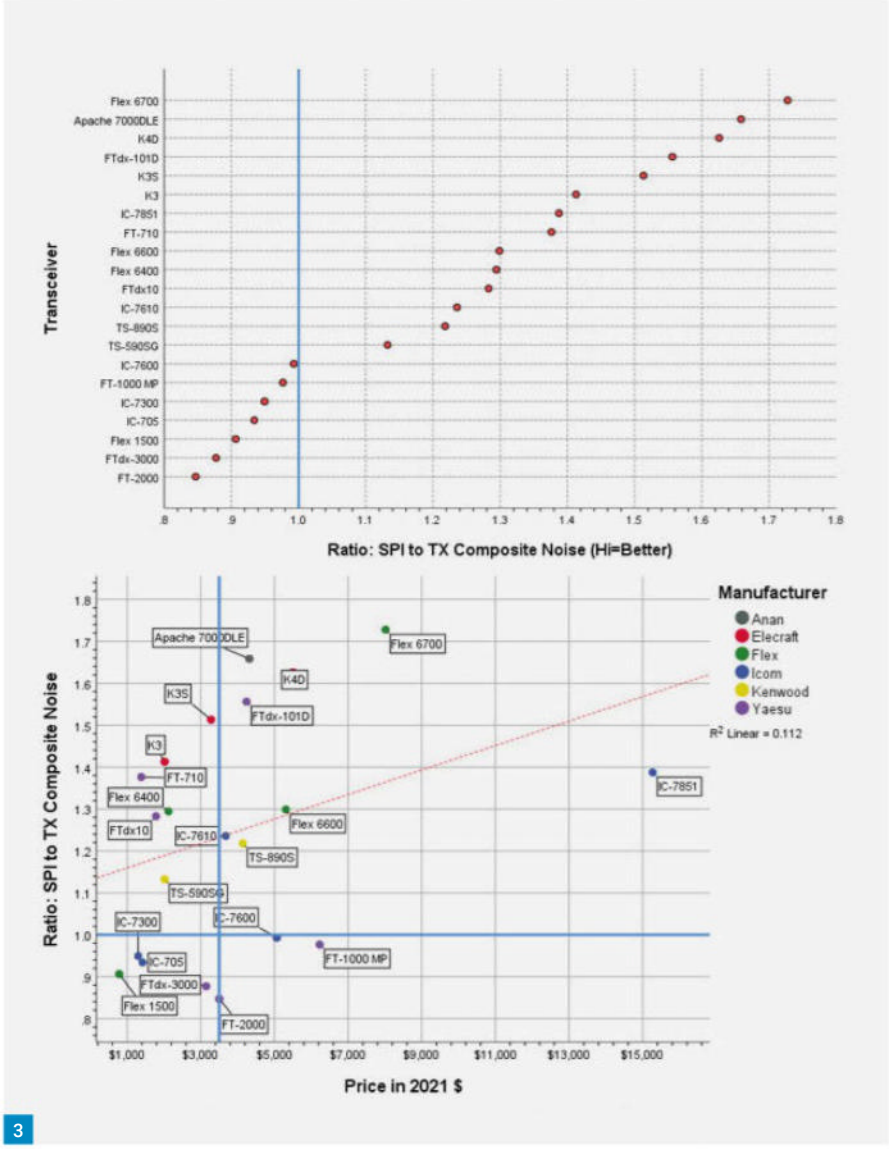

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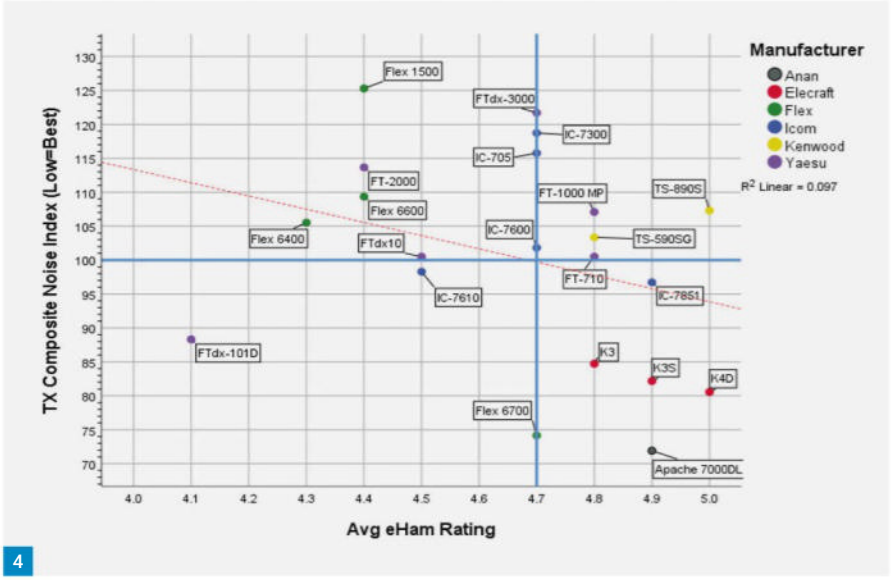
Fig. 4: Scatter Plot of TX Composite Noise Index by average eHam rating by manufacturer.
Fig. 5: Scatter Plot of TX Composite Noise Index by market-entry year by manufacturer.
Note: the blue reference lines are set at the median values. Manufacturers are denoted by colour circles



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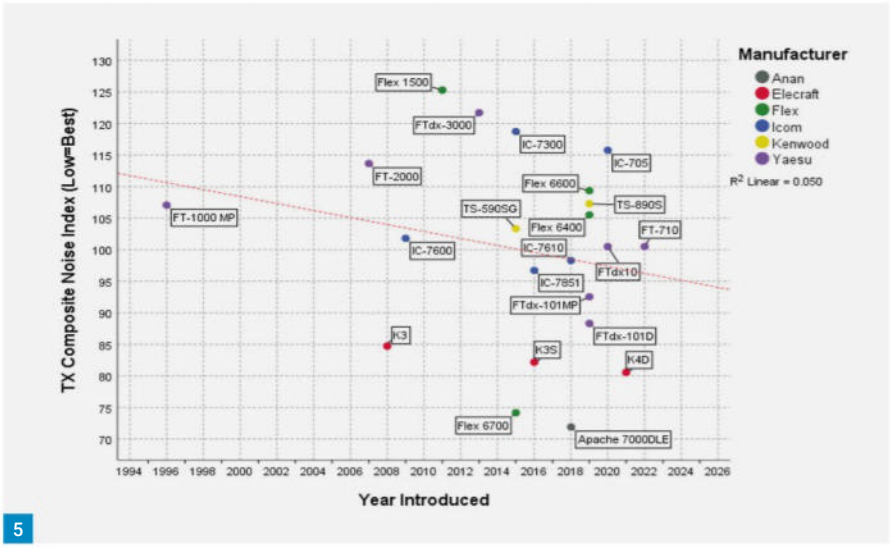

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enhances a simple ranking of radios since it shows the metric distance that adjacently ranked transceivers are from one another.

The reader can discern that there are 'groups' of radios along this ranking using the metric values. The Flex 6700 has the highest receiver performance-to-transmit composite noise ratio, followed by the Apache 7000DLE and the Elecraft K4D. The Yaesu FTdx101D and Elecraft K3S are not far behind. From this group, there is a break in the ratio metric producing the rank-order. The FTdx101D and K3S continue not far behind in the ratio metric. There are four more groups of radios trailing down to the break-even point of 1.0. These are the K3 and IC-7851; Flex 6600, 6400 and FTdx10; the IC-7610 and TS-890S; and, finally, the TS-590SG. The breaks in this continuum illustrate the relative rarity of modern transceivers to have both top receiver and transmitter performance.

There is a modest relationship between this ratio of receive performance-to-lower transceiver composite noise and price (R^2 = .112). In the lower panel, the top three to five transceivers vary considerably in market-entry price. The Apache radio is almost at the ratio of the Flex but at about one-half of the price. The K4D is about $2,000 less than the Flex for a similar receive-to-transmit noise ratio. The FTdx101D and K3S are not far behind this ratio and around the median price of all radios in this comparison. Without such a visualisation, it would be very difficult for the reader to realise these patterns. I also hasten to add, there may well be features that legitimately sway a buyer to a more expensive transceiver. But such research as this allows the reader to better assess what the additional cost is going toward.

But how satisfied are ham operators with transceivers of varying transmit composite noise levels? **Fig. 4** contains a similar scatter plot with the average eHam ratings for these transceivers. The lower right quadrant is the preferred set of transceivers. There is a set of clearly optimal transceivers with lower noise and higher consumer satisfaction. The Apache 7000DLE is one. The three Elecraft transceivers (K3, K3S, K4D) are prominent. The flagship Flex 6700 is at the median eHam rating but has a similarly low transmit composite noise as the Apache. While the Yaesu FTdx101D has a comparable noise figure, it has a much lower satisfaction rating (at 4.1). This is puzzling but clearly this radio has been rated below-average by a number of consumers. The overall association of eHam-rated satisfaction and transmit noise is small (< 10% association as R^2 = .097).

Has transmitter composite noise improved as newer radios are introduced into the market? I noted this trend in my *NCJ* articles using the Sherwood Performance Index (Howell 2021a,b) but trends have never been systematically examined for transmit noise. While this set of modern transceivers has a much shorter scope than the 50-year horizon of radios in the Sherwood Table, **Fig. 5** nonetheless shows little improvement in transmit noise that can be linked to market-entry year. There are trends for improvement by a couple of specific manufacturers, Elecraft in particular. The perceptible drop in composite noise from the K3 to the K3S to the K4D reflects three radios already having among the lowest noise in these transceivers.

In brief, these modern HF transceivers tend to vary independently in terms of their measured composite transmit noise and their receive performance. It hastens the astute reader to examine these results to identify transceivers that match their technical desires for a cleaner transmission and better receive performance. Identifying the price range that is preferred and with what trade-offs that might be necessary to get an HF radio that has the features and ergonomics that could surmount bench test results is facilitated by these data.

In Part III, I will provide a grouping of statistically-similar transceivers in this set of radios. The results will further aid the reader to examine what features and other factors are being paid for when a significantly more expensive transceiver is purchased.

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Frank M. Howell K4FMH. *Price Versus Performance and Satisfaction in an HF Transceiver, Part 2. National Contesting Journal* (Vols 49, 3-4, 2021b). **PW**

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Mauritius

Dear Don,
I was very interested in your Mauritius visit. The RN had a large radio station (GXO) in the 1960s, known as 'the hub of the wheel'. Never went there but did visit Elephant Island, one of the Chagos Chain, in a ship *RFA Gold Ranger* to land an inter-services expedition. The only ship I ever sailed in with a shack on deck. Incidentally how we now call our radio stations 'the shack'. There was no cabin space below for a radio station so a shack was built on deck back in the day. **Dr David Bellamy** was part of that team and their RAF radio operator was using a KW2000 transceiver, which we repaired before he went ashore. Luckily, we carried the correct valve.

My daughter-in-law's mother (SK) was from Mauritius so I have a keen interest. Thanks for the article.

Bruce Keeling G4EUW
Colchester

Nostalgia

Dear Don,
The February 2024 issue of *PW* fell open p54 on **Graham Caldwell's** *Portable military radio communications of WWII*. What a read and what a trip down memory lane!

I will be 74 this year and on our return from Aden (now South Yemen) in 1961 where we had been for five years the radio bug had already bitten me. What we did not have there were surplus stores and walking through Croydon in the 60's one could get radio bargains galore. There were at least four surplus shops plus the 'junk' shop behind Kennards Stores – all gone now, rebuilds, new builds, or buildings destroyed by riot and then rebuilt.

Like many of your readers of a similar age, who would have had access to surplus stores elsewhere, I spent many hours looking at the radios in the displays. Paper rounds and Saturday jobs supplied the cash.

Looking at the images and descriptions in Graham's article took me back to those times. My first buy, for 3/6d (about 17.5p) was a WS46. The shopkeeper even slung in a set of rods for the antenna. My father's greeting (ex-Royal Signals and service in Burma for the entire war), *"What did you get that for, you'll never get it to work"*. He was right of course, crystal and coil units required. What I did have was a start of a junk box. Then, from the now long gone and well-spoken-of emporium in Thornton Heath was Huggett's, where I purchased an R107 at £8-10s-00d (£8.50). Took it home on the bus. It was a task and the conductor kindly stopped the bus outside the block of flats we lived in so I could offload the heavy radio. Gave me hours of fun. A few months later it was the 18 set, good receiver but heavy on batteries!

Once at work I then purchased a 19 set, complete with rotary generator. 49/6d. Less than three quid. Didn't last in the house very long.

Starting work in 1968 I went to Lisle Street W1. I bought a 38 set infantry version (there's also the AFV version for connecting to a 19 set) and so started the understanding of radio proper. In the private houses (I lived on a Council estate) was another radio person, also now licensed. We had a number of low-power QSOs using correct procedure with conjured-up callsigns. The ATP4 and ARP range of valves have a lot to answer for. In fact, in a past legal QSO we spoke of this on 80m; to think when we had our 38 set QSOs we were about 1MHz higher.

The headsets, throat mics and Morse key cost around 1/6s (about 7p) each. I have five of the Morse keys at home, all in good working order. I even sent one to a friend in the Netherlands a couple of years ago. Excellent keys that are a reminder of past times.

Past times and happy times; now the newcomer is faced with a ten quid dongle to connect to his computer, but is it really radio?

Paul Beaumont G7VAK
London

CE Marking

Dear Don,
In response to the letter from **Jim Carter G0LHZ** in the January issue regarding CE marking.

On 1 August 2023, The Department for Business and Trade issued an indefinite extension to the use of CE marking for businesses. See *UK Government announces extension of CE mark recognition for businesses* on the GOV.UK website.

As a result of this, it is still permissible to apply a CE mark to items placed on the market in, or imported into, Great Britain. A CE mark or a UKCA mark (or both) may be applied.

Peter Goodson G4PCF
Bracknell

Active or not

Dear Don,
Today it's my birthday and in the post this morning was the latest copy of *PW*, which made my day. I was reading the article *Active or Not* (*Keylines*) and noted your comment that maybe newcomers are only interested in internet and computers. This was funny as I had a call from a friend of mine who wants to get into the hobby and I invited him to pop over for a chat and to show him my setup. One of the first questions he asked was when on the air is it free and independent from the internet! My response being, yes it's free when you have bought your equipment, and as independent as you wish. Oh good, was his response. So the hobby is not dead yet!

Alistair Burg 2E1AJB
Birchington

Broadband Interference.

Dear Don,
I received an email in September saying my internet was going to fibre on 9 January.

Listening on 13 January on my Zenith TransOceanic I found the 41m band pretty quiet and so listened on my FT-817 on 40m. It's not been this quiet in years. On the 14th I even heard CW on 30m, which years ago was the first band I couldn't use, then 160m to 20m followed with the exception of 60m. All bands seem okay now.

I had got to the point of giving up radio, cancelled the RSGB subscription but later rejoined. All I was using was 60m CW and 2m FM with a rare bit of CW.

Dare I hope this will continue and is due to the use of fibre instead of copper wire? Have I got my hobby back?

Bill Kitchen G4GHB
Ashton-under-Lyne

Licence Changes

Dear Don,
I've just received the latest *PW* where you mention the upcoming licence changes. You have completely misunderstood the Regional Secondary Locator proposals. The RSL will become optional but if you choose to use one, you will still have to use the correct one. So, you can use G3XTT anywhere in the UK but you can only use GW3XTT in Wales or GM3XTT in Scotland, for example. You

could also use GE3XTT in England, if you wished. Your example of a Scottish amateur moving to Wales and continuing to use his GM callsign is nonsense.

An amateur's base callsign is G3, M7 or whatever, regardless of where in the UK they live.

Richard Tomlinson G4TGJ
Ilkley

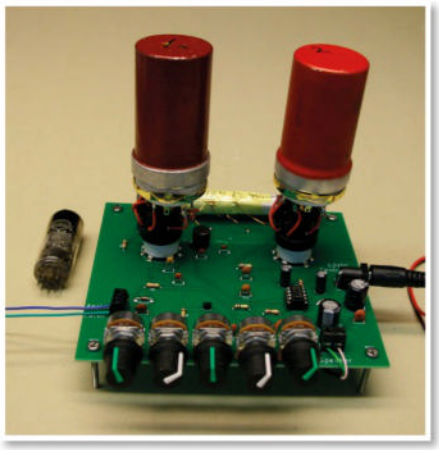
*(**Editor's comment**: Thanks Richard, you may well be right – I find the wording confusing! But I believe that many GM amateurs, as one example, have licences which show their base callsign as GMxxxx, not Gxxxx. Maybe not recently, but certainly in the past. As another correspondent said to me,* "The wording used in the licence from 2006 means if an amateur from Glasgow visits London she must continue to sign MM0ABC, there's no option to change RSL in the current licence wording, Clause 2(2) is applicable only to the Main Station Address callsign". *In practice this doesn't happen of course. Ofcom issued clarification in 2013 as to what was intended:*
http://tinyurl.com/48vdeumt
A tangled web indeed!)

EF50 valves

Dear Don,

The EF50 pentode was originally introduced for television reception on the then high frequency of 45MHz, the vision sub-carrier that later became Channel 1 in Band 1. Sound sub-carrier frequency was slightly lower. **Keith Hamer** and **Garry Smith** introduced us to this valve in their article *BBC coronations Pt X* (*PW* February page 51) and I am pleased to show an example of one from my own collection, in the correct dedicated valveholder, resplendent in Mullard 'Red E' livery - later production was silver. Continuing the history, some amateurs found they could extend the frequency further by removing the outer aluminium jacket and running the bare glass envelope. The result is shown to the right of my photo (actually a Cossor 63SPT direct equivalent). Later, these valves, now proven, were just the thing for the early British radar developments that went on to help our war effort.

The National Museum of Computing (the technical side of Bletchley Park) now sells some clever kits demonstrating old valve techniques but built with modern materials. Shown (the second photo) is the medium wave regenerative receiver kit that I built. No mechanical tuning capacitor - a specific varicap diode achieves a wide frequency range. Turning the reaction up too far causes the inevitable self-oscillation squeal, just as this circuit architecture did in the early valve sets of the 1920s. Unlike then, there is also a front-end RF amplifier valve that blocks the oscillation from being radiated by the aerial, otherwise neighbours would have had their listening interfered with.



The kit came with EF80 pentodes, 9-pin miniature (so they say!) valves familiar to those who worked on 1950s/60s TV sets and the like. There's one lying to the left of the receiver in my photo. The instructions mention that the original design was for the EF50. I made adapter bases (as you see) and can confirm that, with no other changes, I now have a working EF50 two-valve medium-wave 1920s technology regenerative receiver.

Godfrey Manning G4GLM
Edgware

Asymmetrical Hatted Vertical Dipole Antenna, etc

Dear Don,

For some inexplicable reason I don't recall putting together an asymmetrical hatted vertical antenna. Although I must have slipped a capacity 'hat' on a homebrew vertical antenna at some point, I'm sure. So **Billy McFarland GM6DX's** (what a great callsign that is!) excellent article re an *Asymmetrical Hatted Vertical Dipole Antenna* in the January 2024 issue got a bit of my attention. So much so, that come spring time I intend to put one together. Well, that's the plan. We'll see what happens.

On a similar theme, *G3WRT's Skeleton slot antenna* didn't really rock my boat. But what did, was **Ian's** musings on the 'mysteries of electromagnetic radiation'. He points out that *"mass is transferred by electromagnetic radiation"*. Then, a paragraph or so later, states that 'instantaneous communication' - presumably, electromagnetic radiation, does not 'involve mass transfer'. Maybe it was a typo?

Yes, a 'current puzzling paradox' has been stalking the subject of 'partial duality' and the 'duality of radiation' for years. And yes, the late **Mr Einstein** had a lot to say about a lot of things. But his presumption that the wavefield is the sole agency of the particle is, for the moment, correct. However, scientists in general continue to make a fundamental error. That we can 'see' everything. We can't. What we actually see is only an infinitesimal band of frequency that we call 'light' - about 0.005%. That is the only 'reality' humans can 'see'. Hence, why we can't see what Ian calls 'dark matter'. It's only 'dark' because it's not visible to us. We're constricted to one frequency via our five senses. That's our 'world'. It's the scientists' world too. They, and us, only see a mere fraction of what really exists. Unlike ham radio, where we can tune into many frequencies, our 'reality' is 'tuned' into just a small sliver of visible light. 0.005% of it. Exactly how much is still open for debate.

Scientists continue to muse upon the seemingly strange phenomenon that particles can be waves at the same instant. It appears to be impossible. Surely, it should be one thing or the other? But not until you realise that both are manifestations of the same information field. They only appear 'different' because of the form that the information field is presented to the viewer. Waves represent the actual information construct. Particles are the decoded holographic representation/illusion. When we 'observe' something - decode it in our brain, the wave function collapses - this is the act of decoding a holographic illusion. Quantum 'realities' are wavefields of possibilities. The brain decodes all those possibilities into a holographic state. The point I'm making here, is that the 'mysteries of electromagnetic radiation' are not really mysteries at all. You have to think way outside the mainstream box. Be a contrarian.

Ray Howes G4OWY/G6AUW
Weymouth

*(**Editor's comment:** I understand what you are saying Ray, but our 'telescopes' see everything from radio waves through to ultraviolet and beyond nowadays. Quite a lot more than just visible light.)*

Antennas and Transmit quality

Dear Don,

Richard G3UGF (February 2024), is correct, when he says *"You can never have too many antennas!"*. Unless that is, they are not all commercially manufactured antennas.

Transmit quality and the subsequent consequences of it, has been the bane of radio amateurs for decades. No surprise there then. But of course, as technology has advanced radio-wise, manufac-

turers of ham radio equipment have improved their wares significantly. One aspect of which, has been in the transmitter performance department. **K4FMH's** views on the subject might disagree with that.

Yes, some manufacturers are slow to listen to those who rightly point out that their equipment could be better, especially with regards to phase noise and so on. But you have to balance their response with production costs, profitability and other things that may or may not affect sales. You can't have your cake and eat it too.

Of course, ham radio manufacturers could do better. They have. And yes, they could probably design a transceiver that would alleviate many of the problems that K4FMH is so apparently upset about. But would he want to pay the price for it? Would most people? No. And that is the real nub of the dilemma. Because no matter how perfect a piece of equipment is, some of those who purchase it will choose to operate it out of the manufacturer's specification. Like those who buy a car that can do 150mph and think that it's okay to travel at that speed whenever possible. Overdriving it. 'Splatter' on the roads.

Overdriving transmitters and linear amplifiers has always been the main cause of this ongoing problem. The implication that the blame for inappropriate 'speech processor settings' or using 'too much drive' is a fault of badly designed RF amplifiers, is to ignore the real culprit here. Or if not ignore it, push it to one side. No, the bigger issue is this: there is always a small minority of operators who blatantly can't help themselves. For them, overdriving their linear amplifiers, whacking up their speech processors etc is a normal way of life on the ham bands. They couldn't care less about the aggravation they're causing. All they care about is making the contact. That's it. So the next time you hear someone calling CQ (or in a contest) with a signal causing intentional splatter or whatever, move on. Do not condone their selfish activity. Because one thing they hate most, is being ignored.

Vote with your mic button or your Morse key. That's why I do.

Ray Howes G4OWY/G6AUW
Weymouth

*(**Editor's comment**: Yes and no Ray. K4FMH's argument is that spending more doesn't actually guarantee you better transmit performance. In some cases, quite the opposite! But, as he says, buyers may have other factors to consider – ergonomics, size, etc)*

Buying Chinese

Dear Don,

I have been caught by a Chinese product. This is for info, I have accepted that I lost the £100+.

For a long time I used EyeTV to watch and download Freeview programmes, the ones I wanted but my wife did not. Then Geniatech bought out the product and/or the company and eventually stopped support. It ceased to work when Apple did one of their OS updates.

Recently one magazine published an article saying that they had built their own so I ordered it. First, on the website I selected standard delivery but the order turned it into express delivery at extra cost, bringing the total to a tad over £100 instead of a tad under. They took the money almost immediately.

It eventually arrived and while I could receive a programme, there was no EPG and I could not plan and set recordings. When I complained, they said that they were having problems with the EPG. I wonder if they would accept this quality in the program which pays their salaries? They said they would refund my money but they have yet to do so.

Indeed, Caveat Emptor, and silly me for believing an article!

Alan G3XOI
Shoreham by Sea

Antenna column

Dear Don,

Referring to the last *Antennas* column, as a former RAF trained aerial rigger I definitely would not use Rawlbolts as shown in the photo. They would have a very good chance of cracking that brick. A much better and safer method is to use chem fix anchors. These are readily obtainable from outlets such as Screwfix. Care needs to be taken to drill the correct size hole, then clear all the debris and dust from the hole. This method is the industry standard for mobile phone sites and many others. You will end up with a stronger bond with the bricks and less chance of later cracking them.

Reg Woolley G8VHI
Nuneaton

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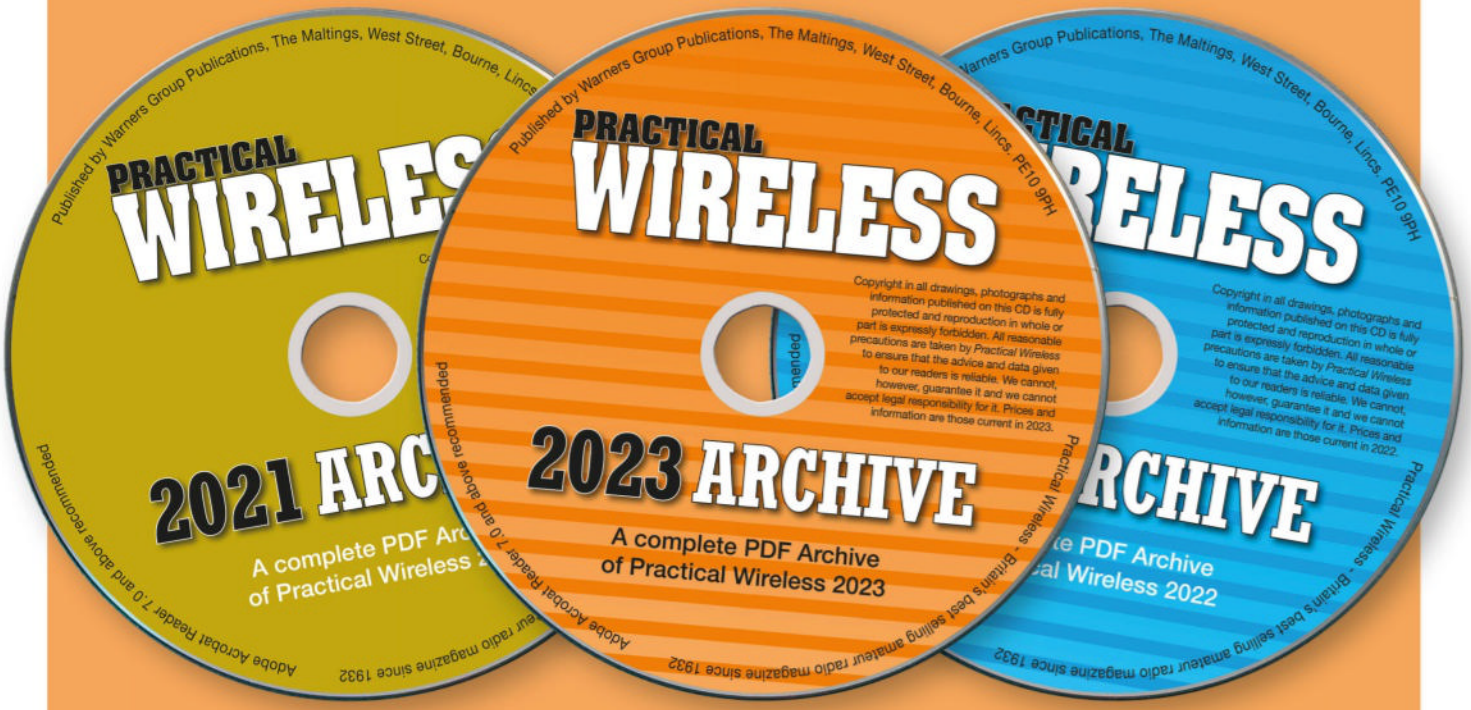

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* Photo shows the FT-710 AESS

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