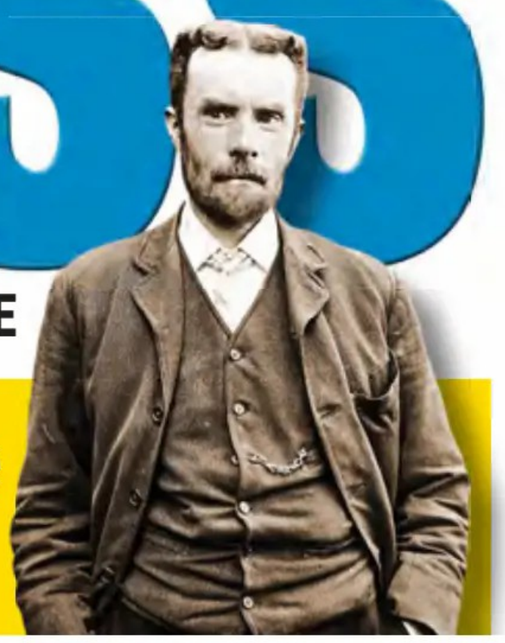
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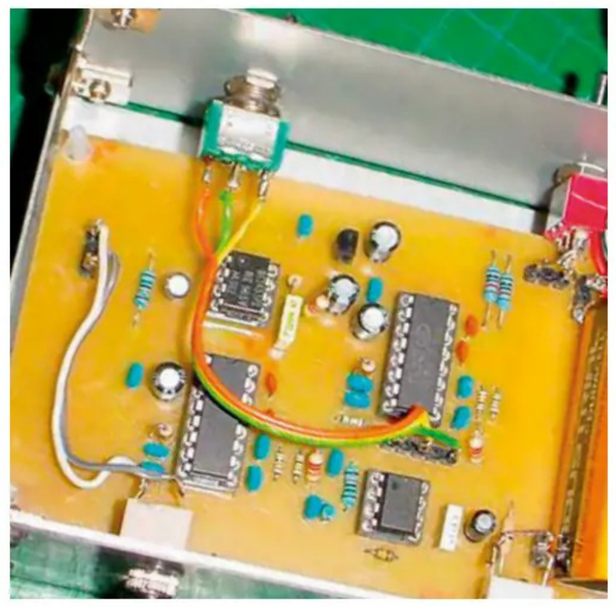


PIONEERS OF RADIO | Profiling an important scientist in the evolution of radio, Oliver Heaviside



AT HOME WITH THE PRESIDENT

Getting to know RSGB President, Bob Beebe GU4YOX



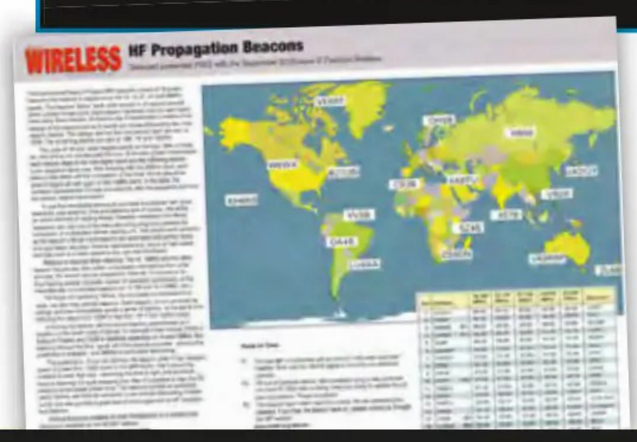
Morse improvements

An update on Eric Edwards' Morse practice oscillator build



70MHz Contest results

An account of how this year's entrants braved the elements



WEATHER The world of radio propagation

A look into the various ways of keeping track of space weather

PRACTICAL Describing the MilliOhm Meter build

Michael Jones constructs a very handy piece of shack test equipment

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Keylines



Well, having said last month that I had done relatively little operating, I had a play in the CQWW Phone contest at the end of October and in a limited effort on the 10m band, made over 700 contacts in 123 DXCC entities. It was fun and probably the last year that we will enjoy such good propagation on 10m until the next sunspot peak.

And I am writing this while in Uganda for the CW leg of the contest, where I will be operating as 5X1DF. I plan a 40m single-band entry as there is no existing record for that category from Uganda so I am sure to set a new record! I was here last year but had to cut my trip short when my wife was taken into hospital, so I'm back to try again. In the days prior to the contest I have been operating on 12m. Sadly, it has proved difficult to generate a pile-up on CW or SSB but FT8 has been extremely productive, with several hundred contacts in the log at the time of writing.

RSGB Convention – mea culpa

I must have had an element of brain-fade when preparing last month's report on the RSGB Convention as I made several mistakes and omissions, for which I apologise.

First and perhaps foremost is that it is, of course, the RSGB Convention, not the HF Convention. The HF and VHF Conventions were merged many years ago now. I'm surprised that only one reader has written to correct me! And while I had thought that last year I had booked a combined package of accommodation and the event itself, I am assured that I cannot possibly have done as the 2025 event is the second time that the two were separated to offer a more flexible approach to booking.

This year's keynote speaker was **Professor Lucie Green**, not Lucy as I spelled her name. And although I had credited **Mark Jones G0GMX** with running the Sunday antenna workshop, I ought to have said that the three workshops were masterminded both by him and Board Chair **Stewart Bryant G3YSX**, along with the Convention planning team. I also failed to mention that AMSAT-UK held its Colloquium at the Convention and ran the stream focusing on satellite-related subjects.

And while I gave **David G7URP** and **Tammy M0TC** credit for the live streaming, it's worth saying that the Convention has an experienced team of technical volunteers led by the RSGB Communications Manager, so of course it's not just David and Tammy. The team members provide detailed tech support in each lecture room, record presentations, provide the infrastructure for and hosting of the livestream content, as well as filming interviews and creating videos during the weekend.

And finally, in the context of GB3HQ which was run brilliantly as always by members of the Camb-Hams, while I said that the station participated in the 145 Alive event, what I hadn't appreciated was that the 145 Alive organisers were hosted in the GB3HQ station to give those enjoying their two-hour net a taste of the Convention, perhaps for the first time."

A New Year

A bumper issue again to start the New Year. And, indeed, a very Happy New Year to all our readers. At the RSGB Convention (see above), I received lots of favourable comments about *PW*, which is very encouraging. Even more encouraging, perhaps, is that there were no criticisms although, much as I would like to think I am perfect, I am realistic enough to know that cannot be the case! I'd love to hear from more of you as to what you enjoy seeing in the magazine, what you think is missing, what gets under your skin, whatever. I can't, of course, guarantee to please all readers all of the time but at least it seems I have the balance about right, when seen across a year if not in each and every issue.

And the good news is that I continue to receive high-quality articles on an eclectic range of topics within the hobby – three have come in in just the last 24 hours, which is amazing. Without my authors, old and new (in more ways than one!), there would be no magazine – with the best will in the world I can't write it all myself!

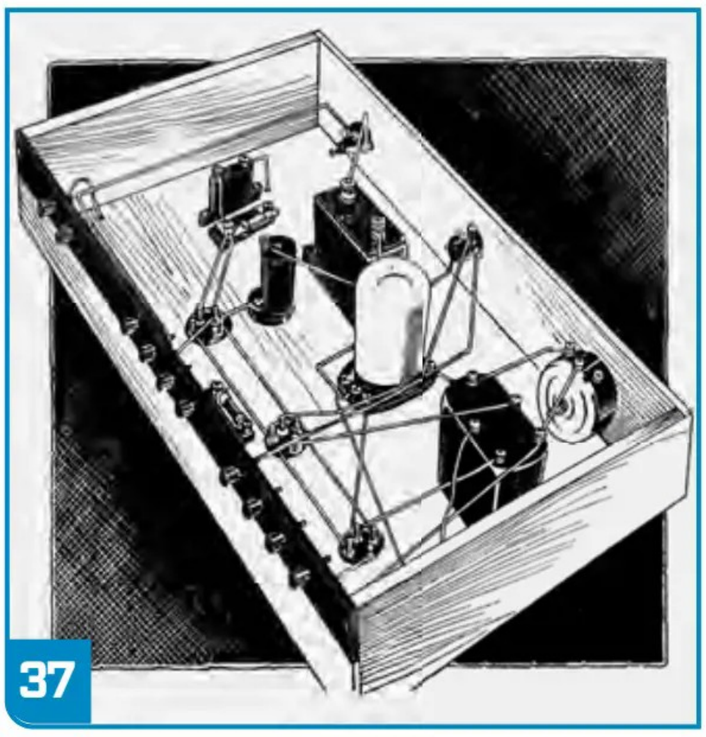
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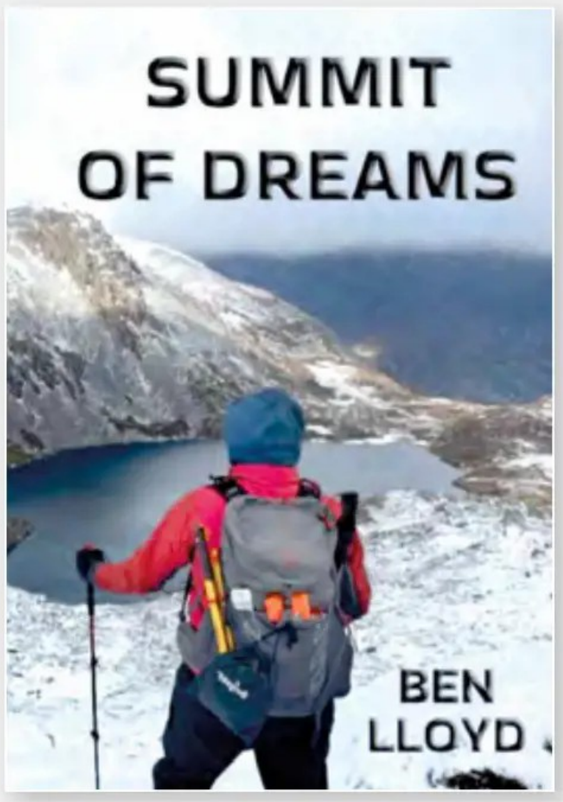
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SUMMIT OF DREAMS – A SOTA ADVENTURE MEMOIR: This is a book for radio amateurs, SOTA activators, and adventurers alike. In *Summit of Dreams*, **Ben Lloyd GW4BML** shares his exhilarating memoir of climbing the UK's wildest summits and broadcasting from the peaks. Blending mountaineering with amateur radio, this story captures the essence of Summits on the Air: resilience, connection, and the thrill of hearing voices reply from across continents while standing on a mountaintop. From windswept ridges to remote island activations, Ben's adventures, joined by his family, show how radio and exploration can unite generations. If you'd like to read these adventures and experience the magic of SOTA, order your copy today (£16.99): **https://tinyurl.com/588bwem7**



Don't miss KW Days 2026

Now a firm fixture celebrating an extensive range of radio equipment made in Kent from 1956 to the late 1970's takes to the air again on 3rd and 4th January 2026.

The GB8KW multi-operator station will be active from Cray Valley radio club's HQ in Eltham, showcasing a whole range of equipment and accessories for visitor inspection 10am -4pm.

Such is the ever growing interest that GB-KW calls will be activated by collectors and restorers across the UK, not only during the first weekend but throughout during January, mainly at weekends and some weekdays. 2025 has seen more radios rediscovered and the publication of the fascinating wartime exploits of the company founder **Roly Shears G8KW**.

If you've ever owned or still own any KW gear, have a memory to share or simply want to know more give them a call. GB-KW stations are encouraging to call 'CQ-KW' on the hour/half hour when active.

The **KW-Radios@groups.io** interest group provides help and support world-wide to those undertaking restorations and repairs. There's an extensive archive of manuals, circuits, and associated material continues to be curated. Vintage KW, AM & CW equipment will be found on VMARS or FISTS frequencies. Classic SSB equipment, in tribute to the famous KW77 Rx, will be using Non-WARC frequencies ending in 77kHz ± QRM. – Primarily 1.877/1.977MHz, 3.77MHz, 7.177MHz, 14.177 & 14.277MHz, 21.277MHz & 28.377MHz ± QRM.

RSGB NATIONAL RADIO CENTRE WINS A SIR ARTHUR CLARKE TEAM AWARD : At a glittering awards ceremony in London recently, the RSGB National Radio Centre team beat two other finalists to win the 2025 Sir Arthur Clarke Education and Outreach Team Award *"For inspiring all Generations about Amateur Satellites by providing a unique insight into the world of radio communications…"*.

The awards are organised by the British Interplanetary Society: The Sir Arthur Clarke Awards - The British Interplanetary Society

The award was accepted by RSGB General Manager **Steve Thomas, M1ACB**; NRC Coordinator **Martyn Baker G0GMB**; and NRC Volunteer **Brian Hardy G4BIP**.

In his acceptance speech, Steve Thomas said, *"The Society is immensely proud of the work that the RSGB National Radio Centre does to welcome 80,000 visitors each year, introducing many of them to amateur radio and satellites for the first time. We know that the Centre and our 65 volunteers there often inspire young people to discover more about amateur radio, and we hope that those young people will also consider careers as RF Engineers which may lead them to work in space or related industries in the future."*

Congratulations to the whole NRC team!

BUMBLEBEES CAN READ MORSE: **Georg Wiessala** sent a newspaper cutting reporting a study by Queen Mary University in which it was found that bees negotiated to find sugar by short bursts of light while something bitter was behind longer bursts. Doctoral student **Alex Davidson** and his supervisor **Elisabetta Versace**, who led the study published in the journal Biology Letters, said it was clear the bees learnt to tell the lights apart based on their duration.

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News from Martin Lynch & Sons

1. The **Ham Radio Guide Book 2025** is a newly released, comprehensive printed guide aimed squarely at amateur radio enthusiasts. It consolidates essential information in a full-colour, magazine-style format—covering frequency allocations, band plans, licensing tips, operational best practices, and handy reference tables. It's your year-round companion, packed with clear diagrams, FAQs, and updates relevant to the 2025 amateur radio landscape.

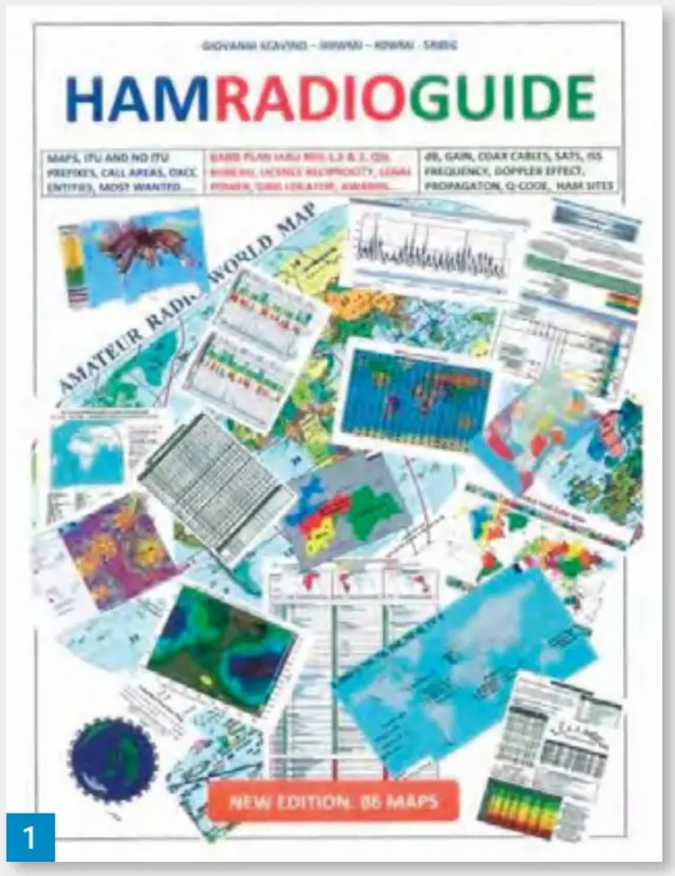
The Problems It Solves:

1. Fragmented Info – Instead of hunting across websites, forums, and PDFs, this guide neatly gathers reliable, up-to-date content in one polished volume.

2. Beginners' Confusion – New hams often struggle with licensing rules, band planning, and tech jargon. This guide breaks it down into accessible chunks.

3. Reference Fatigue – Digital documents can be slow to access or inconvenient in the shack. This guide keeps frequently needed charts and guidelines just a page-turn away.

The **Ham Radio Guide Book** 2025 is a well-crafted utility booklet that strings together regulatory insight, practical advice, and clear mapping of the ham radio world. It's ideal for anyone serious about keeping up with the hobby without missing a single frequency change or procedural update. £24.



1


2

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2. The **Red Pitaya SDRLab 122-16 (External Clock)** stands out as a professional-grade software-defined radio and digitiser platform aimed at advanced amateurs, RF engineers and experimenters. This unit combines high-performance ADC/DAC hardware with flexible clocking and processing capabilities.

What the SDRLab 122-16 Offers

- Dual 16-bit ADC inputs (50 Ω, AC-coupled) operating at 122.88MS/s.
- Dual 14-bit DAC outputs (50 Ω, AC-coupled) at 122.88MS/s.
- Input bandwidth from 300 kHz to 550 MHz; output bandwidth up to 60MHz.
- External reference input (122.88MHz) for synchronisation with GPSDOs, rubidium standards or other high-stability clocks.
- Integration of ARM Cortex-A9 dual-core processor plus a Xilinx Zynq-7020 FPGA for real-time DSP and wide-band radio work.
- Kit contents include the SDR board, protective enclosure, microSD with OS pre-loaded, power supply, Ethernet and USB cables.

In short, the Red Pitaya SDRLab 122-16 is not a basic hobby receiver; it is very much engineered for users who demand high performance, precision clocking and deep integration.

For the UK radio amateurs, especially those interested in advanced SDR work, remote station set-ups, contesting, monitoring or signal analysis, the Red Pitaya platform offers several compelling attractions:

Wide frequency range and high dynamic hardware make it suitable for HF through lower VHF/UHF monitoring, wide-band spectrum analysis and integration into contesting or remote-receiving setups.

- **Clock synchronisation option** means if you already have or plan to acquire a disciplined 10MHz or 100MHz reference (GPSDO, rubidium, etc), you can easily phase-lock the system for coherent reception, multi-receiver beamforming or time-domain measurements.
- **Modular DSP/FPGA architecture** allows for custom development: users can load their own firmware, experiment with digital filters, decode novel modes or integrate into remote server environments.


3

The Red Pitaya SDRLab 122-16 is a serious proposition for the amateur who wants more than "just another SDR receiver". It brings high-spec digitisation, FPGA/DSP capability and synchronised clocking into one platform — clearly aimed at those who want to experiment, innovate and explore rather than simply listen. £649.

---

3. The **DESHIBO WV-601** is an antenna that can be installed permanently or used for portable operation.

This all-band, passive loop receiving antenna is made from precision-cut aluminium and engineered to help you hear what your main antenna might be missing.

Covering an impressive frequency range from 0.1 to 999 MHz, the WV-601 brings a massive chunk of the radio spectrum to life. Whether you're tuning into longwave broadcasts, monitoring HF amateur bands, scanning VHF/UHF and airband or listening to shortwave broadcasts.

Its passive design means no batteries or power supplies are required — it's truly plug-and-play, with no internal amplifiers that could potentially introduce distortion or additional noise.

The loop collapses down neatly, making it a great companion for travel or temporary installations where space is at a premium.

One of the standout benefits of this antenna is its ability to reduce the noise floor — a common headache for home operators. Loop antennas are naturally good at rejecting local interference, and the WV-601 is no exception.

This little antenna also has one more trick up its sleeve, you can TX with a max of 10W on the 2m and 70cm bands. £106.99.

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1

Meet the RSGB President

The editor catches up with Bob Beebe GU4YOX, who became President of the RSGB in 2025.

Don Field G3XTT
practicalwireless@warnersgroup.co.uk

How did you first become interested in amateur radio?

I grew up in the 1960s and, like many of my generation, was fascinated by wireless and electronics from an early age. Hearing signals from faraway places on a valve radio captured my imagination, and once I discovered that people could actually *talk* to one another across the world, I was hooked. That early curiosity led me to become a Short Wave Listener (SWL) and eventually study for my amateur radio licence and I've been active ever since.

And how did life bring you to Guernsey (GU)?

My family and I moved to Guernsey in 1990 with my work, and I eventually became the Island's Electricity Company Operations Director and Chief Engineer. One of the main attractions, apart from the job itself, was the rare GU prefix! I had an antenna up for 20 metres within a day of arriving on the island. That was 35 years ago. I was immediately struck by Guernsey's strong sense of community. When the opportunity arose to settle here, it felt like a natural fit and somewhere with wonderful people and an excellent radio location. Guernsey also enjoys the highest sunshine hours in Great Britain and some truly beautiful beaches.

What are your particular interests within the hobby today?

I've always enjoyed operating, particularly CW, HF, chasing DX and portable work such as National Field Day and contest operating, as well as DXpeditions. I'm also passionate about the organisational and international side of the hobby. I find real satisfaction in encouraging new licensees, supporting education through the RSGB's STEM programmes, and helping to safeguard our spectrum for the future. I was elected to the Derby & District Amateur Radio Society Committee as a junior member when I was just 13 years old.

What persuaded you to take on the challenging role of RSGB President?

It's a privilege to serve the hobby that has given me so much. The Society plays an important role both nationally and internationally, and I wanted to help build on the excellent work of my predecessors. It's certainly a challenge, but it's also very rewarding to work alongside such dedicated volunteers, over 450 of them, and the highly committed HQ staff.

What personal goals have you set yourself for your time as President? Are there particular challenges facing the Society that you'd like to tackle?

I'd like to continue modernising the Society while keeping it welcoming and relevant to everyone, from newcomers to long-time operators. We need to promote training, diversity, and innovation while strengthening our volunteer network.

The main challenge is ensuring we remain adaptable in a rapidly changing communications world. Importantly, the Society works tirelessly to protect the radio spectrum, without it, we wouldn't have a hobby. I would encourage all your readers to join the Society and support our national cause.

Could you explain the role of the President, especially in relation to the Board and its Chair? For example, is it a voting or non-voting position, and do you attend Board meetings?

The President represents the Society publicly and undertakes an ambassadorial role. Being

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2

Photo 1. President of the RSGB - Bob Beebe GU4YOX.
Photo 2. Bob GU4YOX as MJ5E in 2023 where he came World 1st in the CQWW 160 CW Contest.
Photo 3. Bob GU4YOX and 160m vertical antenna with 2400 metres of radials.

President also means becoming a Director registered at Companies House in London, so the role carries fiduciary responsibilities. The President has voting rights on all decisions, and I attend all Board meetings and contribute fully to discussions. The Chair leads the Board's governance, strategy and executive duties, working closely with the General Manager. My focus is on engagement, representation, and inspiration across the entire amateur radio community.



3

The WRTC (World Radio Teamsport Championship) 2026 will take place during your term. What does this event mean for UK amateur radio, and how do you see the RSGB's role in it?

It's an incredible opportunity to showcase UK amateur radio on the world stage. WRTC 2026 will inspire many to aim higher, improve their operating skills, and feel part of a global community. The RSGB will do everything possible to support the organisers and encourage UK participation. I'm really looking forward to the event.

How do you see the future of our hobby—are you an optimist or a pessimist?

For those who know me well, I'm ever the optimist, but also a realist. Amateur radio continues to evolve, and every generation brings fresh ideas and energy.

As long as we embrace change while celebrating our traditions, the hobby will remain vibrant, relevant, and a lifelong source of enjoyment and friendship.

Closing remarks from Bob Beebe GU4YOX

Amateur radio continues to bring people together in ways few other hobbies can. Whether through technical innovation, friendship, or the thrill of making that unexpected contact, it remains as rewarding today as ever. I'm optimistic about its future and proud to help represent such a passionate and skilled community. Most of all, I look forward to meeting and talking to many of you on the air over the coming months. **PW**

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Colin Redwood G6MXL
practicalwireless@warnersgroup.co.uk



1

The 17th PW 70MHz Contest: Results 2025

Colin Redwood G6MXL presents the results of the 2025 contest.

A Yellow Storm warning from the Met Office persuaded many regular participants in the 17th *Practical Wireless* 70MHz Contest to abandon any attempt to operate on hilltops. Those that did venture out found much less activity than usual. Compared with 2024, entries decreased by 36%, with 21 entrants (37 in 2024) making a total of 326 (716) contacts with 97 (115) different stations in 15 (20) different squares (**Fig. 2**).

Several entrants who planned to operate portable, elected to stay home and at least keep dry. Some fixed stations chose either not to operate and luff their towers over or to operate with lower antennas. Others just gave away a few points without submitting a log.

Low power section winner

Wayne Dabrowski MW0LKX/P operated from IO82KL and won the low power section for the third time using a Yaesu FTdx10 transceiver and a 6-element PowAbeam antenna.

Open section winner

Pauline and **Chris Kirby G8HQW/P** were the winners of the high-power section. They used a Yaesu FTdx10 transceiver with a Gemini 4 amplifier feeding a 7-element Yagi antenna.

Full details of the results can be found in the tables in this article.

Atrocious weather

Winner Wayne Dabrowski MW0LKX/P said, *"It was touch and go whether to go or not. I'm pleased I did but it was very quiet on the band, obviously due to this reason. The wind and rain were really giving the hilltops some stick. Quite concerning at times. Amazingly, once the contest finished, the wind and rain stopped and it gave me the 30 minutes I needed to disassemble the antenna. As soon as the van door shut, it all went mad again and wipers on full all the way home".*

Despite a wet and windy day and getting soaked at pack-up time, the **Gloucester Amateur Radio & Electronics Society G2HX/P** still had good fun! (**Fig. 1**)

Dave Shaw G5TO/P reflected that, *"It is usually an enjoyable event although the adverse weather and lack of activity made it less so this year. Propagation poor at start, then deteriorated later. Weather very windy and wet, unpleasant for portable station takedown".*

First time entrant

Jason Bowen G1YOY entered for the first time. *"Sadly, for my first ever time entering the contest, the weather was atrocious in Bristol, and I could not raise my aerial any higher than a few metres above ground."* I hope the weather won't discourage Jason from entering another year.

Description	Name/Team	Callsign
Overall Winner	Wayne Dabrowski Hereford ARS	MW0LKX/P
Open Winner	Pauline and Chris Kirby	G8HQW/P
Low-Power Winner	Wayne Dabrowski Hereford ARS	MW0LKX/P
Leading Multi-Operator	Pauline and Chris Kirby	G8HQW/P
Leading English Station	Pauline and Chris Kirby	G8HQW/P
Leading Welsh Station	Wayne Dabrowski Hereford ARS	MW0LKX/P
Leading EI/GI Station	Roger Greengrass	EI8KN

Table 1: Leading stations

Equipment

The trend to using transceivers that incorporate 4m rather than using transverters increased again this year, with just two stations using transverters.

Logging

Logging accuracy was generally good with just a few points deducted during adjudication. Two stations logged the time of all their contacts in BST and not UTC. They each suffered a 5% penalty to their score. Poor conditions resulted in more CW contacts appearing in the logs than usual this year.

Check log

A very welcome check log was received from **Dave Keston G8FMC** – many thanks.

Certificates

This year certificates will again be sent as a pdf file to all entrants by email - not just to leading stations. Look out for the email, which will be sent to the email address you entered into the contest website.

2026

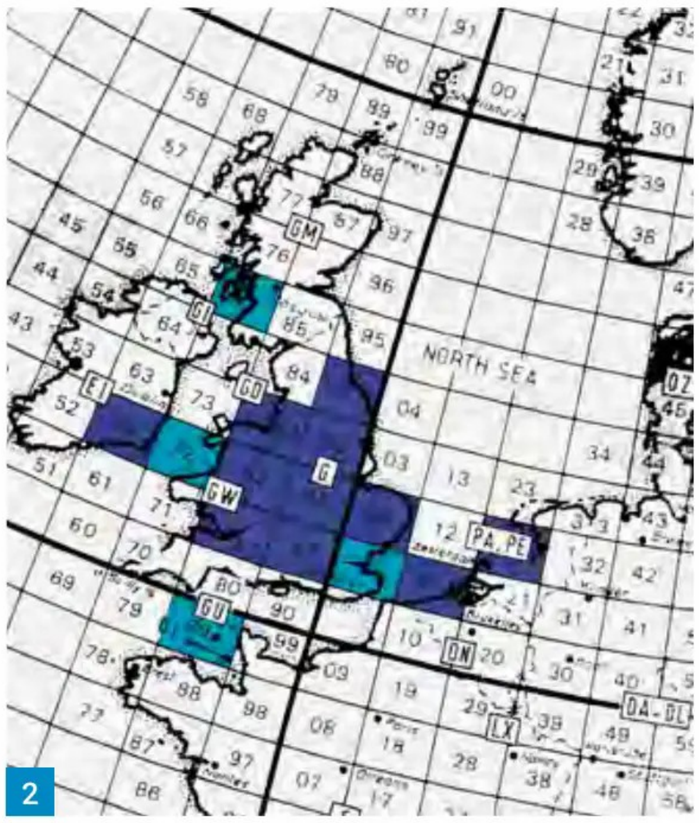
Apart from the weather, there were no adverse comments regarding the change of date in 2025. I'm therefore proposing to schedule the 2026 contest for Sunday 13 September 2026.

I am expecting the rules to appear in the September 2026 issue due in the shops mid-August 2026. Let's hope for better weather in 2026 - surely it can't be worse than 2025!

Congratulations & thanks

Congratulations to the 2025 winners and on behalf of all entrants a big *"Thank You"* to all stations that participated. **PW**

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2

Square	Name	Call	No. entries
IO62	Roger Greengrass	EI8KN	1
IO81	Gloucester Amateur Radio & Electronics Society	G2HX/P	5
IO82	Wayne Dabrowski Hereford ARS	MW0LKX/P	1
IO83	Tony Pugh	GW8ASD	4
IO91	Charlie Mitchell	G0SKA	3
IO92	Carl Peake	G0NZI	2
IO93	Dave Shaw	G5TO/P	2
IO94	Pauline and Chris Kirby	G8HQW/P	1
JO11	Frank	PE1EWR	1
JO22	Robert Van Der Zaal	PA9RZ	1

Table 2: Leading stations in each square.



3

Fig. 1: The Gloucester Amateur Radio & Electronics Society G2HX/P team kept dry under their gazebo.
Fig. 2: Map showing locator squares of stations that entered (in dark blue) and other stations worked (in light blue).
Fig. 3: The antenna used by Charlie Mitchell G0SKA.

Pos	Call	Name	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	MW0LKX/P	Wayne Dabrowski Hereford ARS	41	13	533	IO82KL	Yaesu FTdx10	6-ele PowAbeam	476
2	G0WRS/P	Warrington Amateur Radio Club	23	4	87	IO83XG	Icom IC-7300	3-ele Yagi	460
3	G0OIW/P	Mark Palmer	12	5	60	IO91LO	Yaesu FT-710	Dipole	4
4	G4BZI	Roger Bracey	7	5	35	IO83SB	Yaesu FT-817 + MM TVTR	HB9CV	70
5	G4VPD	Wythall Radio Club	4	5	20	IO92BJ	Icom IC-7300	5-ele LFA	162
6	M0PJA	Paul Archer	4	4	16	IO93II	Icom IC-7100	4 and 6m beam	97

Table 3: *PW* 70MHz low power results table.

Pos	Call	Name	QSOs	Squares	Score	Locator	Transceiver	Antenna	Ht. m asl
1	G8HQW/P	Pauline and Chris Kirby	38	13	494	IO94JF	Yaesu FTdx10 + Gemini Amplifier	7-ele Yagi	294
2	G2HX/P	Gloucester Amateur Radio & Electronics Society	41	10	410	IO81WU	Icom IC-7300 + TVTR, Linear Amps UK amp	8-ele Yagi	275
3	G0SKA	Charlie Mitchell	24	10	240	IO91OQ	Yaesu FTdx10, Icom IC-7300 + linear	7-ele powabeam	204
4	G3LVP	Ken Eastty	26	8	208	IO81WV	Kenwood TS-850 + TVTR	6-ele	30
5	GW8ASD	Tony Pugh	25	8	200	IO83LB	Icom IC-7300	8-ele Yagi	110
6	G5TO/P	Dave Shaw	20	7	140	IO93FL	Icom IC-7100	4-ele HB	310
7	G3TKF	Robin Thompson	18	7	126	IO81RI	Icom IC-7100	Dipole	180
8	G4CIZ	Tony Wallbank	13	7	91	IO91FG	HB 9MHz IF + recent DDS VFO. HB 150W PA	4-ele Yagi	120
9	G0NZI	Carl Peake	12	7	84	IO92GM	Yaesu FT-847	2-ele Moxon	94
10	EI8KN	Roger Greengrass	7	5	35	IO62IE	Yaesu FTdx101MP	6-ele Yagi	80
11	GW4RWR	Rhys Thomas	4	4	15	IO83HE	HB VXO 14.8MHz x 4 + 10.7 IF	HB 7-ele DK7ZB	70
12	G1YOY	Jason Bowen	3	3	9	IO81QL	Icom IC-7300	5-ele Yagi	81
13	PE1EWR	Frank	2	3	6	JO11SL	Icom IC-7300	4-4EPS6/4	0
14	G7CSM	Robert Knight	1	3	3	IO81VU	Yaesu FT-710	Dipole	37
15	PA9RZ	Robert Van Der Zaal	1	1	1	JO22GF	Icom IC-7300	7-ele LogPer for 4 & 6	14

Table 4: *PW* 70MHz open section results table.

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Morse Code Practice Oscillator with Echo

Eric Edwards GW8LJJ brings an earlier project up to date.

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

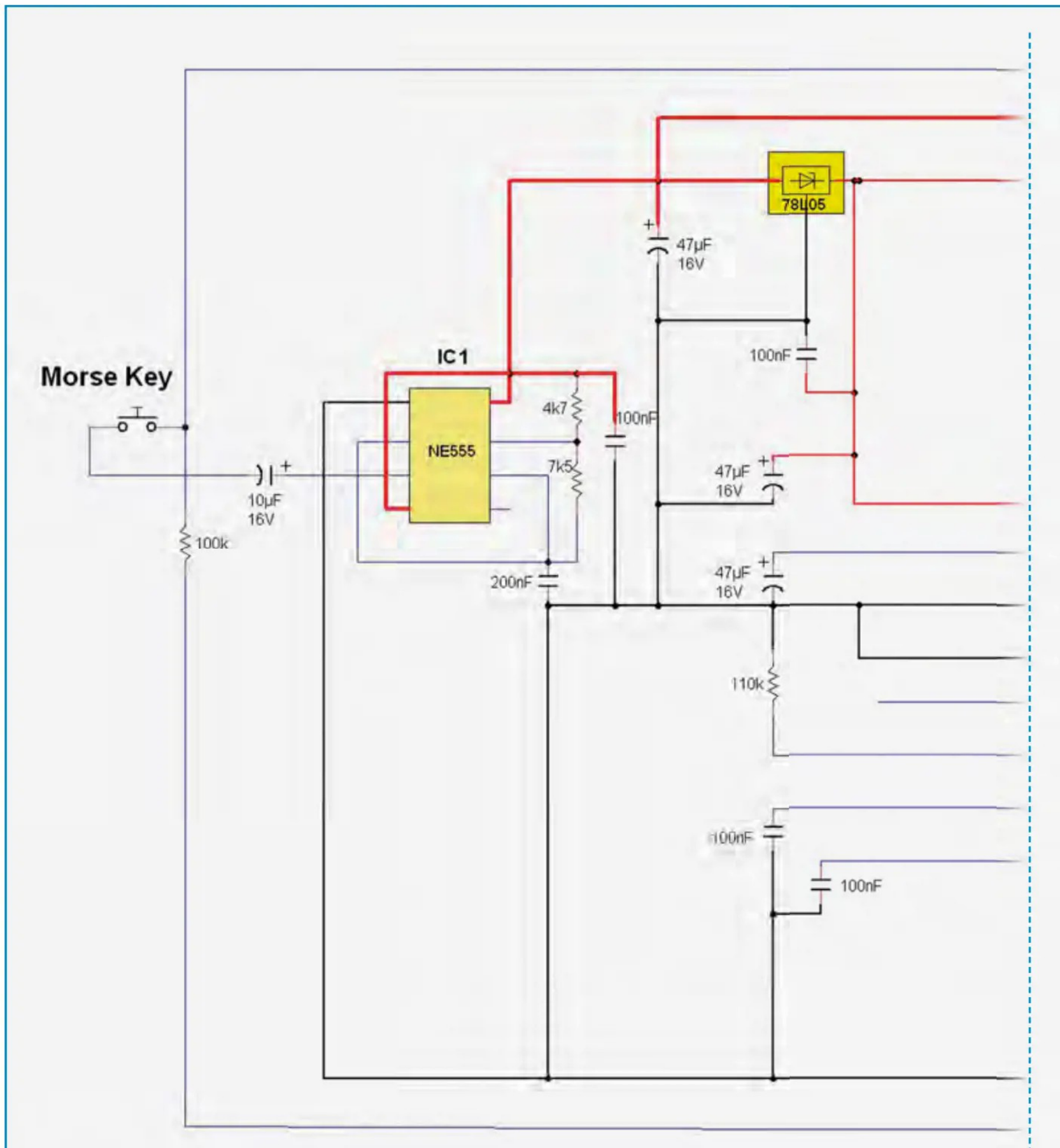
There have been several local interests in this project as more new and some older hams seemingly want to try or brush up on the Morse mode (CW). The project described was published several years ago in *Practical Wireless*. Since then, and because of a revived interest, the project is reproduced here again. A commercial PCB has been manufactured, which makes the project look more professional with its silk screening to show where the components are placed without continual looking at the printed PCB layout. It also has an etch resist layer to reduce the possibility of solder splashes and the component holes are tin plated so easy to solder the components on the board.

Learning CW

There are many ways of learning CW. Receiving tuition at the local radio club is probably the best method and the computer is arguably the best medium when learning at home. However, this project, being completely made from hardware and not a PC in sight, is a little different from the usual CW practice oscillator and it can be used at home or in the shack. It is portable with its own internal battery if fitted or the shack 12V (13.8V) can be used. Not only does it allow you to hear your characters being tapped away on the key in real time but it also has a choice of a short delay (1 second approx) and a long delay (2 second approx) output so that you can hear your results after the character has been sent. This can be the difference in sending and receiving a 'C' and a separate 'Q' or the full 'CQ'. This 'echo' can be useful as maybe it will be difficult to fully appreciate your quality when sending and listening at the same time. Of course, this would be somewhat disconcerting if sending a complete sentence with the echo breaking in while sending. For that reason it is not used with a transceiver but is designed as a stand-alone unit to be able to evaluate your sending quality by listening to individual characters sent. For fast sending the short delay will be useful and for slower senders then the long delay can be selected. The schematic can be seen at **Fig. 1**, the PCB fitted into a small enclosure is shown at **Fig. 2** and the PCB layout (not to scale) is shown at **Fig. 3**.

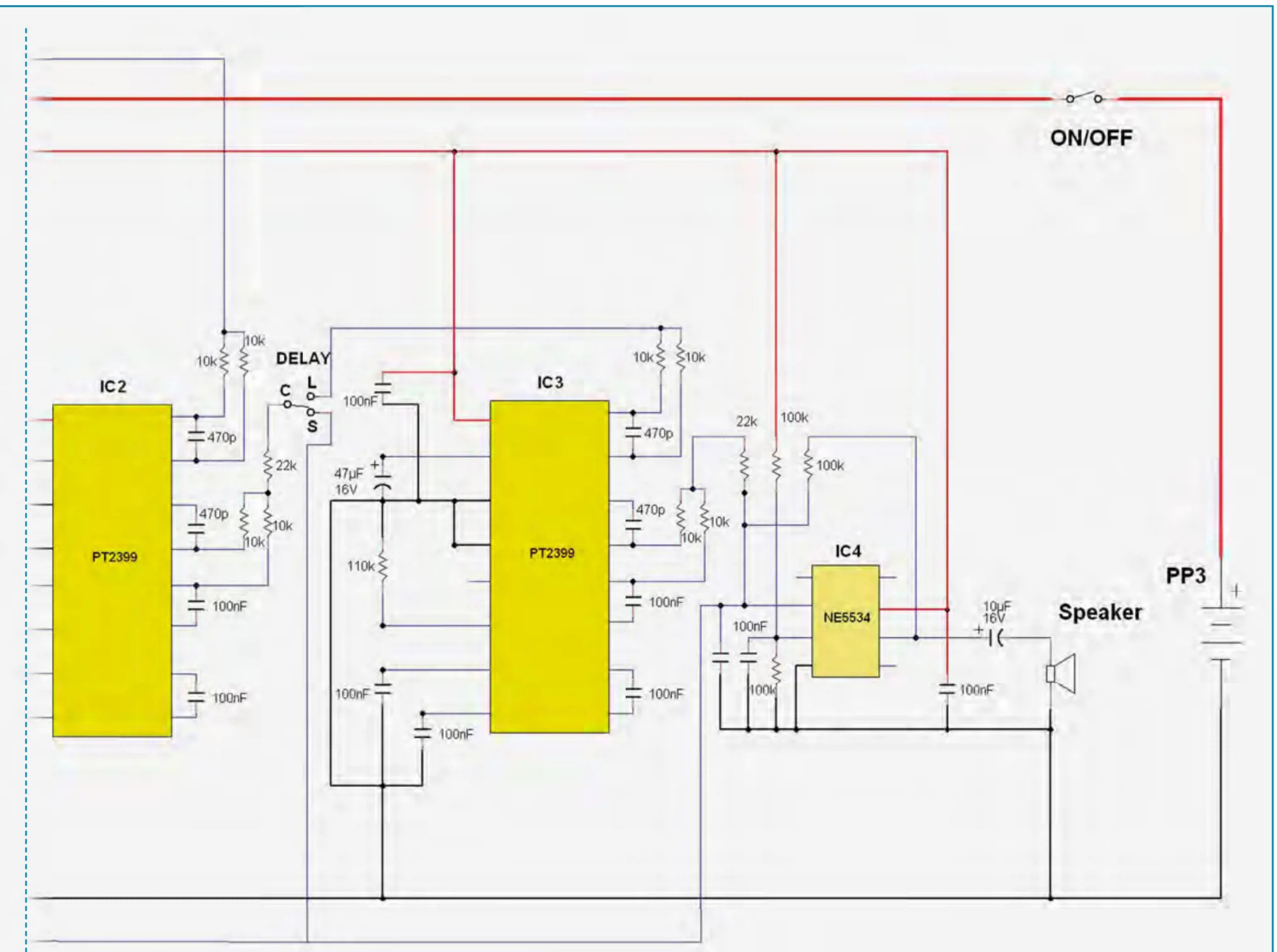
Circuit description

There are various ways to make an oscillator for CW and probably the easiest is with a series of gates such as in a 4011 Quad NAND gate package. I chose an NE555 timer IC here as it is probably more commonplace in the ham shack junk box. The first part of the circuit is the NE555 timer oscillator (IC1) and forms the main part of many CW practice oscillator designs. It is arranged as a timer in astable mode with pins 2 and 6 joined, allowing the circuit to re-trigger itself on every cycle of operation, so it can operate as a free running oscillator. During each cycle the capacitor (200nF) connected on pins 1 and 6 with the other end at ground charges through both timing resistors, 4.7kΩ connected at pin7 and the other end at 9V supply and the 7.5kΩ resistor connected at pin 7 and the other end at pins 2 and 6, but it discharges itself through only the 7.5kΩ resistor. The capacitor charges to 2/3Vcc which is the internal upper comparator limit and is determined by the 'rule' 0.693(R1+R2) C. That's 0.693 × (4.7kΩ + 7.5kΩ = 12.2kΩ) × 200nF and the discharge is set by 0.693(R2×C) which in our circuit is 0.693 × 7.5kΩ × 200nF. The 0.693 has been rounded down from 0.6931718 and is the 'constant' used when finding the charging and discharging times of the capacitor. The charging and discharging with these values produces the note of about 400Hz in this design and these values can be changed to suit the tone frequency of your choice.



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The output of the NE555 is taken via a 10µF capacitor and one of the key connections to a delay switch. This selects either a short or long delay circuit connected with the two 10kΩ resistors on PT2399 (IC2) and another PT2399 (IC3) via its two 10kΩ resistors. The PT2399 is an echo processor, which accepts an analogue input signal and through its internal processing produces delays at the output which is determined by an internal clock frequency. This can be changed externally with a change of a resistor value connected at pin 6 of the device and the other end to ground. The analogue signal (from the NE555) is connected to pin 16 of IC2. There is a set of low pass filters within the device (LPF1 and LPF2) and these are connected with capacitors. The internal OpAmp inputs and outputs are also coupled with capacitors to provide a chain of delays. The delayed output (approx one second) at IC2 is taken via a 10kΩ resistor to the common connection of a changeover switch to allow either this delay circuit to be connected to the summing amplifier IC4 or to the second delay circuit IC3 to provide a further delay of another one second to provide a two second delay, which is also connected to the summing amplifier IC4. This delayed tone is mixed with the direct tone from the 100kΩ resistor also connected at the same key connection. The key connection with the 10µF capacitor is the output at pin 3 of IC1. It will be noted that the oscillator (NE555) is running at all times the power is connected. This is to prevent any possible key clicks (chirps!) and frequency drift. These two tones (direct and delayed) are 'summed' in the OpAmp (IC4) mixer with the speaker output at pin 6 via the 10µF capacitor. The delay integrated circuits (IC2 and IC3) are the types used in the 'analogue' music industry as echo chambers and other reverberation effects and are readily available and easy to use. It is important not to exceed the 5V supply to this chip and is the reason for the 78L05 regulator.

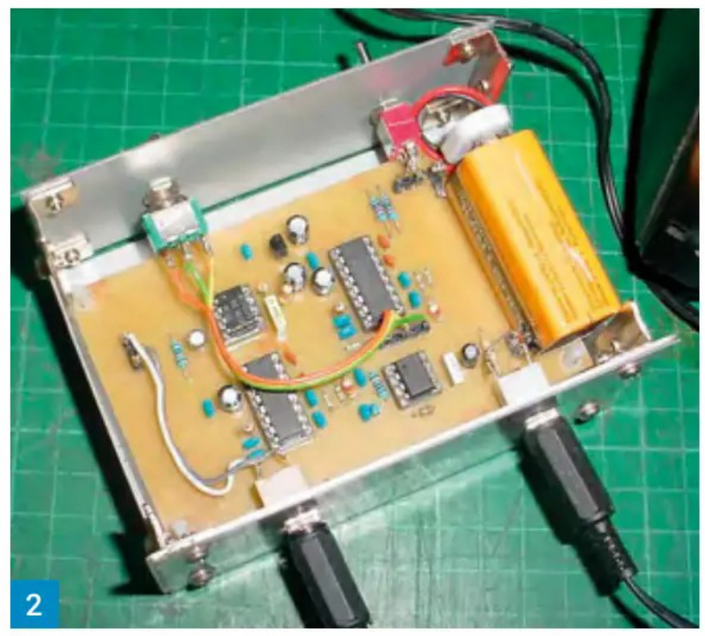


Fig. 1: The circuit diagram.
Fig. 2: The PCB fitted into the enclosure.

In use

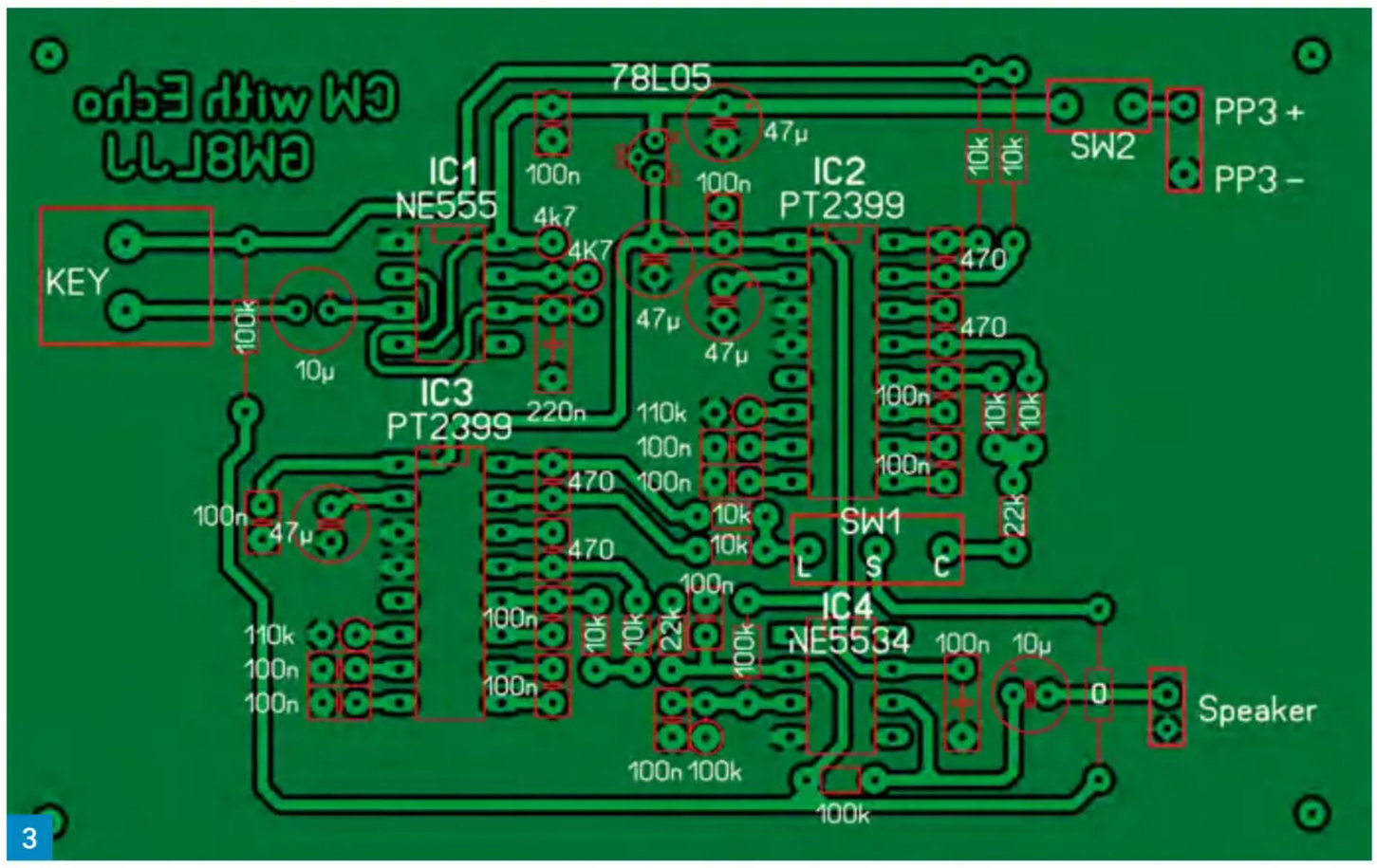
The output at Pin 6 of IC4, NE5534 is capable of driving a small 8Ω speaker but if headphones are to be used, then a potentiometer connected between the output and the headphones as a volume control could be used to lower the

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Parts List

Component	Type	Qty
PT2399	Or CD2399	2
NE5534	Op Amp	1
NE555	Timer	1
78L05	Low power 5V regulator	1
100nF	Ceramic capacitor 2.54mm spacing	13
100nF	Ceramic capacitor 5mm spacing	1
10µF	Electrolytic capacitor	2
47µF	Electrolytic capacitor	4
470pF	Ceramic capacitor	4
220nF	Polyester capacitor	1
10kΩ	1/4W resistor	8
100kΩ	1/4W resistor	4
0Ω	1/4W resistor zero Ohms (link)	1
4.7kΩ	1/4W resistor	2
7.5kΩ	1/4W resistor	1
110kΩ	1/4W resistor	2
22kΩ	1/4W resistor	2
Toggle switch	ON-ON 3-terminal (Echo speed)	1
Toggle switch	ON-OFF	1
IC Holder	16 DIL Turnpin type	2
IC Holder	8 DIL Turnpin type	2
PCB	GW8LJJ (professionally made)	1

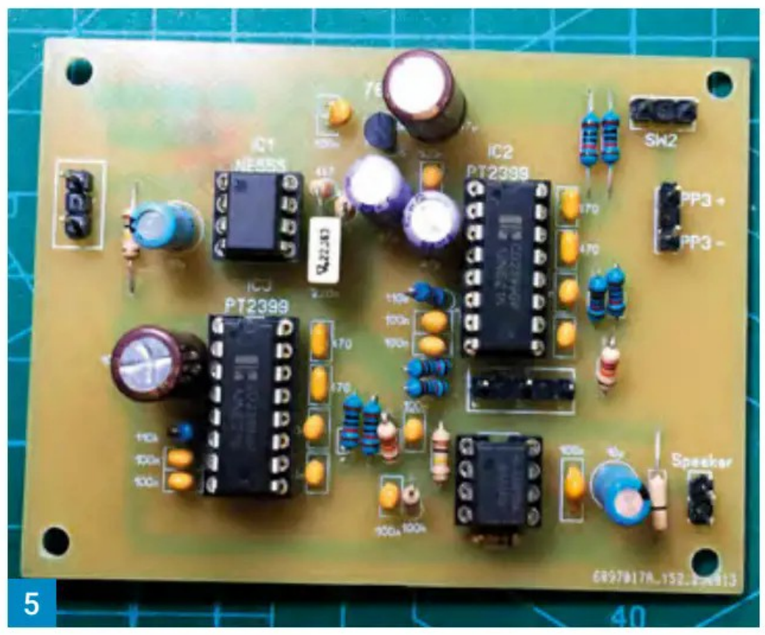
Ref: Data sheets for NE555, NE5534 and PT2399 (CD2399) are available off the internet



3



4



5

Fig. 3: The PCB (not actual size).
Fig. 4: The author's finished version.
Fig. 5: The PCB with components installed.

output level unless you want to loosen the wax in your ears. If you have assembled the circuit and connectors in a box similar to the one in the photo, **Fig. 4**, then the battery can be connected as shown. Plug the Morse key into the jack socket or whatever type of socket you have fitted and also a small 8Ω speaker or headphones. Apply the battery-on switch (SPST) and select either L (long) or S (short) delay with a suitable changeover switch which can be a slider type or, as I have used, a SPDT (single-pole double-throw) toggle switch. Press the key to make a Morse character and the one you have chosen will be heard in the speaker or headphone with a suitable level volume control fitted and a second later or two seconds later, depending which delay has been selected, the character will appear at the output again.

Construction

The NE555 signal is routed via the key jack so the key jack socket should be an insulated type (supplied in the kit or separate as on the picking list) such that the outer connection is isolated from any metalwork and negative polarity of the battery so as not to 'ground' either of the two Morse key connections. The On-Off battery switch can be a miniature SPST toggle switch and the delay switch can be either a SPDT toggle switch or a slider type. The speaker output jack can be conventionally wired with the outer sleeve of the jack plug connection connected to ground in the usual way.

Is there a kit?

A complete kit is available along with a 'picking list' for you to choose what you want, as you may have some parts in the shack junk box, or the complete kit of parts less the metal box (enclosure) can be supplied. All of the parts are supplied on a non-profit, cost-recovery basis.

Assembling the kit

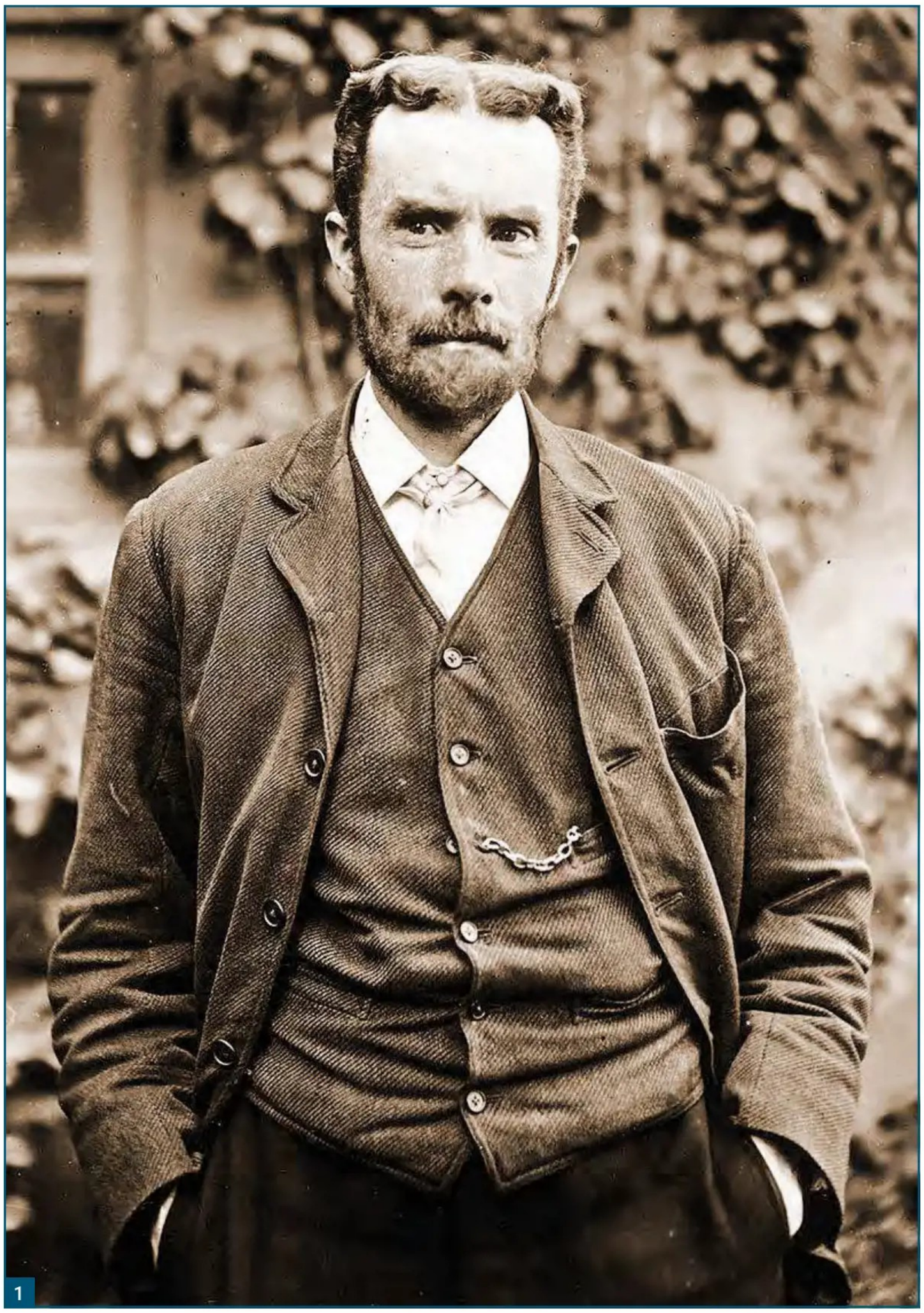
The PCB has a silk screen layer on top for easy assembly, so no need for continuingly referring to a printed paper PCB layout. Some order method of component placement is preferable. Gather all the parts for the construction for easy access. It is probably a good idea to fit the IC holders along with the 5V low power regulator first as this helps in locating the other parts. It may be useful placing a tick next to the components fitted on the printed out parts list. Set aside a couple of hours, or maybe an evening to assemble and solder the parts on the PCB. Use leaded solder for the assembly as unleaded solder may damage the PCB pads due to the extensive heat required with the unleaded solder.

Start with fitting the resistors. There are eight 10kΩ resistors and these can be fitted first. Next the four 100kΩ resistors can be placed. There are two 110kΩ transistors along with two 22kΩ and two 4.7kΩ resistors that can be fitted next then the single resistors, 7.5kΩ and the 0Ω, can be fitted to complete the resistors. The 0Ω resistor is a link and is Zero Ohms which is represented by a black band around the centre of the body.

Next to fit on the board can be the capacitors and the same method can be used with those with the same values fitted first. There are thirteen 100nF ceramic radial type capacitors with 2.54mm lead spacing and one at 5mm spacing. The rest of the standard capacitors and electrolytic type can be fitted and then the PCB pins for connections off the board. This completes the PCB build. The PCB can be fitted into a suitable enclosure and the jack sockets (one jack socket is insulated and is used for the key) along with the toggle switches can be fitted to the panels on the enclosure. A DC connector with an external 12V power supply, or a PP3 'flying lead' connector can be used with the battery inside the box. Remember to switch off the battery power supply when not in use as the oscillator is running all the time the power is connected. **Fig. 5** shows the populated PCB. **PW**

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1

Oliver Heaviside

Tony Jones G7ETW profiles an important scientist in the evolution of radio.

What does the name Heaviside bring to mind? The ionosphere, I wager, but this article's 'Radio Great' gave us much more than that.

Oliver Heaviside, pictured in **Fig. 1**, was born on 18 May 1850 into a working-class family in Camden, North London. He was bright and went to a grammar school, but left at 16. Some accounts attribute this to his family's finances but others, if they're correct, give us our first glimpse of his nature. He might have ceased formal education because he hated the way he was being taught, especially in mathematics.

Whatever the reason, he spent the next two years in scientific and mathematical self-study, including telegraphy and Morse code. These were *the* skills to have; it was the equivalent of going into AI today.

Practical Telegraphy

Sir Charles Wheatstone, pictured in **Fig. 2**, was Heaviside's uncle by marriage, and he helped the 18 year old get a job as a telegrapher for the Danish Great Northern Telegraph Company. Three years later Wheatstone employed him himself, to work with his (Heaviside's) brother **Arthur**, pictured in **Fig. 3,** in Wheatstone's telegraphy business.

Heaviside continued his self-study and in 1872 he published his first (some say second) paper *'Optimal Arrangement of the Wheatstone Bridge'* in the prestigious *Philosophical Magazine*. This paper was well received by the scientific luminaries of the day, including **William Thomson** and **James Clerk Maxwell**, pictured in **Figs 4** and **5** respectively.

Heaviside and Maxwell

In 1873, Heaviside read Maxwell's ground-breaking *'Treatise on Electricity and Magnetism'*, in which Maxwell proved that electricity, magnetism and light were all manifestations of the same thing. This paper included his famous 20 equations in 20 variables.

Heaviside did not understand these equations (he was in good company there!) but he recognised how crucial they were to the rapidly expanding world of communications. *"I was determined to master the book and set to work"*, he wrote.

By 1876 Heaviside had learned enough from Maxwell's equations to publish his own *'Telegraphers Equations'* in which he modelled voltage and current along the length of a transmission line in terms of induction, capacitance, resistance and conductance, the reciprocal of resistance. He coined many of the terms we use today, e.g. impedance.

Heaviside does something practical

In 1880 Heaviside did something radio amateurs really should know him for; he obtained British patent 1407 for coaxial cable, after studying skin effect. **Fig.6** shows an excerpt of this patent.

1884 saw **Siemens** and **Halke** register a similar German coax patent and in 1931, **Lloyd Espenschied** and **Herman Affel**, working for AT&T were awarded another one, the first that resembled coax as we see it now.

Mathematics applied to Maxwell

From 1880 to 1887, Heaviside worked on Operational Calculus, a new approach to solving differential equations. With this he met with disapproval from his peers who, not unreasonably, saw mathematics as a discipline of logic and rigour which produces definitive, incontrovertible proofs. But Heaviside took a more flexible view. To him, mathematics was a

Fig. 1: Oliver Heaviside.

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Fig. 2: Sir Charles Wheatstone.
Fig. 3: Arthur Heaviside.
Fig. 4: William Thomson.
Fig. 5: James Clerkenwell Maxwell.

tool and just as physical toolmakers can make new tools to solve problems, he did the same. Applications and results were what mattered to him, proofs could come later.

In 1884 Heaviside revisited Maxwell's equations. He invented the 'Step Function', which led to today's Laplace Transforms. Using this and other techniques, Heaviside reworked Maxwells cartesian equations into four differential vector equations in just two variables.

This was of major importance, comparable to Maxwell's originating work. When people make use of Maxwell's equations today, it is usually via Heaviside's interpretations. **Fig. 7** shows Heaviside's Maxwell equations.

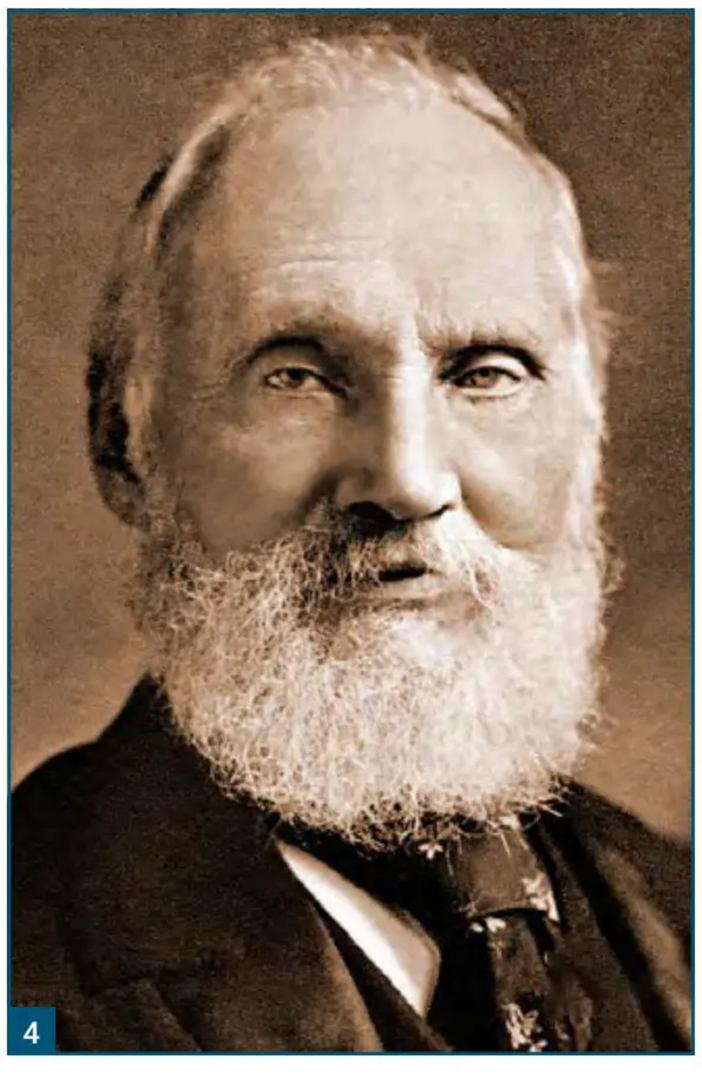
Heaviside in print

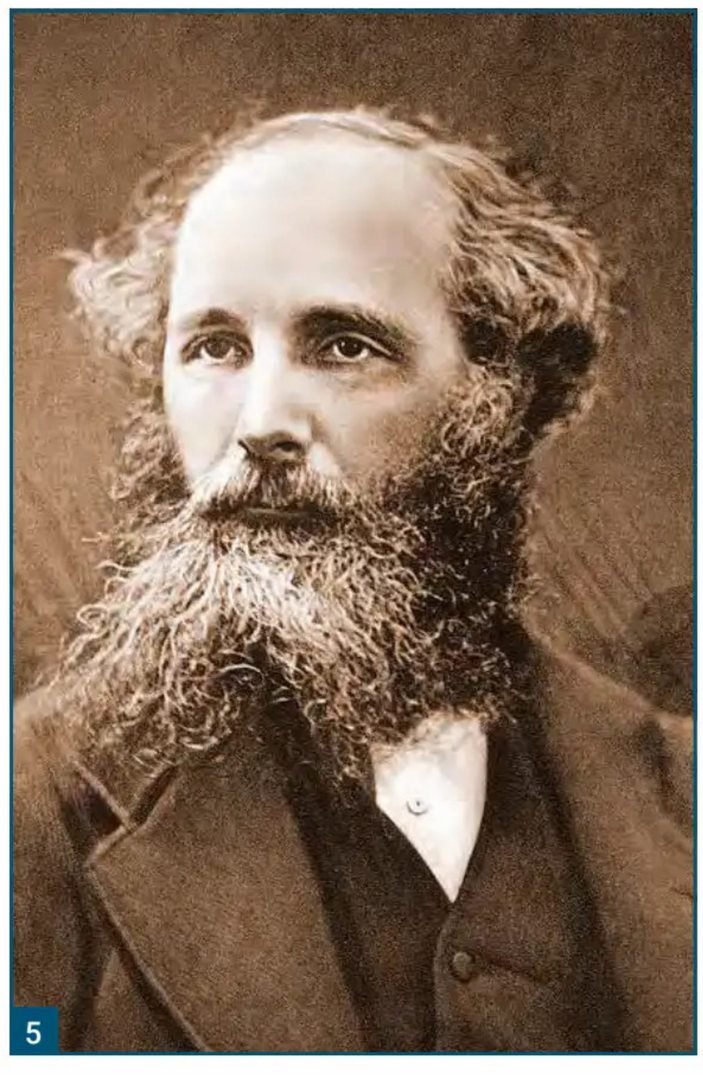
From 1882 to 1902, Heaviside published articles in *The Electrician*, a weekly telegraphy trade journal which concerned itself with 'Telegraphy, Electricity and Applied Chemistry'.

He was paid for this; £40 a year at first. He had no other employment, and lived extremely frugally, partially supported by his brother.

Producing sometimes three articles a month, he was prolific. Three volumes of electromagnetic theory he published in this magazine.







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Fig. 6: Patent 1407.
Fig. 7: Heaviside Maxwell equations.
Fig. 8: Arthur Kenelly.
Fig. 9: The Electrician magazine.

Back to telephony

In 1887, Heaviside worked, with his brother Arthur, on a paper called *'The Bridge System of Telephony'*, the central tenet of which was that adding induction to transmission lines reduced the distortion in transmissions. This theory was vehemently opposed by **William Henry Preece**, who was the Post Office's chief consulting engineer. Arthur worked for Preece, and Preece stopped the paper from being published.

1888 was a key year for Heaviside. He was known and respected in scientific circles, largely because of his extensive published works. Not without contacts, could he not have published anyway, or gone straight to a patent? One might think so, but he didn't try.

Polymath that he was, Heaviside turned his attention to a new interest: electromagnetic radiation. In two papers of 1888 and 1899, he explored the mathematics of the forces on electrons as electric and magnetic fields acted on them.

Heaviside looks to the skies

Heaviside postulated in 1902 that there was a band of ionised particles which would allow radio waves to 'follow the earth', allowing over-the-horizon communications, as **Guglielmo Marconi** had observed but not understood in 1901.

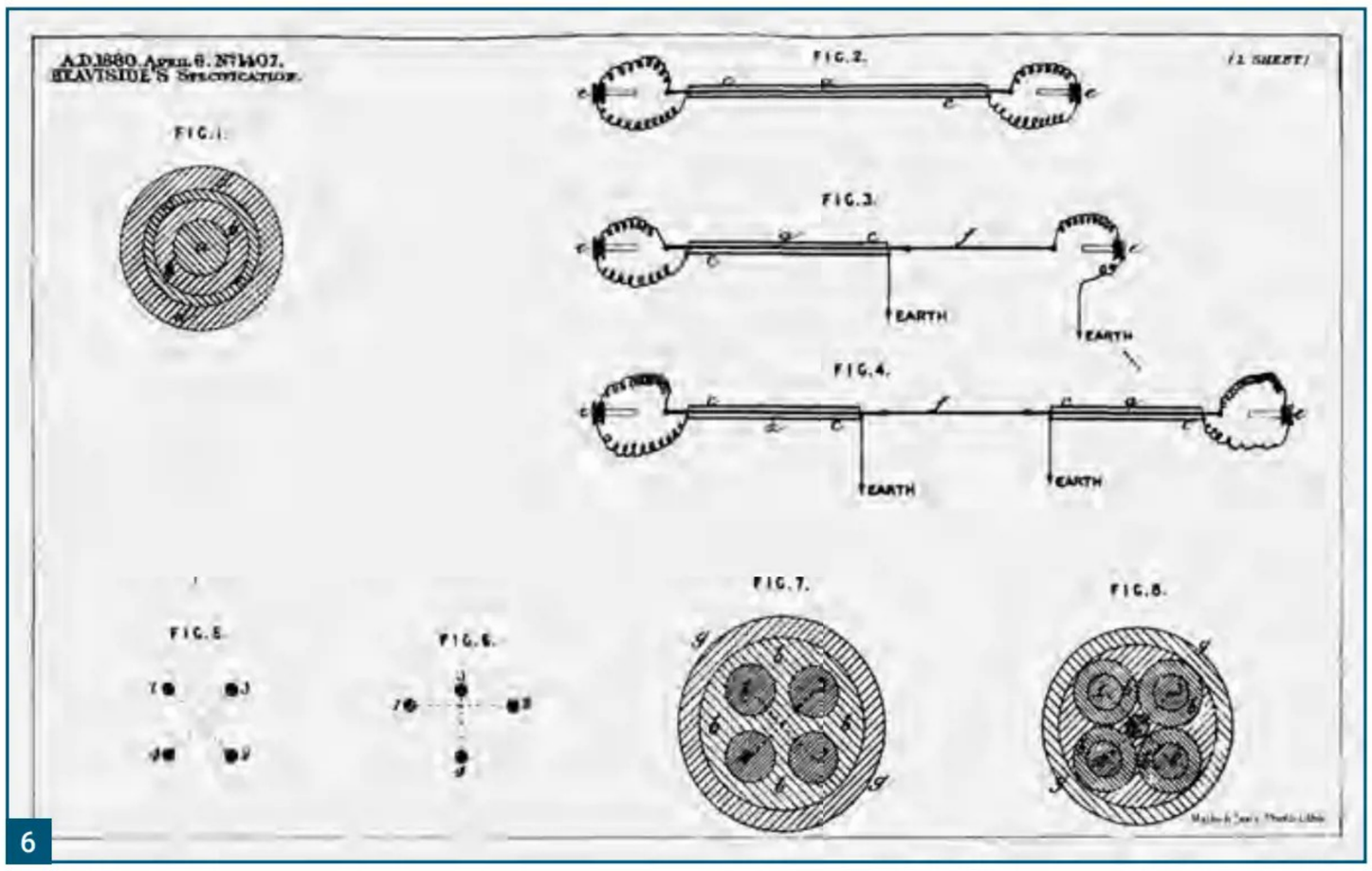
A few months earlier, **Arthur Edwin Kennelly** (American), pictured in **Fig. 8**, had made the same prediction. In 1910 the 'Heaviside layer' name was proposed and accepted, and in 1924, **Edward Appleton** (British) proved this did exist, by sending high-frequency radio pulses straight up and detecting the bounce-backs. For discovering what we now know as the E layer, Appleton was given a Nobel Prize for Physics in 1947.

In 1925 the Heaviside layer was renamed 'Heaviside-Kennelly'. Heaviside probably never knew this, because he'd died earlier that year, falling off a ladder at his Torquay home. He was 75 years old.

Recognition

Heaviside considered that he'd been deprived of recognition and was bitter for most of his life. This seems to have been an occupational hazard for radio greats, I'm learning.

He was, perhaps, partially to blame. He was, by all accounts, a somewhat prickly person with a sarcastic sense of humour, but **Charles Biggs**, the editor of the *Electrician*, **Fig. 9**, stuck by him for two decades.



6

1. $\nabla . E = \frac{\rho}{\epsilon_0}$
2. $\nabla . B = 0$
3. $\nabla \times E = -\frac{\partial B}{\partial t}$
4. $\nabla \times H = J + \frac{\partial D}{\partial t}$

1. Gauss' Law 2. Magnetic Monopoles
3. Faraday's Law 4. Ampere-Maxwell Law

7



8

Thomson, later **Lord Kelvin**, was a supporter and was instrumental in Heaviside being made a Fellow of the Royal Society in 1906.

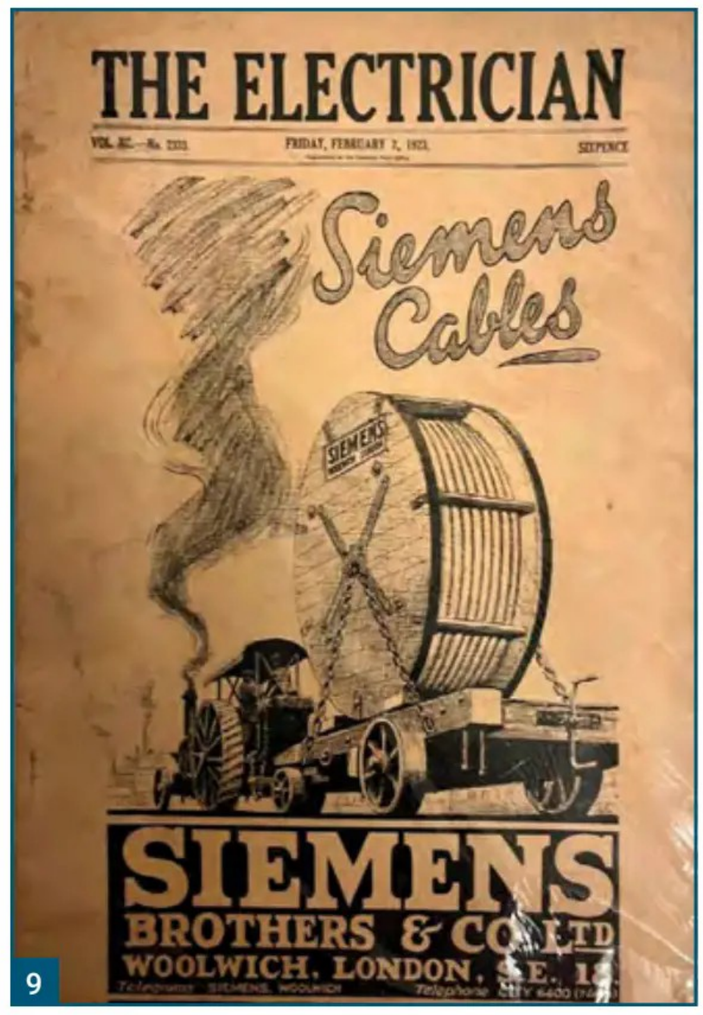
Michael Pupin of Columbia University and **George Campbell** of AT&T studied Heaviside's published work, validated it, built on it and were awarded an American patent in 1904. AT&T offered Heaviside money for his contribution, but despite his poverty he turned them down, unwilling to share the credit.

Conclusion

The world tends to revere and remember 'showy' people – the inventors, discoverers, above all the extrovert self-publicists.

I don't think Heaviside was like that. He was an ideas man. His workshop was his head and his products were his scientific thoughts, laid out in a weekly trade magazine for anyone interested to learn from. How much of today's technology can be traced back to his writings? We will never know.

Oliver Heaviside, we salute you. **PW**



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1

Licence changes, FT8 and more

Steve Telenius-Lowe G4JVG has another full column, as we move into the busy autumn HF season.

Welcome to the January *HF Highlights* and a very Happy New Year to all readers. Just after this column's deadline last month, Ofcom implemented Phases 2 and 3 of their amateur radio licence review. For HF operators, the most noticeable change on the air will be the emergence of M8 and M9 stations. These are Intermediate licensees, formerly 2#0 and 2#1 (where # is the Regional Secondary Locator, RSL, such as 'E' for England, 'M' for Scotland etc). Now 2#0 and 2#1 licensees can, if they wish, change to M8 or M9 callsigns and they may also change the following three letters to ones of their own choice, provided that callsign is available. Ofcom will no longer be issuing new 2#0 or 2#1 calls and wish to phase them out altogether, although those licensees who want to keep their original Intermediate calls may do so.

The RSL *may* still be used but is no longer obligatory *except* by those Intermediate licensees who choose to retain their 2#0 or 2#1 calls. This means that a station with a G4, M0 etc callsign could be anywhere in the United Kingdom, including the Channel Islands or Isle of Man. If the RSL *is* used it must be the appropriate one, so a GM station is in Scotland or an MW in Wales. The 'E' RSL can now be used by any amateur in England. So, to summarise, ME8XYZ is definitely in England but M8XYZ could be anywhere in the UK and Crown Dependencies. Confused?!

Why I like FT8

After the 'Why I Like SSB' and 'Why I Like CW' features over the last two months, it is time for **Eva Telenius-Lowe M9TEL**, **Fig. 1** (who just happens to be my wife!), to explain why she likes FT8. Eva wrote: *"I had been licensed for 24 years before I came into contact with the FT modes in late 2020. My main interest is DXing, chasing new DXCC entities as and when they pop up on the bands. Being a YL and DX station myself (until March 2024), both as 9M6EVA and PJ4EVA, running pile-ups on SSB scared me, to be frank, so until then I had been content with doing the chasing myself.*

"There was something that just 'clicked' inside me when a friend demonstrated FT8 for me in Bonaire. Perhaps it's because I have used computers both at work since 1981 and then at home and have always liked working with them. But the main attraction was to be able to run pile-ups without having to listen and decode a cacophony of voices! The following day both ***Steve G4JVG*** *(then PJ4DX) and I downloaded JTDX and were soon up and running. PJ4EVA went on the air and I have never looked back, I just love it! By the way, I have never run an automatic station, all my QSOs are handpicked as I sit in front of the computer.*

"There are a couple more reasons why I like the FT modes (FT4 as well as FT8, FT4 being twice as fast): 1) You do not need to be a 'big gun' to work really good DX. In fact, I received emails from several JA 'small pistol' stations who had never been able to work PJ4 before. Stealth antennas can be used with great success if you live in a flat, for example (as did one of the JA stations). Simply said, it has opened up DXing to more amateurs. 2) When conditions are challenging on SSB and CW, FT often still decodes. It helps to keep the hobby alive and thriving!"

Solar activity

An X5.1-class solar flare took place on 11 November, peaking at 1000UTC, **Fig. 2**. This was the most intense solar flare of 2025 (so far) and the strongest since the massive X7.1 and X9.0 flares of early October 2024. The solar flux rose to 180sfu and there were HF blackouts across Europe and Africa. The flare caused two Coronal Mass Ejections (CMEs) and led to a severe G4 geomagnetic storm. In the early hours of 12 November visual auroras were seen as far south as Surbiton in Greater London and Florida in the USA, with more predicted for the following nights.

Smaller, but still intense, X1-class flares had also taken place on 9 and 10 November and all emanated from the very active sunspot group AR4274. For up-to-date information and images see:

www.spaceweather.com
www.spaceweather.gov

New CEPT Licence countries

In the May 2025 *PW* I wrote about the 'Forty Years of the CEPT Licence'. I recently checked the T/R 61-01 document, the so-called 'CEPT Licence', for the first time since then and found there had been another update which included three 'new' countries. British amateurs visiting Malta have always had to apply for a reciprocal licence to operate while on holiday there (indeed, I operated as 9H3XY a couple of times in the 1990s). No more: Malta has finally signed up to T/R 61-01 and visiting Full licensees can now sign 9H/own call. Two other countries have also joined the CEPT Licence: Georgia (4L) and the Cayman Islands (ZF).

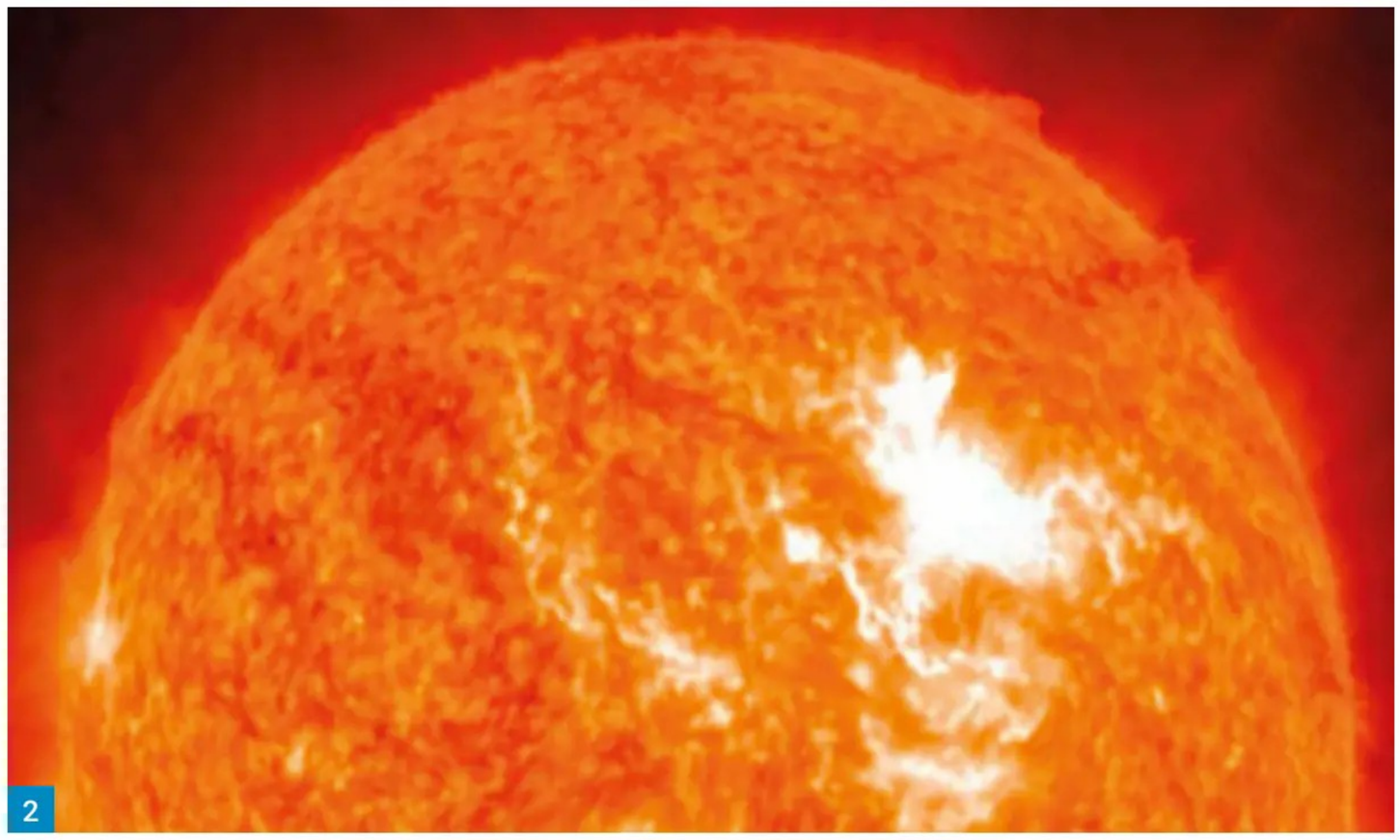
https://docdb.cept.org/download/4541

QSL from yesteryear

The small Russian island of Malyj Vysotskij, located near the city of Vyborg, roughly halfway between Helsinki and St Petersburg, was a separate DXCC entity for nearly a quarter of a century until 2012. The first ever joint East-West

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Fig. 1: Eva M9TEL operating FT8 as PJ4EVA from Bonaire. Fig. 2: The X5.1 solar flare of 11 November 2025 (Photo: NOAA Space Weather Prediction Center). Fig. 3: Back (left) and front of four-sided QSL from 4J1FS dating from 1988. The operators (l to r) were OH2RF, OH2BH, UZ3AU, UW3AX, UR2AR and OH5NZ. Fig. 4: Malyj Vysotskij Island, as seen from the Saimaa Canal.


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DXpedition took place from there in 1988, using the callsign 4J1FS (the 4J prefix then belonged to the Soviet Union but was later allocated to Azerbaijan by the ITU).

My QSO with 4J1FS took place on 9 July 1988 on 14MHz SSB and the four-sided QSL card is shown in **Fig. 3**. The reason this island became a separate DXCC entity makes for interesting reading. To quote from the QSL: *"Malyj Vysotskij Island – M-V Island – is situated at 28º 34' E and 60º 38' N within Soviet territory in the Baltic Sea. The island is about a mile long – lush but desolate and uninhabited* [see **Fig. 4** – ***Ed***]…

"It was on September 27, 1962 that Finland leased M-V Island from the Soviet Union along with the Saimaa Canal which serves as a gateway for shipping from the Finnish Lake District to the seven seas... An ARRL decision of November 17, 1970 to establish DXCC country status for M-V Island was firm and unconditional.

"The first M-V Island operation was long in the making. In the meantime, the island's DXCC status had almost fallen into oblivion. But in July 1988, the last obstacles were finally overcome...

"On November 17, 1988 the ARRL reaffirmed its original decision to add M-V Island to the DXCC Countries list – another new country was born..."

The 4J1FS operators were **Martti Laine OH2BH**, **Pertti Turunen OH2RF, John Ahlbom OH5NZ**, **Enn Lohk UR2AR**, **Boris Stephanov UW3AX** and **Gene Shulgin UZ3AU**. They only had one station, a Kenwood TS-940S with TL-922 linear, powered by a Honda generator, to a KLM KT-34A 4-element triband beam. The team made 14,765 contacts, which might seem a surprisingly small number for what was the first activity from a new DXCC entity, but the station was only on the air for four days.

After the fall of the Soviet Union the prefix used for M-V Island DXpeditions was changed to R1M, with R1MVI used on several occasions. The island remained on the DXCC list until 2012 when, following ratification of the Saimaa Canal Treaty, control of the island was returned to Russia. Malyj Vysotskij was moved to the DXCC deleted entities list on 17 February 2012.

More background on this island can be found on Wikipedia at:
wikipedia.org/wiki/Maly_Vysotsky_Island

425 DX News

One of the sources of DX information used in this column is the *425 DX News*, a free web-based and email DX bulletin. On 1 November *425 DX News* published its 1800th issue, having started in May 1991. Thanks to the editors, **Mauro I1JQJ** and **Valeria IK1ADH**, and the 'Responsible Director', **Gabriele I2VGW**, for over 34 years of service to the HF operating community.
www.425dxn.org

The month on the air

As is normal in October / November, there was a large number of DXpedition and other 'rare' stations on the air. The theory is that propagation on the higher HF bands tends to peak during the autumn months, and the CQ World Wide Phone and CW contests take place in these months. Both factors lead to operators planning their activity in these months. By all accounts, propagation was excellent on 28MHz during the CQWW Phone contest in October, so the theory seems to be borne out! The following are just a few of the many operations active during the month.

The PJ6Y DXpedition from Saba (**Fig. 5**) between 16 and 28 October was a team of mainly young operators, including nine on their first DXpedition. Thanks to a grant from the Northern California DX Foundation (NCDXF), a further 30-plus young amateurs operated the station

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Fig. 5: Logo of the Pacific Island DX Group's PJ6Y DXpedition – from the Caribbean!

remotely using NexGen2 RiBs.

A multi-national group operated as 5K0UA from San Andres, a Colombian Caribbean island, between 16 October and 3 November making 77,000 QSOs.

6O3T was a surprise operation from Somalia by three Italian operators including experienced African DXpeditioner **Elvira IV3FSG**. Between 20 October and 4 November they made 75,000 QSOs.

https://dxexplorer.net

Darek TL8GD is a Polish priest in Bangui, who made over 75,000 QSOs as TJ1GD from Cameroon between July 2024 and 30 October 2025, after which he moved to the Central African Republic. Look for him on FT8, CW and SSB.

9L8MD and 9L9L were two callsigns used from Sierra Leone by members of the Mediterraneo DX Club between 30 October and 10 November. 9L8MD was on the mainland and 9L9L on the Banana Islands, IOTA AF-037. The group made over 101,000 QSOs in total.

ZL7/LZ1GC from the Chatham Islands was activated on SSB, CW and FT4/FT8 from 0001UTC on 3 November.

www.c21gc.com

What to look for in December-January

WE9G plans activity as J3WG from Grenada from 1 to 16 January. He operates FT8, with a little SSB and CW.

VU7R is the callsign requested by a multi-national team for a DXpedition from the Lakshadweep islands between 10 and 22 January.

www.vu2rs.com/vu7r

The Caribbean island of St Martin is divided into French and Dutch halves, with the FS and PJ7 prefixes. IZ2DPX plans to operate from both sides of the island between 13 and 21 January using FT4/FT8 and SSB.

Readers' news

Martin Burch VK4CG recently visited the Queensland Communications Museum which charts the history of Telstra, Australia's national communications provider. Martin wrote: *"This museum is a collection based upon landline and satellite communications through the ages from the early days of telecom landlines to the more recent days of commercial communications... It is well worth a visit with lots to hold your attention if you are visiting Brisbane."* **Fig. 6** shows Martin operating a Traeger radio powered by a pedal generator for use in the Australian bush where no power was available. *"The Traeger HF radio was the original 'Outback' radio but the case was made of timber which kept getting eaten by the termites*



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over here so they changed over in the 1930s to metal casing so the creepy crawlies couldn't eat through it. These radios revolutionised the early days of radio communications down-under using these sets for the Australian inland mission aerial medical service to enable remote families access to medical treatment. The first Traeger HF pedal sets were introduced in 1929."

Tim Kirby GW4VXE has been spending some time setting up remote control software, allowing him to operate his station when he's away from home. He started off using the TS-590SG remote control software provided by Kenwood. Although the radio control software itself worked very well, the software to stream audio from the rig to the operator didn't work reliably on some internet connections. Tim found the DF3CB 'RemAud' software and has used that which seems to work more consistently. The DF3CB software appears to work with any rig that a computer would see as a sound card. Tim says he can get remote audio from his Yaesu FTdx10 in the same way – although he has no radio remote control software to use with this rig. However, with a remote control desktop session and N1MM, for example, the rig could be operated remotely.

The Kenwood radio control software only provides fairly rudimentary CW features – a set of memories and the ability to type into a buffer. It's decent enough for short or 'rubber stamp' QSOs, but the lack of sidetone and the inability to see or hear what the rig is sending is challenging! Tim is working on using two Winkeys, which can be connected over the internet. So, in theory, it should be possible to have a keyer and paddle plugged into the remote PC and this will key the rig 10, 100 or 1000 miles away.

Jim Bovill PA3FDR wrote: *"Although 15m (21MHz) still remains the most prolific band for DX activity, it has been good to see a return this month to better conditions on the upper HF bands and also with activity on both the FT8 and especially FT4 modes. I managed to log three new DXCC entities this month, Singapore (9V1DE), Cameroon (TJ1GD), and French Guiana (FY/PY8WW). One interesting contact was with the Pacific Island DX Group (PJ6Y) on 15m FT4"* [from the Caribbean island of Saba – ***Ed***].

Reg Williams G0OOF reckoned it was very difficult to resolve signals from V6D in Micronesia, but he *"managed to complete a contact on 30m, which is another tick on my DXCC list for a confirmed FT8 contact on any band... E51MWA, North Cook Islands, I was really keen to work this DXpedition but unfortunately it was very difficult to resolve their signal. Just hoping their signal strength would improve and, with assistance, DX Alert etc, I would be on the right band at the right time. It was not to be [the activity was cut short] due to a fire in the power station generator room...*

"5K0UA, San Andres and Providencia, suffered a great deal from local high noise levels. Their FT8 signals were strong on most bands. Lots of callers, but the team could not hear many of the weaker stations calling... Surprisingly, I worked them on 24MHz one early evening. Early next morning it was possible to work the DXpedition on 10MHz and 24MHz FT8. Although I could hear the operator on certain bands on SSB, it was impossible to work them. Noisy bands and many callers... One particular band stands out, which is 28MHz. This has been open in the early mornings for DX."

Owen Williams G0PHY said that his *"highlight of the month was a long stint on the Saturday of the CQWW Phone contest at the Shefford Club's contest station using the call G3B. The highlight on 21MHz was working VK9A on Norfolk Island in the early morning. Most of the time was spent on 28MHz and the band was wide open with world-wide contacts. There were many QSOs with China, Japan, North and South America and a few with Africa and with KH0/KC0W on the Mariana Islands in Oceania. Things were a little slower at the home QTH. I found conditions were variable with the A-index remaining high for days on end. However, I did manage to get 5R8TT and 9L9L both on 14MHz and 9L8MD on 28MHz during the last week."*

Carl Gorse, formerly 2E0HPI, has changed his callsign to **M8HPI** and says *"This really helps, especially working stations in North America. I managed to work another new state for Parks on the Air (WA) and it was also on SSB... I have also set myself a challenge for the past 14 days to see how many contacts made running the small (tr) uSDX 5W transceiver* (**Fig. 7**)*, with nearly 800 QSOs activated and the most recent one in London at St James's Park by the Palace."*

Etienne Vrebos OS8D had *"a horrible month"*. Why? He lost his voice, which he admits could be punishment for his hubris after writing that he only ever uses SSB (see *HF Highlights*, November 2025, page 38). *"I'm still not fully OK concerning my voice, but I did not even think about going digital. My wish to start CW again (must be the 10th time!), took my paddle out... I can send an 'A' (di-dah) after one week, but nobody replied to my di-dah!"* His doctor told him not to speak for three to four weeks, *"nevertheless I could not stay silent and made about 600 QSOs at home (short*

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QSOs with a 59 thank you only) and I went twice on activity by motorcycle and made only 220 QSOs... I really hope being able to talk normally again ASAP and I've learned the lesson: never being proud of using SSB only, and there my 'friends' have a huge advantage using CW and digital modes."

28MHz beacons

Our regular 'beaconologist', **Neil Clarke G0CAS**, wrote: *"From time to time I get asked what the fascination is with 28MHz beacons. Well, their primary function is to inform you that the band is open between your location and where the beacon is located. The vast majority of beacons run 10W or less to a simple dipole or vertical antenna and this fills me with optimism and excitement that my 50W of CW from a Yaesu FT-891 to an Ampro vertical antenna when out Portable from within my car will produce QSOs, and it often does."*

Here's Neil's 28MHz beacon report for October 2025. Sporadic E continued to take place, for example to Italy during the morning of the 8th, the afternoon of the 10th and again during the morning of the 25th, when IW3FZQ 28228 running 5W, IZ8RVA 28240 at 6W and IQ8BB 28260 (power not known) were logged. Also from Italy, several new beacons have appeared over recent months including IW8PNY 28185, IU4RTQ 28195, IZ8JFA 28250 and IQ7PU 28288.

From North America, USA beacons were heard every day from the 4th except on the 8th, but it was not until the 22nd when all the ten USA call areas were heard for the first time this DX season, thanks to beacons KI6MTV 28250 running 40 watts and NG7I 28231 at 5 watts being logged. The other eight call areas were heard on 13 days during the month with a lesser number on other days. VE3TEN 28175 (10 watts) was logged on 19 days with 559 reports while VA3XCD 28170 was heard on 16 days and it runs only 2W.

Down to South America and both LU2DT 28193 running 5W and PY4MAB 28270 running 10W were logged on every day of the month. Closer to home, 5B4CY 28219, running 6W, was logged on 18 days and YM7TEN 28225 running only one watt was logged on 24 days.

Band highlights

In order to give these band reports more meaning, the two letters in brackets following the reporter's callsign mean the following: "**Q**": Most or all QSOs were made using QRP (<20W); "**M**": Most or all QSOs made with Medium power (20 – 100W); "**H**": Most or all QSOs made with High power (>100W). "**S**": Single-element antennas used on all bands; "**B**": Beam used on 14 to 28MHz bands (anything with two or more elements).

Martin VK4CG (MS): 14MHz SSB: CB3A, KH6J, YL2SM. **21MHz SSB:** JA7YRR, S53MM. **28MHz SSB:** 3D2AG, BD7IS, DX1ARM, FW5K, HK1T, JS6TSE, NN6P, VE7BC, YB2CPO.



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Fig. 6: Traeger radio with pedal generator in Brisbane's Telstra museum, with Martin VK4CG having a go! Fig. 7: Carl M8HPI operating the (tr) uSDX 5W transceiver.

Tim GW4VXE on FT8 / **GW4MM** on CW **(HS): 3.5MHz CW:** VK6LW. **3.5MHz FT8:** 9L8MD. **7MHz CW:** 9L8MD, 9L9L, VK2GR, VK3ACU. **10MHz CW:** 9L8MD, FS/DL8DYL. **10MHz FT8:** 9L8MD, 9U1RU, ZL7/LZ1GC. **14MHz CW:** 9L8MD, K6AR (CA), V4/K5ZD, VK2GR. **18MHz CW:** 9L8MD, AA7FV (AZ). **18MHz FT8:** 9U1RU. **21MHz CW:** 9L8MD, K6AR (CA), P40W, V26K, V4/K5ZD, VK5GG. **24MHz CW:** 9L8MD, HP3/VE3DZ. **28MHz CW:** 9L8MD, CX5FK, TI5/N3KS, V26K, W6ZBA (CA), XQ6CF. **28MHz FT8:** 5K0UA, VP2MAA.

Jim Bovill PA3FDR (MS): 14MHz FT8: UN3P, VK2LAW. **18MHz FT8:** FY/PY8WW, HK3X, JA4FKX, PP5ZP, VO2ET, ZL1VAH. **21MHz FT4:** 7Z1GF, 9V1DE, E21EIC/8, PJ6Y, JG8LOL, VE6WQ. **21MHz FT8:** 4L/UN7IDW, A71GA, AP2FLY, BA7SAY, CX6TU, EX7CQ, FG5FI, HL5YOO, JA1IFD, PU2YFR, RA0AG, TJ1GD, UN7LEW, VA7QI, VU2SW, YC1RHC, ZD7CTO. **24MHz FT4:** ZS6KBS. **24MHz FT8:** 4L4DX, 7M4HOA, BI4IWL, KE7AUB, UA0SU, ZB2CM, ZS4AW. **28MHz FT4:** A99AA, JF6TLZ, UA0FF, VE3/UT3UA. **28MHz FT8:** AA7A, BG7SFE, CX1TF, JA4NIJ, PU8WZS.

Reg G0OOF (MS): 7MHz FT8: 5X2I, FY/PY8WW, YD2ULK. **10MHz FT8:** 5K0UA, V6D. **14MHz FT8:** KL7HRO. **21MHz FT8:** TJ1GD. **24MHz FT8:** 5K0UA, PJ2/DH8BQA, TJ1GD. **28MHz FT8:** 9J2FI, FM5GB, HK3ESF, TJ1GD, VP2MA, ZD7CTO.

Owen G0PHY (HS): 7MHz SSB: FM5/VE3LA. **14MHz SSB:** 5R8TT, 9L9L. **21MHz SSB:** N6AR. **28MHz SSB:** 9L8MD.



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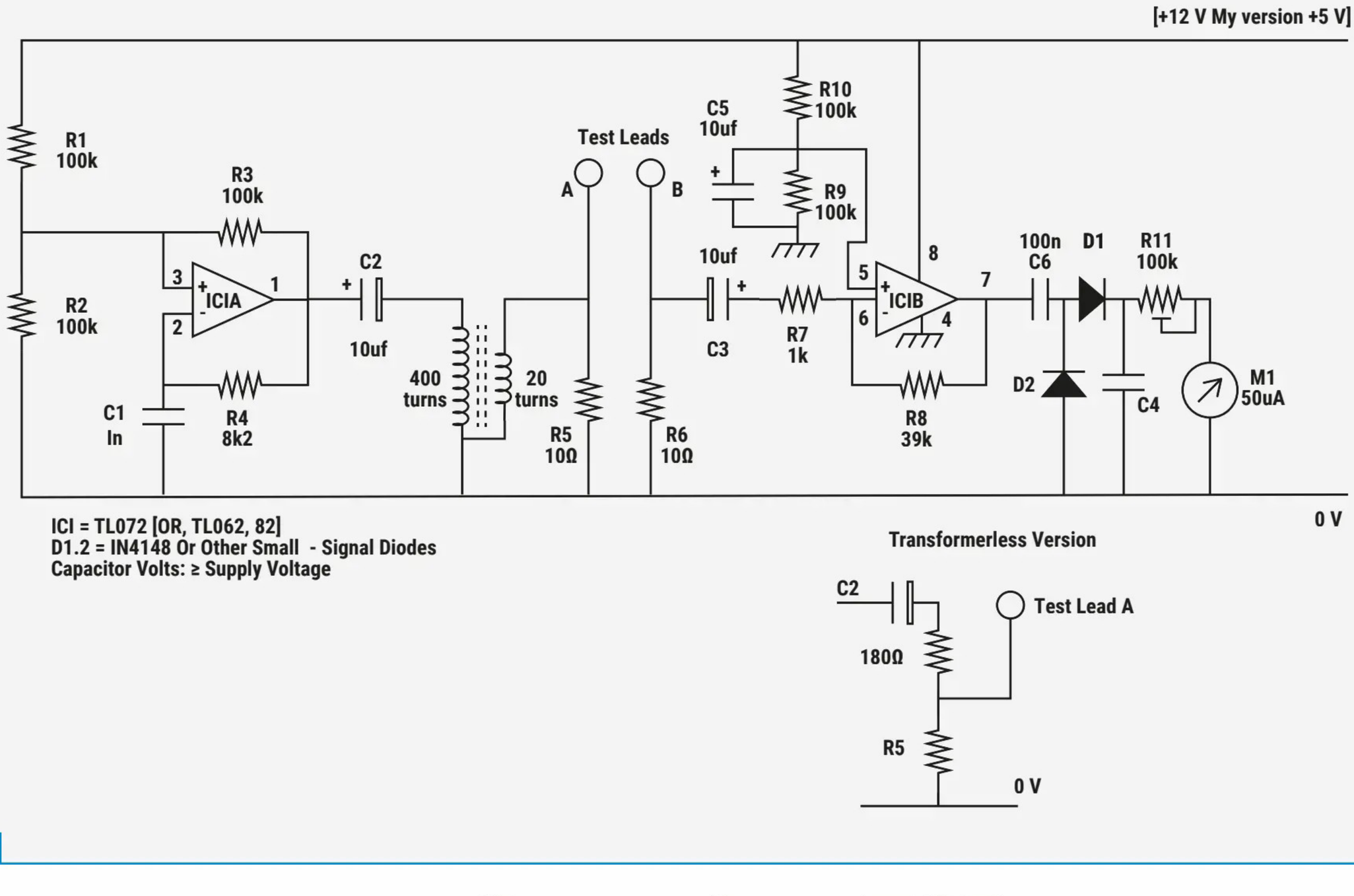
Carl M8HPI/P (MS): 18MHz SSB: KB9MYP, W4O. **21MHz SSB:** KK7CSK (US-3227, WA), VE3ZN.

Etienne OS8D (HB): 14MHz SSB: 9L8MD, VK2SR. **18MHz SSB:** 9U1RU, PJ6Y. **21MHz SSB:** EP2EPL, PJ2/PC8M. **24MHz SSB:** D2A, J62K, OX3MC, VP9NT. **28MHz SSB:** 8P5A, 8P5UD, 9Y4M, B1Z, BD7IS, BG0DXC, C5Y, CA3HHE, D2A, FS5GL, HJ4V, J38LD, J88IH, JH8RJS, LU6HPA/P, OA4O, PJ4G, PZ5DX, TI2CMM, UN7CFI/P, YJ0CA, ZL2GUN.

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 March issue the deadline is 11 January. Photos of your station, antennas or you in the shack are always welcome. 73, Steve G4JVG. **PW**

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Philip Moss M0PBM
practicalwireless@warnersgroup.co.uk

Capacitor ESR meter

Philip Moss M0PBM has a handy constructional project.

The article (*From the Ground Up*) in the December 2020 *PW* inspired me to share this little project with you. It combines simplicity with being very useful, and is a very clever design. I hasten immediately to say that alas I am not the inventor, but I do offer a couple of modifications. I found this on the web at:

www.ludens.cl/Electron/esr/esr.gif

where there are other things too.

To start at the beginning (a very good place to begin: as Julie Andrews once told us, singing), the term ESR may well be unknown to you. It is Effective Series Resistance, a reference to an inescapable imperfection of components that ideally would have none. It applies mainly to capacitors and inductors (chokes and transformers). There is another term with regard to resistors and capacitors, among other things: ESL (Effective Series Inductance), and this meter measures that, lumped in with resistance.

The next thing is why does it matter? And when would one need to measure it? For our purposes, it will almost always be when carrying out a repair, though when selecting a component for a project it may be a good idea in some cases to check first. A most obvious case is where a power supply, especially a switched-mode one (SMPSU), is not working, but has not blown up, and may well be OK voltage-wise till one tries to draw much current. These can be very awkward to work on as much of it is live-to-the-mains, combined with very small SMD (surface mount device) components. This test can be carried out with no need to power, and no problem with connected circuitry as it only produces 200mV peak, so cannot even turn on Schottky diodes. So why it matters. A capacitor may well show the correct value, and not be leaky, yet not work. The reason being that it has a high series resistance, so current can neither enter nor leave at the rate one would expect. This is especially important at high frequency. The capacitor is effectively part-disconnected from the circuit. An in-circuit check can find it and enable a quick repair. One can have problems in RF and AF circuits too. An interesting aside – while old electrolytics can be low-value, often they are much larger than they were originally. Strange but true. This can also apply to waxed-paper ones. I assume that corrosion in both cases increases the effective surface area of the foils, which in modern electrolytics is done when they are made to a great extent, hence the very small size of them compared to old ones.

The circuit

So to the circuit. In its original form, it runs off 5V regulated down from a PP3 9V source using a 3-terminal regulator. This feeds the exceedingly useful TLO72 dual OpAmp IC. The first half is an approximately 50kHz oscillator, driving a square-wave into the primary of the step-down transformer. This, one is told, can be made by re-winding a gap-less ferrite transformer possibly from a scrap TV or PSU, 400 turns primary, 20 secondary. I didn't like that idea, so I have used a 12V supply, from the mains, and a 180Ω resistor, in series with the 10Ω, R5. The output is therefore at very low impedance, whichever way one does it. It 'sees' another 10Ω on the input side to the detector, feeding the other half of the IC, which is an amplifier providing enough volts to turn the two diodes on in the voltage doubling rectifier circuit, which drives the meter. Again, a difference with mine – I don't

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Fig. 1: Circuit diagram.
Fig. 2: The finished meter.
Fig. 3: An internal view.

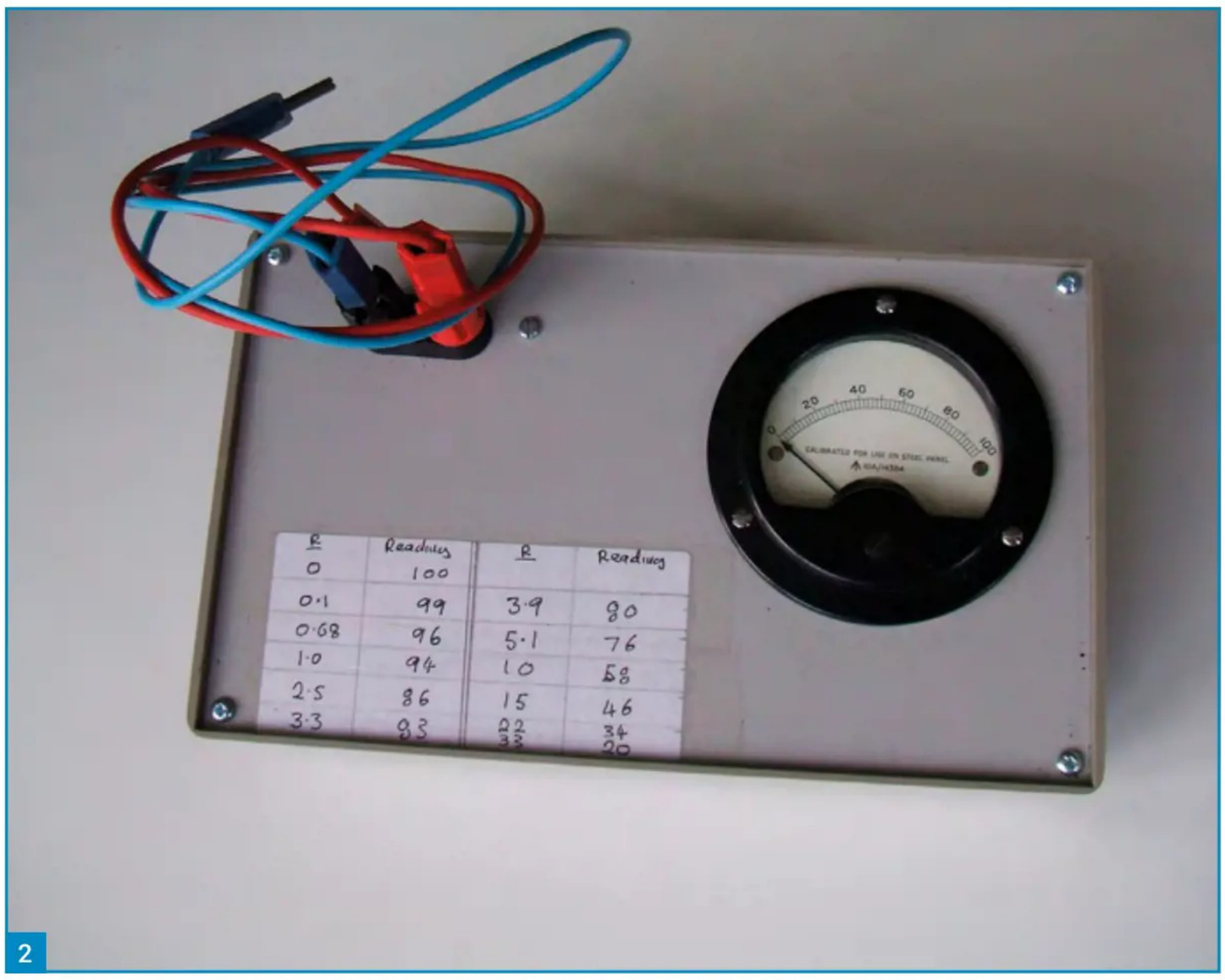
want to use a high sensitivity meter where a less so one will do. I suspect a 1mA would be fine, but anyway I used a 100µA. The value of R11 would need to be reduced probably. I built mine on Veroboard, but it could be 'dead-bug'.

For those unfamiliar with the use of OpAmps, they usually have two inputs, marked + and -, which do not mean negative and positive, but that the + terminal will not invert the phase of the signal, ie a positive-going signal will come out positive, and vice-versa, and conversely a +Ve signal applied to the - or inverting input will come out negative. This allows negative feedback to be applied across the amplifier among other uses. Here the -Ve inputs are used for signal both times, but the +Ve input is used to carry DC bias at half the supply volts. OpAmps are often used with split, or symmetrical supplies, such as + & - 15V about earth, or common. In battery operated equipment, it would be inconvenient to have to use two to achieve this. R1 & 2 biases the first half, R9 & 10 the second half. The shown IC is the 'posh' version, TLO62, the ceramic packaged type. This is not needed. One could probably use TLO82, the low-current type, but I have not tried. My PSU was a very small mains transformer, I think 1.2VA, and a Zener-stabilised supply. There were not enough spare volts to run an IC regulator.

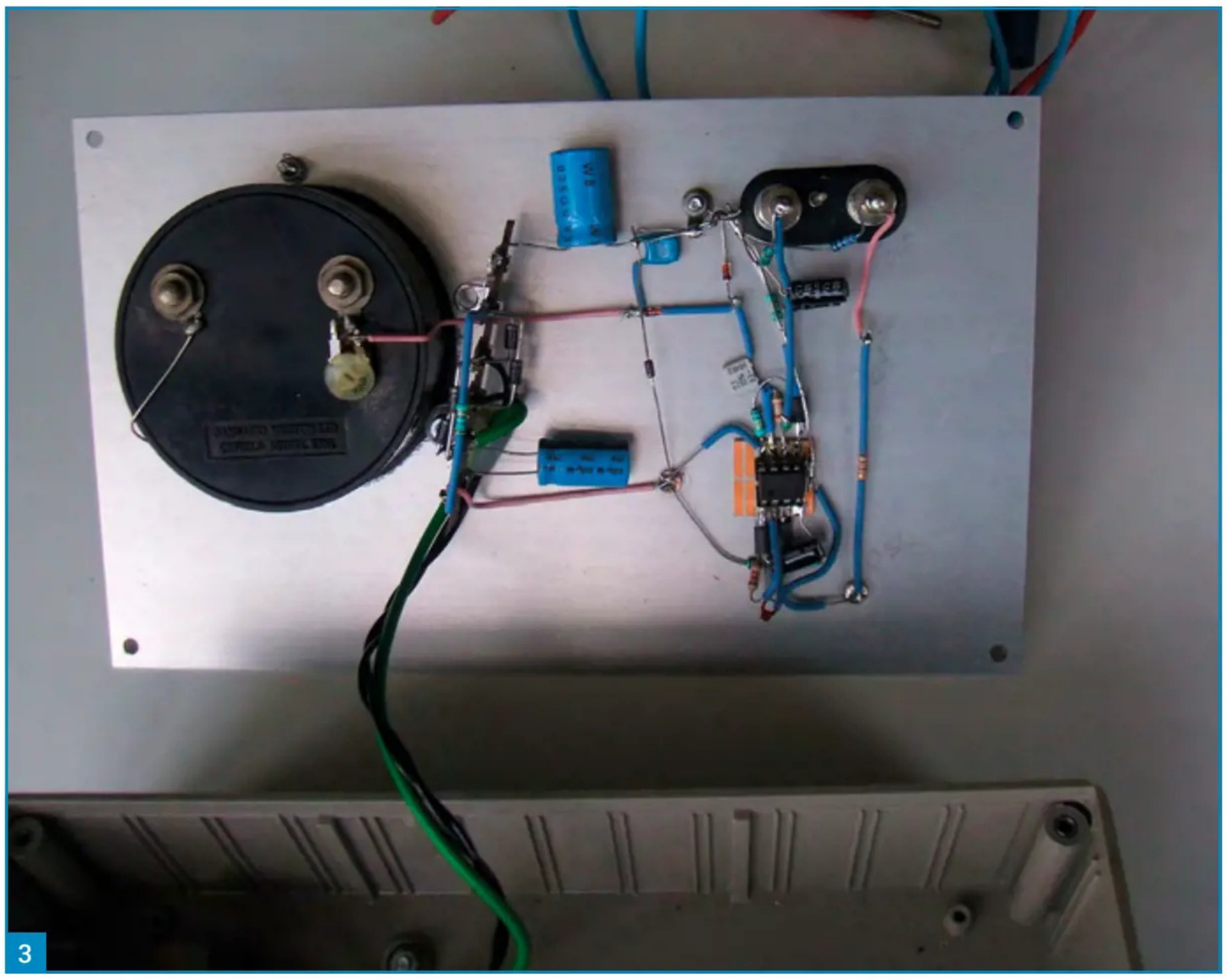
Calibration and use

Firstly, join the input and output terminals, and with the pre-set resistor, R11, at full resistance, turn on. Set the meter for FSD (full scale deflection). Now you will need a number of low value resistors from about 0.1Ω to 100Ω. Add the lowest first between the terminals, and note the meter reading. Then progress till the meter hardly moves. One can now make up a table of meter reading versus resistance.

To use, apply the terminals across the capacitor. Modern electrolytics will show a very low ESR, ie almost FSD, even small values. If they are higher, then they are probably duff. You will need to learn from experience, and use some judgement, an example being don't expect very low readings from old electrolytics in valve sets, or you will be changing perfectly adequate components. You can go through your collection and see the variation between different capacitors of the same value. This instrument is useful down to about 1µF, though modern polymer-film caps can show low at smaller values. Try comparison with some old 'waxys', waxed-paper dielectric capacitors.



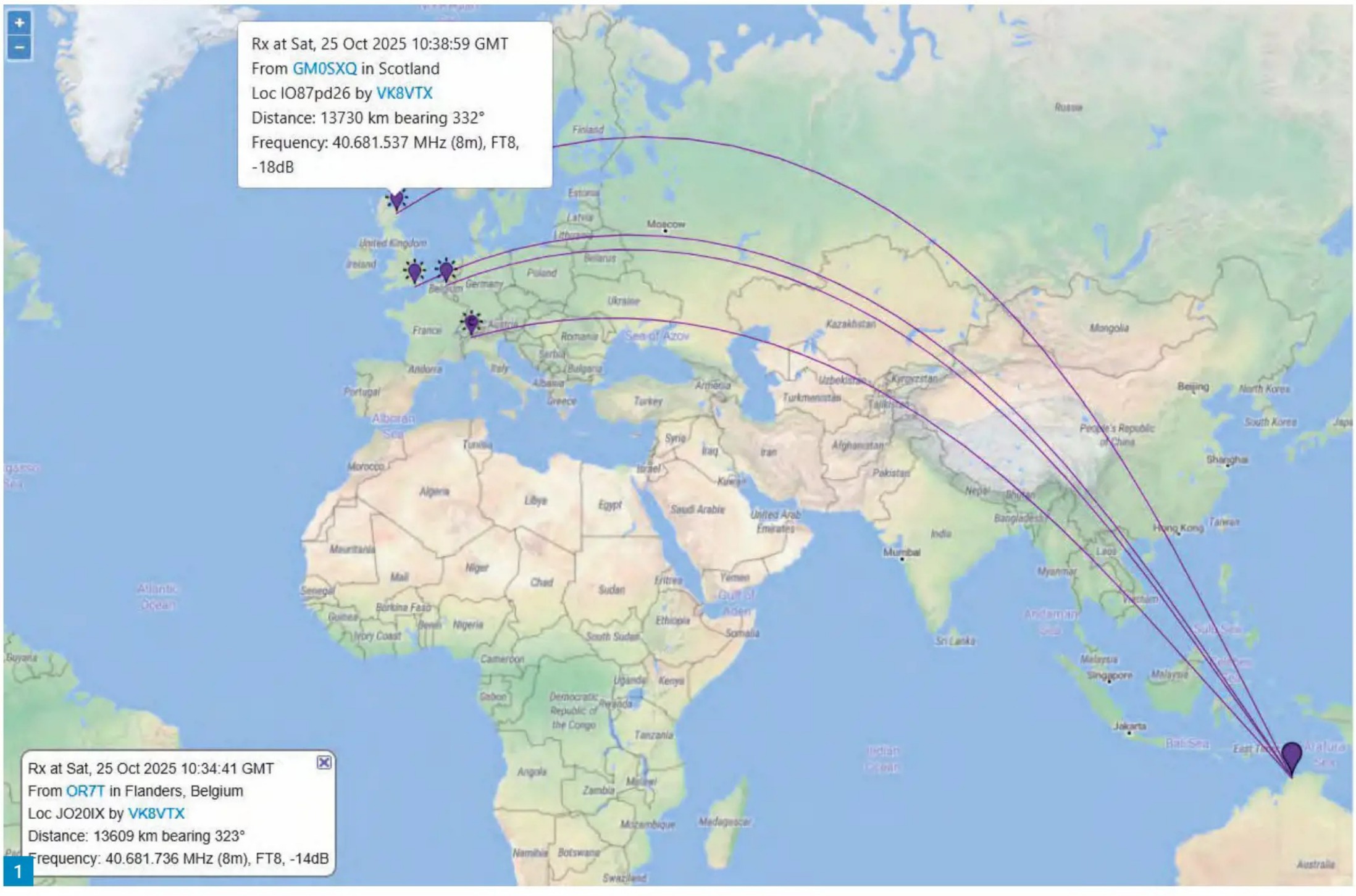
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I have found this a very useful little project, and am much indebted to its designer. Sadly no name given so I cannot make this personal.

A bit more on the TLO72, and the like. These are general-purpose ICs, with very many uses. They can be used in instruments, especially the expensive versions with very low offset voltages, not needed here. In audio they give very high gain without feedback, and will in almost all circuits be used with a lot of feedback. They can do low-level audio, with very low noise and distortion and wide bandwidth, though bipolar devices are better here, such as NE5534 (single) and NE5532 (dual). Yes, I have got that the right way round. The TLO71 is a single OpAmp, the TLO74 is a quad. They can drive headphones to adequate level, especially if they are reasonably high resistance. The maker's datasheet is bound to be online, with many worked examples of circuits. The 8x series are very low quiescent current, and the 6x are ceramic packages which meet military spec. **PW**

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Looking back on 2025

Tim Kirby GW4VXE reflects on VHF/UHF propagation and activity during 2025.

Looking back over the past 12 months, it seems we have almost certainly seen the peak of Cycle 25, with some observers putting the peak as early as October 2024. Cycle 25 has been the first 'solar maximum' that I have been able to observe without the constraints of corporate work. And it's not what I expected! Certainly, this summer saw the HF bands in poor condition for several months with very few 'good' days. Why? Simply, because there was so much geomagnetic disturbance going on, the bands never got a chance to recover. The geomagnetic disturbances almost certainly affected the VHF Es season too. Although there were some good single hop Es openings, the extended openings to both North America and Japan were simply not present this year. It will be interesting to see how quickly this recovers and whether 2026 will return to a more 'normal' pattern.

Of course, that's not to say that there haven't been some outstanding contacts made on 50MHz this year – there have – and I'm sure many of us, if we look back through our logs for the year will find plenty to be happy with. Whatever, there was certainly plenty to learn – which after all, is what it is all about.

WSJTX-Improved and JTDX-Improved

The WSJT-X software written by **Joe Taylor K1JT** and his talented team continues to evolve and as part of that there have been some interesting alternative versions of the software.

Uwe Risse DG2YCB is part of the WSJT-X development team, but he also has his own 'improved' forks of both the WSJT-X and JTDX software. I have been using WSJT-X Improved for some time and enjoy some of the extra facilities it provides, including the ability to automatically upload QSOs as they are made to the '*Cloudlog*' logging system conceived by **Peter MM9SQL**. There are also features such as 'Wait and Pounce' so you can have the software wait for a station to come up and then call and, hopefully, work it! Yes, there are ethical and licensing implications to using that feature, but it's available should you be able to use it and you wish to use it. Also, the latest version 3 of the software includes a multi-threaded FT8 decoder which may provide quicker decodes, depending on the architecture of the machine it's running on. It's well worth a look if you are a WSJT-X user. You can read more at:

https://wsjt-x-improved.sourceforge.io

Although I didn't realise it until I wrote this piece, as I am not a JTDX user, there's a JTDX-Improved fork as well, which will almost certainly be worth a look for keen JTDX users. You can find more information about JTDX-Improved at:

https://jtdx-improved.sourceforge.io

Activity Night for 70MHz

It was good to hear from **Mark Payton 2E0VOV** who is promoting a new national activity night for 4m. The event will be held on the 4th of every month from 1900 to 2100 local time. Mark chose the 4th to be memorable and says the day of the week will change as the months roll on, allowing more people to take part. Mark says that the event is not a contest but has been inspired by the loss of the RSGB 4m FM Activity Contests. FM with a vertical antenna is the preferred choice for these events but Mark

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Fig. 1: Stations heard by VK8VTX on 8m on 25 October. Fig. 2: G4ALG's 23cm antenna and mast head transverter. Fig. 3: Endaf N6UTC working satellites during his recent October road trip to the AMSAT Symposium.

says that of course, all activity on the band is welcome! Mark has started a Facebook group for those interested:

www.facebook.com/share/g/14MUJsEeW9m

This sounds a great idea and I'd welcome any reports on contacts made during the events, or on 4m in general, of course.

The 8m band

Paul Farley G7PUV (Sussex) operating on 8m as G9PUV, found the autumn season was fairly slow to get started, but on 25 October, Paul's FT8 signal was flagged by VK8VTX (PH57) as well as a WebSDR in the same area. Paul says that reception on the WebSDR was particularly interesting as the aerial in use there is a vertical dipole cut for the FM broadcast band. **Marshall GM0SXQ** (Aberdeenshire) was also heard by VK8VTX during the same opening, **Fig. 1**. On 8 November, Paul was very happy to have a two-way contact with VK8VTX, if a little surprised as the geomagnetic field was fairly disturbed at the time. There was a fair amount of fading on the signal, with signal strength ranging from nothing to -4dB during the contact. Paul says that ZL2WHO continues to run a beacon, ZL28M on 40.680MHz, but that he has not decoded it so far this season.

The 6m band

Roger Lapthorn G3XBM (Cambridge) says that on every occasion that he has been on the band with 5W to his V-2000 vertical he has been widely spotted in continental Europe. Roger says that he has no way of telling if this is Es, although he says it looks very much like it.

Jef VanRaepenbusch ON8NT (Aalter) had a good day on 30 October, working C5R (IK13), OH6KTL (KP02) and SM5CUI (JO89).

Phil Oakley G0BVD (Great Torrington) worked C5R (IK13) and EA5NW on 30 October.

Paul G7PUV has an RX888 SDR connected to his IC-7100 via an RF tap, allowing him to monitor all low VHF and therefore can monitor 50MHz FT8 at the same time. On 8 November, Paul had a couple of decodes from A71QO around 1230UTC.

Dave Edwards G7RAU (The Lizard, Cornwall) found plenty of DX on the band: 11 October PY, HC and VE; 12 October HB9 on tropo; 21 October PY/LU; 24 October FR5CU; 25 October TZ4AM, XT2AW and PY; 30 October TZ4AM, C5R, LU, KP4 plus backscatter to EU and Middle East, 31 October 9L8MD and 2 November 6O3T. Dave says that he has missed both VK and JA openings, so the cycle is still providing plenty of DX if you are around at the right time.

Highlights here at **GW4VXE** (Goodwick, Pembrokeshire) were C5R (IK13) and EL2BG (IJ46) worked within ten minutes of each other on 30 October for two new DXCCs on the band. The expedition to Sierra Leone, 9L8MD has also been heard, but sadly not worked.

The 2m band

Roger G3XBM takes part in a local net on 145.550MHz every Wednesday at 8pm local time.

Jef ON8NT worked G0LTG/P (IO81) on SSB during the contest on 7 October. The 11th and 12th were good days and Jef's FT8 log includes MW0AXA (IO81), MI0IHH (IO74), M0DSR (IO82), EI3KD (IO51), OZ9KY (JO57), EI4ACB (IO62), G7RAU (IN79), DG8NCO (JO50), GI6ATZ (IO74), G0HVQ (IO81), HB9EFK (JN46), EA2XR (IN83) and GW7SMV (IO81).

On 12 October, Phil G0BVD worked 2W0JMK, M7GFJ/P and G0LTG all on SSB.

Ian Bontoft G4ELW (Bridgwater) enjoyed the opening on 12 October, making some nice QSOs with 15W of FT8 to his 5-element Yagi; HB9MKV (JN37), F6GHG (JN28), HB9EFK (JN46), F6GCP (JN18), F1NQP (JN19), F0EYI (IN98), F1GTU (JN05) and EA2XR (IN83). Ian says that the propagation seemed to swing around from the East to the South as the day went on and by the next morning, he was hearing Scottish stations although he could not raise them and then, by the afternoon, the tropo had died out.

Steve Rawlings G4ALG (Lydney, Gloucestershire) writes, *"Although I've been short of spare time recently, I usually manage to join the weekly 'Two Metre Tuesday' 2m CW activities. In addition to local chats on a Tuesday with G0NXA, G0SDD, G4KKU, and G8EJN, I often have a natter with more distant stations such as 2E0JGV (Norwich, now M9BLX), G3YPZ (Long Sutton), G4GIR (Bedford), G4RHR (Felixstowe), and M0GSX (Dudley). This CW activity starts at 1800UTC every Tuesday around 144.050MHz, with the majority of stations joining in from about 19:00".*

Andy Adams GW0KZG (Letterston, Pembrokeshire) had a number of QSOs in early November with UT1FG/MM travelling from Montreal to Waterford. Andy used meteor scatter and the FSK441 mode for his contacts to HO53, HO63, HO73, HO83, IO31 and IO41. The most distant contact was 1672km to HO53CO. Thanks to **Yuri UT1FG** for his activity from interesting squares on several VHF bands.

Dave G7RAU says that the tropo on 11 and 12 October was 'mad' with QSOs to DL/OZ/EI/SM/SP/GW/PA/ON/G/OK/F/OE/OM/HA/HB/I/GM/EA/GI/LX. The best DX was HA5UA (JN97) at 1844km. Dave says that he heard the OY beacons on both 2m and 70cm for two days, but sadly there was no QSO.

Here at GW4VXE, despite only having a vertical up for the band, I was delighted to work DJ5AR (JN49) during the tropo on 12 October at a distance of over 1000km. It was also great to work UT1FG/MM from IO31, IO41 and IO51 squares on 3 November.

The 70cm band

Jef ON8NT runs 25W from an IC-9700 to a 5-element LPDA and reports the following, all on FT8: 8 October GW4HDF (IO81); 11 October EI3KD (IO51), GW4HDF (IO81), GI6ATZ (IO74); 12 October DF4IAE (JN49), DJ6AG (JO51) and then on SSB on 14 October; G1YBB/P (IO82), MW0LKX (IO82), GI4SNA (IO64), G0CNN/P (IO94) and GW8ASD (IO83).

Steve G4ALG writes, *"Poor propagation*

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conditions have made the weekly 70cm Friday CW activities quite challenging! With fewer /P stations active during the winter months, more participation in these activities by fixed stations would be much appreciated. This CW activity starts at 1800UTC every Friday around 432.050MHz, with most contacts taking place between 1900 and 2000UTC".

Dave G7RAU found the tropo on 11 and 12 October excellent, with QSOs to SM/PA/G/DL/SP/OK/F/OE/ON/HB/GM – he says he thinks HA would have been possible, but he was working.

During the tropo on 12 October, I was pleased to work GM0HBK (IO77) and MD0MAN (IO74) using 50W of FT8 to a vertical.

UT1FG/MM can be active on 70cm FT8 and it was good to see **Mark EI3KD** work Yuri from IO41 on the band.

The 23cm band

Steve G4ALG writes, *"I have installed my SG Laboratory 23cm transverter and 25 watt PA/LNA in a waterproof diecast enclosure. Following some testing on the bench, I then mounted the assembly and my home-made 16-element Yagi on a portable mast in the garden* [**Fig. 2**]. *This setup will probably remain like this through the winter. Skeds would be most welcome!"* Contact details for G4ALG are on QRZ.com.

Dave G7RAU made four contacts during the tropo on 12 October, including three DL stations and a G. Best DX was DC1NNN (JO50). Perhaps surprisingly, Dave says that the band was not open for long.

Satellites

Jef ON8NT reports receiving 41 SSTV pictures in total during the ARISS SSTV event held between 3 and 9 October and says that around 20 of those were of good quality. Jef also heard OR4ISS from the International Space Station during the schools contact on 9 October at 1037UTC. Jef also enjoyed an FT4 QSO with F5RRS (JN36) on the RS-44 satellite on 5 October.

Thanks as usual to **Patrick Stoddard WD9EWK** (Phoenix) for his interesting wrap-up of satellite activity in North America and beyond. Patrick writes, *"AMSAT held its annual Symposium in Phoenix on 17-20 October 2025. **Endaf N6UTC/MW1BQO** made the drive from southern California to attend this event, and that meant it was time to get out and work satellites from different places. On the Friday morning of that weekend (18 October), Endaf and I drove south of Phoenix to the area of a four-grid junction (DM32, DM33, DM42, & DM43 - 33° North, 112° West). We parked on the DM32/DM42 line for some passes. After that, we went a few miles north to a spot on the DM33/DM43 line. We visited two more grids the next morning (Saturday, 19 October), the DM34/DM44 line about 80 miles north of Phoenix.*

*"After the Symposium wrapped up, N6UTC went home, and I started a road trip to New Mexico. A long-time satellite operator, **Gene KJ4M** in Alabama, had worked all but one of the 488 grid squares covering the continental USA, DM82. Much of the grid covers southeastern New Mexico, along with part of the Texas 'Panhandle' (northern Texas).*

"On Monday 20 October, I left my house early in the morning. About 3.5 hours later, I reached New Mexico. There was an SO-50 pass coming up, so I stopped at a truck stop in the small town of Road Forks, in grid DM52. I worked the SO-50 pass, and then resumed my drive. An hour later, I reached the DM52/DM62 grid line. From this location, I worked four passes within an hour - one each on SO-50, SO-124, SO-125 and the ISS cross-band repeater.

"I left Alamogordo early in the morning and drove east on US-82 toward the DM72/DM82 grid line. I made it to Artesia, west of the grid line, and made a quick stop for breakfast. After that stop, it took about 20 minutes to reach the DM72/DM82 grid line. After pulling off the road and setting up my station, I took pictures to document my location, and prepared to work KJ4M.

"Just after 1500UTC, there were several passes available to KJ4M and me, starting with AO-91 and JO-97. AO-91 has had issues turning on even when it is in sunlight. On this morning, AO-91 came on - barely. It was on long enough for KJ4M and me to make a contact, before it switched off for the remainder of the pass. KJ4M's quest to work all 488 grids in the continental USA was complete, but we also worked the JO-97 pass a few minutes later. After the JO-97 pass, I worked passes on the same four satellites I used the day before (SO-50, SO-124, SO-125, ISS repeater) over the next three hours.

*"Day 3, Wednesday 22 October, would be my drive back to Phoenix. Before that, I wanted to do some operating. After working from four different grids already (DM52, DM62, DM72, DM82), I looked at two more grids near Alamogordo - DM63 and DM73, a few miles to the northwest. I was told that **Mike N8MR**, in Michigan, needed DM73 for his 488-grid quest in this part of the country.*

"The first pass for me, which also covered N8MR, was an SO-50 pass. A few minutes in the pass, I heard N8MR call me. We made the contact, and I worked a few other stations before and after working N8MR. After the operating, and a quick lunch stop in Alamogordo, it was a seven-hour drive back to Phoenix, completing a trip of 1286 miles in three days" [**Fig. 3**].

FM and DAB DX

Simon Evans (Twyning, Gloucestershire) writes, *"October was very good for tropo particularly to the West over the mountains of Wales. Truskmore at 489km was in here for days".* On DAB, Simon says that the Poole multiplex on 9C was a regular for some time.

Final final!

That's it for this column and for this year! May I take the opportunity to wish all readers and their families compliments of the season. Thanks to everyone who has contributed to the column over the last 12 months – I really appreciate your support and look forward to another exciting year on the VHF/UHF bands in 2026. **PW**

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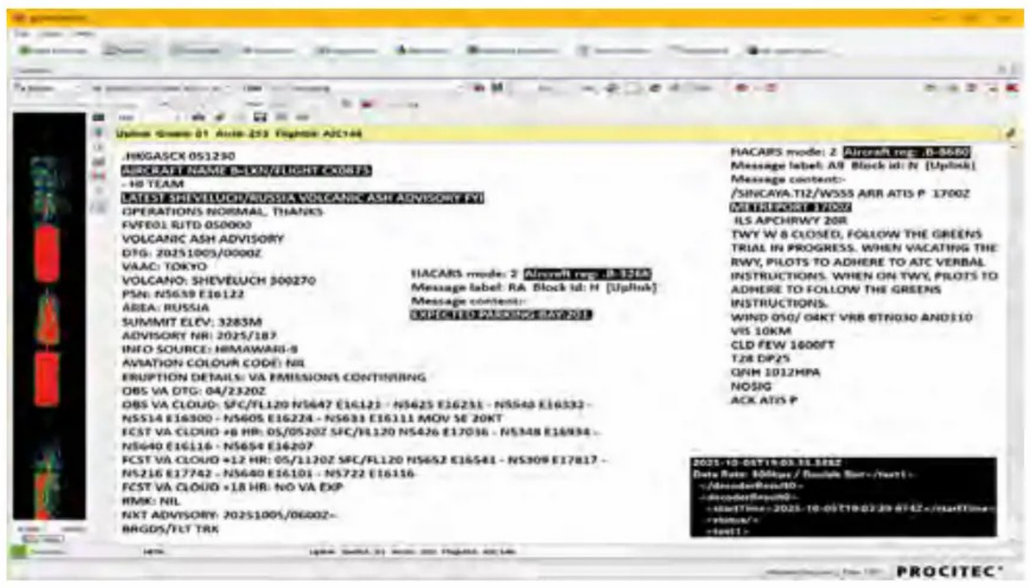
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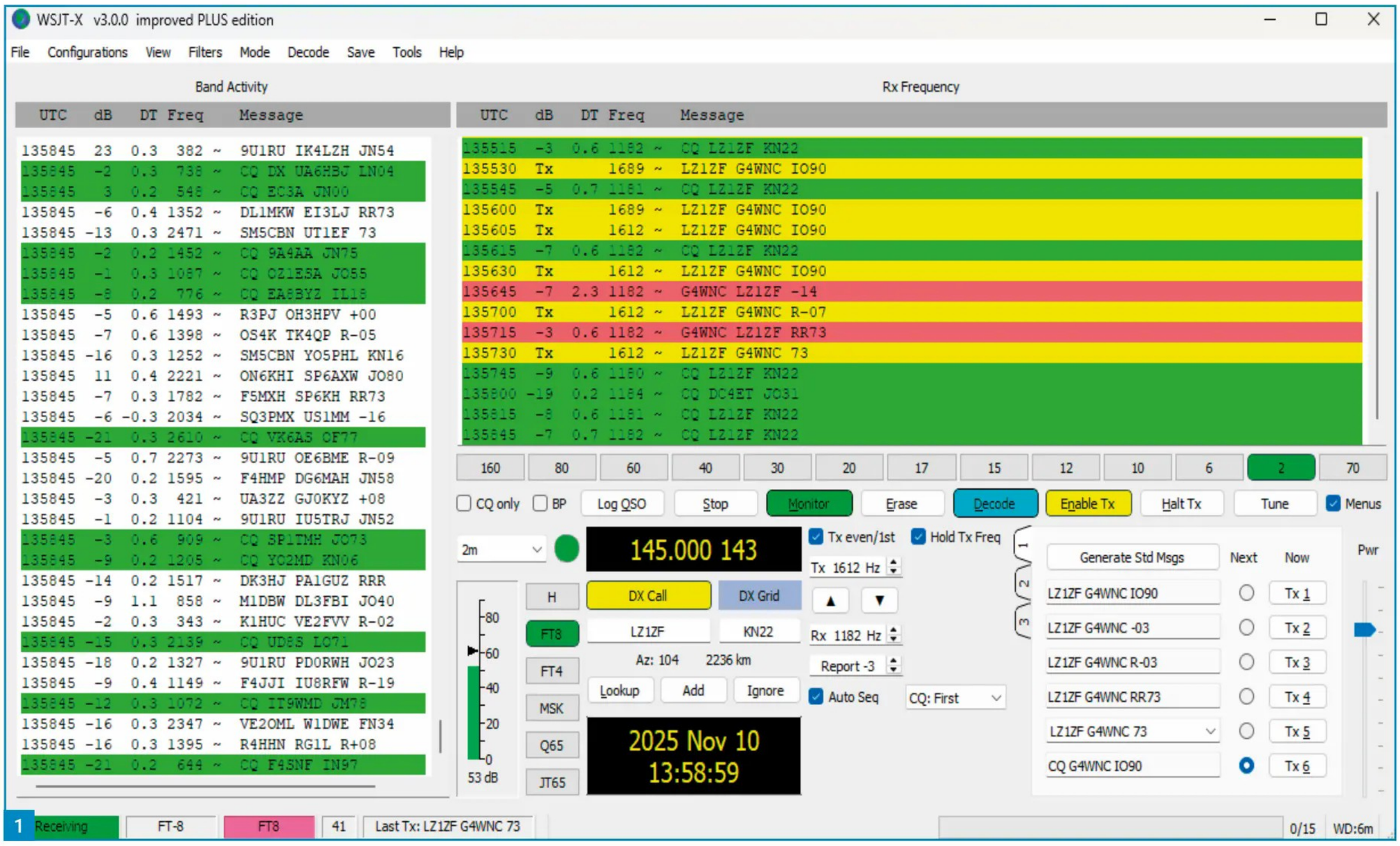


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Data modes software versions

Mike Richards G4WNC
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Mike Richards G4WNC looks at what software versions are in use, before turning to generating reliable test signals.

Regular readers will know that I like to keep an eye on data-mode activity using the excellent range of statistics available from the *PSK Reporter* site. This site is an outstanding resource not only for DX spotting but also for observing how operators use the available software and modes.

For this month's exercise, I wanted to explore which of the main software packages are in regular use. To track this, *PSK Reporter* provides the *Software in Use* table on its statistics page. At first glance, this table appears to be a simple summary of the most common software packages. However, by following the associated links, users can view detailed summaries of the software versions currently in operation. The data is collected over a rolling seven-day period, offering valuable and up-to-date insight into how operators are utilising the available software.

Data Modes software

In **Table 1**, I have shown the distribution of activity across the top 91.5% of software usage. Not surprisingly, WSJT-X continues to hold the top position at nearly 60%, while its nearest rival, JTDX, accounts for 22%. Given that these packages support the same operating modes, together they account for around 80% of total activity. The next most prominent software is VarAC, which was pleasing to see, as I have been promoting this mode for some time. The key distinction between VarAC and the WSJT-X weak-signal modes lies in VarAC's strong support for keyboard-to-keyboard conversations. This encourages genuine communication rather than the more sterile exchanges typical of weak signal modes.

WSJT-X detail

I've provided a breakdown of WSJT-X activity in **Table 2**, showing that just under 20% of operators are still using outdated versions. This is a shame because they're missing out on the improved decoding performance and operational features of the later versions. It also means that operators using up-to-date versions may not be able to contact those using out-of-date versions. How about starting a campaign in your local club to get everyone to upgrade to v3.0 when the public release arrives?

VarAC detail

Looking beneath the headlines of the VarAC data, **Table 3**, it was encouraging to see that most operators (93%) are keeping up to date, and the majority are using either V12 or the latest V13 release. This is good news because the VarAC development team are actively working on new features and have completely transformed the software from its early versions. However, operators can only take full advantage of the enhancements if everyone keeps up to date.

WSJT-X Improved

Published by **Uwe Risse DG2YCB**, WSJT-X Improved is an experimental version of WSJT-X intended for more advanced operators who want to work with the latest developments. Although this project started as an independent development, Uwe has since joined the main WSJT development team. That facilitates using this platform to experiment with potential improvements before migrating the successful candidates to the main project. The project is licensed under GNU GPL v3, the same as the main project.

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Software	Number	Percentage
WSJT-X	27,018	57.3%
JTDX	10,371	22.0%
VARAC	2,265	4.8%
MSHV	2,067	4.4%
JS8CALL	1,465	3.1%
Total (all software)	47,185	91.5%

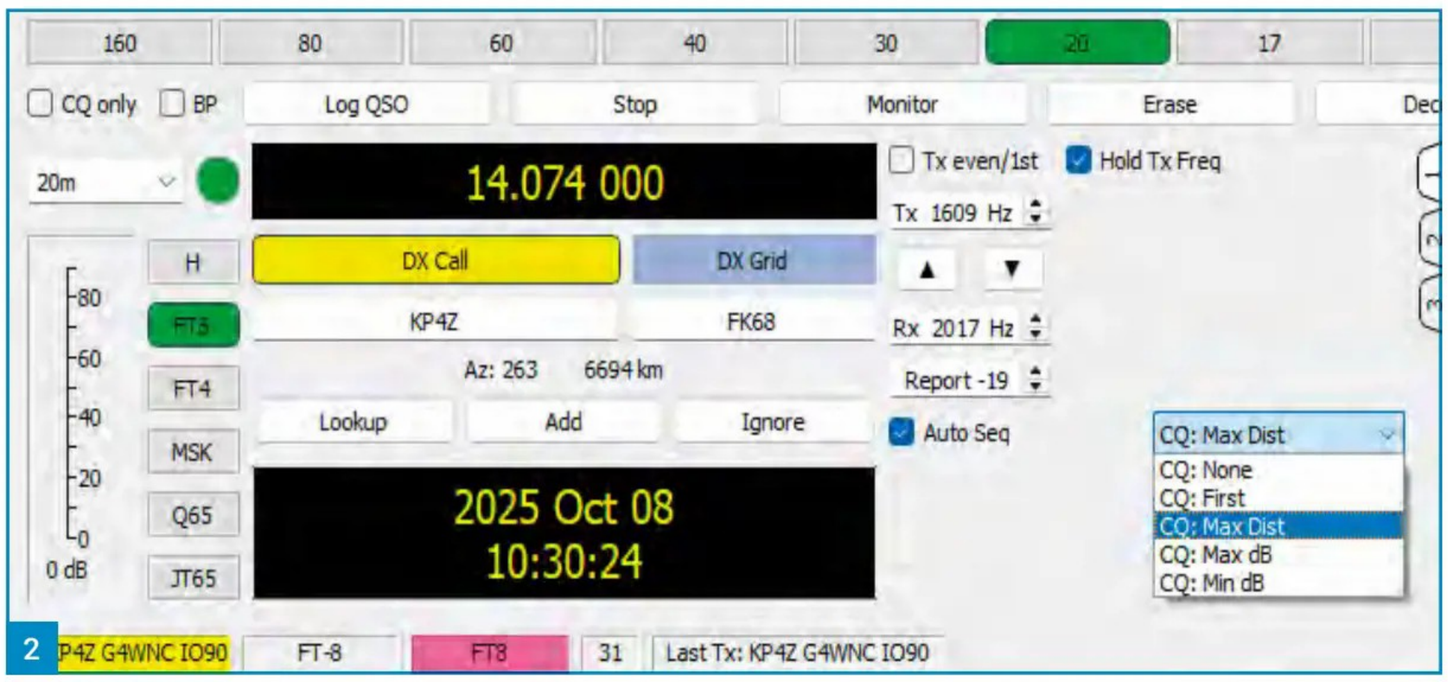
Table 1: Major Data Modes Software

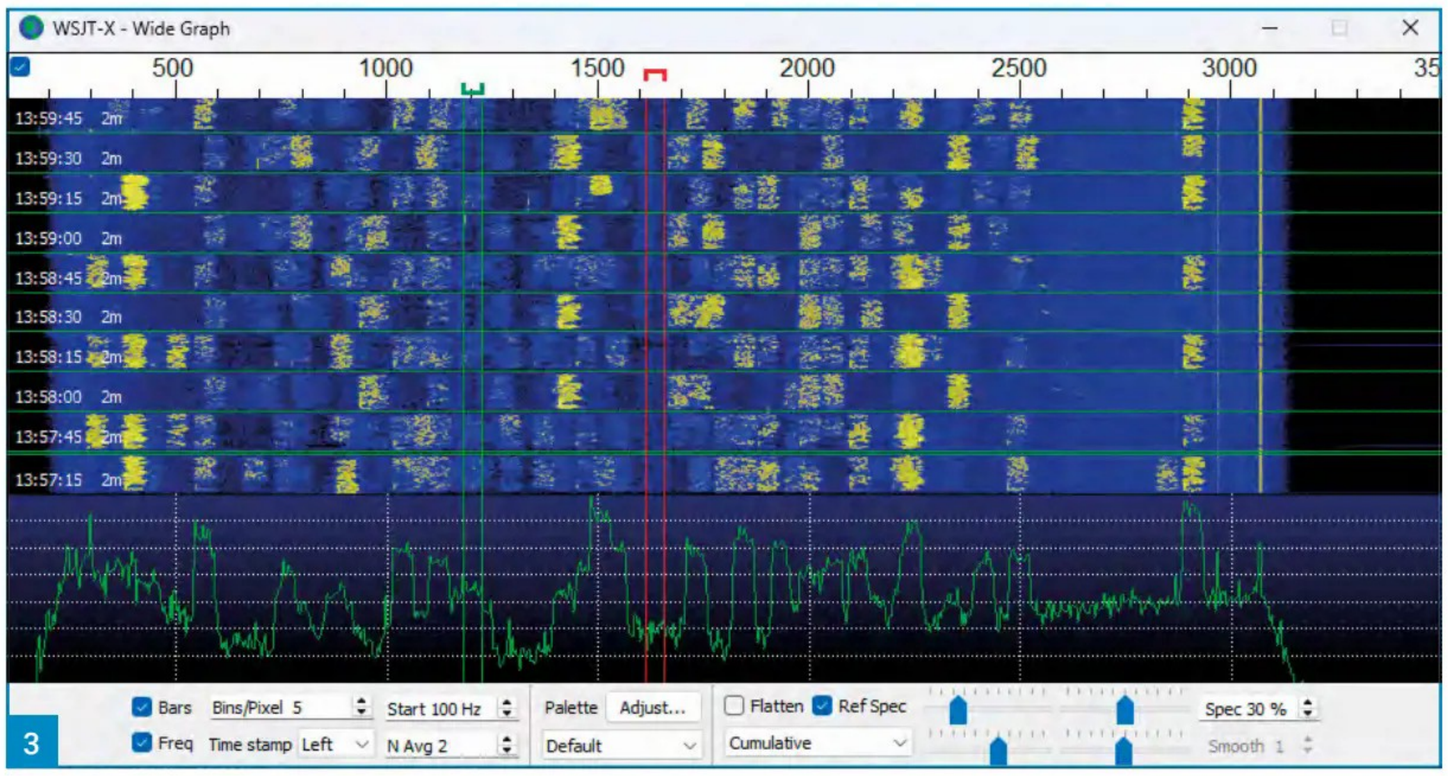
WSJT-X Version	Number	Percentage
v2.6	4991	18.5%
v2.7	11903	44.1%
v2.8	1756	6.5%
v3.0	6263	23.2%
Total (all versions)	27018	92.2%

Table 2: WSJT-X Versions

VarAC Version	Number	Percentage
VarAC V10	43	1.9%
VarAC V11	70	3.1%
VarAC V12	1114	49.2%
VarAC V13	998	44.1%
Total All versions	2265	98.2%

Table 3: VarAC Versions





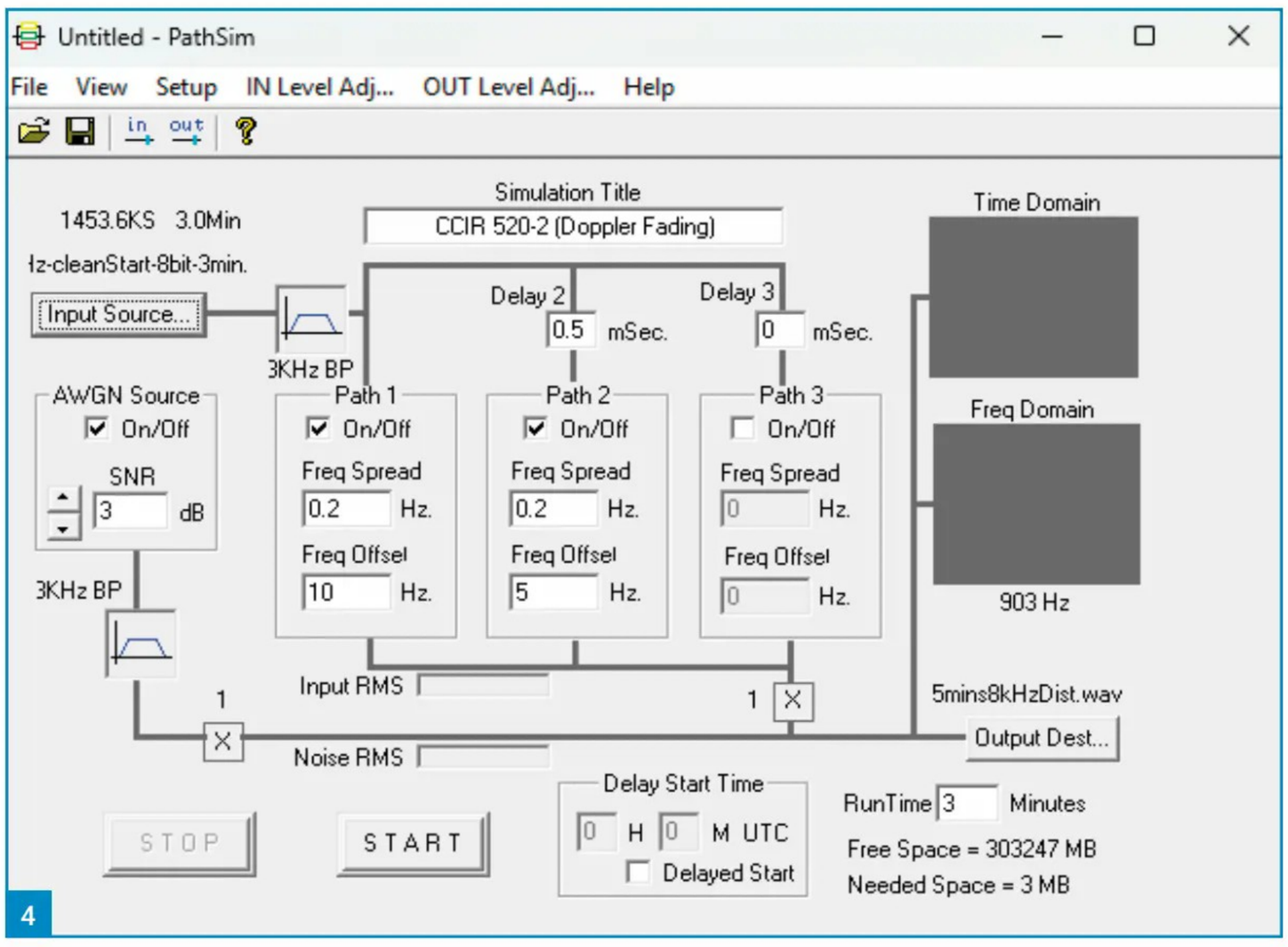


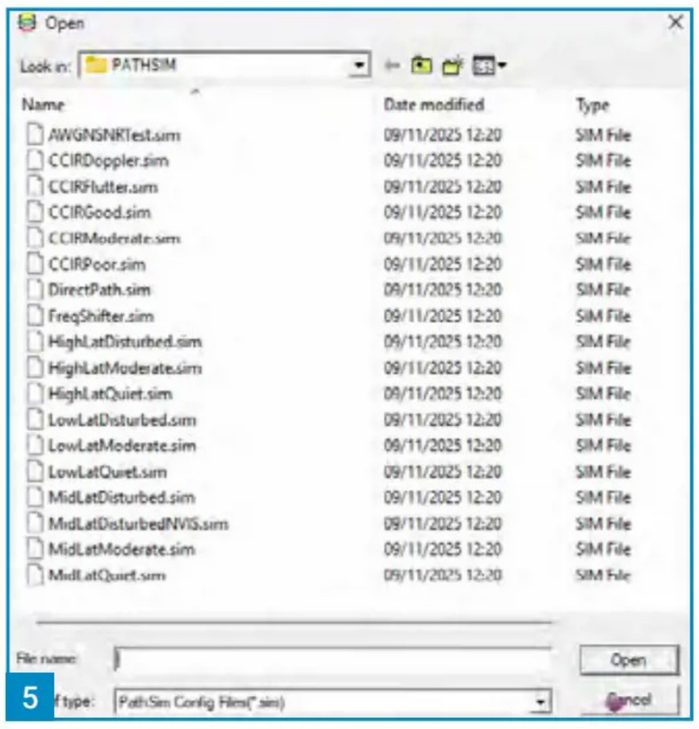
Fig. 1: WSJT-X Improved - widescreen version.
Fig. 2: WSJT-X Improved – new button panel.
Fig. 3: WSJT-X Improved - Wide Graph.
Fig. 4: PathSim main panel.

The latest version includes highlighting of CQ and 73/RR73 messages to help identify potential contacts. The software also comes with three GUIs (Graphical User Interfaces). They are the standard look, a widescreen version, **Fig. 1**, and an AL alternative look optimised for smaller screens and laptop displays. This latter feature is handy for Raspberry Pi and other users of smaller screens. WSJT-X Improved has also introduced a Hound button that simplifies working DX stations that are using the Fox & Hounds mode. You can now switch between standard and Hound mode with a click of the H (Hound) button, which is in the set of buttons to the right of the input signal level gauge, **Fig. 2**. The same bank of buttons can also be used to switch between the main digital modes.

The FT8 and FT4 decoder settings have been optimised for DX operating, which is helpful. This is also combined with changes that reduce the number of false decodes without affecting sensitivity. I did a quick performance comparison between the standard WSJT-X V3 release, set to 12 parallel decoders, and the improved version, and the latter produced slightly more decodes from the same noisy, fading signal, which is encouraging. If you want to try your own tests, I have more on how to create reliable, challenging test signals elsewhere in this column.

The Wide Graph window is also improved, **Fig. 3** and includes bars to show the Tx and Rx audio frequencies (like JTDX). The CQ process has also seen improvements, and you can now call CQ with individual contest names. Another helpful change lets you set the Tx frequency with a right-click; it used to be a shift-right-click. The software can also automatically stop a transmission if the SWR exceeds 2.5. This is just a sample of the enhancements and there will be many more as the software develops. The benefit of this version is that software updates flow through much more quickly than with the

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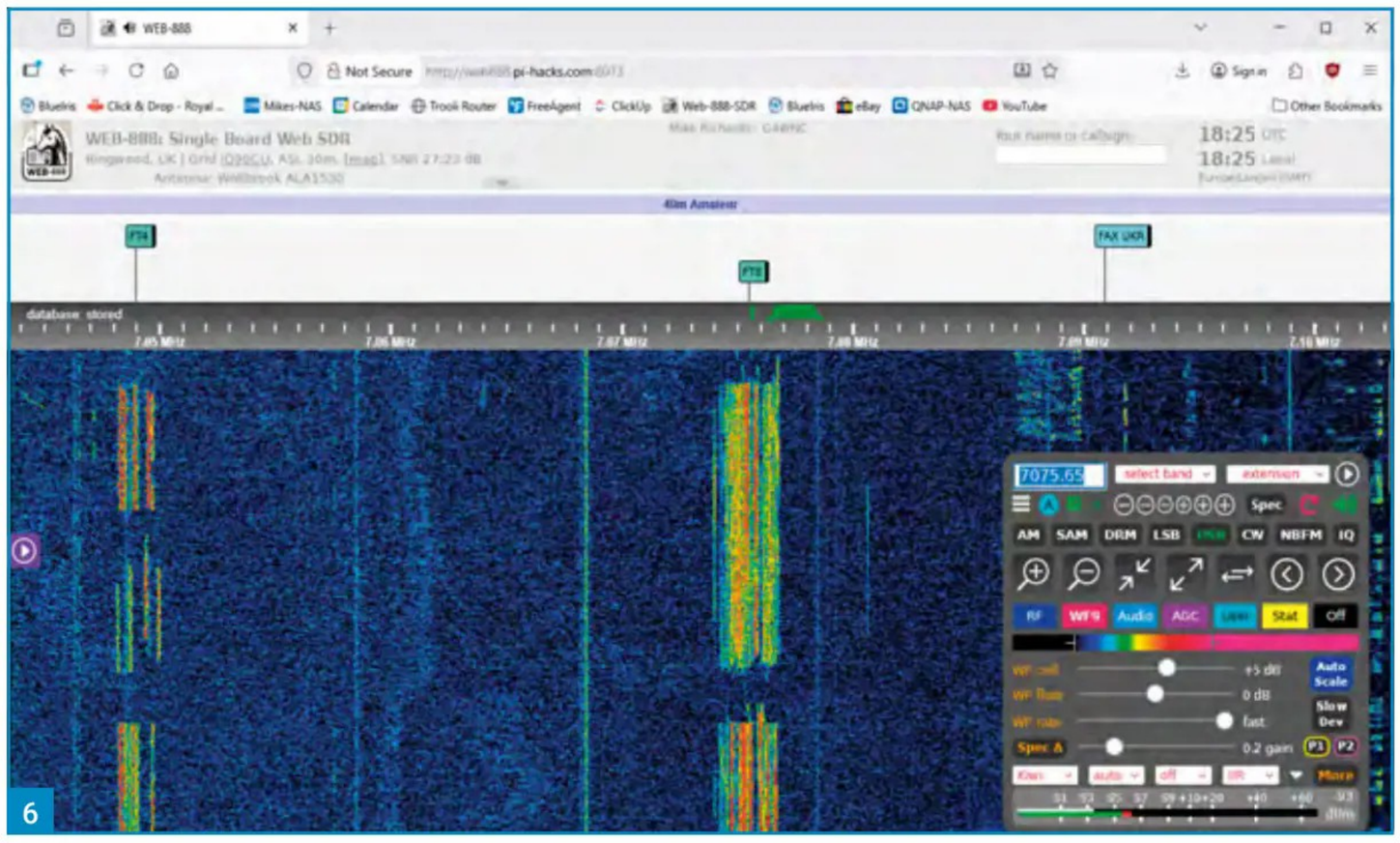


Fig. 5: PathSim supplied simulations.
Fig. 6: Web-888 receiver, browser interface.

main release. However, the rub is that faster releases increase the risk of bugs, and you have to accept that. The alternative is to stick to the main WSJT-X releases, where each is thoroughly tested before release.

Generating reliable test signals

Last month I explained how I produced the signals I use for testing FT8 software. These all started with an off-air recording, which was subsequently tidied up for use as a test signal. This is often good enough, but occasionally I want to see how a decoder performs under very poor RF conditions. For that, we need a signal that's been distorted by phase shifts, fading, and random noise. Doing this in a controlled way requires some dedicated software. If you have DSP (Digital Signal Processing) programming skills, it can be straightforward, but most of us do not have the required skills, so we need software to handle the task. Fortunately, there is one package I know of that was developed by the generous and talented **Moe Wheatley AE4JY**, who is sadly no longer with us. Moe produced a program called PathSim that does precisely what we need. The software is available free of charge for amateur use from this website:

www.moetronix.com/ae4jy/pathsim.htm

The software is supplied as a zip file that includes the standalone Windows executable, a help file, and a helpful selection of standard simulations. The software doesn't need to be installed and doesn't modify the Windows registry. Just unzip the download, save all the files in a convenient directory (I used C:\PathSim), and run PathSim.exe to start the program. The main screen comprises a block diagram of the available functions, **Fig. 4**. All the configuration steps can be done via this screen. However, unless you're confident with all these settings, I recommend sticking with the preset configurations. These have been chosen to provide a good selection of commonly encountered propagation conditions. To access these, go to the File menu and choose Open. That will open a disk navigation box where you can navigate to the PathSim folder, and you will see the simulations listed, **Fig. 5**. The range of simulations available is excellent and includes versions that introduce doppler shifts as well as a good range of fades and random noise. To complete the setup, a few more configuration steps are required. The input and output sources must be selected; they can be a sound card or a wave file. In both cases, the software only supports mono 8kb/s samples at 16-bit depth. If you've selected a soundcard for input or output, the program will only use the Windows default soundcard. Because of this limitation, you may need to change the Windows default sound card to route audio to the desired card. Although there are input and output level adjustment buttons on the menu bar, these don't work in the current versions of Windows. You therefore need to use the Windows mixer controls to set levels. An alternative is to go to the Microsoft Store and download EarTrumpet. This is a handy, free volume control application for Windows that runs in the background and provides quick access to volume controls for all audio sources on your PC.

The next setting is the AWGN (Additive White Gaussian Noise). Although this is set as part of the loaded simulation, you may occasionally want to alter the level. You have two options. You can turn the AWGN on/off via the tick box, or adjust the SNR in dB using the SNR box. It's unlikely you'll want a delayed start, but the feature is available if necessary. The final setting – the Run Time – is a bit of a Gotcha. By default, this is set to 0. If you simulate with that setting, you get a short burst of signal, then it stops. It's caught me out before, so it could catch you! The run time should be set for a period greater than the duration of the signal you're processing. Once the configuration is complete, click Start to begin the simulation.

When I'm preparing test signals, I usually start with a high-quality off-air recording and then use PathSim to generate a selection of degraded samples. You can generate test signals that are both challenging and realistic, and repeatable, using this technique.

Web-888 available to share

My Web-888 receiver is now permanently online and available for readers to use. The unit is configured with 13 independent receivers. Of these, five are in use, providing FT8 reports to PSKreporter on the 10m, 15m, 20m, 30m and 40m bands. A further three receivers are providing WSPR reports on the 10m, 15m and 20m bands. The remaining five receivers are available for general use and can be independently tuned from LF to 30MHz. The antenna is a Wellbrook ALA1530 low-noise active antenna mounted at about 3m above ground. To access the receiver you just need a web browser, **Fig. 6**. This can be on your main PC laptop, tablet or phone. The interface automatically reconfigures to match the device you're using. I've password-protected the receiver so it's available exclusively to *PW* readers. To access the receiver, use this link:

http://web888.pi-hacks.com:8073

The password is: **datamodes**

Although the receiver is usually available 24/7, there is a scheduled overnight update window. However, this will not kick users off, but will wait until the receiver has no externally connected users. **PW**

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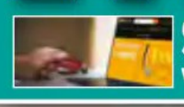


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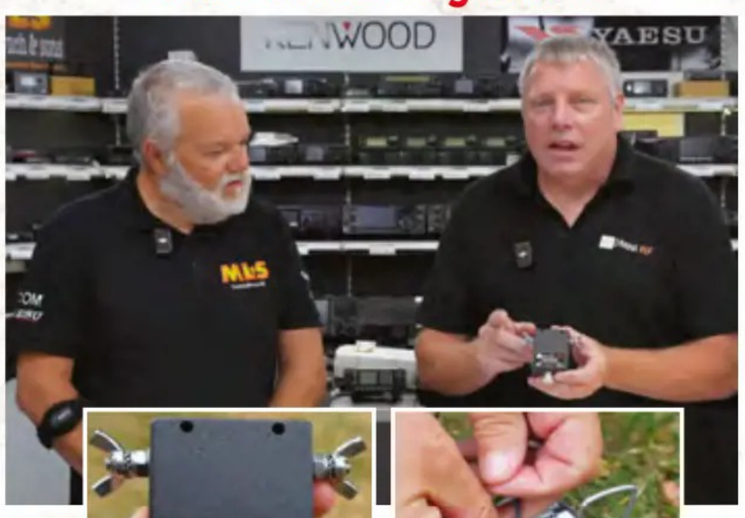
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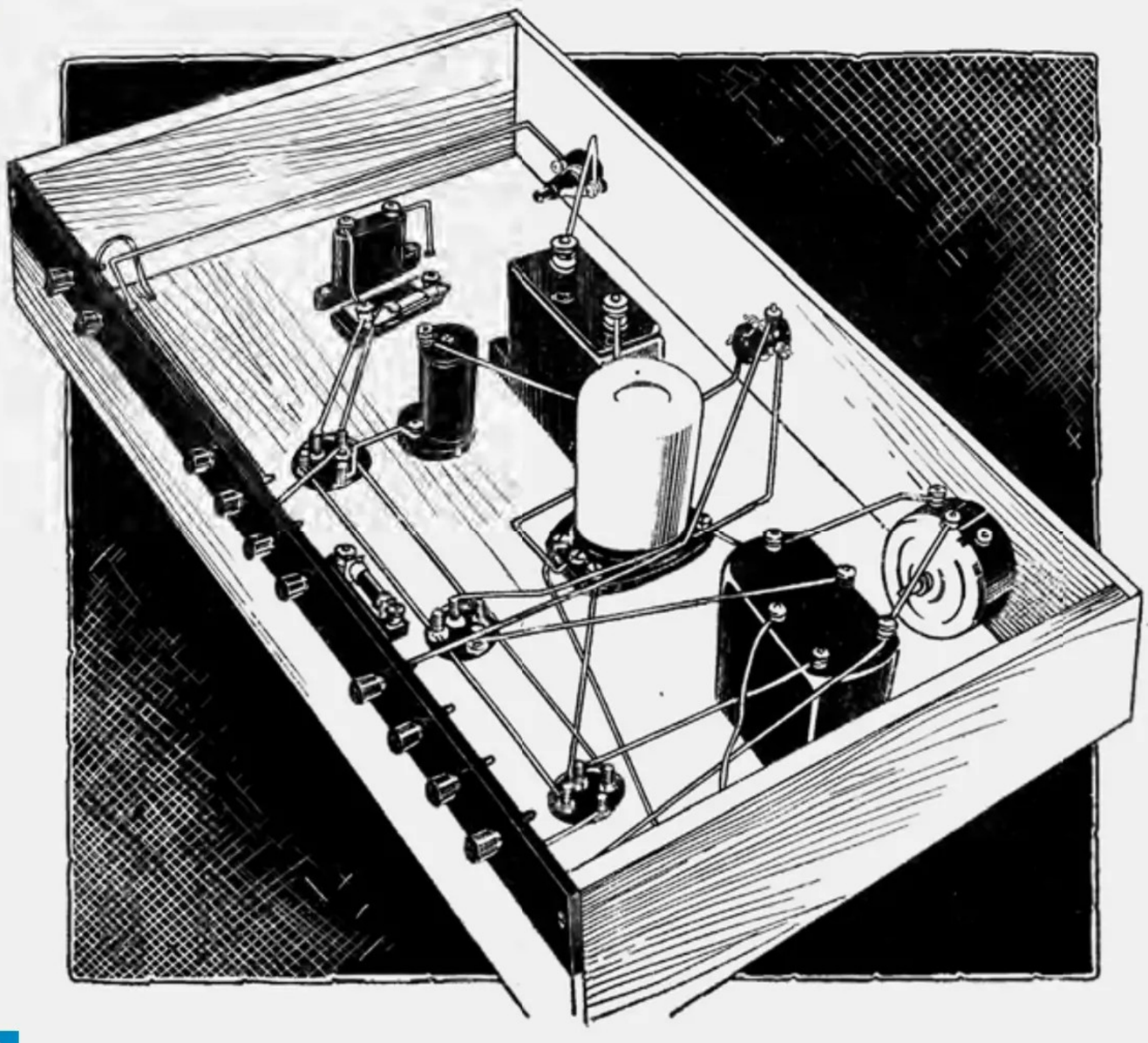
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1

The Selectone (Pt III)

Connecting up, and using the Selectone.

Now that you have finished the construction of your Selectone you will naturally be very anxious to give it a test and see what it will do. First, fit the G.B. battery in its clip, and put in the wander plugs. Plug "GB+" goes into the "+" socket, but the positions of the other plugs will depend to a certain extent on the voltage of the H.T. battery employed. Assuming it to be of 108 volts, "G.B-" should be put in the 1½-volt socket, "G.B-1" in the 3-volt socket, and "G.B-2" in the 6-volt socket. If a 120-volt battery is to be used, plugs "G.B-" and "G.B.-1" should be taken to the 3 volt and 4½-volt sockets respectively, whilst plug "G.B.-2" should be put in the 9-volt socket. Now insert the valves into their respective holders as indicated in Fig. 3. Connect the H.T. and L.T. batteries by means of suitable lengths of flex (when I say "suitable" I mean that the lengths must be such that the wires will reach to the batteries, wherever you propose to store them). Attach the aerial and earth leads to terminals "A" and "E", and then connect two speaker wires to terminals "L.S.+" and "L.S.-" - it doesn't matter which way round the latter wires are connected. The speaker is fitted with an output transformer, having ratios suitable for either ordinary or pentode output valves; in this case the wires should be connected to those terminals provided for "ordinary" valves.

The First Trial

And now we are ready for giving the Selectone a "trial run". Do not put it in the cabinet until you have tried it and so verified everything. Do not forget to pull out the radiogram switch knob to put the set into the "radio" position, and to put the wave-change switch into the position required - for long waves, push in, and for medium, pull out, the knob. For a start, put the coil plug into socket No. 1, which provides maximum sensitivity and minimum selectivity. Set the reaction condenser to its minimum (fully anti-clockwise) position, turn the tuning dial to zero and commence to rotate it by means of the slow-motion knob. Continue this until a station is heard and then increase strength by carefully adjusting the reaction condenser. If the condenser is turned too far, the set will oscillate (whistle), so care must be taken not to turn it past the point at which distortion begins. Incidentally, it should be added that oscillation can cause interference to neighbouring receivers, but it is not of a very serious nature, due to the loose coupling between the aerial and grid coils of the tuner.

Having brought the signal up to full. strength you can adjust the tone control ; when set to the maximum clockwise position the resistance is entirely out of circuit and, consequently, reproduction is low pitched and rather boomy, but by turning the knob in an anti-clockwise direction reproduction is gradually raised in pitch until it becomes "thin" and "screechy". Somewhere between the two extremes you should be able to obtain just the tone you require. Do not be misled by the fact that as the control is turned towards the "shrill" position there is a certain reduction in overall volume; this is quite normal.

Overloading

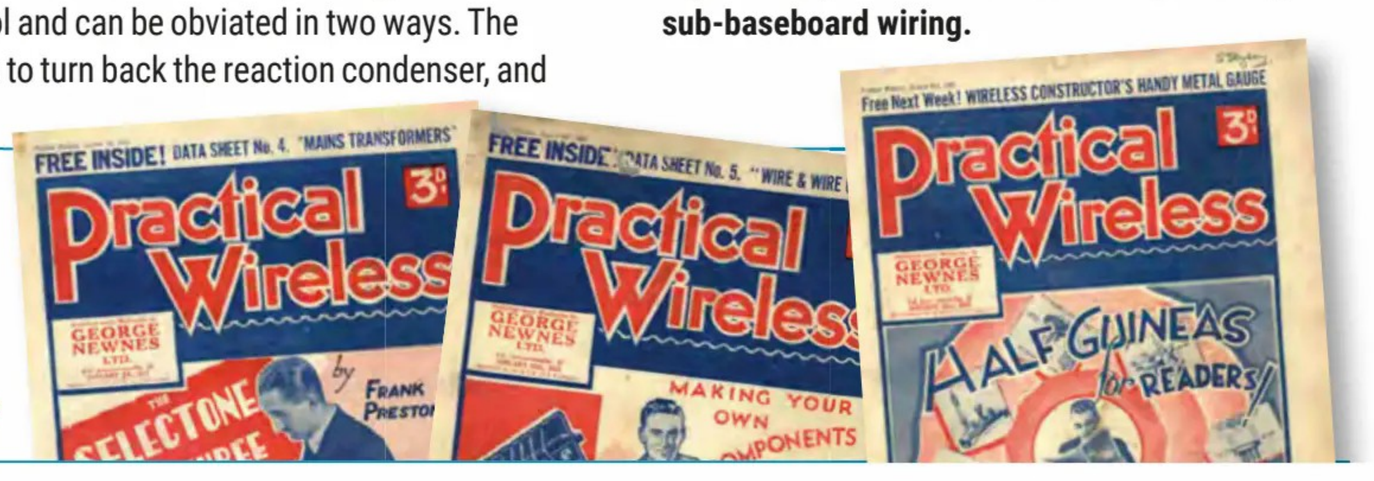
Due to the high amplification properties of the Selectone it is possible to overload the second and last valves when listening to local stations. Overloading is indicated when good reproduction cannot be obtained with any setting of the tone control and can be obviated in two ways. The first is to turn back the reaction condenser, and the second is to transfer the coil plug to a lower tapping (sockets 2, 4 and 5). In one or two cases, where a long aerial is used near to a powerful station, it might be necessary to connect a .0001 mfd. pre-set condenser in series, with the aerial lead-in. The latter has not been included in the set itself because it will only be necessary in very rare instances. Overloading could be avoided by replacing the 210 H.L. and 220 P. valves by types 215 P and 230 X.P., respectively, but the latter valves would give less amplification on distant stations besides consuming considerably more high-tension current.

Getting Distant Stations

After having tuned in the first stations, others can be received in a similar manner. Remember, that the set is in its most sensitive condition when it

Fig. 1: Perspective of the Selectone, showing sub-baseboard wiring.

We conclude the three-part constructional series from January 1933, as described at the time by its designer Frank Preston.

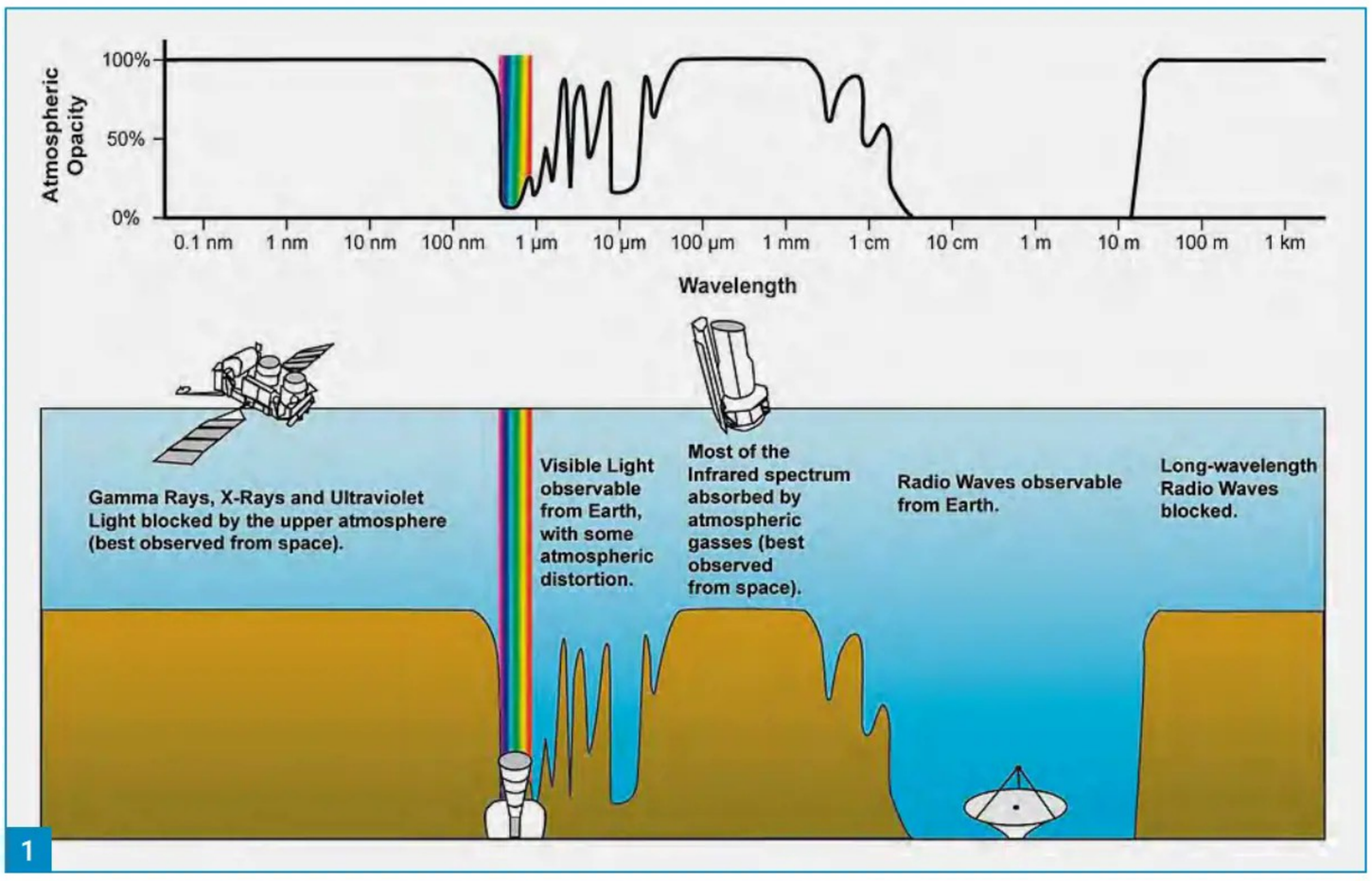


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is just off the point of oscillation - indicated by a faint "breathing" sound - and so when searching for very distant or low-power stations, it - should be kept in this condition by advancing the reaction knob at the same time as the tuning condenser. For most purposes, however, it will be sufficient to set the reaction condenser roughly, and tune in with the slow-motion knob of the tuning dial only. When two stations can be heard together, selectivity must be sharpened by advancing the reaction condenser and/or by putting the coil plug into a socket of a higher number. The optimum setting of the tone control will be dependent upon the degree of selectivity employed, and will vary for different stations. Of course, it is not essential that the tone control should be altered from, say, its midway position, but by making suitable adjustments, distant stations can be brought in as clearly as the locals. As you are well aware, the latter is quite impossible with ordinary receivers, and explains why distant stations are not usually so clear as the nearer ones. If you make a note of the dial settings for stations identified, these will be of great assistance in helping you to locate others. Once you have made a log of stations received it will be an easy matter to get any particular one just when you want it. Suppose, for instance, that you have logged Fécamp on 50 degrees. To get it again you will set the tuner to 50, advance reaction almost to oscillation point, and slightly re-tune, if necessary. Tuning can be carried out with great accuracy because the micro dial gives a reduction drive of 100 to 1. In other words, the knob must be turned through fifty complete revolutions to drive the pointer from 0 to 180 degrees. Moreover, tuning is so sharp that many stations can be tuned in and out again in little more than half a degree. After having had some experience of tuning you can try altering the grid-bias voltages to plugs "G.B.-" and "G.B.-2". Before making any changes, switch off the set, and then try moving one plug at a time. Remember that the H.T. consumption will be least when the maximum amount of bias is employed; therefore, use the highest G.B. voltages which give good results.

Using A Pick-Up

The Selectone can be used as an excellent gramophone amplifier by connecting a pick-up to the terminals provided, and pushing in the radiogram switch knob. Find the best value of grid-bias for plug "G.B.-" in the same way as before - it will probably be either 1½ or 3 volts. If it is required to use the tone control on gramophone reproduction, the pick-up volume control must be of rather lower resistance than normal. When a volume control is not used, the pick-up should be shunted by a resistance of suitable value - generally about 30,000 ohms for a low resistance instrument, and 150,000 ohms for a high resistance one. **PW**



1

Tools & Ideas for Monitoring Radio Wave Propagation (Pt I)

Georg Wiessala looks at ways of keeping track of Space Weather and radio propagation generally.

Georg Wiessala
wiessala@hotmail.com

I have a confession to make: I have developed a habit. You'll be relieved to hear it's not an addiction – unless radio is a drug. What I mean concerns a practice I have rather fallen into naturally over the last few years. With interests in both radio and climate, I have written about radio-assisted weather-watching. In the past, when I said 'weather', I always meant *terrestrial* weather. Last month, for example, I mused about the UK *Shipping Forecast*; and previously, I have covered NAVTEX, WEFAX, VOLMET, weather maps, and RTTY.

This time, my ambitions are sky-high: For this article, 'weather' includes 'space weather', by which I mean phenomena beyond the Earth's atmosphere, especially in the ionosphere. Space weather has become more important over the last decade, as our climate heats up. Protecting our infrastructure, communications, and satellites is now a definite concern for UK (and EU) politics.

This month, for instance, scientists are meeting at the *21st European Space Weather Week* in Umeå, Sweden, to discuss this new 'natural hazard'. In our hobby, many of us might look at radio, auroras and our weather by means of programmes such as *Simon's World Map:*

https://www.sdr-radio.com/world-map

or *HamClock:*

https://qso365.co.uk/2024/01/hamclock

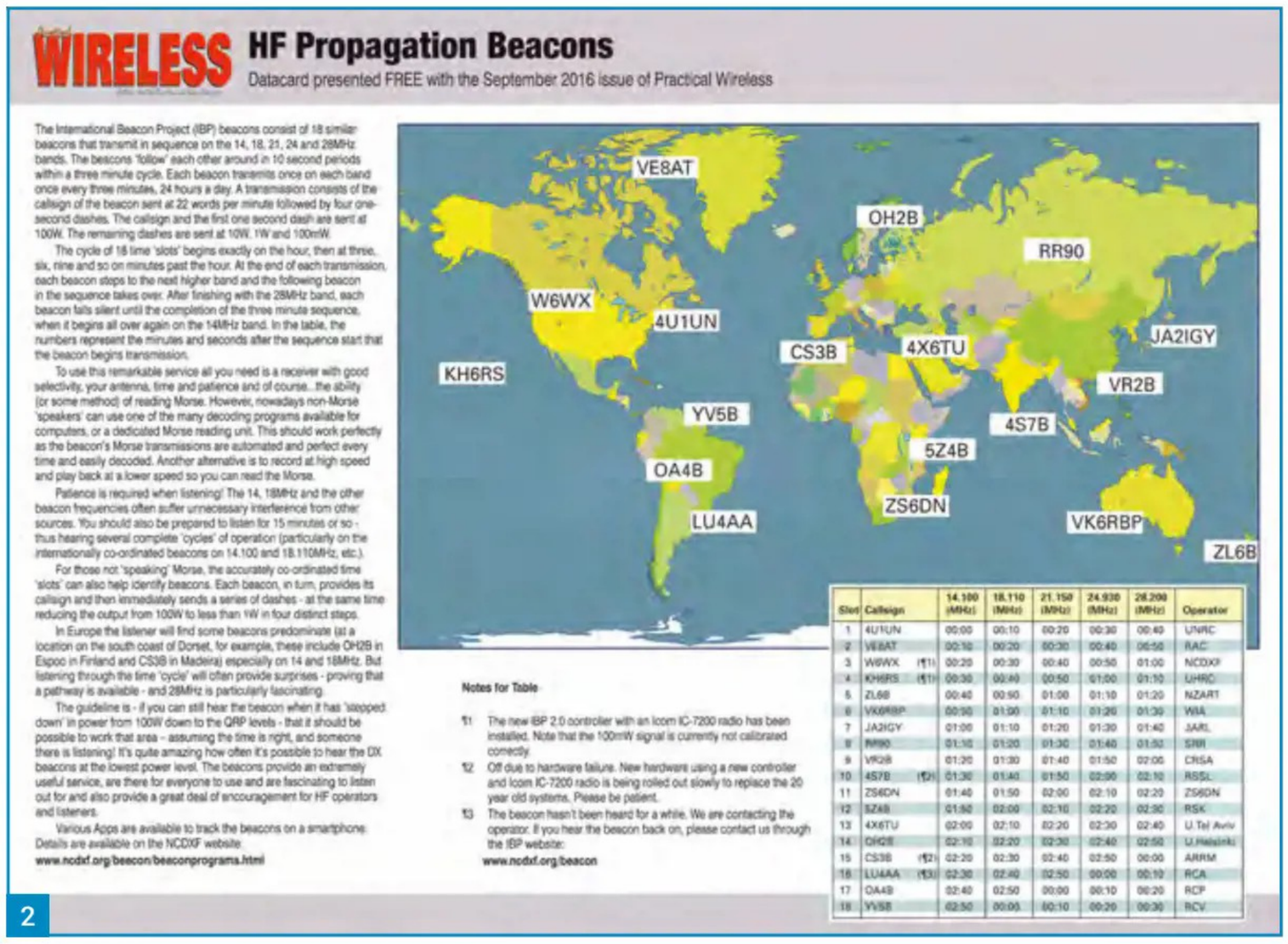
It is just a small step, then, to move from there to space weather observation. I certainly did.

The last decade has seen significantly more research in space weather. There are now stable mathematical models, such as ray-tracing and wave-guide theory. Radio magazines now cover atmospheric physics, too. For example, in last month's issue, **W. Reeve** touched on space weather and sudden frequency deviations (*PW* November 2025: 14; **https://reeve.com/index.htm**). And staying in Alaska, the *High-Frequency Active Auroral Research Program* (*HAARP*; **https://haarp.gi.alaska.edu**) never ceases

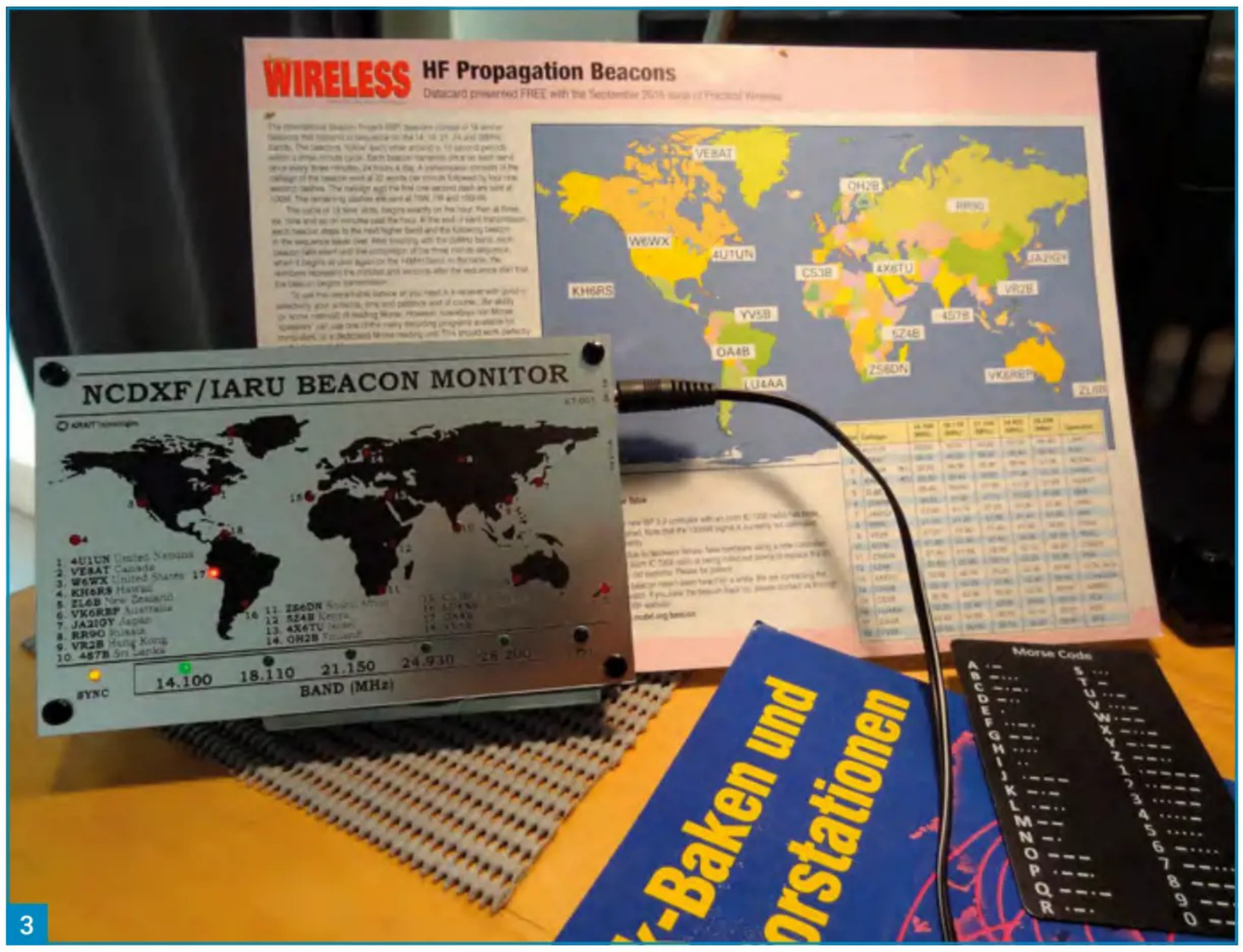
Fig. 1: The Earth's atmosphere is opaque to certain kinds of frequencies and blocks others. This is the atmospheric radio window. (Wikipedia: 'Radio Window' (November 2025))

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Fig. 2: This great *NCDXF/ IARU Data Card* came as a supplement to the September 2016 issue of *PW*. (PW/ Don Field/ Warners)
Fig. 3: The *KRAIT Technologies NCDXF/ IARU Beacon Monitor KT-003* synchronises via a built-in GPS receiver. It replaces the older MFJ Enterprises MFJ-890/UK, which relied on VLF Standard Frequency and Time Signal (SFTS) stations. (Georg Wiessala)



2



3

to fascinate me. And no, they do not heat the atmosphere. Moreover, I enjoyed the article on the *WavViewDX* propagation conditions visualisation programme by **Satoshi Miyauchi**, from the wonderful magazine *Propagation* by the *Totsuka DXers Circle* in Japan:
https://tinyurl.com/mr3rnhk6

Propagation prediction is truly a worldwide concern.

In what follows, I would like to introduce the 'bare bones' of the kind of atmospheric physics and propagation mechanisms that you may find useful. More importantly for me, I will suggest some practical hints and tips on how you can find out more and put together your own regular in-shack schedule of monitoring the prevailing propagation conditions. You cannot control solar activity, but you can control your observation routine. So, in this first part of this two-parter, I offer some easy-to-use, 'analogue' – some might say 'old-fashioned' – ways of finding out about, and predicting, solar activity and propagation. Next month, I'll move to online resources.

I hope to achieve this by briefly indicating how our Sun interacts with the ionosphere – the planet's atmospheric layer of most interest to hams and DXers. I will say a few words about science later, but like I said, this is not a comprehensive course on the Sun-Earth environment; there are excellent books on that already, some of which I will recommend at the end of next month's instalment. What is more, as radio amateurs, I guess that you know much more about radio wave propagation than I do.

Pillars of propagation and layers of ionisation

Our subject here concerns quite complex atmospheric processes and the ways these aid reception in your shack or mobile. To begin with, **Fig. 1** shows the atmospheric 'radio window', and **Table 1** contains some of the physics. You can skip this bit if you have a basic idea about radio wave propagation. There is a wealth of research available in this area, both in print and online, for example, through the *Voice of America Coverage Analysis Program* (VOACAP; **https://www.voacap.com/hf**) and elsewhere. I am not an expert in this, but I will briefly mention three scientific aspects of propagation. First, there are a number of key variables which always determine the propagation of radio waves:

- Geographical location of the observer, time of day, seasonal changes, and frequency choice;
- Terrestrial weather (e.g. rainfall can attenuate waves through absorption);
- The 11-Year Solar Cycle (currently: No. 25); the Sun's position and activity; solar flux and solar wind;
- The Earth's magnetosphere, its magnetic field and magnetic storms; and
- Directional properties, polarisation, transmit angles of your aerials to catch ground/ sky/ space waves.

Second, the main layers of the atmosphere are the Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere. The most relevant to us are the Troposphere and the Ionosphere. The latter is the essential dispersive medium for radio. It spans the Mesosphere and Thermosphere. Remember, the ionosphere is directly made by sunspots: internal solar magnetism creates sunspots, and the resulting solar UV rays hurtle to Earth. This fuels higher electron density in the ionosphere (ionisation). During a high in sunspot numbers, the Earth's ionosphere is (electrically) strong, and the DXing is good. At low solar flux, the opposite is true.

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A great new tool from Poland

So, how can you make use of the science to develop a working propagation watching scheme? Well, I still like the old ways of doing things. Listening to general weather forecasts on a vintage radio still gives me joy. In terms of HF propagation, one of my favourite shack accessories was the MFJ-890 Beacon Monitor from the (now-defunct) *MFJ Enterprises*. The device is linked to the International Beacon Project (IBP), coordinated by the Northern California DX Foundation (NCDXF). It enables users with a receiver on certain frequencies (**14100, 18110, 21150, 24930**, and **28200kHz**) to evaluate conditions on the HF Bands every three minutes. The image in **Fig. 2** shows the lovely data card from the September 2016 issue of *PW* to illustrate this.

Recently, I have acquired an updated version, the new NCDXF/IARU Beacon Monitor KT-003 from *KRAIT Technologies* (Poland). This device is 'updated', in that it does not derive time signals from VLF transmitters (MSF, WWVH) anymore. Instead, it has a built-in GPS receiver. This obviates the need to find a 'sweet spot' for synchronisation in the shack. So far, it works flawlessly with my HF receivers and SDRs (**Fig. 3**). The KT-003 may not be the most sophisticated forecasting tool, but it is easy, handsome and fun to use.

Hardware, printed tables, and diagrams

In terms of hardware for checking the ionosphere, you might also think about acquiring (or building) your own Sudden Ionospheric Disturbance (SID) monitor to track solar storms. The one offered by the *Stanford Solar Centre* in the US is handy for this. Or you can try the kit from the *UK Radio Astronomy Association (UKRAA)*. Use a logger and software such as *Radio Sky Pipe* (URL below). Some space weather enthusiasts are providing dedicated SID observation stations (*Backyard Astronomy, Stanford Solar Center*, and *SDI Monitor*). But this is online – I am ahead of myself.

www.radiosky.com/skypipeishere.html

On top of this, there are many ways of checking propagation by means of appreciating and analysing data directly. I still swear by the monthly MUF and LUF Tables in some radio magazines. The one in **Fig. 4** is from *Radio Kurier* of November 2025 (p. 38). By the way, the German term *Funkwetter* neatly encapsulates what this is all about – 'radio-weather'. A *Funkprognose* is literally a 'radio-weather-forecast'.

Dedicated research

Published tables like these are the result of meticulous recording and research by

The principal forces shaping radio wave propagation are our star (the Sun), the Earth's magnetic field, electrons, ions, and the atmosphere. Our atmosphere is transparent to radio waves, as long as none of its component gaseous layers absorbs them. In other words, there is an atmospheric 'radio window' (between ca. 15MHz to 1.5THz; Fig. 1). Solar activity is key, and specific solar emissions of interest to radio are electromagnetic radiation, solar cosmic rays (solar flares) and magnetic storm particles (the solar wind). One of the best explanations of these phenomena still comes from the 1995 edition of *the New Shortwave Propagation Handbook* (**https://tinyurl.com/2rf8777r**).

The propagation environment is shaped by interactions in the Sun-Earth system, our magnetic field, and the process of ionisation of atmospheric layers. *Ionisation* occurs through EM radiation, stripping an electron off an atom or molecule, as well as the reverse of this process, which is called *reconstitution*. This is the dynamic engine that drives what we can hear, or not. Vital information about our magnetic field comes in the well-known radio weather reports, for instance, regarding the two (logarithmically linked) A and K indices. The former (A) measures solar particle radiation *by its magnetic effects* (0 = 'quiet' to 400 = 'severe magnetic storm'), whereas the latter (K) is a *measure of variations in the terrestrial magnetic field*. We measure some solar activity at a 10.7 cm frequency; this is the solar flux value in forecasts.

The layers of charged electrons in the atmospheric layers exhibit varying electron density, which is why radio waves are absorbed, attenuated and reflected (better: 'refracted') in different ways. This explains phenomena like grey-line-propagation, the day-night terminator, 'skip' zones, fading, 'dead' zones, path loss, chordal hops, meteor scatter, sporadic-E propagation, and others. Pioneering projects such as the *NASA Equatorial Vortex (EVEX) Experiment* have helped us understand this. Each atmospheric layer (D, E, Sporadic-E ('Es'), Fl, F2, F3) has its own maximum value of electron concentration. The highest frequency that will 'return' (vertically irradiated pulses of) radio waves as an 'echo' is the Critical Frequency. The upper limit of the MUF (the highest frequency reflected on a given path between two distant stations) is determined by ionisation density at the point of reflection, while the LUF (the lowest frequency reflected on the same path) is demarcated by ionospheric absorption along the path and by prevailing noise conditions on the receiving end.

The optimum working frequency (OWF) lies somewhere in between. When the LUF exceeds the MUF, you get a radio blackout. The MUF is often established by sounders (ionosondes) that produce a diagram (an ionogram). The relationship between the height of ionospheric layers and frequencies used is critical for radio. This interplay causes radio waves to 'bend' and, consequently, energy to be absorbed The refractive and attenuating propensities of the layers are determined not just by their height but also the thickness and time of appearance (diurnal or nocturnal), the solar flux (radiation) and solar wind (particles), pollution at altitude, frequency of the 'source signal', and degrees of ionisation (see above).

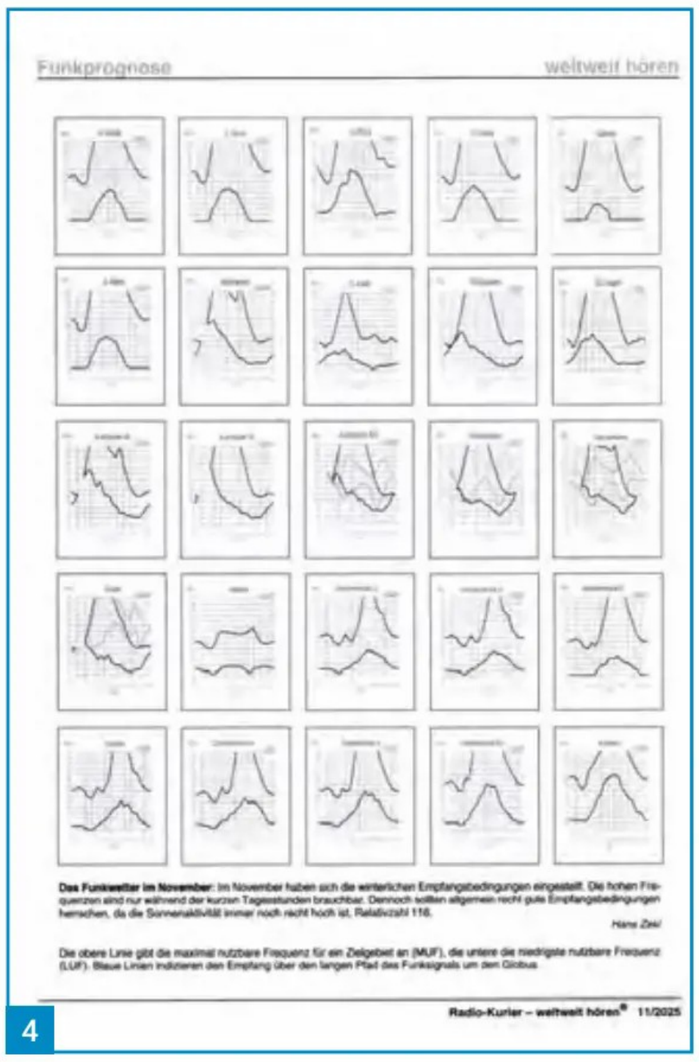
These degrees of ionisation determine the (variable) width of the 'mesh' in the 'electronic wire mesh fence' that is our atmosphere. The electron densities vary from day to night. The physical process of ionisation (photo-ionisation) is predicated on the fact that, by definition, an atom is electrically neutral. An atom-like particle that possesses an electric charge is an ion. The process by means of which the atom is (positively or negatively) changed into an ion is described as 'ionisation'. EM fields and high-energy radiation solar particles, can trigger it, as follows:

Photons (light particles) from the Sun transmit their energy to the electrons in the atoms as excess kinetic energy. Thus, (negatively charged) electrons are broken free from their neutral gas atoms (dislodged), escaping the (positively-charged) hold of the atoms' orbits. This generates free electrons and ions. EM radiation at wavelengths of 1 - 10 Angstroms (Å) ionises the D-layer, and at 100 to 1000 Å, the E-layer is excited. Varying ionisation levels are mainly caused by ultraviolet (UV) and shorter wavelength light and vary with altitude.

Finally, the Sporadic-E layer has been described as follows: *"The global distribution of sporadic E layer occurrence shows strong variations on different time scales, with the highest sporadic E occurrence rates during the afternoon at the mid-latitudes of the summer hemisphere. Furthermore, sporadic E occurrence depends on several geophysical parameters, such as dynamic conditions in the lower thermosphere, the intensity of Earth's magnetic field, and meteor flux"*. We know that radio hobbyists, amateurs and DXers rely on the fact that, during the hours of daylight, there are two F layers (F1 and F2). The well-known phenomenon of the F1 layer disappearing at night – while the F2 layer remains intact – makes the F2 layer one of the best friends of radio listeners worldwide.

Table 1: The Earth-Sun System and the Electronic Wire Mesh Fence

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4



5



6

Fig. 4: A traditional propagation prediction table (*Radio Kurier*, November 2025: 38). (Courtesy: *ADDX/ Radio Kurier*). Fig. 5: Still fascinating: a vintage list of beacons and propagation indicator stations, by Gerd Klawitter. (*Siebel Verlag*). Fig. 6: A great deal of propagation information may be extracted from CD-ROMs like these (Siebel Verlag/ vth).

committed amateurs. They are handy in helping to build an archive or diary about propagation watching – just like checking your home rain gauge, in fact. These charts come either as three-line plot-graphs or propagation prediction tables (draft analysis curves), which can contain different colours to indicate values for the LUF, MUF and other values.

These circuit analysis diagrams, propagation columns or monthly grids are still a staple of magazines (e.g. *RadCom*, *Funkamateur* and *Radio Kurier*). The latter also has online links, giving access to 'clickable' word regions. And *CQ Magazine* in the USA offered printed forecasts, until recently. However, most such content has now migrated onto the World Wide Web. More on that later.

A lookout and a listening watch

So, use your senses, watch, listen and log/ record. One of the easiest ways of checking space weather during the current Solar Cycle (No. 25) is to track solar activity by looking at sunspots (never with the naked eye!). Track and record their occurrence, and you'll get the basic idea. In this regard, the *Coronado* solar telescopes are very popular with many radio and astronomy enthusiasts:
https://tinyurl.com/ypfj5mp8

Next, any hands-on methods of propagation monitoring must surely include actually *listening in*, specifically on HF bands. You could try what used to be termed the 'Tropical Bands', when I was younger (2300 to 2495kHz). Most of them are silent as the grave now, but there are still broadcast and utility stations in this segment and on the other SW bands. You can use these to gauge overall HF propagation conditions.

You might consult the 2026 *WRTH* or *Klingenfuss* books to guide you. Don't forget that these books also contain high-quality reading on propagation. In this way, monitoring during certain times of day (or night) enables you to weigh up whether it's worth firing up your transceiver or going after that elusive DX catch.

One step further away from *reading, watching, listening and logging*, there are *indirect* ways of hunting down propagation knowledge. *Indirect* means acquiring predictive data by proxy, by using something other than direct data to gain access to propagation details. Of course, some will argue that listening to HF broadcast radio, monitoring utility stations, or hunting beacons are all already in this category. The borders are fluid.

Bringing home the beacon

One established method is the observation of aeronautical or maritime beacon transmissions, NDBs, amateur radio beacons, repeaters, TV transmitters (DXTV), and so on. There used to be entire books listing those aids to evaluating propagation. **Fig. 5** shows a German example of old, which I still find very helpful. Like elsewhere, though, much content has now migrated to the internet, e.g. the *RSGB List of Propagation Beacons*:
https://tinyurl.com/k4ujuy28

While I am on beacons, check your archive CDs for **Robert Connolly's** column in *RadioUser*. Beyond that, there are many software suites like *COAA's NDB Finder, BeaconTime Wizard, NDBList, BeaconSee, Faros, DXAtlas*, and *Pskov NDB*. NDB reception is a reliable tool for establishing forecasts; results of regular beacon-hunting become feeds for the key software packages in this area.

The *Faros* beacon programme, for example, uses DSP techniques and measures SNR values for long-term observation. This is handy for checking the ionosphere and the prevailing isobar tendencies on the globe, for propagation and atmospheric pressure lines are closely connected (*RadioUser*, October 2013: 50).

Next month: digital and online

In **Part Two** of this article next month, I will be moving on to propagation prediction tools that you can find on digital data carriers like CD-ROMs, **Fig. 6**. I will delve into some online resources, blogs, Facebook groups, and what one might call semi-professional citizen-science initiatives on propagation, in which you can participate. I will cover propagation prediction via the new remote and web-based SDRs. And to cap it all off, I plan to cover a few surprising tools, which you may not have thought about in the context of this topic. At the end of Part 2, I will also include a full reading list and recommendations for books, articles and websites.

See you next month. **PW**

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The Practical Wireless End of Year Quiz

This year's quiz is a little different. It looks back on the 2025 issues of PW and, conveniently, the questions are in chronological order with at least one from every issue of PW during the course of the year.

1. What was the earlier callsign of Don Beattie G3BJ
2. Who is credited with the discovery of the Ionosphere?
3. What is the RSGB's Brickworks?
4. Which PW author had a serious tower collapse?
5. What is the callsign of the Chancellor of Germany?
6. Which 10m multimode rig started life as a CB transceiver?
7. What is a VNA?
8. What was the new Icom flagship transceiver, reviewed in the May issue by Richard G3UGF?
9. What did Daimon build in an Altoids tin?
10. Where was this year's International DX Convention, reported on by the PW editor?
11. What is a UMPP-ASK?
12. Which husband and wife team are responsible for the RSGB Tonight at 8 and many other video presentations?
13. What does SINAD stand for?
14. What, in a radio sense, was Hedy Lamarr famous for inventing?
15. What is the callsign of Martin Lynch, the 'retailing legend'?
16. What is the website for the PW 70 and 144MHz contests?
17. What top selling transceiver was updated to a Mk2 version, unveiled at the Japanese Ham Fair?
18. What is an FA-VA6?
19. Where is 'The Radio Museum'?
20. How many years has the Shipping Forecast been going?

The answers can be found on page 40

NEWS EXTRA

FT8 OPERATION ON 60 M: AVOIDING OUT-OF-BAND TRANSMISSIONS: From **David G4NVB**:
There has been increasing discussion among UK amateurs about FT8 activity on the 60-metre band, particularly the allocated segment from 5354 to 5358kHz. A common issue is accidental out-of-band operation caused by transmit-audio offsets. When operating FT8 on the usual 5357kHz dial frequency (USB), software such as WSJT-X allows a wide range of audio offsets. However, using a Tx offset above 1000Hz will place your transmitted signal outside the upper band edge. Many operators therefore keep offsets at 950Hz or below as a safety margin.
This becomes a problem when frequently switching bands. For example, if you were previously on 3573kHz (80m) with a 1500Hz FT8 offset, and then move to 60m without adjusting it, your actual transmit frequency would be: 5357kHz + 1500Hz = 5358.500kHz, which is beyond the permitted band segment.
Fortunately, there is a new release of FT8 software developed by **Dr. Uwe Risse**, WSJT-X Improved, available at:
https://tinyurl.com/2h6x9va7
https://tinyurl.com/3dne3uhv
When using WSJT-X Improved on 3573kHz with a 1500Hz offset, and you change to the 60m band, you will be greeted with a pop-up message stating: *"UK stations must transmit below 5358kHz on 60m. The Tx Offset will be automatically reduced to 950Hz."*
If you are already using a Tx offset of 950Hz or lower when selecting the 60m band, no pop-up appears. The software simply enforces the correct behaviour. Additionally, WSJT-X Improved will not allow you to enter a Tx offset greater than 950Hz on 60m, preventing out-of-band transmissions.
(**Editor**: Thanks to David for the above. The MoD is unlikely to agree any changes to the UK 60m allocations in the foreseeable future and a number of UK amateurs have already received warning notices from OFCOM for transmitting outside the band.)

BRING YOUR TECHNICAL SKILLS TO THE METEOR BEACON PROJECT: Did you see the Meteor Beacon Project presentation by **Brian Coleman G4NNS** at the RSGB Convention or on the Convention livestream? Would you like to explore the science that the project supports and be involved in the technical research and activities? Brian is creating a small group to contribute to the ongoing development of the project and will start to record, classify and analyse the data the system can already gather. If you'd like to know more about the project, you can watch Brian's presentation on the RSGB YouTube channel. If you'd like to be part of the ongoing development group, please contact Brian via
brian@brcg4nns.org
for a chat about what would be involved.

MIDWAY ATOLL: *"The Intrepid DX Group has been working hard over the years to gain permission to activate Kure Atoll, Johnston Island, and most recently Midway Island"*, Paul, N6PSE posted to Facebook on 19 November.
The Midway Atoll National Wildlife Refuge and the Battle of Midway National Memorial are currently closed to visitors due to limited staffing and infrastructure. The atoll is a sanctuary for endangered birds and marine life. Before considering an amateur radio operation, a formal compatibility determination is required to ensure that it will not interfere with the refuge's mission. However, the current staff and operational capacity are fully committed to essential priorities, such as human health and safety, historical preservation, and wildlife and habitat conservation. *"We will keep trying"*, says Paul, although no changes to this situation are expected in the near future.
The most recent large-scale DXpedition to Midway Atoll was K4M in October 2009.

DXLOOK: Created by **Rodrigo Vazquez AK6FP**, this tool offers a comprehensive view of real-time signal reception, making amateur radio operations more informed and engaging. In focusing on actual reception data, DXLook aggregates information from multiple sources, including WSPRnet, the Reverse Beacon Network, PSK Reporter, DX Clusters, and more, along with solar data overlays for added context. DXLook runs in a web browser with no login required:
https://dxlook.com

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A Low Cost Cable Rack

This note describes how to make a low-cost cable rack from a redundant wire frame CD rack.

Kevin Bilke G8VIV
practicalwireless@warnersgroup.co.uk

Cable racks are a truly useful addition to any shack, workshop, or lab. I could possibly say that they are an essential item. Use a cable rack, or two, to avoid knots and make it easy to see what you have.

It is wise and good practice to look after your test cables and scope (oscilloscope) probes.

Getting reliable and repeatable test results is a great skill. This is only possible with well cared for test equipment and test leads. Test leads and scope probes, if not well looked after, can be prone to subtle degradation.

Also, with oscilloscope probes I avoid returning my frequently used ones to their original cases, as typically the bends are always in the same place and this creates a likely point of failure. My four regularly used probes are stored on this rack. I do have some of the less frequently used probes stored in their original cases with all their accessories and kept in near pristine condition.

Sadly, cable racks can be relatively expensive, but it is easy to convert a wire-based CD rack into a cable rack.

This is very timely as CDs are dropping out of regular use and hence many CD racks are headed to charity shops or the scrap heap.

All that is required is a sturdy pair of wire cutters, or a junior hacksaw, and maybe a file to take off any rough edges.

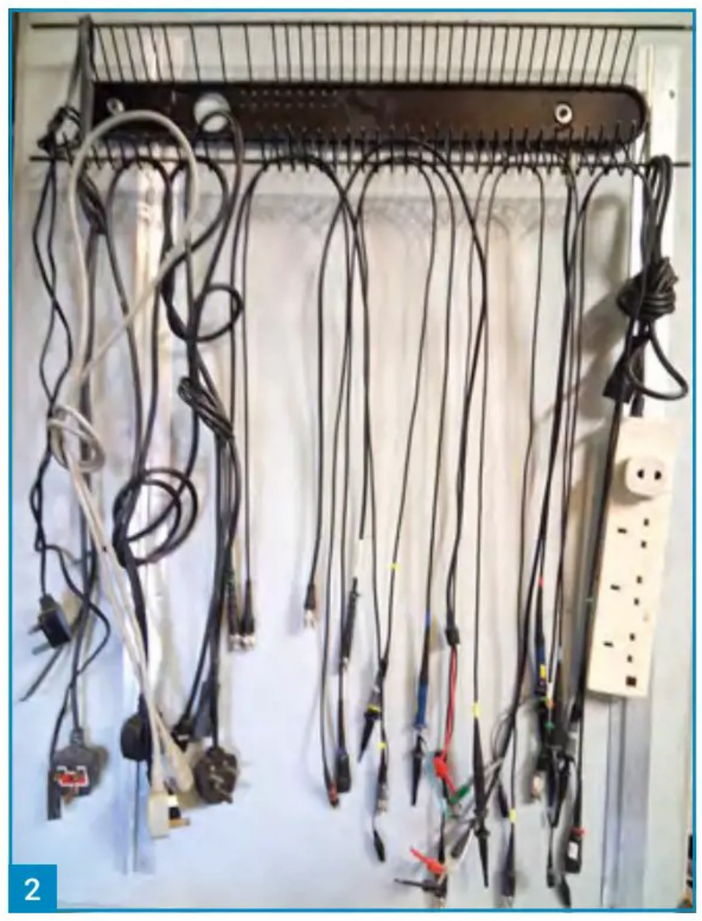


1

Photo 1 shows the CD rack in its original form; this was approximately one metre tall. My donor CD rack had some larger spaces for double albums; this spacing variation is a minor bonus. The wide spacing is well suited to mains power cables.

Photo 2 shows the cable rack in use. The rack is wall mounted horizontally.

The process for converting the CD rack is to select a top side. On mine, I cut the wire tangs close to this top edge. On the lower edge I left about 40mm (1.5in) of the tang to act as the cable hook. I also left some length of the strong structure wire in place on both sides, to be used for hanging heavier items like mains blocks. The exact method of converting the CD rack will depend on the form of the donor item. If the final mounting position is likely to see much passing traffic, then I would suggest that brightly coloured insulating tape or heatshrink is used to cover any sharp points.


2

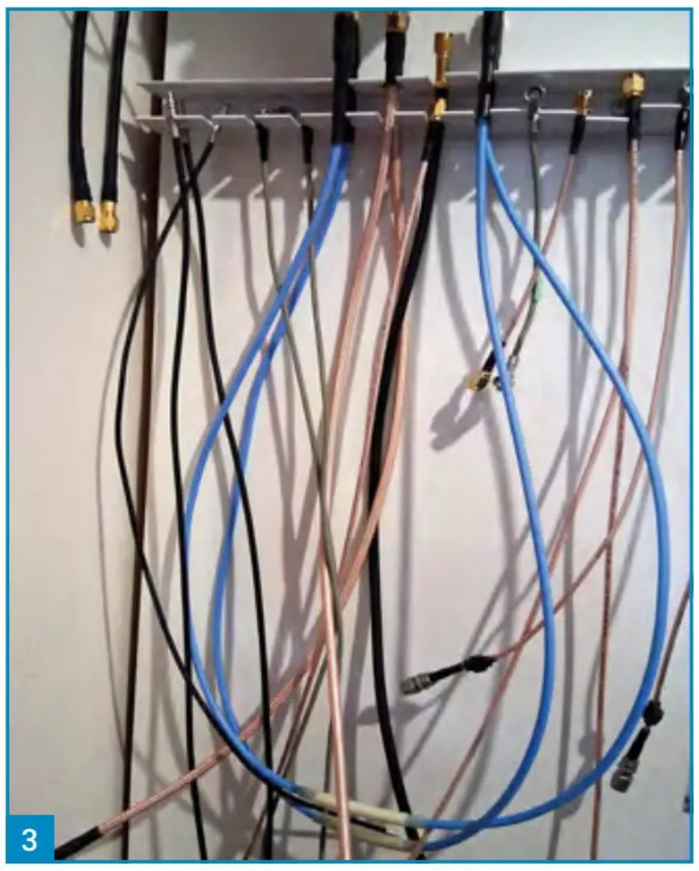

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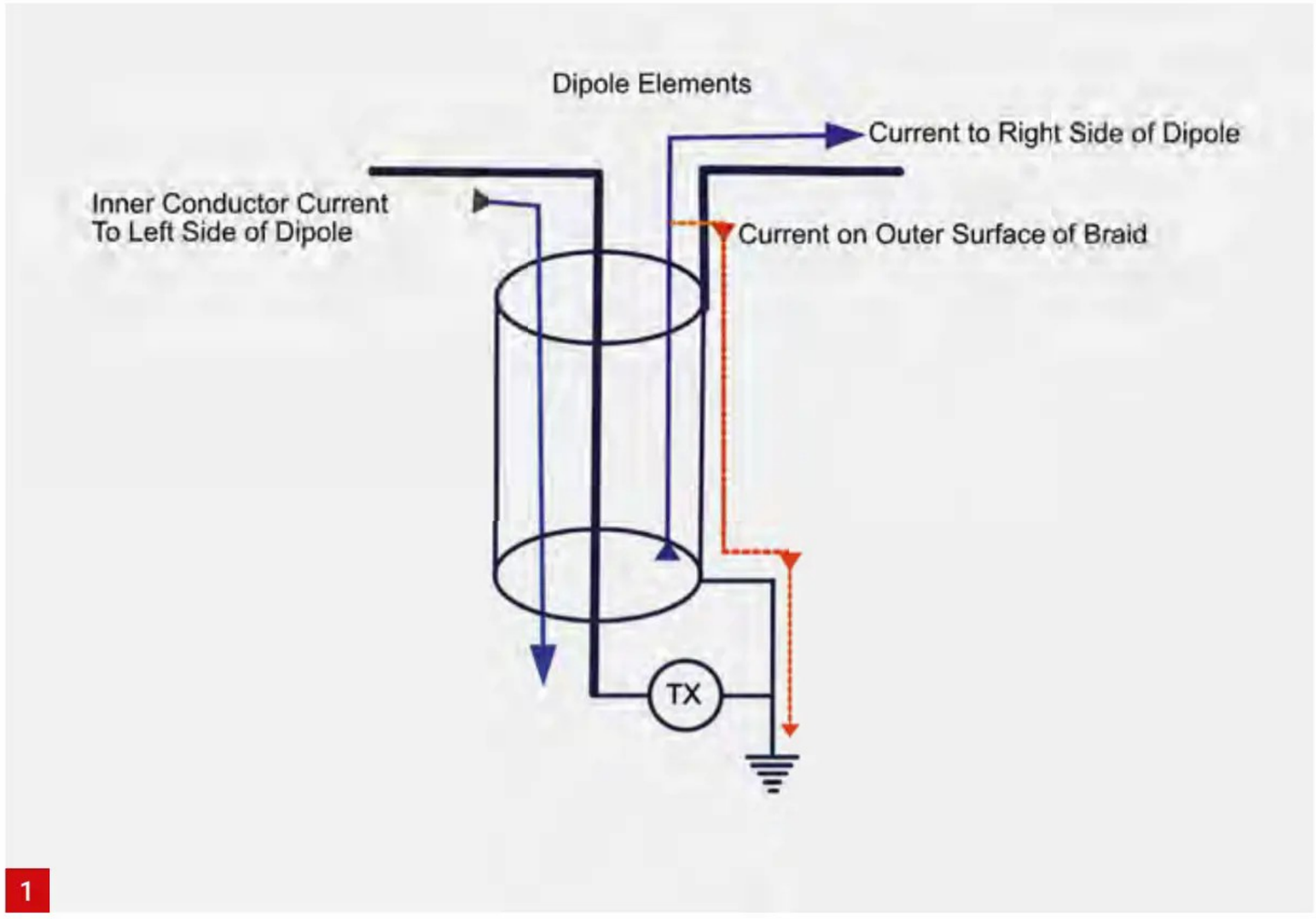
Photo 3 shows one of my other cable racks, this is for SMA and SMB cables. It is made from some U-shape plastic stock material. Construction is not covered here, but I leave it as an idea for anyone who has several SMA and SMB cables. **PW**



Question 1. G3OZF (Jan, p.35) **Question 2.** Edward Appleton (Feb, p.7) **Question 3.** A scheme from the RSGB to encourage newcomers to explore a wide range of aspects of the amateur radio hobby (Feb, p.58) **Question 4.** Roger Cooke G3LDI (Mar, p.52) **Question 5.** DK7DQ (Apr, p.7) **Question 6.** The Anytone AT-6666 Pro (Apr, p.12) **Question 7.** Vector Network Analyser (Apr, p.46 and others) **Question 8.** The IC-7760 (May, p.8) **Question 9.** An 80m CW transmitter (Jun, p.22 **Question 10.** Visalia, California (Jun, p.26) **Question 11.** A CW Key (Jun, p.30) **Question 12.** David and Tammy Palmer (Jul, p.37) **Question 13.** Signal In Noise and Distortion (Jul, p.56) **Question 14.** Frequency hopping (Aug, p.15) **Question 15.** G4HKS (Sep, p.24) **Question 16.** www.pwcontest.org.uk (Sep, p.37, etc) **Question 17.** The Icom IC-7300 (Oct, p.7) **Question 18.** A vector network analyser (Nov, p.20) **Question 19.** Watchet, Somerset (Nov, p.56) **Question 20.** 101 (Dec, p.14)

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Keith Rawlings G4MIU
keith.g4miu@gmail.com



1

Further Two Port Measurements Using the NanoVNA

Keith Rawlings G4MIU looks at further uses for a NanoVNA, starting with Common Mode Chokes.

Something which most of us have experienced and which can be very annoying is RF (Radio Frequency) feedback in the shack.

Signs of RF feedback include distorted audio on transmit, equipment malfunctions such as computer lockups, flickering lights, distorted audio picked up on external speakers, RF burns (of varying levels) from touching exposed parts of the equipment and increased local noise on reception.

These problems are often caused by Common Mode Currents. In most cases they can flow along the outside of coaxial cables, which are inherently unbalanced, but problems can also arise from open wire line if, for any reason, they become unbalanced.

This is a subject I have touched on before (*PW* November 2024) but is worth repeating in the context of using a NanoVNA to evaluate the effectiveness, or otherwise, of a suitable choke to supress RF current which may flow along the outside of a coaxial able.

Fig. 1 is an image I have used before depicting how currents get to flow along the outside of a coaxial cable. This is a simplified diagram demonstrating the path of RF currents on a coaxial cable, which in this case, is fed directly to a dipole element causing an imbalance from the balanced dipole element and the unbalanced coax. Ideally to overcome these problems a BALUN would be placed at the feedpoint.

When these currents flow on the coax outer they can radiate and, as mentioned, cause RF to get into house wiring, speaker cables, telephone lines etc. and they can also travel back into the shack to cause hot spots on equipment and generally cause a nuisance! As well as radiating RF these currents can pick up unwanted RF/noise on receive as the cable will have lost a degree of its shielding properties.

To attempt to eradicate this we can use Common Mode Chokes and these may be placed not only over an offending coaxial cable but also over any other cable that may be picking up stray RF, speaker cables being an example.

Most often CMC (common mode chokes) are made up by winding a cable through a ferrite core, which can be a toroid type but also one of a clip-on variety as well. The latter being more convenient where the end of a cable cannot be easily passed through the core.

A typical toroid configuration may be seen at **Fig. 2**. This demonstrates a choke made from a few windings of coaxial cable, but windings can be made from bifilar windings of insulated wire as well. There are various grades of ferrite material used for cores and some will work better at some frequencies than others.

Steve G3TXQ (SK) has left us with a lot of useful information on common mode current and chokes:

www.karinya.net/g3txq/chokes

And a copy of a *RadCom* article written by him may be found here.

https://tinyurl.com/2v4b7yyu

If you read this document, you would probably be thinking that there is a lot that goes into making an effective choke, and you would be right!

In saying this, following the data in Steve's document, and that published on the webpage, should result in a choke that works without spending too much time trying to evaluate it other than using it on the air, which is of course what most of us are worried about. We are fortunate that Steve has done all of the groundwork here.

Nonetheless it can still be desirable to be able to assess the performance of a choke once it has been built and a VNA can be used very effectively for this.

Common mode choke evaluation set-up

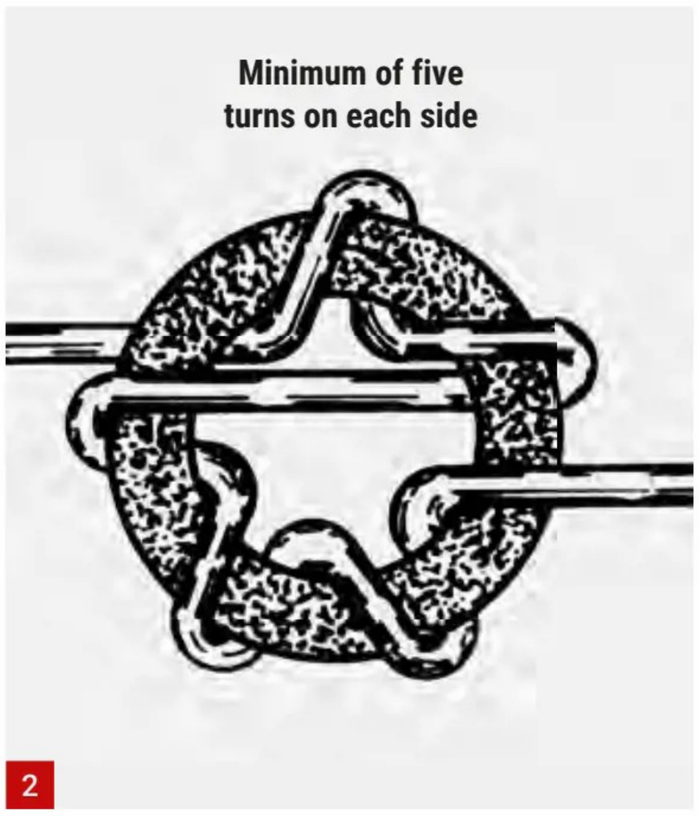
The NanoVNA needs to be configured for an S21 Through calibration, as described last month. The required sweep range needs to be entered, so let's say for example a span of 1.5-30MHz as this will cover the 160-10m bands. Enter the number of sweep points (the more the merrier) and I suggest that all but one of the traces are cleared so the display is easier to read.
This trace must be set to read S21 because as mentioned, we are making a through measurement and the Nano needs to know it has to look at both Ports. In this case the device also needs to be set to read in dB, which in the case of the Nano means assigning LogMag to the selected trace.

A Short, Open, Load and Through calibration is then performed, to a similar, but not exact way, as described in previous months. This is because the method of measurement we are going to undertake here may differ to those already described in this series on VNA's.

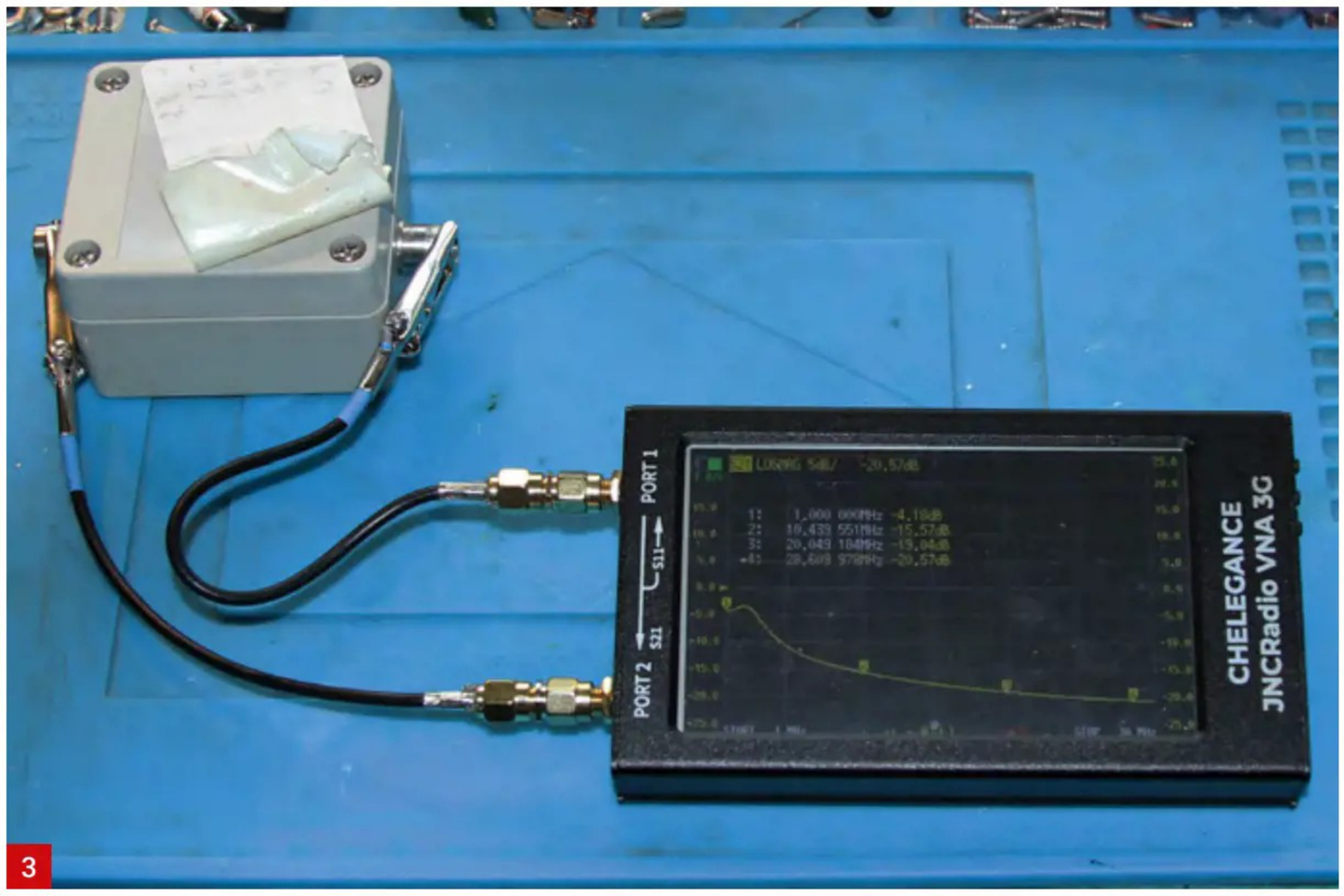
Up to now we have discussed characterising our 'networks' in the conventional way that is, connected to and using coaxial cables with signals travelling along the inside of the cable, typically to something like an antenna or filter.

Common mode current, which is what we want to measure here, travels along the OUTSIDE of

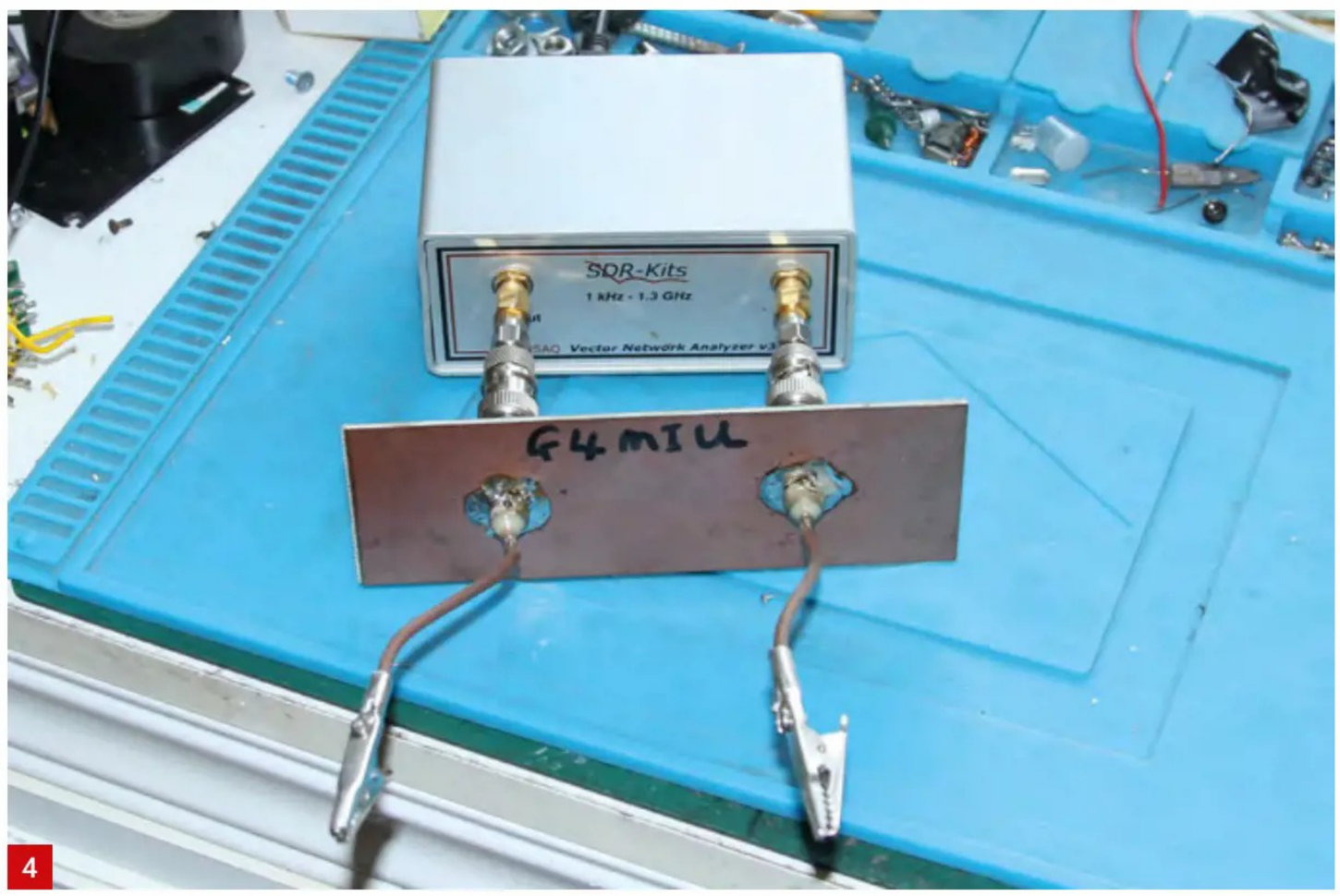
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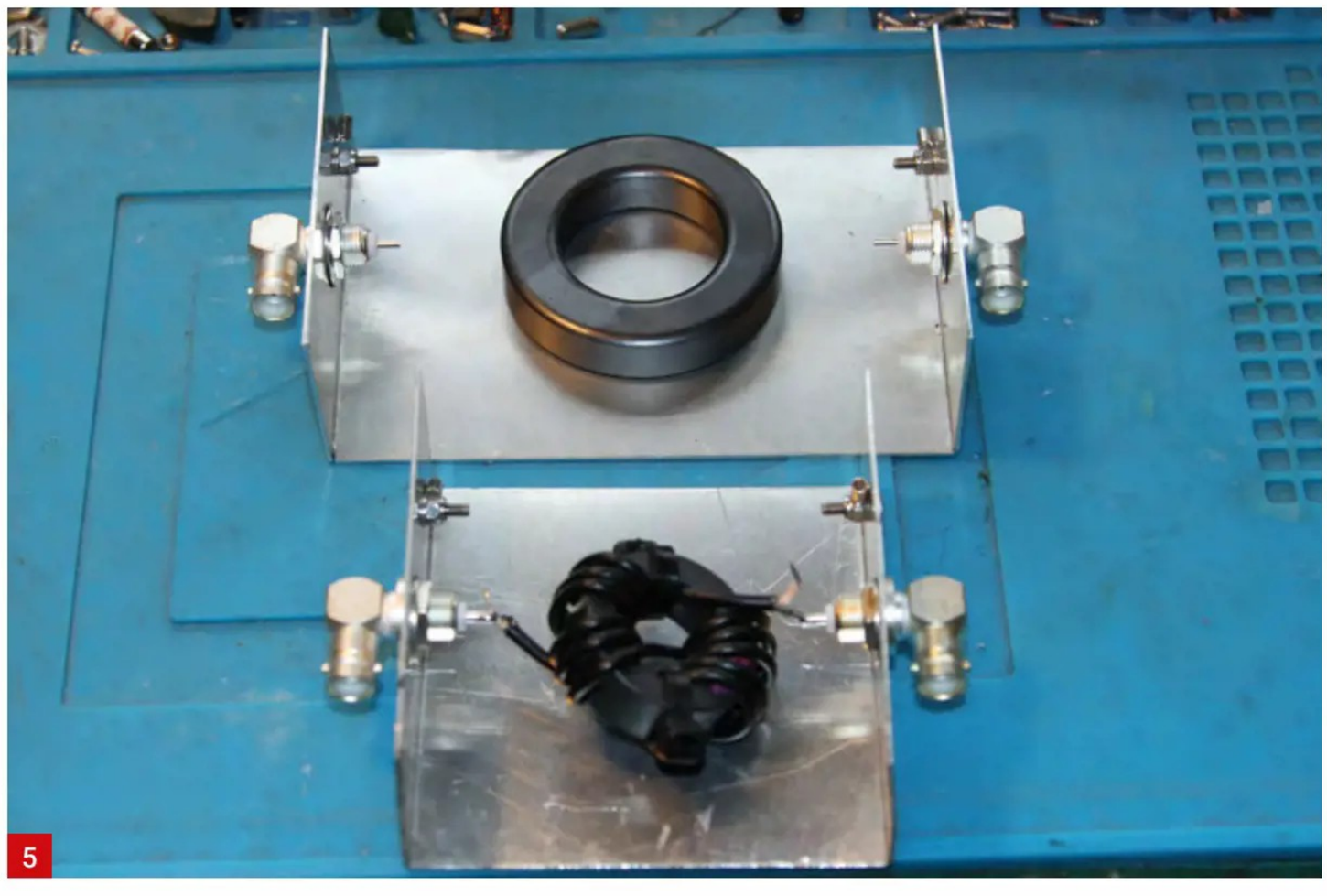
2



3



4



5

Fig. 1: How currents can flow on the outside of coaxial cable. Fig. 2: A typical common mode choke. Fig. 3: Evaluating an enclosed choke using croc clips. Fig. 4: Jig made up to evaluate chokes using the VNWA. Fig. 5: A pair of fixtures made up to improve the consistency of choke measurements.

the cable so hooking a choke up in the same way as we would a BALUN or Transformer won't work, we need to connect the 'inner' pins of the VNA Ports to the outer connection of the choke.

So how we connect to the device under test (DUT) is going to depend very much on the physical construction of the DUT and the frequency range of interest and this will dictate how we calibrate the VNA.

What we are actually going to do here is to measure the Insertion Loss of the choke which is acting on currents flowing on the *outside* of the choke.

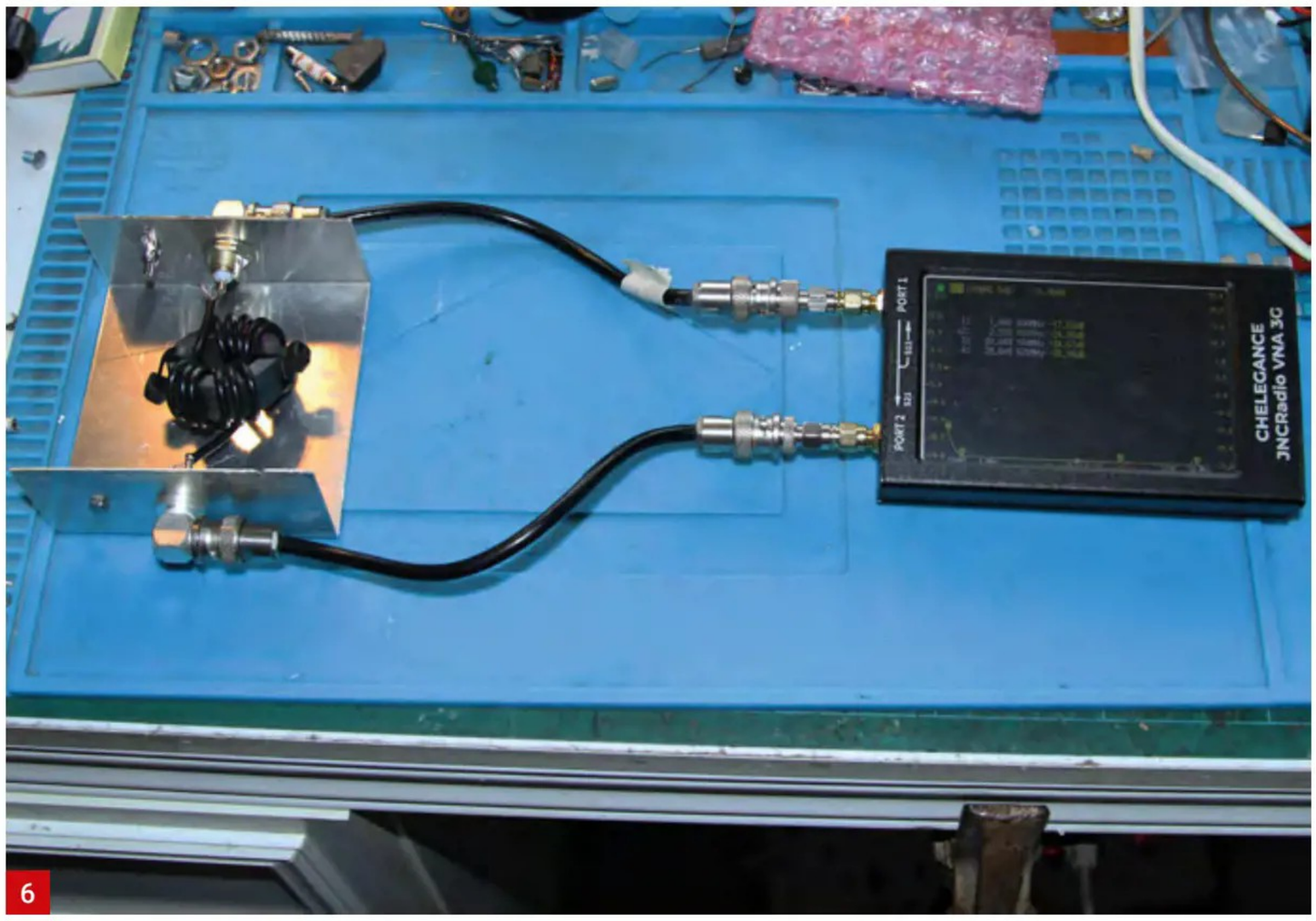
I should point out now that the method I am describing, while it is probably a good indication of the choke's performance, only measures the differential insertion loss at a very low signal level. Testing the choke under working conditions is really the only way to determine if the choke is functioning satisfactorily. Preferably we should place the choke on the line just as it would be when in use running the full level of RF power it is intended to use. Then place a current meter over the line to sample any currents flowing on the outer of the cable.

A suitable current meter/RF ammeter is a very simple device to make as it just comprises of a few components such as a meter, capacitors, resistors ferrite core and a diode, either germanium or Schottky. Some ideas for such a meter may be found in these links:

www.ifwtech.co.uk/g3sek/clamp-on/clamp-on.htm
https://tinyurl.com/2emfekpy
www.w8ji.com/building_a_current_meter.htm

Nonetheless measuring the choke with the VNA will give a very good idea as to whether the choke

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6

Fig. 6: Homemade jig in action with the VNA-3G.

is up to the job or not and indeed the only way to check if the choke is being used for reception only.

I have used three different ways to measure chokes; two of them are based on jigs in an attempt to improve consistency.

The first and most basic may be seen in use in **Fig. 3**. This merely consists of two short lengths of RG174 with SMA plugs fitted on one end and a croc clip to the other, the croc clip being soldered to the inner of the RG174 with the outer braid being cut back and insulated. The clips are then placed onto the choke, either by clipping onto the connector being used as in Fig. 3 or directly to the wire of the choke. This will also work on a choke made up of coiled coax cable by connecting to the outer braid.

Calibration is simple, the clips are left disconnected for Open, shorted to the SMA connector on the VNA for the Short and then a suitable load connected across Port 0 to ground for the Load, the clips are then connected together for the Through.

With the wires being short I rely on the chassis of the VNA to act as the ground connection between ports.

This method can be used by either my VNA-3G or my SDR-Kits VNWA.

The next one is a copy of the technique used by Steve G3TXQ with his VNA, **Fig. 4**. Here a couple of connectors are attached to a piece of double-sided PCB at a spacing that suits the pitch of SDR-Kits VNWA connectors. It has two wires fitted with croc clips that are used in the same way as described above. The jig simply fits directly on to the VNWA ports.

The third method and the one which I prefer when evaluating toroid chokes can be seen in **Fig. 5**. These jigs are made up using a piece of 1mm aluminium sheet formed to make the fixture as seen in Fig. 5. I have used BNC sockets because I have a lot of them but it does mean I have to use SMA/BNC adaptors when using either the VNWA or the VNA-3G. The proximity of the choke, close to what is in effect a ground plane with these jigs, does not seem to cause a problem.

Calibration is made easier using these jigs as I just perform a normal SOLT as described in previous months. This does mean that my calibration plane is not exactly at the point of contact on the choke but for HF this seems to make little difference. The Through calibration could also be made by soldering a wire between the two pins of the BNC sockets. Obviously, this fixture is not suitable for measuring chokes where it is not possible to access the choke's wires directly.

I made two sizes of jig one for smaller cores and one for larger ones such as the FT240-43 seen awaiting construction in Fig. 5. On reflection when I made these jigs I could have saved time and material by making a single jig that was adjustable for length.

Measurements

So, what are we looking for when we evaluate a common mode coke?

It seems to be universally recognised that a choking impedance of 500Ω is the absolute minimum value required with 1000Ω or more being preferred over the range of interest. Clearly the higher the impedance presented to the unwanted current the better. But, the method discussed here does not measure impedance but insertion loss and this will be measured in dB. The minimum value deemed suitable for a common mode choke is 25dB of attenuation but again, the more the better. So, what we will be looking for on the NanoVNA is a LogMag value of at least 25dB at the frequency or frequencies of interest.

Fig. 6 demonstrates a choke wound with 11 turns of RG174 over an FT140-43 core. The measured attenuation was found to be as follows:

- 1MHz -17.82dB
- 2.6MHz -24.96dB
- 20MHz -34.67dB
- 28.6MHz -36.0dB

So, this choke should be adequate on the bands from 80 through to 10m at least; unfortunately, there is a sharp decline in attenuation below 2.6MHz so it will be of questionable use on 160m.

A similar enclosed choke which only has only five turns, unsurprisingly, returned much poorer figures, as may be seen from Fig. 3.

Always remember that we are measuring currents on the outer of the coax and that wanted RF remains happily running along the inside of the choke completely unware of what is occurring on the outside!

So, here are a couple of methods for measuring chokes, for HF at least. If you have a favourite method of measuring common mode chokes/current, at HF and higher, with or without a VNA, and you would like to share please let me know.

Reader feedback

After hearing from *PW* reader and contributor Whit who is located in Alaska I was pleased to hear from **Harold ZS1NA** who is in Cape Town South Africa!

Harold wrote regarding the pickup loops I described, *"I have read your article in* Practical Wireless *October 2025.I wanted to try it (out) and went on to read the previous magazine where the pickup loops were given. I cut wires to the correct length for the coils but made the smallest loop first. Calculated the circumference and found that an insect repellent spray can was close to the diameter. Fortunately, I had a set of traps I previously wound for a trapped Inverted-V antenna but never used. At first there was no pick-up and after a while I decide to just dump the idea. However, as I moved the trap out of the loop there was a flash on the VNA and I checked everything again. I then found that the trap only needed a very small insertion into the pickup! Checking all my traps this way it worked like a charm. Thank you for the article. I am now trying to share the idea between all my ham friends because it is real (and) so much easier than the dip meter. Best wishes from Cape Town."*

Nice to hear from you Harold and thank you for mentioning this. You have proved that it is worth experimenting with the positioning of the trap within the pickup loop as the reaction of the trap may vary from type to type. I hope your ham friends have similar success!

See you all next month. **PW**

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Broadcasting history

Another tour de force of radio and TV history with **Keith** and **Garry**.

Keith Hamer
Keith405625.kh1@gmail.com
Garry Smith
Garry405625.gs@gmail.com

BBC Broadcasting House, London: Part V

During World War II, the German bombing raids were relentless. Enemy action had already severely damaged *Broadcasting House* on 15 October 1940. On 19 November of that year, the radio transmitter located in Birmingham was demolished by enemy bombing and the BBC premises in Swansea were destroyed on 21 February 1941. For security reasons, the *BBC European Service* was transferred from Broadcasting House to *Bush House* in London on 17 March 1941. On 30 June 1944, Bush House was severely damaged by a 'flying-bomb'.

On 10 May 1941, *Queen's Hall* in London, historic home of *The BBC Proms*, was demolished by bombs. The music continued, however, from the *Albert Hall* with the undaunted veteran conductor, **Sir Henry Wood**, still in charge on the rostrum, baton at the ready. On the same day, the *BBC Maida Vale* studios and other buildings were destroyed.

Most of the larger studios at Broadcasting House had *Listening Rooms* attached to them for the use of producers, announcers, and other people concerned with the actual programme in the studio. These were different to what the BBC termed *Listening Halls,* which were intended to provide comfortable rooms where members of the Press and privileged visitors could hear the programme on first-class apparatus.

Vintage New Year's equipment advertisement

This month's meander through vintage copies of deserted newspapers and magazines has discovered a New Year's advertisement by *Verdik Sales Limited* for their reel-to-reel tape recorders and amplifiers, **Fig. 1**. The advertisement dates from December 1956. The text has been left in its original format to reflect the spelling, grammar and punctuation of the time.

Verdik Sales Limited were manufacturers of high-quality tape recorders, amplifiers and associated equipment. Their two-speed tape recorder used a *Lane Tape Unit*. According to some very elusive literature from Verdik, the equipment employed *"the latest amplifier techniques"* and was "*suitable for playing pre-recorded tapes at their best*".

Their tape recorders were valve operated and the deck surface would often become too hot to touch. Regarding their valve amplifiers, and the *Mark II EL84* in particular, Verdik claimed that harmonic distortion was set at 0.1% with a power output of 10W.

This issue of *PW* marks the third anniversary of this column. Paraphrasing the Verdik advertisement, the authors would like to wish our readers and contributors a *Happy New Year* and *true enjoyment* reading forthcoming columns!

100 years ago: January 1926

This series features some of the events, technical achievements and personalities associated with the world of broadcasting from exactly 100 years ago this month.

2RN, the first radio station in the *Irish Free State* (*IFS*), went on-air on 1 January 1926, and was operated by the *Irish Post Office* under the *Department of Posts and Telegraphs* from Little Denmark Street until 1928. At this point, the station was transferred to the *General Post Office*. 2RN continued until 1933, when it was succeeded by *Radio Athlone* which, in turn, became *Radio Éireann*. The station is now known as *RTÉ Radio* and is owned by Raidió Teilifís *Éireann*. The IFS was established as a dominion of the *British Empire* in December 1922.

A radio play by **Ronald Knox**, broadcast by the *British Broadcasting Company* on 16 January, caused panic amongst many listeners as it reported a workers' revolution taking place in London. For those who didn't hear the preliminary announcement, the play was, in fact, a harmless satire on broadcasting!

The earliest *named* radio programme to be found in the BBC archives was *The Week's Good Cause*. The first edition was broadcast on 24 January.

On 26 January, the Scottish inventor, **John Logie Baird**, demonstrated the world's first television system capable of producing 'live', moving images with tone graduations. The 30-line pictures were scanned mechanically by a disc with a spiral of lenses at 12.5 images per second. The demonstration was in front of 40 members of the *Royal Institution*. Unfortunately for Baird, they were decidedly unimpressed by his efforts!



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New Year
and True Enjoyment
from the use of Verdik Products
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PRE-AMPLIFIER
20 Gns. ONLY
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WARDOUR ST., LONDON, W.1 (GERrard 8266)"

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2

In focus: The BBC Penmon transmitter: Part I

BBC broadcasting in Wales began at 5pm on 13 February 1923, when the *British Broadcasting Company* (as it then was) opened their Cardiff station. The BBC's *General Manager*, **Sir John Reith**, visited Cardiff for the Region's inauguration ceremony in July 1923. In December 1924, the BBC opened a station in Swansea. In 1927 the company became the *British Broadcasting Corporation* under *Royal Charter* and within three years, the Welsh stations were part of what was known as the *West Region*.

In the 1930's, many listeners in Wales

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wanted a separate Welsh Region, providing programmes in both English and Welsh. After a lengthy campaign, a transmitter was erected at *Penmon* in Anglesey. It was brought into service at midday on 1 February 1937, signalling the beginning of the *BBC Welsh Regional Programme*. The site was initially called *Beaumaris*. The BBC's Chief Engineer, **Sir Noel Ashbridge KBE**, took part in the first broadcast, **Fig. 2**.

Sir Noel was originally employed by the *Marconi Company*. His involvement in developing the *2MT* transmitter resulted in him transferring to the BBC to become the *Assistant Chief Engineer* from January 1926. He worked alongside the BBC's *Chief Engineer*, **Peter Eckersley**. After three years, Sir Noel took over this position.

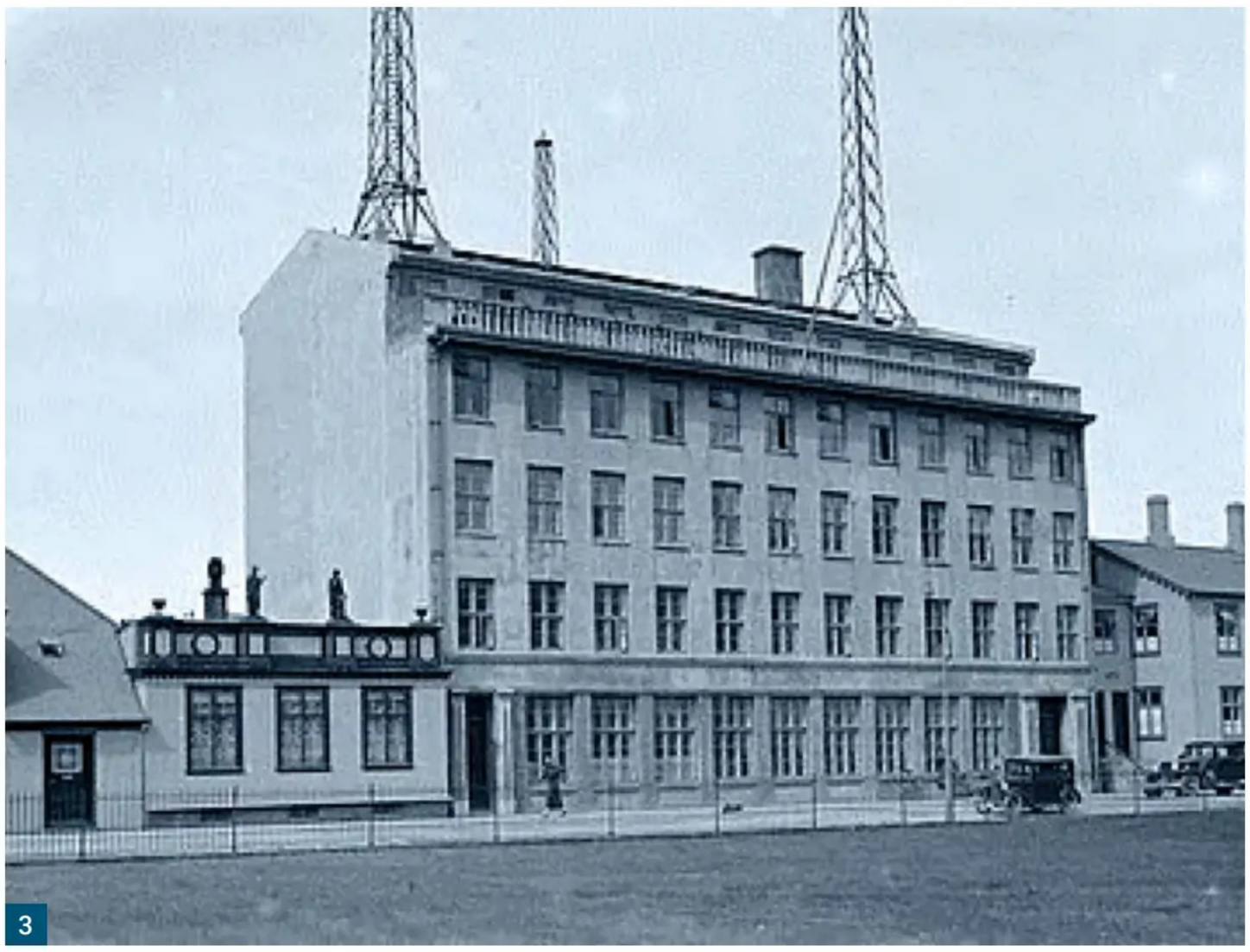
Whilst at the BBC as Chief Engineer, he also offered technical advice to other European radio services. For his work, the Danish monarch made him a *Knight of the Order of the Dannebrog* in 1934. He was knighted in the United Kingdom in 1935. Later, he became part of a wartime committee set up to plan for the post-war resumption of the television service.

In 1943, he became the BBC's *Deputy Director-General*. In 1950, he was involved in the foundation of the *European Broadcasting Union*. After retiring from the BBC in 1952, he returned to Marconi as a board member for seven years.

The Penmon transmitter operated on 804kHz and was brought into service in time to broadcast the **Coronation of King George VI and Queen Elizabeth** to the Welsh nation on Wednesday 12 May 1937. The Coronation was also broadcast from the Washford transmitter in Somerset.

The transmitter played a vital role during World War II and had a significant part in the development of Welsh broadcasting. During the war, the installation radiated the *BBC Home Service* and later, the *BBC Welsh Home Service*.

At the time of writing, the current operators, *Arqiva*, have lodged a planning application to demolish the historic Penmon transmitter!



3

Fig. 1: A New Year's advertisement by *Verdik Limited* for their reel-to-reel tape recorders and amplifiers. The advertisement dates from December, 1956.
Fig. 2: The BBC's Chief Engineer, Sir Noel Ashbridge KBE, took part in the first broadcast from the Penmon transmitter on 1 February 1937.
Fig. 3: The original building occupied by the Icelandic radio service, *Útvarp Reykjavik*, in 1930.

60 years of BBC-2: Part XXII

When BBC-2 opened in April 1964, due to the lack of ideas for programmes to fill the hours, a *Seven Faces* approach was instituted whereby different genres were introduced for each day of the week. Sunday evenings presented viewers with various thriller serials. The first was a six-part drama called *Melissa* which was shown under the umbrella title, *Francis Durbridge Presents*. This serial was one of several written by **Francis Durbridge**. In later weeks, **Mantovani** brought viewers *The Best Of Both Worlds* which was a programme of light music.

Apart from the programmes mentioned above, BBC-2 also brought excited viewers all the party political broadcasts plus a weekly review of Parliament. Perhaps it wasn't too surprising, therefore, that when BBC-2 started in 1964, the audience was only around one million. It wasn't too long before viewers found the 'Seven Faces' approach indigestible and the plan had to be fine-tuned over a period of several months. By the time the second Controller of BBC-2, **David Attenborough**, came onto the scene in 1965, the 'Seven Faces' idea had been dropped completely!

Service information, Iceland: Part I

Ríkisútvarpið, abbreviated to *RÚV*, is the national public radio and television service in Iceland. The organisation began in 1930 with the launch of the Icelandic national radio service, *Útvarp Reykjavik* (*Radio Reykjavik*). The original RÚV building in Reykjavik is shown in **Fig. 3**.

RÚV has been a full, active member of the *European Broadcasting Union* since 1956. RÚV operates from studios in Iceland's capital, Reykjavik, as well as regional centres around the country.

Radio broadcasts began on long-wave in 1930 from the transmitting tower at Vatnsendhæð, near Reykjavík. In 1938, the transmitter's power was increased to 100kW. Unfortunately, the structure collapsed in 1991, so a new site had to be found. Eventually, a transmitting tower was erected at Hellissandur and radiated long-wave programmes on 189kHz. At the time, this was the tallest radio tower in Western Europe.

In 1938, Iceland's first medium-wave transmissions began in East Iceland at Eiðar. In 1966, the transmitter was converted to long-wave with an ERP of 20kW. In 1998 the height of the structure was increased to 220m (722ft) and operated on 207kHz with 100kW.

From 1999, long-wave broadcasts were a mix of the output from the two main RÚV radio stations, *Rás-1* and *Rás-2*. The long-wave transmissions were mainly intended to fill gaps in the FM coverage, as well as serve the Icelandic fishing fleet. LW also acted as a back-up during emergencies.

RÚV began the retirement of their long-wave transmissions in 2023, citing the fact that most vehicles and domestic radios no longer had LW tuners fitted as standard.

Stay tuned!

The photos are once again from Keith and Garry's collection. Please send archive photographs, information or suggestions for future topics via the email addresses shown at the top of this column. **PW**

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practicalwireless@warnersgroup.co.uk

Delta Vee AutoLoop

Frank Howell K4FMH describes a Lightweight Portable Auto-Tuning HF Antenna.

Portable operating has bloomed significantly in the past couple of decades, led from the origins of Worldwide Flora and Fauna and Summits on the Air. These were mainly niche activities until the year-long ARRL National Parks on the Air event in 2016. That unexpectedly strong participation morphed into the more general but independent Parks on the Air (POTA) program. It has been the fastest-growing amateur radio activity in the U.S. as well as becoming an international phenomenon. This organised activity space has promoted innovation in portable power, radios, and, especially, antennas that fit the criteria of easy installation, take-down and transportation.

Portable operators face several challenges, mostly involving the choice and deployment of an effective HF antenna. For instance, the highly popular end-fed half-wave (EFHW) wire antenna needs a tree or temporary mast for deployment. Dipoles or random-wire antennas also need one or more mounts for effective use. Ground-mounted verticals are an alternative but need a stake, tripod, mast, or attachable mount to an existing object, such as a picnic table, fence post, or automobile. Then the radials or recently popular 'Faraday cloth' are needed for a counterpoise.

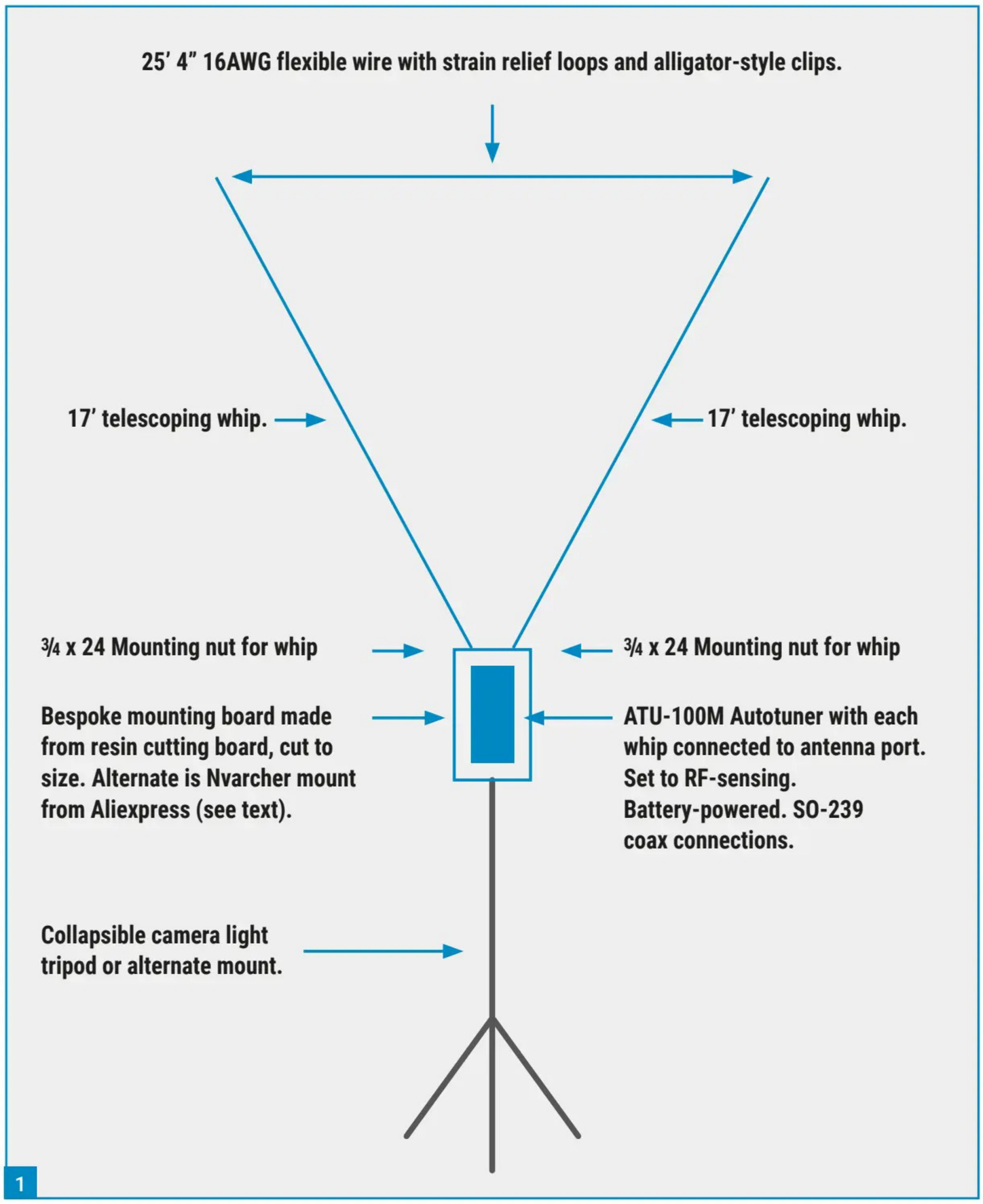
I have used some version of all these antennas in portable operating with varying degrees of success. Ease of setup and transportation do vary. Some parks do not allow stakes in the ground or lines strung in trees for preservation reasons. Many Park Managers do not mind or just do not know about it. A tripod or, alternatively, a patio umbrella mount, might get around these specific limitations. For SOTA, this might be prohibitive due to the weight of these objects. But portable operators still face the challenge to minimise the time for setup and take-down as well as transporting an antenna. Thus, there is a limitation for many popular antennas at some locations regardless of the operator's preference.

Why not use a multiband loop? Generally, it is a quieter antenna in terms of noise versus other wire antennas. It can have harmonic resonance on multiple bands, like the EFHW. But it can be difficult to install due to multiple mount points for the size needed, which is the most likely reason that it has not caught on in the POTA world. It does not have to be a challenging installation and can be quickly set up, taken down, and transported to the operation.

The Chameleon Tactical Delta Loop, for instance, is a moderately expensive commercial offering, receiving many reviews, especially on YouTube. It has a fixed wind-ratio balun (5:1) emphasising resonance on a given frequency with harmonics on a few others. (I have yet to see a formal RF sweep in a review.) In published reviews, this loop is often mounted low to the ground, which has the impact of increasing the take-off angle. Note that it is not a small magnetic loop in the style of the MFJ or Ciro Mazzoni loops.

The literature on Delta Loops (**Carr** 1999, **Stutzman** and **Theile** 1998) describes the basic properties of ideal designs and installations. In the field, however, these ideals usually get lost in the shuffle for a given temporary location. **L.E. Cebik's** antenna models on Delta Loops (and HF loops in general) showed that height and frequency band change the loop's impedance and take-off angle (Cebik 2004). The commercial versions optimise their loop on a single band with harmonic resonance on the others, making portable installations vary in performance because of the height of installation. To deal with this, I make a novel change in the usual design of the Delta Loop to deal with the impedance variation but take-off angle will remain dependent on the installation height relative to the band used in the operation.

We can build a better Delta Loop that successfully matches from 80-10m. I call my design the *Delta Vee AutoLoop*. For this configuration, the feedpoint is at the apex of the Vee, making it centre-fed (Cebik 1997), like the Chameleon Tactical Delta Loop. What is unique about the Delta Vee AutoLoop is that it bypasses the choice of the balun in favour of an autotuner directly at the feedpoint ('bare wires') of the loop. I use a small battery-powered, RF-sensing ATU. It is part of the antenna hardware. While there are several available in the marketplace, I chose



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Fig. 1: Diagram of Delta Vee AutoLoop.
Fig. 2: Fabricating and assembling AutoLoop mount point.
Fig. 3: Alternate AutoLoop mount using Nvarcher product from AliExpress.

the open source N7DCC design manufactured by Antuner, the ATU-500M.

Design features of the Delta Vee AutoLoop

As illustrated in **Fig. 1**, the bottom-fed Delta Vee uses two 17ft telescoping stainless steel whips to form the Vee. A simple wire connects the two tips using alligator clips and a ferrule-based cinch loop to secure the wire around the ball tip of each whip. This completes the loop circuit to the feedpoint at the ATU. This provides an optimal match over the HF bands from 80-10m. It does not guarantee antenna efficiency on lower bands so be aware of that issue.

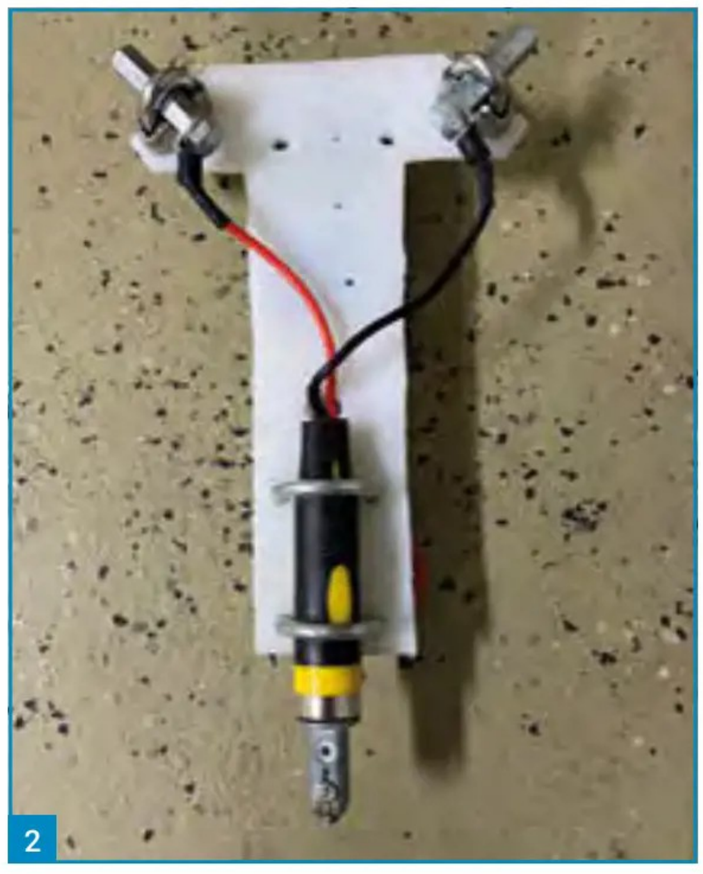
The Loop is mounted on a tripod through a resin mounting plate made for this antenna. The circumference of the loop is 17ft+17ft+25ft4in or 710in (or 59.2ft). I did experiment with various balun transformers (2:1, 4:1, 6:1) but each balun bound the loop to one optimal band. This left the antenna with few harmonics for effective use, even with a matching tuner. Bypassing a transformer balun, the insertion of an ATU at the feedpoint produced a set of acceptable SWR levels across the HF bands.

The Loop doesn't need a counterpoise or an independent tree or mast-like support. It can be mounted on a ground stake with the sacrifice of a higher take-off angle. Some parks or other environments do not allow stakes and such, even temporarily. I prefer a tripod that can stabilise the size of the loop's dimensions. It can be slightly directional so a rotatable mount might also be desirable. It breaks down to an inexpensive lightweight camera tripod bag for transportation and storage. Should the builder wish to get lower take-off angles, a push-up pole might be used but guying could easily come into play with wind at the operation site.

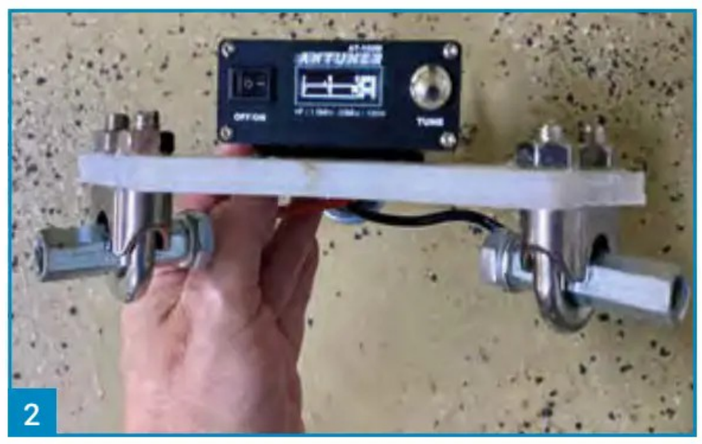
Assembling the loop

The mount point can be assembled in one of two ways. One is to obtain an inexpensive resin cutting board, draw out the Tee-shape desired, and use a saw to cut it to suit. A second is to purchase a premade mount point from a seller of antenna parts in China (Nvarcher) via AliExpress. I found the Nvarcher mount after I fabricated one from a cutting board that I already had in my junk box. It would be less work to simply purchase the Nvarcher mount point. For those would rather make it themselves, here is how I fabricated mine.

Homebrew Mount Point. **Fig. 2** displays the key assembly stages. Two heavy duty wire cable U-bolts were used to harness a common ¾ x 24in


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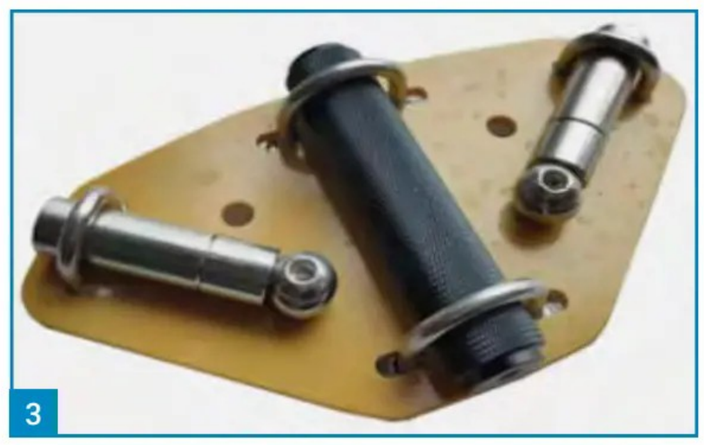

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coupler nut to the resin board. They are at 90° angles from one another (measure this). These coupler nuts securely hold the two 17ft stainless steel telescoping whips. Ring terminals to fit each bolt inserted into the rear of the coupler nuts were soldered to a pair of wires. At the opposite end, these wires were soldered into a PL-259 connector after feeding the cables through a hole drilled through the resin board to the other side. This is where the ATU is mounted to the board using Velcro strips. I used U-bolts to clamp a 'painters' pole' handle to the physical mount point. I use such fittings on most of my vertical antennas. This one came from the handle of an inexpensive roller brush, which I cut off for use in this project.

The connecting wire is fitted with a cinch loop using a ferrule to allow for firm attachment to the end of the telescoping whips. A ferrule is used to allow for a small loop to be formed with only one side of the ferrule crimped as a slip-lock on the wire. The ball on the whip's end is where the cinch loop is tightened. Stainless-steel alligator clips make electrical connections to the tip of each whip. The addition of this wire completes the Delta Loop circuit.

The ATU meter is placed facing upward so the operator can verify or manually change settings. When in RF-sensing mode, the ATU automatically initiates a tuning cycle (see ATU-100M manual). Finally, the two whips, connected by a wire with clips (see below) are fed into the ATU input. The remaining SO-239 port is where a coax cable is connected to the transceiver.

Modifying Commercial Dipole Mount Point. If the reader wants to bypass this part of the construction process, **Fig. 3** illustrates the recommended alternative build using a 'dipole mount with fixer rod' available from Nvarcher on AliExpress. This alternate build uses the existing bolts from the pre-mounted coupler nuts already arranged at 90°. On the rear, I attached a premade cable to each bolt leading into an PL-259 connector for the ATU input. There are also two existing holes in the resin plate, which I used to secure a steel strip parallel to the board. This

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Fig. 4: Tripod mount and field deployment.





steel strip has a neodymium magnetic strip I bolted to it. The bolt heads were ground smooth with a small grinder tool. Two adhesive-backed magnet strips were attached to the top underside of the ATU case for placement on the mount. This allows a firm attachment with easy removal by simply twisting the ATU to right angles from the magnets on the mount (i.e., do not pull directly away from the ATU as it will eventually stress the adhesive strips).

The 'fixer rod', as Nvarcher calls the black metal tube secured by U-bolts to the plate, has two common insert threading's for photography tripods on each end. In my case, I had purchased a heavy-duty aluminium surveyor tripod made by Manfrotto-Bogen in a recycling shop for $40. These are available for not much more than that on eBay. I used a common set of photography thread adapters to attach the 'fixer rod' to the mounting point on the tripod. It has telescoping legs and centre pole, presenting a lightweight but very sturdy mount.

Deployment of the Delta Vee AutoLoop is illustrated in **Fig. 4**. **Mike N5DU** is using an Icom IC-705 to work stations with 10 watts SSB in this park setting. The size of the Loop is significant but by comparison to most EFHW wire antennas, it is somewhat demure in scope. Most of the antenna's mass is within a circular radius around the tripod itself. This tripod puts the height above ground for the Loop at about 7ft, a reasonable compromise height versus a ground-mounted stake. I have used a 30ft telescoping fiberglass pole inserted into a patio umbrella mount for this antenna to improve performance. At this height, it would need guying if there were appreciable wind. An operator might only consider using a mast for longer activations due to the efforts necessary to deploy and take it down, in addition to the added weight for transportation.





RF characteristics and proof of concept

How well does the Delta Vee AutoLoop work? For the 'bare wire' configuration of this Delta loop's dimensions (59.33ft; see Fig. 1), it is resonant outside any amateur band at 16.01MHz with an SWR of 2.06 (where X=0). This was measured at 2ft AGL. The measured impedance was 97.44 +j20.4 ohms. This might suggest a 2:1 balun transformation would possibly work *at that frequency and height*. When the loop was at 15ft AGL, the impedance dropped to 55.34 -j217.75 ohms, almost matching the nominal 50Ω a transceiver expects but with considerable capacitive reactance. At 25ft AGL, the impedance rose to 134.0 -j45.95 ohms. This confirms Cebik's earlier modelling in that height can greatly affect the feedpoint impedance of a loop (Cebik 2004). It also shows how a single balun transformer will work better on one band but not others as antenna height inevitably varies in the field setting.

I further examined the patterns of feedpoint impedance variation in this basic loop configuration by HF band in **Fig. 5** (from **Howell** 2023). Using a RigExpert Stick Pro analyser, I measured the lower and upper boundaries of each HF band, noting the impedance range. By dividing these band edge figures by 50Ω, the third column illustrates the various balun transformer ratios that would be necessary to match a nominal 50Ω input. Most built-in antenna tuners will match up to a 3:1 ratio while many of the better performing external models can match a 10:1 ratio or even higher. *This table suggests that an ATU placed directly at the feedpoint of the Delta Loop could achieve a reasonable match to all but the 60m band*. This is the source of this Delta loop configuration name, the 'AutoLoop'. In field use, it matches to low SWR with the Antuner ATU-100M on all bands except 60m. It is easily used with a QRP radio without an inboard tuner like the Icom 705 shown in Fig. 4.

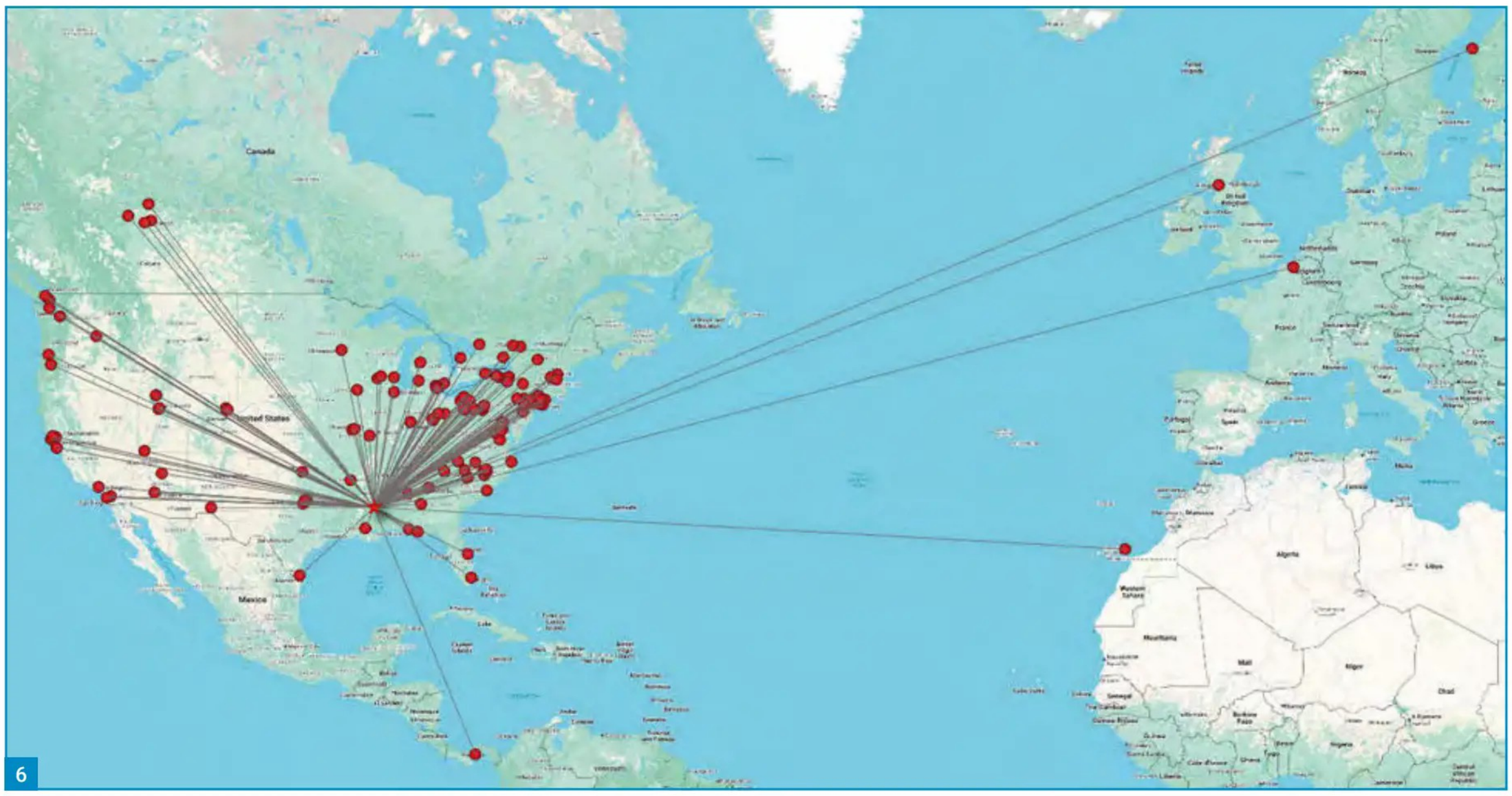
Band	*Range of Impedance*	*Ratio to 50 ohms*
80M	188-380	3.76-7.6
60M	5454-4222	109-84.4
40M	314-256	6.28-5.12
30M	43-42.59	0.86-0.85
20M	33-40	0.66-0.80
17M	477-524	9.54-10.48
15M	231-171	4.62-3.42
12M	55-59	1.1-1.18
10M	49-48	0.98-0.96

Impedance (R) taken from RF sweep results, reflecting lower and upper ends of each HF band. The Ratio column is the impedance divided by 50

Fig. 5: Configuration of Delta Loop at bare wire.

The WSPR beacon spots for 40-10m taken one morning using a 0.2W transmitter made by Zachtek are shown in **Fig. 6**. While the Delta Vee AutoLoop was pointed at about 32° from Jackson MS in the U.S., it had no problems being heard off the side in the Northwestern U.S. and Canada. It was received all over the continental U.S., in Panama, West Africa, and parts of Europe. The sunspot number on this day (1 September 2025) was 165, the SFI was 130. There was a moderate M2.7 flare and coronal mass ejection (CME) with an expected impact of G2 (Moderate) to G3 (Strong) geomagnetic storm conditions on the following day per the Space Weather Prediction

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Fig. 6: WSPR beacon spots for 40, 20, 15 and 10m over one morning.
Fig. 7:Delat Vee AutoLoop packs down into a small zippered tripod case.

In the future, the addition of a small battery-powered rotator with remote control and bearing measurement will be added to this portable antenna system.

The Delta Vee AutoLoop fits into that portable operation niche where a low-impact, somewhat directional, and lower noise antenna on the HF bands is just the ticket. Thus far, it has performed equal to the verticals I have built and used in the field but with noticeably lower noise. Without the need for a counterpoise, the setup time is about the same as a vertical. The only way the reader will see if that is true for them is to build one!

Center. Thus, band conditions were average, at best, during the WSPR beacon data collection.

In field use, I placed it two feet above ground and worked every station I called during the Illinois QSO Party in 2024. This was using an FX-4CR transceiver on SSB at 20 watts. The loop was broadside to the Midwest during this field test. In other installations, I used a 30ft extensible pole to put the AutoLoop up over 20ft above ground. Performance for distant stations was noticeable improved. This is indeed more work so a 7ft tripod like the Manfrotto-Bogen one is a good accommodation in the field. It performs very well at this height.

The AutoLoop is lightweight and packs down into a zippered tripod case. **Fig. 7** illustrates that there is room to spare for other items in this case. The lightweight aluminium yet heavy-duty Manfrotto-Bogen tripod provides a firm and secure mount even in modest winds for the AutoLoop. A lighter weight tripod can be used with caution, preferably with weights on each leg for stability, and mounted lower to the ground. This antenna system travels well and provides a low-impact HF antenna for areas that are not welcoming to rods put into the ground or ropes up in trees. The lack of an extra item to launch a line is also something to consider.

Final thoughts on the Delta Vee AutoLoop Antenna

This is a novel adaptation to the Delta Loop antenna for portable use. By bypassing a specific balun transformer, the use of a battery-powered, RF-sensing ATU at the feedpoint gives great flexibility to change bands with the modest key-up of a few watts to quickly retune the antenna match. Power, however, is limited to the specifications of the ATU. In my case with the ATU-100M, it is about 100 watts (peaks up to 150W) on SSB or CW. On AM/FM/FT8, the manufacturer (Antuner) suggests a power level of less than 50W. A more power-tolerant ATU could be substituted but with the likely burden of additional weight and power needs. It has some directivity to reduce competing signals in a narrow bandwidth and easily repointed manually when mounted on a tripod like I have shown here.

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Michael Jones GW7BBY/GB2MOP
michael@gb2mop.org

Build a MilliOhm Meter

Michael Jones GW7BBY/GB2MOP constructs a handy piece of shack test equipment.

Why would you need a MilliOhm Meter? To test and debug cables, connectors, PC board tracks and other low resistance issues, as a fault finding tool to locate the source of a shorted component; to measure the series resistance of power inductors that can be a few tenths of an Ohm; for accurate measurements of components like switches and relay contacts you will need to resolve resistance values of 1Ω or less with resolution in the MilliOhms. The instrument to be described here, **Fig. 1**, has a resolution of 0.1mΩ. At the outset I must credit DanielRP (see Links) with the original design and software. I have laid out my own circuit board to accommodate an on-board 5V regulator and some very minor changes.

Fault finding

Let's say you have a piece of equipment with many circuits supplied from a 5V supply or rail. You've disconnected the power supply and established that it still provides a healthy 5V. You leave the supply disconnected and measure the resistance between ground (chassis) and the 5V rail and read a short circuit or very low resistance: one of the dependent circuits is pulling the supply down, but which one?

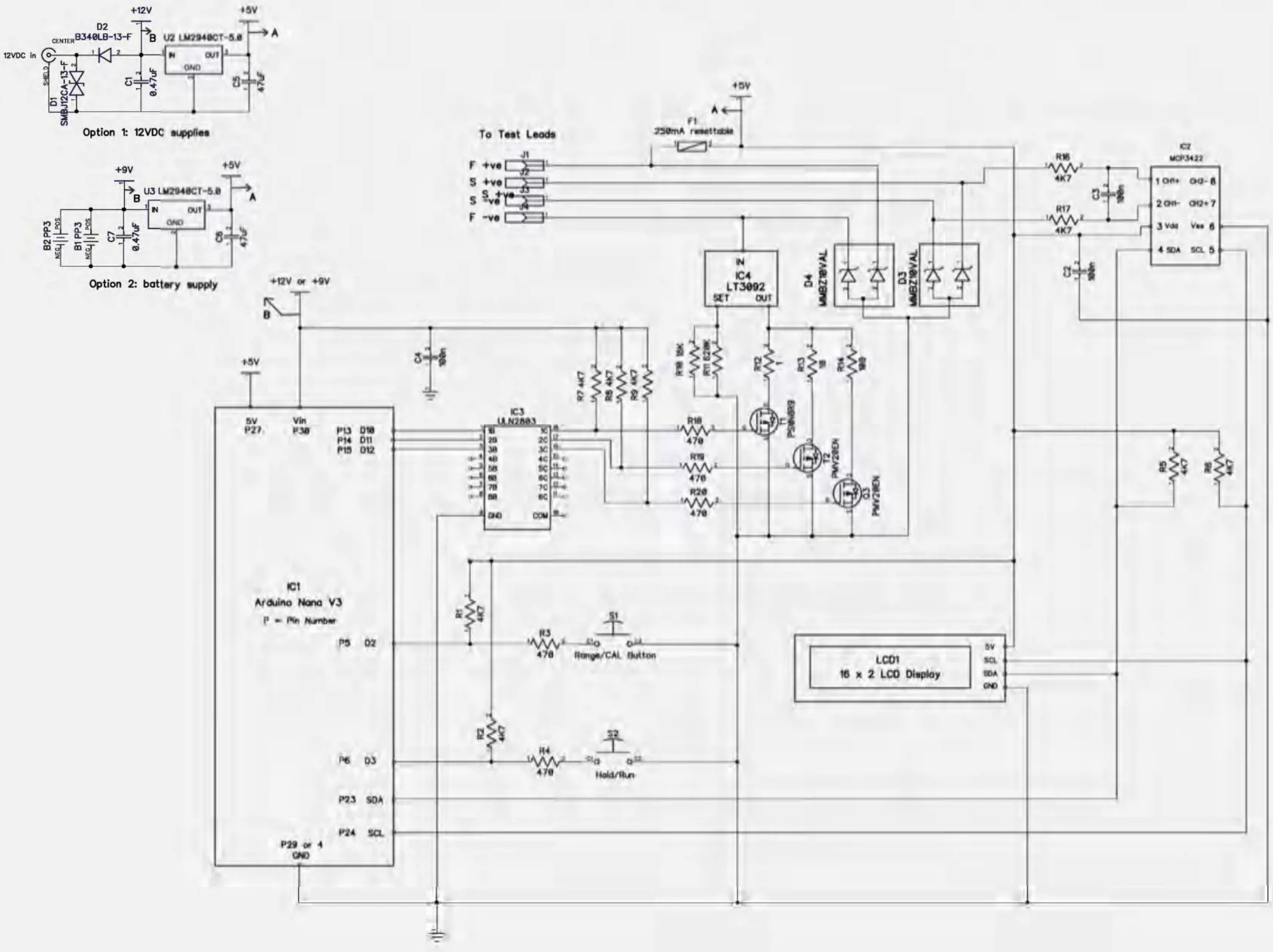
Use the MilliOhm Meter to measure between chassis and the 5V rail and you get a reading of, say, 0.350Ω, then move along the 5V rail and find the resistance decreases. As it gets closer to zero you know you are getting closer to the errant component or circuit. If the resistance starts to rise again as you move along the rail, you know you are moving away from the fault.

With this information you should now be able to home in on the faulty circuit, probably right down to the component.

Switch and relay contacts

A switch or relay contact in good condition will have very low contact resistance, probably much less than 1Ω. As the switch ages the contact resistance will rise for a number of reasons: oxidation, wear, spring weakening or grease drying out into a solid mass, eventually inhibiting correct operation. Even though the actual contact resistance may be 20 or 30Ω it will pass a continuity or beep test on most multimeters. To confirm the functionality of the contacts an accurate resistance test should also be performed. The lowest resistance range on a typical three and a half digit digital multimeter (DMM) is 200Ω with a claimed resolution of 0.1Ω. In reality, the resistance of the leads and test probes makes measurements less than 3 – 5Ω unreliable. This then is one application for a MilliOhm meter. A 2A current across contacts with 1mΩ resistance will dissipate 0.004W (4mW). If the contact resistance rises to 1Ω, the

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contacts will have to dissipate 4W. Consequently, at low currents a faulty switch may only work intermittently, at high currents, or high voltages arcing and consequent burning of the contacts may occur. Even fire may result.

How does it work? Theory

If a known fixed current (I) is applied to a resistance (R) under test, the voltage drop (V) across the resistor can be measured and from these two values we can calculate the resistance using Ohm's law: R = V/I. See **Fig. 2**: A constant current is applied to the unknown resistance, say 0.1A, the voltage drop across the unknown resistor is measured, say 3V, then the resistance is R = V/I = 3/0.1 = 30Ω.

To achieve this a circuit usually known as a constant current source is used to deliver a specified current despite varying load conditions by automatically adjusting the applied voltage. Since the current is the same in all parts of a series circuit, voltage drops in the wires applying the fixed current can be ignored.

The circuit

The complete circuit is shown at **Fig. 3**. Using the LT3092 Programmable Current Source (IC4) from Analogue Devices simplifies implementation of the current source. The application circuit from the Analogue Devices Datasheet is shown in **Fig. 4**. The output current, between 0.5mA and 200mA, is programmed as the ratio between two resistors: R_{SET} and $R_{OUT.}$ R_{SET} is chosen first to give an output between 100mV and 1V. A precise current of 10µA is generated on board the chip and applied to $R_{SET.}$ For this circuit R_{SET} consists of two resistors R10 (16kΩ) and R11 (620kΩ) in parallel to give 15.597kΩ. Using the formula from the datasheet: Vset = 10µA x R_{SET} gives a set voltage of 0.15597V, which rounds down to 0.156V.

R_{OUT} is either R12, R13 or R14 depending upon the range selected. Taking R12 (1Ω) as an example, the output current will be: 10µA x R_{SET}/

Fig. 1: Completed MilliOhm Meter.
Fig. 2: Four-wire Kelvin method.
Fig. 3: Complete circuit diagram.

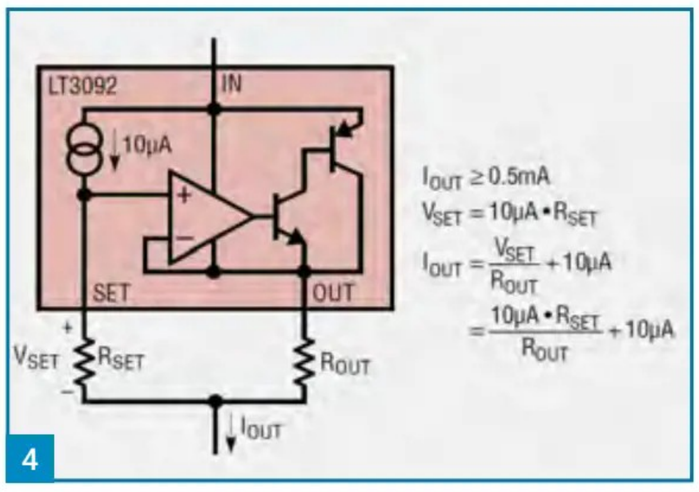
R_{OUT} + 10µA = (10x10^{-6}A x 15597Ω/1Ω) + 10x10^{-6}A = 0.15568A (156mA). Selecting R13 (10Ω) will give 15.6mA and R14 (100Ω) will give an output of 1.56mA. These values result in sensible ranges of R12; 0 – 13Ω, R13; 0 – 130Ω and R14; 0 – 1.3kΩ. The significance of these values will be explained when considering the Analogue-to-Digital Converter.

The range is selected by the three MOSFETS, T1, T2 and T3. T1 has less than 1mΩ Resistance Drain to Source when fully on (RDS_{ON}) which is less than 1% of R12 while T2 and T3 have RDS_{ON} of 20mΩ. These values are insignificant compared to the programming resistors R12,13 and 14.

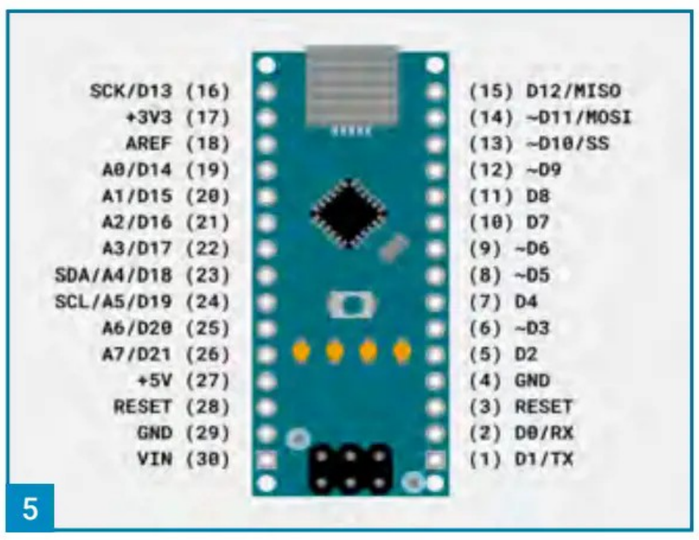
Controller

The Arduino Nano, **Fig. 5**, is recommended for this project; other controllers in the Arduino range can be used with suitable changes to the PCB layout. Note that the Nano33 IoT, 33BLE and 33BLE/Sense versions are not suitable as they are 3.3V modules; more than 3.3V on the GPIO pins will damage the board.

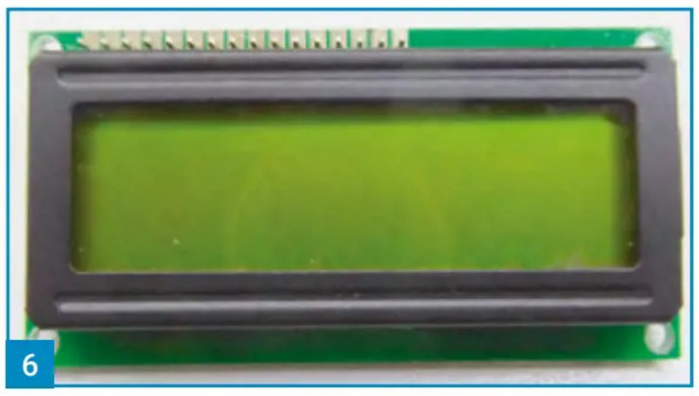
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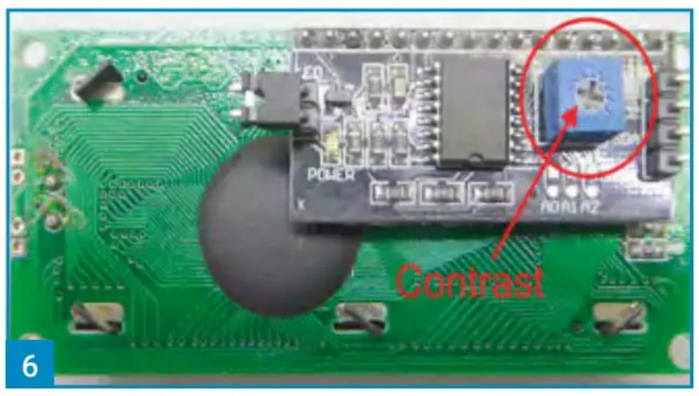


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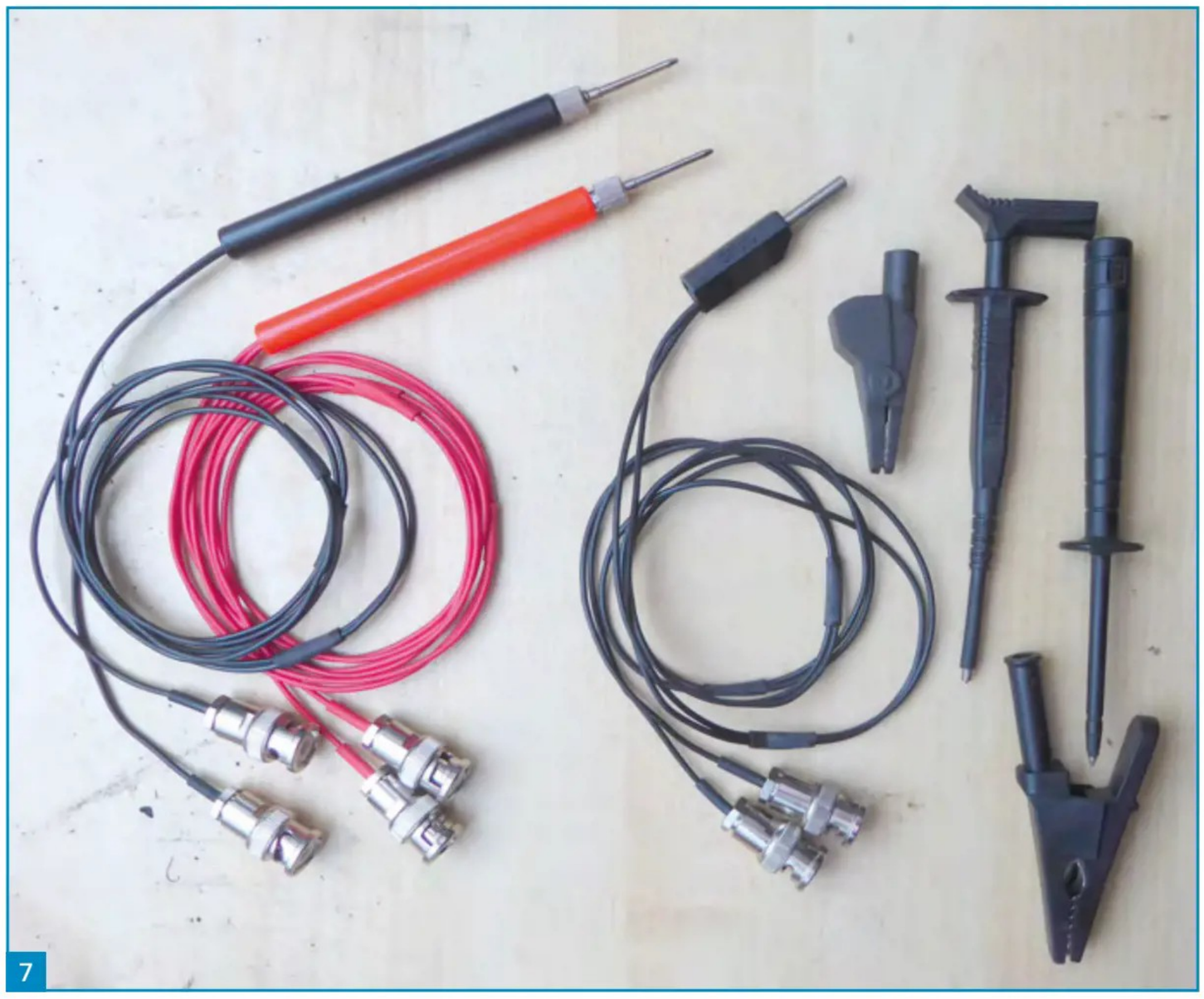


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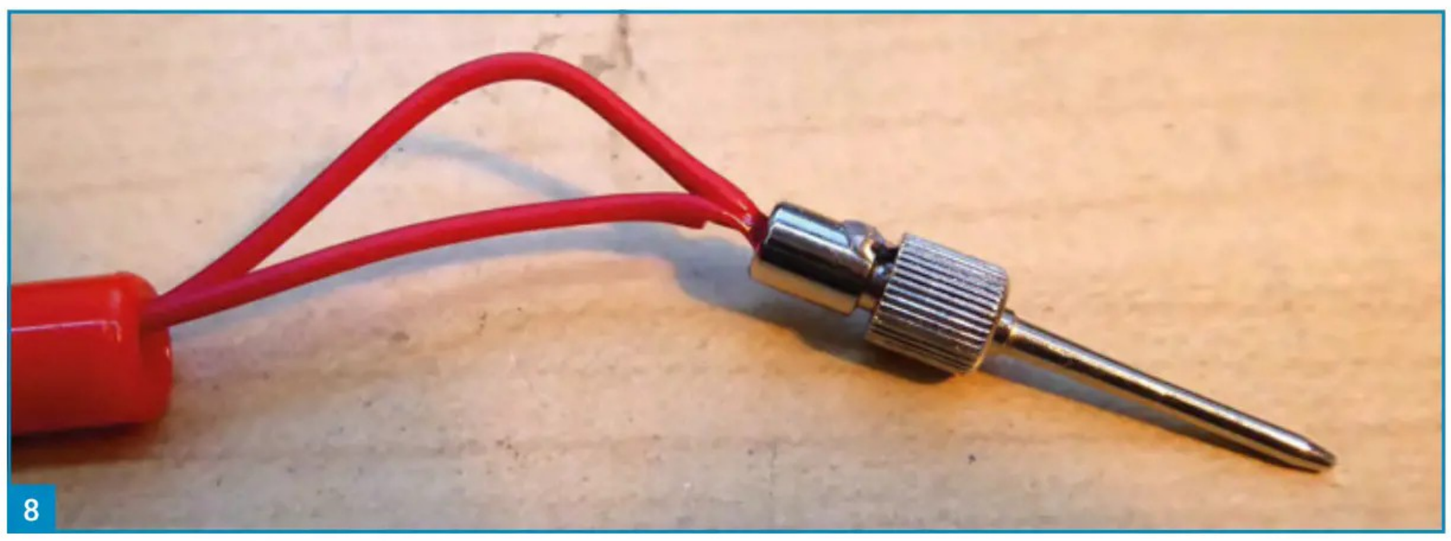

6



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8


8

The range selection and all calculations are carried out by an Arduino controller. There are autoranging and calibration routines built into the software. There is a version that provides a millivolt meter function that I have not implemented. All the software was written by DanielRP and can be downloaded from his site [**1**].

The Arduino uses I²C bus (Inter Integrated Circuit) to access an ADC (Analogue to Digital Converter), IC2 and the LCD display. The range selection is made via a line driver, IC3, connected directly to the Arduino. The two push buttons for range and calibration are connected to digital inputs D2 and D3 via 470Ω current limiting resistors and 4.7kΩ pullup resistors.

Software

The software can be downloaded from DanielRP's site [1]. As downloaded the LCD address in the software will be 0x3F, (0xnn indicates a hexadecimal number). Some LCD displays will have an address of either 0x20, 0x26 or 0x27. If you don't know the address for the LCD you have, download and run 'I2C_Scanner' or I2CScanner, either of these will scan your Arduino and detect valid I2C addresses and display them via the Serial Monitor. Once you know the address, go to line 151 in the software or search for 'LiquidCrystal_I2C' (the line number may have been displaced by comments). You will find the following line:

LiquidCrystal_I2C lcd(**0x27**, 2, 1, 0, 4, 5, 6, 7, 3, POSITIVE);

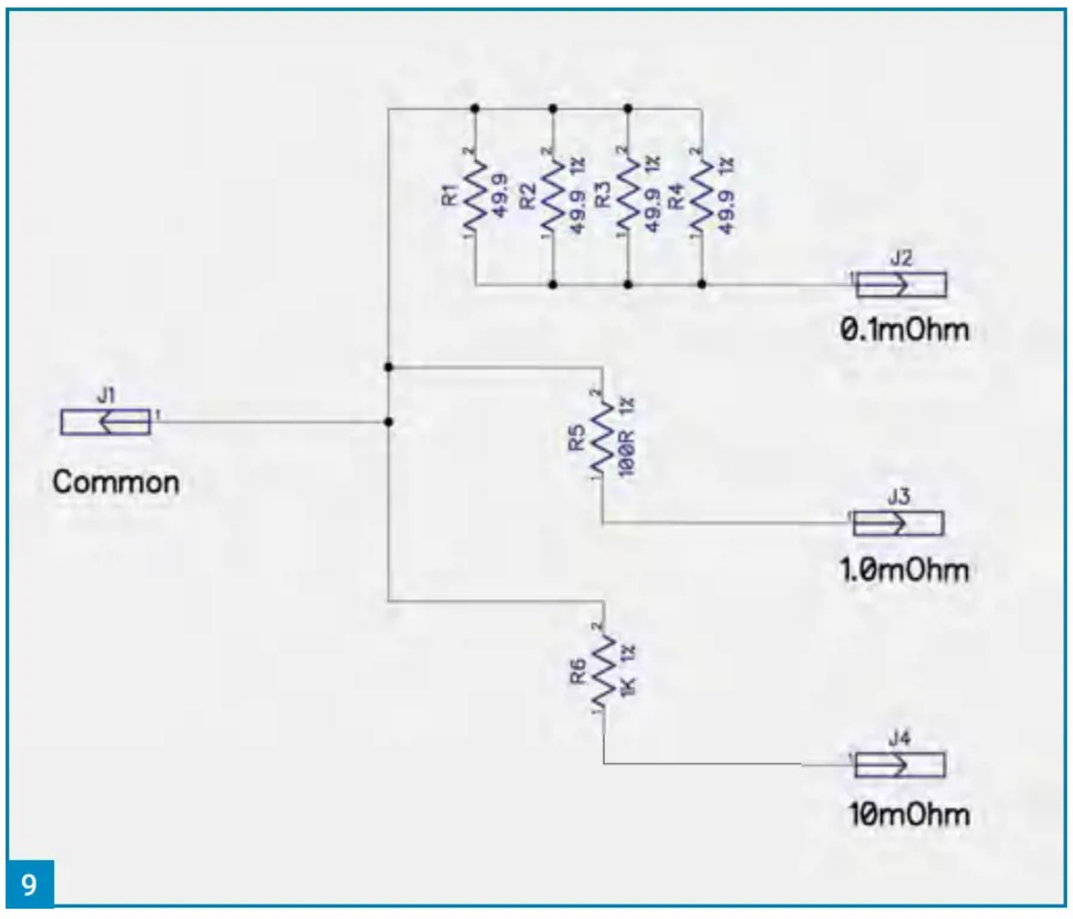
Change '0x27' to the address of your display.

Remember that if you power up the MilliOhm Meter and nothing is displayed, it might well be that you need to adjust the contrast using the trimpot on the back of the I2C PCB, **Fig. 6**.

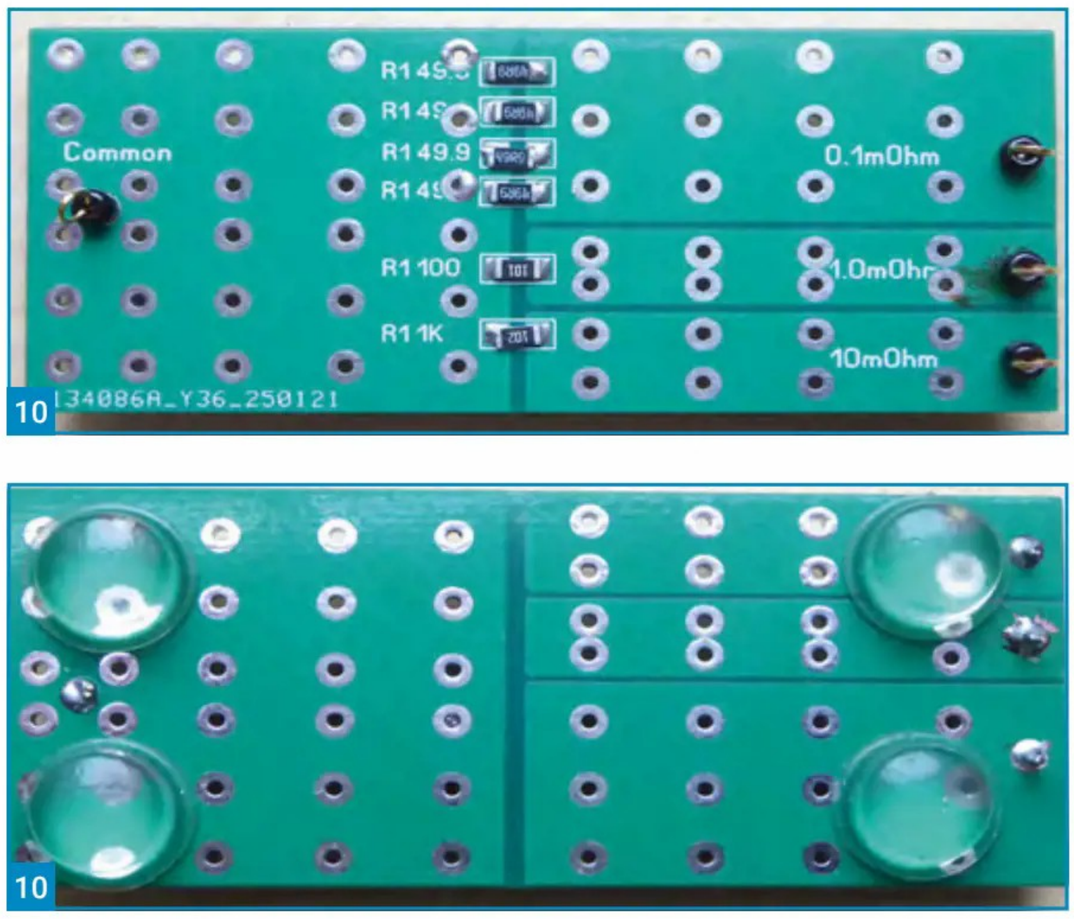
The buttons used on the original unit were black (B) and red (R). Depending upon what you have in stock you may not necessarily use the same colours, to change the LCD instructions to show your colours modify line 77 or search for 'CAL?' and change 'B' or 'R' to suit:

const char strECAL[17] = "CAL? B:Yes R:No";

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LCD library

There are two LCD libraries with the same name the correct one is downloaded from:

https://tinyurl.com/46aex3xz

or Google: 'arduino liquid crystal i2c library download dfrobot' to find it. The incorrect library will cause an error: 'POSITIVE not declared in this scope' when compiling.

ADC

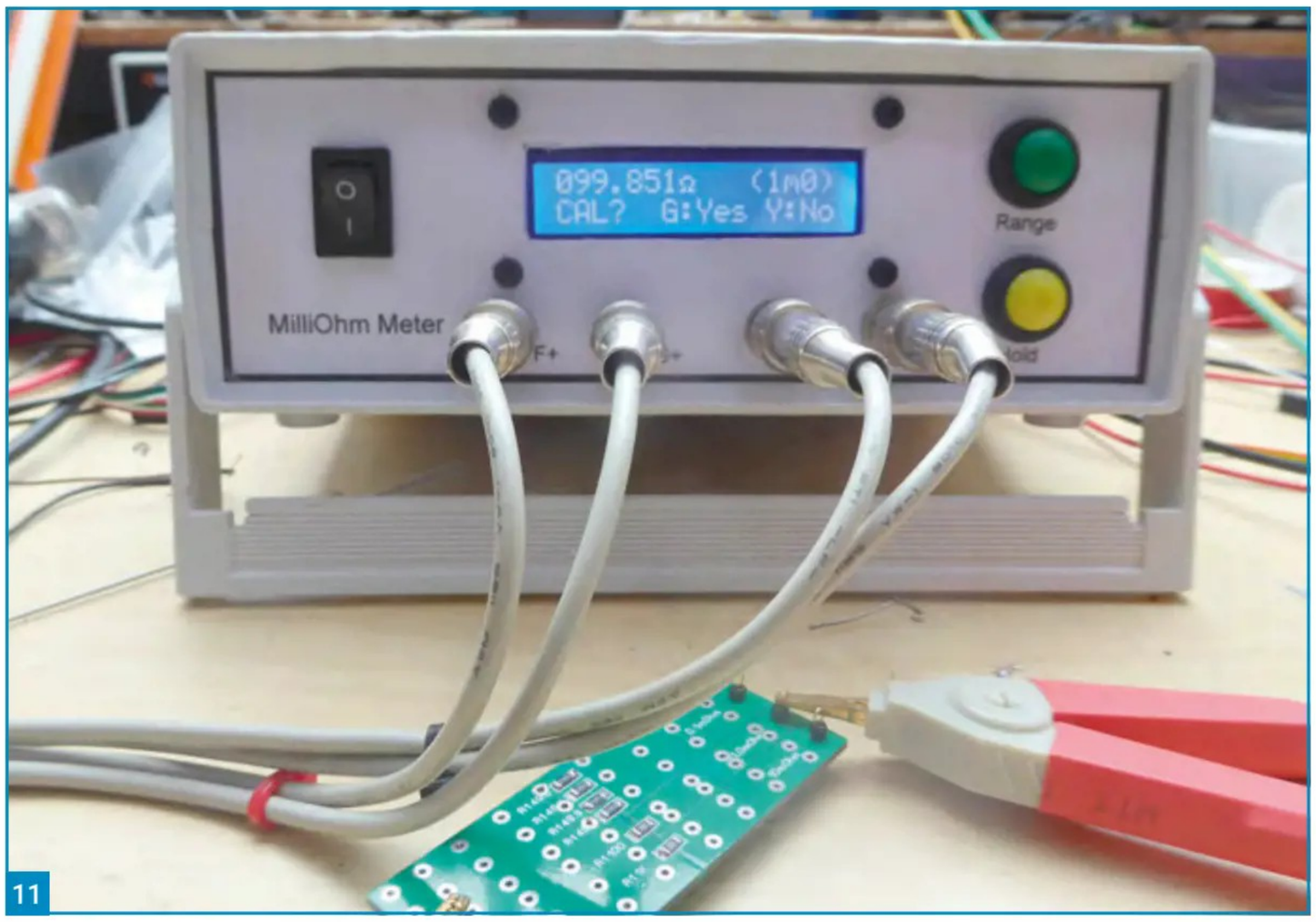
IC2 is an MCP3422A0 I²C Analogue-to-Digital Converter (ADC) with an internal voltage reference of 2.048V. It has a selectable voltage gain of 1, 2 or 4, and a resolution of 12, 14, 16 or 18bits. In this circuit, only channel 1 of IC2 is used, and is connected differentially to the resistor under test via 'S+ S-'. The MCP3422 is configured for a voltage gain of 1 and resolution of 2^{18}bits. However, as S+ is always going to be greater than S- the effective resolution is 2^{17}bit. That is to say 131,072 bits giving a resolution of 2.048V / 2^{17} = 15.6µV per bit.

Thus on the lowest range with T1 on, the current through the resistance under test is 156mA. This results in a voltage change of 15.6µV per 0.1mΩ or 1 bit of the ADC. So the lowest range is from 0.1mΩ or 1 bit (15.6µV/156mA = 0 1mΩ) to 2^{17} bits (2.048V/156mA = 13Ω).

Similarly, the middle range with T2 selected the current is divided by 10 to give 15.6mA giving a range from 1mΩ or 1 bit (15.6µV/15.6mA = 1mΩ) to 2^{17} bits (2.048V/15.6mA = 130Ω). With T3 selected the highest range is from 10mΩ to 1.3kΩ.

Range selection

Arduino digital outputs D10, 11 and 12 are used for range selection. These are fed via IC3, a ULN2803 line driver. This is a current sink device, which means that if pin 1 (T1 selection) is high, then pin 16 will be pulled low thus enabling the gate of T1. The 2803 is a very useful device as it provides up to 500mA of current sink on each of eight



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channels. It also isolates a controller from faults on the driven side of the device. For applications driving inductive loads such as relays, the common pin (10) is taken to the drive side high to enable flywheel diodes. ULN2003 can be used instead of ULN2803. However, the 2003 only has seven channels, enough for this project, but I had plenty of 2803s on hand as I find the eight channels or more useful in digital applications. The pinouts are similar, but the 2803 has 18 pins against 16 pins for the 2003.

R7, R8 and R9 (4.7kΩ) are pull-up resistors, R18, 19 and 20 (470Ω) are current limiting resistors for the gates of the MOSFETS T1, T2 and T3. D3 and D4 are Transient Voltage Suppression (TVS) diodes to remove unwanted spikes on the test leads. F1 is a resettable 250mA fuse that protects the 5V rail in the event that the + lead accidentally touches the circuit's GND. The fuse will sustain a current of 250mA, but will trip at 500mA. They generally recover quickly, but being thermal devices recovery time will vary from milliseconds to a few seconds depending upon ambient temperature and the thermal conductivity of the circuit board.

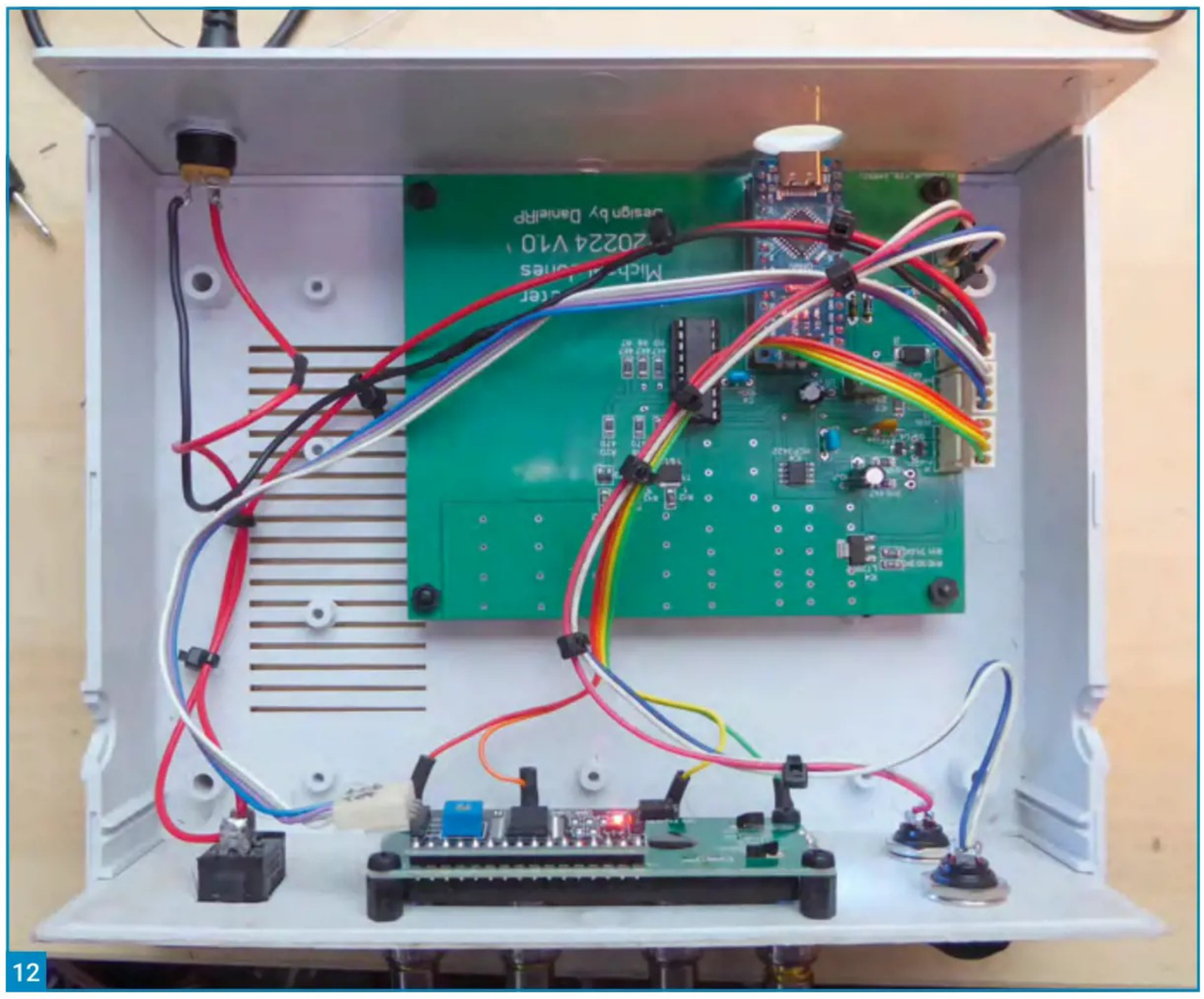
Fig. 4: AD3092 Application Circuit.
Fig. 5: Arduino Nano pinout
Fig. 6: 16 Character x 2-line LCD display. Note contrast adjustment.
Fig. 7: Range of useful probes.
Fig. 8: Wiring custom probes.
Fig. 9: Calibrator circuit.
Fig. 10: Calibrator PCB top & bottom.
Fig. 11: Calibrator in use.

Display

The display is a common 16-character x 2-line LCD display with an adapter for I²C attached, Fig. 6. See software section for addressing and libraries required.

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Fig. 12: Inside of the MilliOhm meter.
Fig 13: 1Ω resistor. Note the difference between measurement close to the resistor body and at the ends of the leads.


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13



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Powersupplies

A change I have made to DanielRP's circuit is to add a 5V regulator to supply the 3092 current sink to reduce the demand on the Arduino's onboard regulator. I chose an LM29040-5 low drop-out regulator that only needs 0.5V above the output voltage to maintain regulation, making it suitable for battery operation from either a single PP3 9V battery or perhaps two in parallel. Theoretically, the maximum input voltage to the regulator is 26V, but only with suitable heatsinking. In practice I restrict the input to 12V from a plug-in supply. The regulator is perfectly happy at this voltage without any additional heatsinking.

The diode D1 is a Transient Voltage Suppressor (TVS) to protect against voltage spikes and static discharges. D2 protects against reverse polarity. If you are not using SMD components, D2 could be any diode in the 1N400n series.

Note that the maximum raw input voltage at Vin for the Arduino Nano is 20V, while the recommended range is 6 to 12V. However, it has been reported that some clones may not tolerate 12V. I have not experienced any problems with any of the many Nanos that I have used in various projects. However, if you are in doubt about the provenance of your Nano, you could instead feed 5V from the 2940 regulator to the Nano's 5V pin or use the 9V battery power option.

The Kelvin measurement technique

When working with such small resistances the resistance of the test leads becomes significant and needs to be eliminated from our enquiries, so to speak! This is achieved by using a 4-wire or Kelvin technique. The four wires consist of two sense wires: S+ and S- to take the voltage measurements, and two Force wires: F+ and F- to supply the test current, Fig. 2. In this way the effects of test lead and probe resistance can be eliminated.

A current of known value from a current source is forced to flow through the test resistance R_{DUT} (Resistance – Device Under Test) via the F+ and F- leads. The voltage drop across R_{DUT} is measured (sensed) between the current forcing connections via S+ and S-. Ohm's law can then be used to calculate just the resistance seen between S+ and S-. Any voltage drop in the current loop due to any resistance in the F+ and F- force test leads is not seen. and resistance in the S+ and S- sense test leads becomes unimportant given the very high input impedance of the A/D converter compared to $R_{DUT.}$

The Kelvin crocodile clip halves are isolated from each other so that the voltage drop across the test resistance is measured at the probe tips thus eliminating the resistance of the test leads carrying the constant current. Therefore, the unknown resistance = Voltage drop divided by the constant Current in accordance with Ohm's Law R =V/I.

Probes

I chose a set of Kelvin probe clips with BNC connectors as shown in Fig. 1. If you wish, you can use 4mm binding posts to suit your choice of probes.

The Kelvin test clips are fine where they can be clipped onto a component or where an absolute value is required. For in-circuit probing only relative readings are usually required. For this it is useful to have a range of probes available, **Fig. 7**. The probes shown at **Fig. 8** are available from eBay: each pair of leads (S+ & F+, S- & F-) are soldered only at the tip leaving only the length of the tip, about 10 – 15mm, subject to any voltage drop. The length of the tip can be shortened if necessary and it can be sharpened to improve penetration of insulation, solder resist coatings or oxide deposits. The probes shown in Fig. 7 are terminated in standard 4mm jacks that I find very useful as I have a range of 4mm probes that I use routinely with various pieces of test gear.

Calibrator

For precision work the MilliOhm Meter should be calibrated, for this a calibration fixture is needed. The circuit shown at **Fig. 9** provides test resistances of 12.5Ω, 100Ω and 1kΩ, the 12.5Ω being achieved with four 49.9Ω resistances in parallel. All resistors are 1% or better. I made up the circuit on a PCB, **Fig. 10**, using SMD components, it could equally well be made with through-hole parts.

To calibrate the unit, press and hold the top button, green in my case, until the calibration screen shows. Select the range to be calibrated and attach the probes to common and the correct range on the calibration fixture. Press and release the green button and the automated calibration routine will run. Repeat for the other two ranges. All the calibration parameters are stored in non-volatile memory so frequent calibration is not necessary. A periodic check is all that is needed, **Fig. 11**.

Components and case

Fig. 12 shows the inside of my MilliOhm meter. I have used surface mount components for my circuit board design. Although not critical, this is the route I recommend. A bill of materials is given at Table 1. The circuit will work equally

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Components List

Reference	Value	Description	Quantity
B1, B2	PP3	PP3 9V battery (optional)	2
C1, C7	0.47µF	Capacitor	2
C2, C3, C4	100nF	Capacitor	3
C5, C6	47µF	Capacitor	2
D1	SMBJ12CA-13-F	Transient Voltage Sppressor	1
D2	B340LB-13-F	Diode, 1N4006 optional.	1
D3, D4	MMBZ10VAL	Transient Voltage Sppressor	2
F1	Bourns MF-R025	250mA Resettable fuse	1
IC3	ULN2803	8 channel line driver	1
J1, J2, J3, J4	Test lead connectors.		4
J5	2.1mm coaxial	Power connector	1
T3, T2	PMV20EN	30V N-Channel MOSFET	2
R1, R2, R5, R6	4.7kΩ	Resistor 1%	4
R3, R4	470Ω	Resistor 1%	2
R7, R8, R9, R16, R17	4.7kΩ	Resistor 1%	5
R10	16kΩ	Resistor 1%	1
R11	620kΩ	Resistor 1%	1
R12	1Ω	Resistor 1%	1
R13	10Ω	Resistor 1%	1
R14	100Ω	Resistor 1%	1
R18, R19, R20	470Ω	Resistor 1%	3
S1	Range Button	Button n/o	1
S2	Range/Cal Button	Button n/o	1
T1	PSMN0R9	25V N-Channel MOSFET	1
U2 or U3	LM2940CT-5.0	Low drop out 5V Regulator	1
Controller	Arduino Nano	1	
Display 1	1602 LCD Display	1	

well with through-hole components on circuit board layout or on a prototyping board such as Veroboard with some component changes. The LT3092 is only available in SMD form, the LT3080 could be substituted as it is in through-hole format. Similarly, MCP3422 ADC would have to be replaced with a through-hole 18-bit device. The MOSFETS T1, 2 and 3 could be replaced with similar devices but pay attention to the low RDSON characteristics. D3 and D4 can be replaced with any other similar TVS diodes or four discrete diodes. Note also that the resistors R10 to R14 should be 1% or better. For F1 I used a Bourns MF-R025 250mA resettable fuse; this is a through hole part that is mounted on the surface mount pads.

The case that I used was from Miowake on eBay, item number 355877738592; other similar ones are available.

In use

There are two buttons, the top one selects the range and calibration option. The other button selects display hold. Repeatedly pressing the range button cycles through the ranges: 0.1mΩ to 12.9999Ω, 1mΩ to 129.999Ω, 10mΩ to 1299.99Ω and Auto range. Pressing Hold freezes the display; the value is stored in non-volatile memory so that if the unit is turned off while 'Hold' is active, the value will be returned when the unit is next turned on. Pressing the range button for a few seconds will shift the meter into calibration mode: see above under 'Calibrator' for details. A line of dashes is shown on the screen if the resistance to be measured is out of range or the leads are open.

When making measurements allow a few seconds for the display to settle. As an example of the sensitivity of the meter **Fig. 13** shows the difference between measuring close to the resistor body and at the ends of the leads: about a 3.5% difference.

PCBs

I do have a small number of PCBs available at £5.00 each plus £2.50 p&p. There are three simple errors on the PCBs where pads are not grounded. These are easily fixed and a diagram will be provided with PCBs

Thanks are due to DanielRP for permission publish his design and use material from his website.

Notes and links

1. DanielRP's original project site:
www.danielrp.net/projects/proj-MilliOhm-meter-1
also see:
www.instructables.com/MilliOhm-Meter

NEWS EXTRA

THE RAOTA WINTER 2025 EDITION: The winter edition of the Radio Amateur Old Timers Association magazine has been sent to the printer and should be with members in the near future. Additionally a copy has been sent to the Audio editor who will arrange for audio copies to reach members with limited vision at the same time as the printed version.

As always the magazine opens with comments from the President and Editor, followed by the opinions, news, and comments submitted by members. The comments are often quite wide-ranging and not always directly about amateur radio, but are always thought provoking.

The subject of the Apollo moon landing has surfaced again, with some describing the incredible technical challenges that cause others to still wonder if it was all faked, and **Ray G4OWY** considers the 'fiddle-factors' that underpin some of the fundamentals of science theory.

There is a lengthy article about British Science week by **Ian M0KEO** suggesting ways that we could become involved, followed by a Morse key made in Meccano, submitted by **Alan G4GQL** shortly before he went SK.

RAOTA attended the Newark Hamfest again this year and there are a number of photos which were taken there, along with details of the 'Early Years' USB stick which they launched at the show.

Primarily targeted at potential members the USB contains both issues of the *Early Years* books which outline the history of how amateur radio came to be, plus a copy of the 'Best of OTNews' issue. Hopefully people with an interest in the history of our hobby might have their curiosity piqued. Then looking at the 'best-of' book and be sufficiently impressed with the contents of *OTNews* that they consider joining.

RAOTA were recently gifted an example of a RAOTA founder's badge by **Mary G0BQV** which she recovered from the dust and detritus while helping clear out G2FM's shack after his SK some 30 years ago. A chance meeting with me on-air reminded her she had it and had finally found an appropriate resting place for it. I spent some time cleaning it and then realised how tricky it is to get a good photograph of something shiny. I found an AI program that not only removed the background precisely but also improved the image quite dramatically.

GM4FZH continues his series of cryptic puzzles, and **Malcolm G0UYN** relates his introduction to amateur radio. This issue contains an obituary for **David G3SET** who served as RAOTA treasurer for some time. He flew in Vulcans during the cold war and the one on display at the Cosford aerospace museum is the actual one he flew.

Construction articles are always popular and this issue contains two of them.

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Andrew Woodfield ZL2PD
andrew@zl2pd.com



1

A Compact QRP Antenna Tuner and SWR Meter

The conversion of a series of portable QRP SSB HF transceivers led to the development of a compact antenna tuner.

I have been restoring and modifying a series of portable and handheld QRP HF SSB transceivers over the past three years. These radios were previously used by search and rescue (SAR) teams as well as by recreational hikers and hunters in the remote rugged rural regions of New Zealand. The modified transceivers operate on the 80m and 40m amateur radio bands. Versions of my SugarCube VFO lie at the heart of these conversions. (See my website, below, for details of these transceiver conversions)
www.ZL2PD.com

When it came time to operate the modified transceivers 'in the wild', I needed a suitable HF antenna. It's very popular these days to opt for an antenna that does not require an antenna tuning unit (ATU). Examples include the resonant End-Fed Half Wave (EFHW) and non-resonant End-Fed Long Wire (EFLW) antennas.

The EFHW (at resonance) has an impedance of about 2400-3300Ω while the EFLW non-resonant antenna may have an impedance closer to 450Ω. Two different baluns, a 49:1 or 9:1 unbalanced to unbalanced (UnUn) balun respectively, are often used with these antennas to achieve a suitable 50Ω match.

I tested several of these antennas and baluns with the modified transceivers. The antennas worked well with the transceivers when the antennas were clear of obstructions and mounted at least a few metres above ground. Understandably, however, these antennas did not always work quite so well in dense bush conditions or when deployed in a less orderly fashion.

Further testing showed these simple antennas could have some quite different load impedances from those expected and desired. Consequently, without a suitable antenna tuner, the modified portable SSB transceivers were often unable to deliver full power into these antennas.

As a result, the best antenna arrangement appeared to be a combination of a random length of wire, with or without a counterpoise or ground, tuned for a good SWR match using a small ATU.

Selecting an ATU

There are many choices when it comes to choosing the type of ATU to use. These include the L-match, Z-match, T-match, Pi-match, and a number of other, more esoteric, types. Most of these ATUs require a variable inductor along with one or two variable capacitors. An exception is the Z-match which uses one or two fixed inductors as well as two variable capacitors.

I focused on the Z-match, the T-match, and several L-match ATUs. Any of these could meet the majority of matching situations I was encountering. I spent some time modelling each type of ATU followed by building and testing each ATU. In the end, the simple L-match offered simplicity and the best overall impedance matching range.

Build or buy?

When it came to the question of building or buying an ATU for this portable QRP application, I found a number of kits available and several compact ready-to-use ATUs. Suitable kits range in price from about $US40 to over $US400. Those costing above $100 are almost all automatic. While auto ATUs are easy to use, they require a power source, typically 12V at up to 500mA.

Our QRP portable HF SSB transceivers are all quite compact, and all feature an internal battery supply. Providing power for an external automatic ATU in most cases would require additional modification to the transceivers. The additional ATU power drain, while modest, would also reduce the operating time of the transceiver in the field.

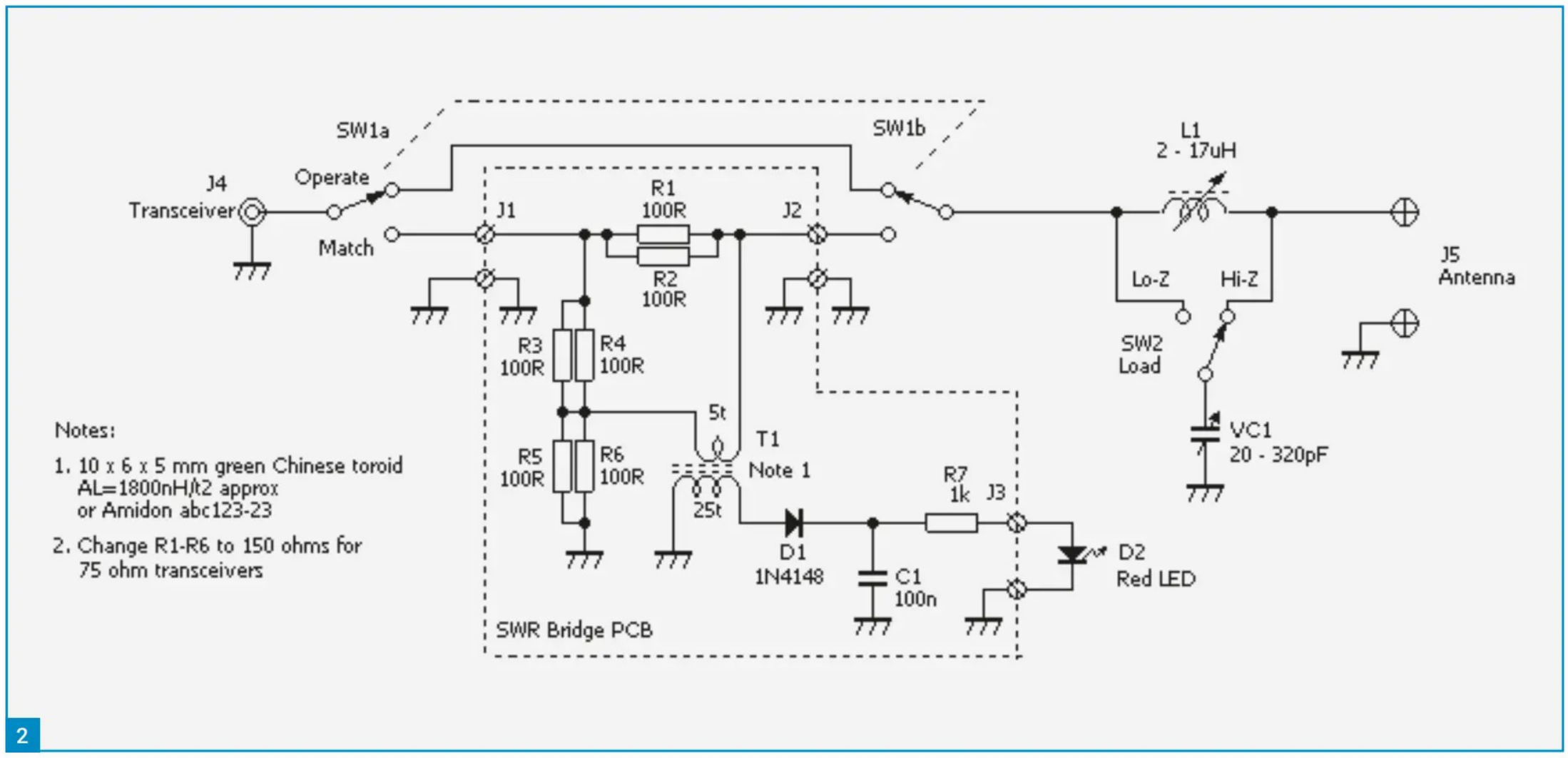
This suggested that a conventional manually tuned ATU was the preferred choice. These need no power for operation. If fitted, the ATU's SWR meter can be driven by the transmitter's RF output power. Actually, several of our transceivers already had an internal RF current sensing LED which gets brighter as the match (and output power) approached the best match.

Circuit description

Fig. 2 shows the schematic of the ATU. The SWR bridge, on the left-hand side of Fig. 2, is a standard resistor bridge designed to suit standard 50Ω output transceivers. It can be (and one ATU was!) readily modified to suit 75Ω transceivers. In that case, the 100Ω resistors were replaced by 150Ω resistors.

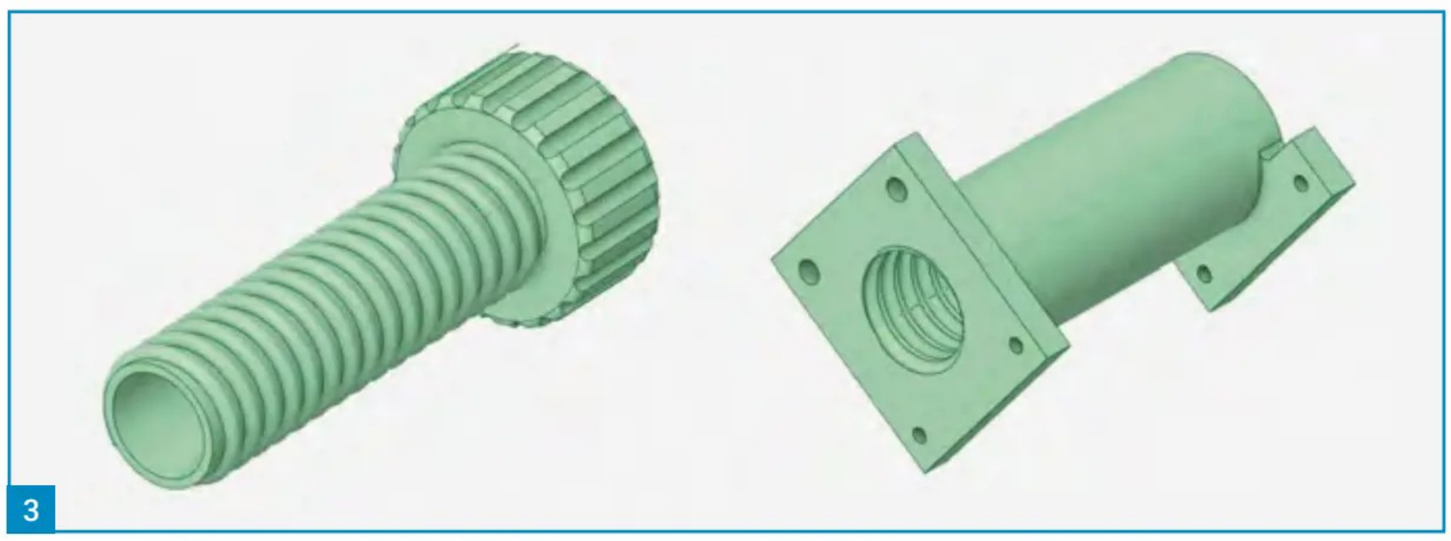
The Operate/Match switch allows the lossy SWR bridge to be in circuit for adjustment of the ATU and then bypassed during transceiver operation.

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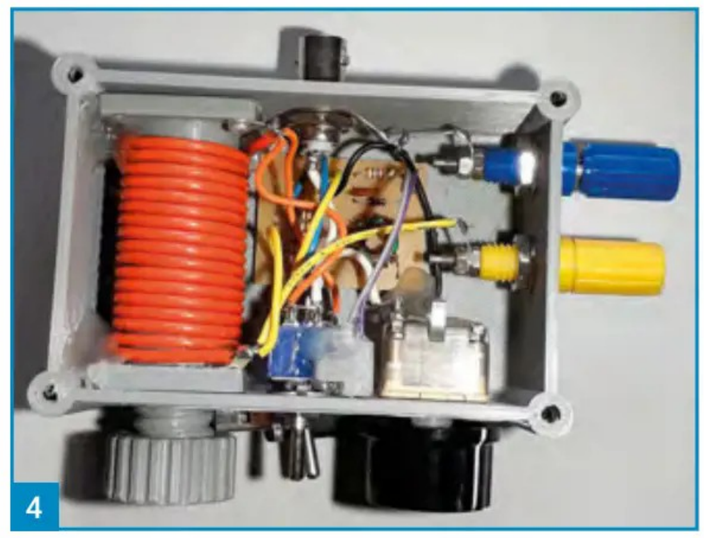
2

The SWR bridge is connected to the L-match tuner components (The right-hand side of Fig. 2). The ATU itself consists of a variable inductor and a variable capacitor, the latter connected via a switch to the upstream or downstream side of the inductor. The selection depends on whether the nominal antenna impedance is less than or greater than 75 (or 50) ohm transceiver output impedance.



3

Fig. 1: This little ATU with its SWR LED is easy to make and delivers a wide range of matching options for portable HF QRP SSB transceivers.
Fig. 2: Schematic of ATU and SWR bridge.
Fig. 3: The adjustable inner (left) and fixed outer (right) sections of the 3D-printed variable inductor former are 3D-printed.
Fig. 4: The variable inductor, made from a length of stranded hookup wire, a 3D-printed former, and short length of ferrite rod, can be seen in this view of the inside of one of the prototype ATUs.



4

The variable inductor

Like most of you, my parts boxes have a rather limited range of variable capacitors, and a complete absence of suitable variable inductors for QRP ATUs. The alternative often used is an inductor with multiple switched taps.

I wanted to avoid this approach. Four or five toggle switches coupled with multiple fixed inductors, or, say, a 10-way rotary switch for selecting taps on an air-wound inductor are quite clumsy to use, especially in wet and cold conditions. Also, the limited inductance steps available do not always deliver a good match quickly and easily.

The alternative is a continuously variable inductor. I didn't have the luxury of a miniature roller inductor in my junk box either, so I decided to design and fabricate my own QRP continuously variable inductor. A little time with my 3D design software and 3D printer yielded a suitably compact lightweight multi-turn continuously adjustable inductor, **Fig. 3**.

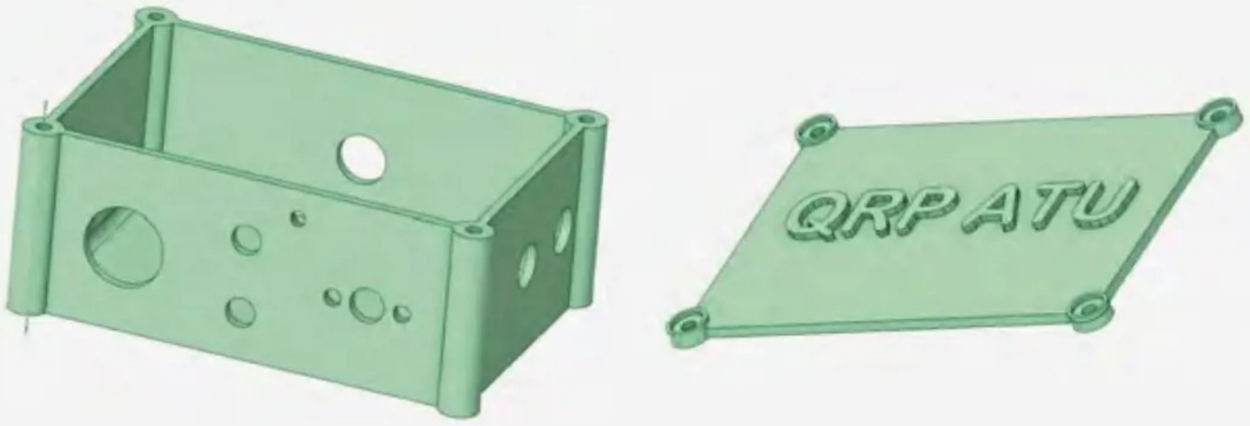
A section of ferrite rod is glued inside the variable inductor's adjustable core (left hand image in Fig. 3) which then threads into the variable inductor's former (right hand image in Fig. 3). The inductor is wound over the former (right). The wire ends of the inductor are terminated onto solder lugs which are screwed into two of the six holes in the 3D printed part using small self-tapping sheet metal screws.

The inner section of the variable inductor is made from the 3D-printed adjustable core. Into this, a section of a 10mm diameter broadcast/shortwave ferrite rod is fitted. I used a section of a ferrite rod taken from my junk box glued into the inner 3D-printed section.

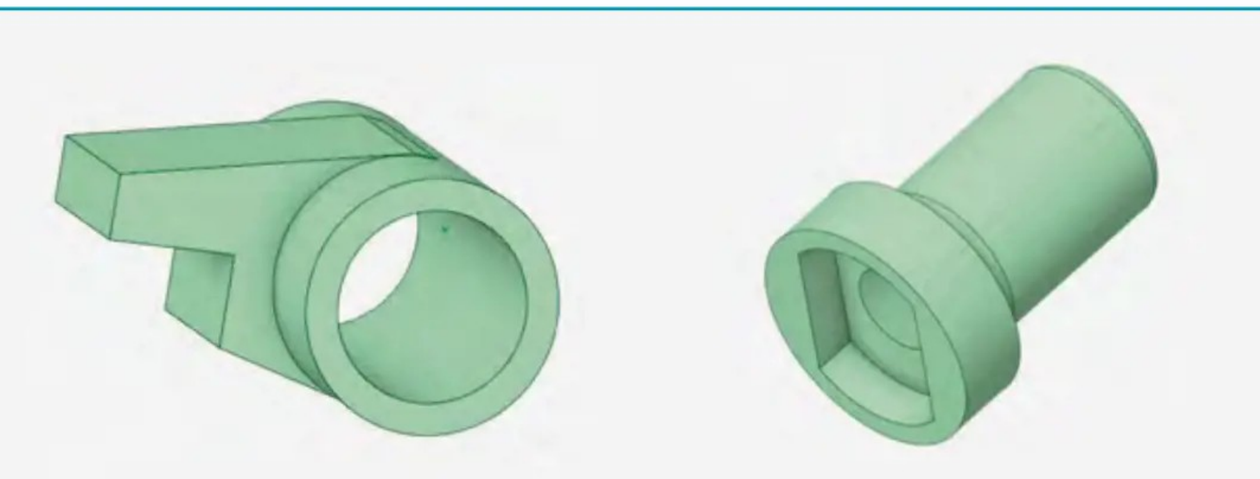
Take care when selecting your ferrite rod. I found that one or two in my junk box seem to be more 'fishing rod' than ferrite rod. You should test your ferrite rod to check that it's going to be suitable. To do this, just grab a metre or so of thin hookup wire and wind it into a single-layer multiturn coil around your ferrite rod. Measure the inductance as you slide the rod in and out of the coil.

The inductor I made for the ATU illustrated in **Fig. 4** used 17 turns of hookup wire. It was relatively heavy stranded wire that was close to hand. It produced an inductance of about 2 to 17µH with a measured *Q* of 160 at 4MHz. I found it was just right for the 80m, 60m and 40m bands, i.e. 3.5 – 7.5MHz, and may be useful on several higher bands, too,

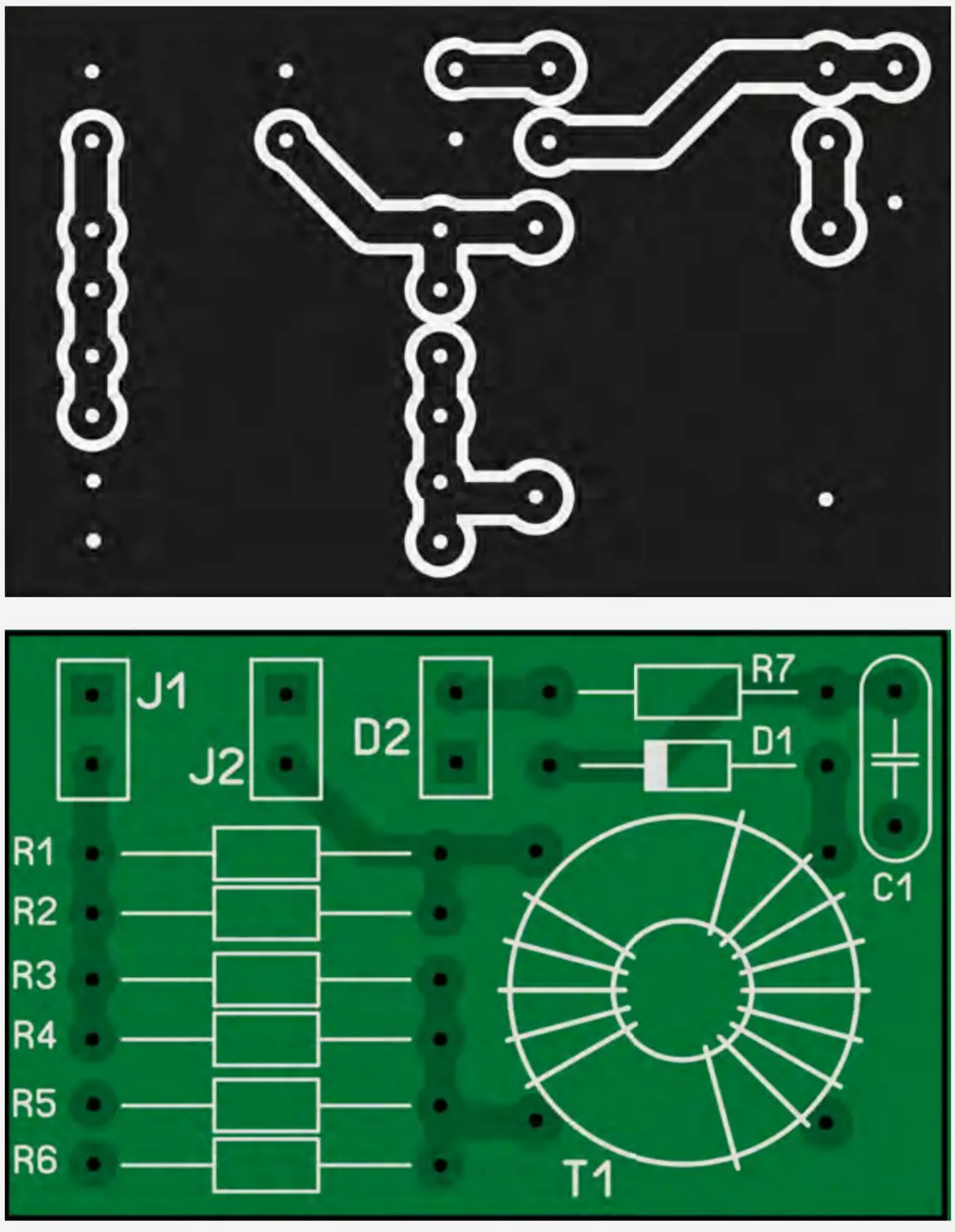
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5



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Fig. 5: The box base and top cover are also 3D-printed with standard PLA filament with the latter fixed with four self-tapping screws.
Fig. 6: The LED bracket (optional) and the capacitor shaft adapter may also be 3D-printed if required.
Fig. 7: SWR bridge PCB (viewed from the solder-side) and the component overlay. The PCB measures just 35 x 22 mm.
Fig. 8: The front panel artwork for the ATU measures 80 x 35mm.

although it has not been tested there. The result is an easy to use QRP version of the traditional roller inductor without the high cost, complexity, and size of those original full power types.

Another variable inductor made with 30 turns of 26SWG enamelled copper wire instead of hookup wire gave an inductance range of about 4 to 45µH. Used in an L-match, that's perhaps better suited to 160m operation. A third inductor made with 12 turns of 26SWG wire gave an inductance range of 2 – 17µH, possibly better suited to an ATU covering the 40m to 10m bands. (There's nothing magical about 26SWG. Just use what you have but avoid any wire thinner than say 0.3mm diameter.)

In any case, your inductor will likely differ from my inductors due to the variations in the composition of ferrite rods. For example, 15 turns of hookup wire on a 'ferrite-ish' rod of very dubious origin only gave a range of 3 to 7µH. It also had a very low Q when tested. This one was not used.

Two small solder lugs are mounted at either end of the 3D printed coil former using small self-tapping screws. They make it much easier to solder the enamelled copper wire or insulated stranded copper wire used for the coil. The inductor can then be slid into position in the ATU box and glued in place.

The variable inductor was fabricated as a separate component to make it easier to wind and measure prior to final assembly, and to allow it to be used more easily in other ATU designs.

The variable capacitor

Most of the variable capacitors in my junk box were simple AM/FM radio polyvaricon types with a limited capacitance range, typically 20 – 160pF. Fortunately, my local radio club had some dusty but perfectly serviceable polyvaricons available on the trading table with a greater capacitance range. Some small coins changed hands.

One of these gave a useful 20 – 320pF range, about the minimum range suitable for the 80m/60m/40m bands and antenna impedances encountered in the field.

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ATU box

The ATU case was also designed for the ATU and 3D printed. All of these parts are made from standard inexpensive PLA filament. This kept the cost of the ATU to a minimum. The printed parts include the cover for the box and the small shaft adapter to permit a standard off-the-shelf knob to be fitted onto the polyvaricon capacitor. This is screwed into place on the polyvaricon using a 12mm long 2.5mm countersunk bolt.

In the prototype, the LED was fitted into a small 3D-printed 'light pipe' which is glued to the top of one of the switches. This places the LED back from the face of the front panel and effectively mounts it deeper inside the box. At the time, I thought that the LED's light would be swamped by external sunlight. In practice, this was not the case. Consequently, fitting the 'light pipe' is entirely optional, depending in part on the brightness of your LED.

Just note that this ATU box is not waterproof. It's OK in light showers, but in really heavy rain, moisture can enter around the capacitor shaft.

SWR meter

The SWR meter is built on a small 35 x 22mm single sided PCB. This is glued into place in the base of the box. If your ATU is to be used on the more typical 50Ω type transceiver, simply change the six 150Ω resistors in the SWR bridge to 100Ω.

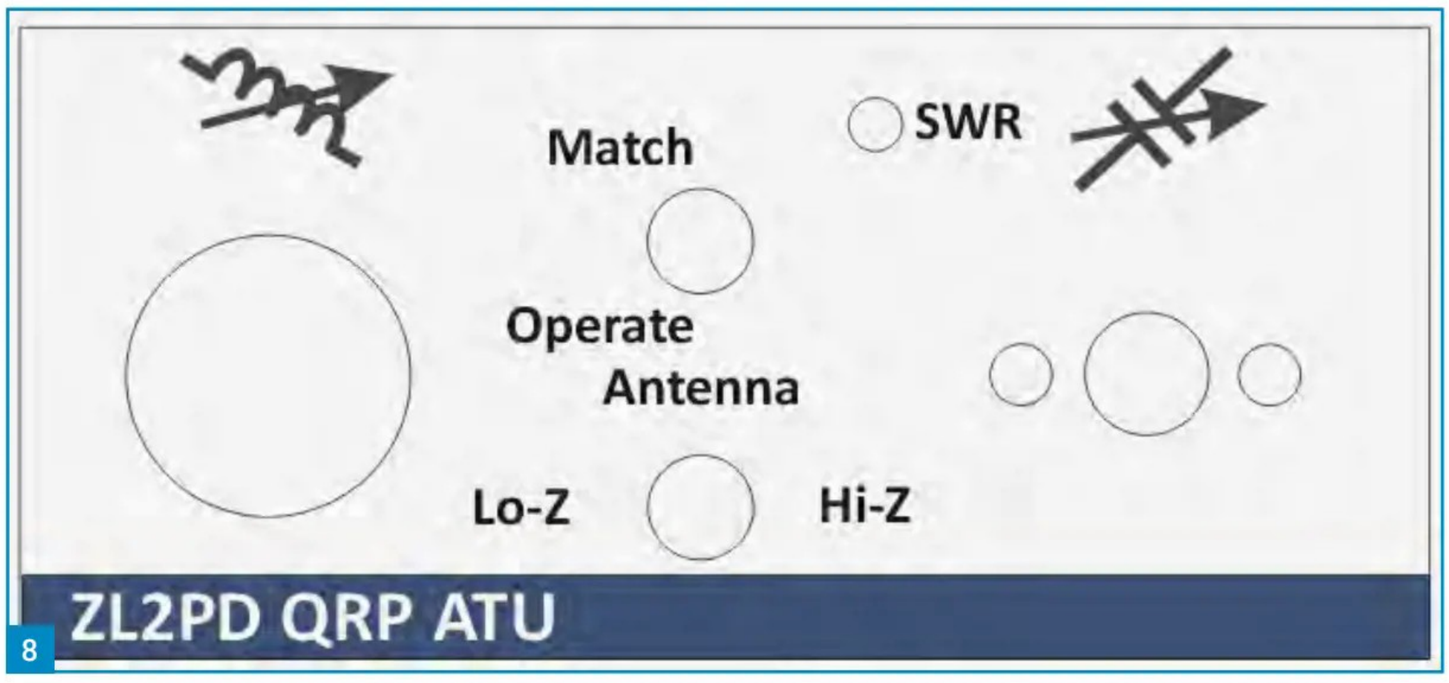
The prototype used an inexpensive 10 x 6 x 5mm green Chinese toroid which had an A_L value of 1800nH/t^2. Actually, the set of 50 such toroids I purchased averaged this A_L value, but they had a somewhat random spread of values ranging from 800 to 4500! Despite this, any of these toroids will work in this circuit. Alternatively, the Amidon FT37-43 is also suitable.

Assembly

Start by fabricating the various 3D-printed parts required. Public libraries in many locations offer 3D printing facilities for those without access to a printer. It is also possible to have the 3D parts made by a local 3D printing business.

Cut and glue the ferrite rod stub into the inner part of the variable inductor. To cut the rod to length, use a metal file to score the ferrite rod at the desired spot. Place it in a bench vice aligning the score with the end of the vice, and tap it sharply with a small hammer. Then glue the rod section into place with epoxy glue.

Mount the solder lugs for the coil onto the base and then wind the inductor, completing the assembly by soldering the coil ends to the solder lugs. This has to be done quickly to avoid melting the PLA!



8

Slide the inductor base into place in the body of the ATU box, checking that the threaded shaft and knob with its integrated ferrite rod is centred in the front panel hole. The inductor frame is then hot-glued in place. Then mount the variable capacitor including the shaft adapter using M2.5 hardware.

Assemble the SWR bridge on its PCB. Solder the input and output wires (J1, J2) and the wires for the LED (D2). Don't mount the LED on the front panel just yet. Hot-glue the PCB to the inner base of the box.

Add short wires to the two toggle switches and mount these in place on the front panel. Add the BNC input connector and two antenna banana jacks. Glue the LED mounting tube in place (This is optional) and then complete the remaining wiring.

Add the front panel artwork to the front of the ATU. This was printed on an inkjet printer, covered with clear self-adhesive plastic film, and then glued in place on the front of the ATU box. It's surprisingly wear-resistant and robust.

After testing the ATU, complete the ATU by screwing the top cover onto the ATU box using four short self-tapping screws.

Operation

Select the antenna type (i.e. Hi-Z for random wires and dipoles or Lo-Z for short verticals) and then select 'Match' on the SWR bridge switch to monitor the ATU matching. If you wish, you can initially adjust the ATU for maximum received signal strength (or noise) on the transceiver. On many transceivers, this is often close to a good SWR match.

Bring up the carrier on the transceiver. If the ATU SWR exceeds about 2.5 or 3:1, the SWR LED will be quite brightly lit. Adjust the ATU controls until the LED dims or is at a minimum. In some cases, this point can be quite sharp. Once adjusted, make sure you select 'Operate' on the SWR switch to remove the lossy SWR detector with its LED. The ATU is now tuned and the transceiver is ready for use. Note: The SWR LED does not light while transmitting.

The transceiver is protected from any antenna mismatch during the tuning process due to the resistive SWR meter bridge. The worst match the transceiver will see is a VSWR of 2:1! That's handy with the occasional relatively delicate legacy transceiver.

The LED used in the prototypes were 'high efficiency' types as almost all LEDs are these days. Mine was brightly lit with the Codan/Condor handheld transceiver's 1W PEP output when the SWR was over 2.5:1. The value of R7 (1kΩ here) may need to be increased (Try, say, 4.7kΩ) if you are using transmitters with more than 5W output.

Final remarks

This compact L-match ATU has proven to be ideal for operating the restored QRP HF SSB transceiver in the field. It's light, easy to carry, and simple to use with almost any reasonable length of antenna wire and almost all antenna layouts tried to date.

There's practically no weight penalty when compared with EFHW/EFLW antennas with their baluns, although this ATU may be slightly bulkier when the necessary 0.5m coax cable for connecting it to the transceiver is considered.

Tuning the ATU is usually quite quick. The receiver noise peak is easy to hear and usually indicates a near-match. In particular, the variable inductor has proven to be a very successful and inexpensive component, and very robust in service. **PW**

Related downloadable files

(Available from **www.ZL2PD.com**)

- Front panel artwork (JPG format)
- Industry-standard STL 3D printer files for the printed inductor fixed outer, inductor inner former, ATU box base, and ATU box cover (ZIP file)
- Gerber PCB files and JPG image for SWR bridge PCB (ZIP file)

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Various Musings

Dear Don,

"What's so special about VHF/UHF?", asks **Tim GW4VXE** (*PW* December 2025). For me, it will always remain a reminder of my very first foray into the world of actually talking to someone I heard rather than, just eavesdropping on a conversation - not being able to put my oar in, so to speak. They were exciting times, peppered with occasional jaw-dropping surprises. Like working stations out in the Sun-drenched Balearic archipelago, using a few watts and a DIY indoor antenna.

To paraphrase Forrest Gump, when operating on VHF/UHF, you never really know what is going to pop up next. A station on the other side of town, or maybe a station a thousand miles distant. The lure of VHF, and of course its side-kick UHF, is the fact that it's in a constant state of flux - one day, it's sort of predictable, another, it can be a potential gob-smacking DX deliciousness. A lucky dip.

With line-of-sight, tropospheric ducting, sporadic E's, diffraction, the scattering effect and other weird propagation anomalies, we really are spoilt for choice. And unless VHF/UHF SSB/CW is a preference, where or course much larger directional metal structures are a necessity, casual FM operation can and often does perform with much smaller antennas. Compared with HF, if you're just happy to chat with locals or with someone a bit further afield, wire dipoles or verticals will usually suffice. However, if the plan is to consistently crack DX, big antennas and a big wallop of RF atop a tower is a must (CW helps). Some people will no doubt disagree. But the operative word here is consistency. Not now and again - or on a wing and a prayer. Of course, the popularity of FT8 etc has now ridden to the rescue to tweak the methodology of DX operation.

As **Don**, our editor notes, I also like to read about the histories of those who have been involved with radio in some shape or form. Many of whom, are still sadly forgotten - hidden in the recesses of history. And like Don, I don't recall **Basil Shonland** either. As for **Mr Tesla**, there are more books written about him than you can shake a stick at. And whether it be a good thing or not, his name has now been purloined by you-know-who as a prominent trade sticker for battery-powered car merchandise.

Kristen McIntyre K6WX, explanations of Maxwell's Equations on the Tonight@8 Autumn programme is a welcome addition to a radio ham's armoury (not that I've seen it), if only because Mr Maxwell's equations are, as stated, intricately linked with almost everything radio - and a lot more useful and relevant to bring the world of radio to life. Thankfully (given her MIT associations), Kristen, didn't bother to widen her talk to breathe more life and relevance into to **Mr Hawking's** impenetrable Black Hole theories.

After a speed-read through G3UGF's getting to grips with a Yaesu FTX-1, described as a Game Changer, might the next game changer FTX-2 have an option of no operator being present when operational on-air? Imagine the scene, out shopping, or maybe sat in your favourite coffee shop supping a long glass of latte, whilst the FTX-2 simulates your voice on SSB, or effortlessly trots out the dots and dashes or any other digital mode of your choice, as it tots up, logs and makes all the QSO's on your behalf, automatically. No operator needed. No sweat. And 'AI' will no doubt be implanted into the hobby of ham-radio very soon. Its impact on ham-radio will probably be resisted and welcomed in equal measure. And like SSB, FT8 and the present and upcoming data modes, resistance is maybe futile.

Yet another new VNA! Well, the FA-VA6 is a kit build, sort of. And one of its claims to fame, it is readable in sunlight. Not Moon-light. I guess that will be the VA7 model? I see it's also aimed at 'professional users'. As a back-up presumably. Ham-radio is an amateur hobby not a professional hobby, of course.

Lastly, as Don the editor notes, it is indeed amazing just how fast the progression has been from 'Spark' to now, RF tech wise. However, that same progression hasn't occurred with the ionosphere. Given the ongoing effort expended on it after 100 years or so, we remain with just a basic working knowledge of it. And much like the ionosphere, the mysterious actions of those so-called 'electrons' and their other 'particle' brethren (Quarks, up, down, top etc, Higgs boson, gluons, leptons and so on), many of which, defy rational explanation and common sense - and also remain a 'basic working' model. It often reminds me of that Victorian era bloke, **Charles Dodgson** (**Lewis Carroll**), feted mathematician and novelist. Dodgson, wrote a famous book called *Alice's Adventures in Wonderland*. He'd obviously possessed a vivid imagination. Perhaps only a mathematician would be capable of writing such a book? Dodgson's contemporaries continue to follow in his wake.

Ray Howes G4OWY/G6AUW
Weymouth

*(**Editor's comment**: Thanks as always Ray. Your comment about Black Holes amused me as I have just finished reading the book* Black Holes *by **Professors Brian Cox** and **Jeff Forshaw** and, fascinating as it was, I struggled to understand even a fraction of it!)*

Chertsey

Dear Don,

I very much enjoyed **Jim G4AEH's** interview with **Martin Lynch** in September's *PW*.

If I remember correctly Martin's Chertsey shop had a plaque in the car park reserving spaces for Cecil E Watts Ltd. I assume this was the Watts company that produced gadgets such as the Dust Bug and Parastat for cleaning LPs (which you may remember and might have used if you were interested in audio in the 1960s and 1970s). I think these gadgets were launched in the 1950s.

The Dust Bug was an arm with a soft roller that swept the LP groove ahead of the stylus. There was noticeably more surface noise coming from the LP when I forgot to use it. Even better results were obtained using a Groovac which was quite literally a small vacuum arm that vacuumed the groove ahead of the stylus.

I see there is still a noteworthy radio association with Chertsey - Roberts Radio is based on Hanworth Lane in Chertsey.

I liked the double page photo spread of the National Hamfest. I hope there'll be a photo of a *PW* stand next year.

Ian Brothwell G4EAN
Nottingham

*(**Editor's comment**: Thanks Ian, and on the subject the Hamfest photos, I owe **Pauline G8HQW** an apology for labelling her as Paula! As I know Pauline and Chris well, I should have been more careful.)*

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Packet Radio

Dear Don,

Last week I was listening to one of those increasingly rare, but always refreshing to hear, group chats on a local repeater.

What fascinated me was the very honest admissions by more than one participant that they knew next to nothing about Packet Radio. One person even suggested that it worked along the lines of the 'S.O.S alarm fobs' sometimes used by people at risk of a fall.

This really made me stop and think. It seems that in around 30 short years commercial internet connections have managed to almost kill this aspect of amateur radio stone dead in the UK. I'm guessing it's a global story though; not just here.

The conversation piqued my interest as I have been considering the investment in time and money to build a VHF Packet Node at the home QTH. I understand there is (or was) a resurgence in interest in Packet Radio in the UK but it needs a 'critical mass' to become reliable.

I just wondered if any other *PW* readers have considered expanding the UK Packet network as well? Or, is this a pipedream in 2025 with reliable commercial internet connectivity readily available.

Perhaps the experimentation, self-learning and the 'build it and see' approach to amateur radio needs a kick start here?

Just an idea!

Richard White G6NFE
Shrewsbury

(***Editor's comment**: A good question Richard. In the late 80s I wrote a monthly packet radio column for the now defunct* Amateur Radio *magazine. Sending mail via AX25 was popular and, in due course, using Packet Radio to access the early Packet Cluster nodes. However, since the universal adoption of email, not to mention WhatsApp and the like, I suspect the demand is no longer there. But I'd love to be corrected!)*

Rallies & Events

All information published here reflects the situation up to and including **21st November 2025**. Readers are advised to always check with the organisers of any rally or event before setting out for a visit. To get your event on this list, email the full details, as early as possible, to: **practicalwireless@warnersgroup.co.uk**

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1 March 2026

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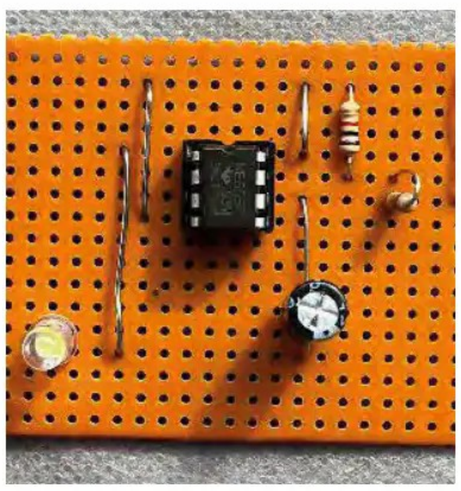
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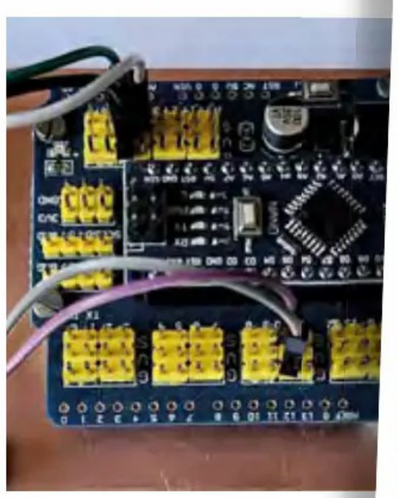
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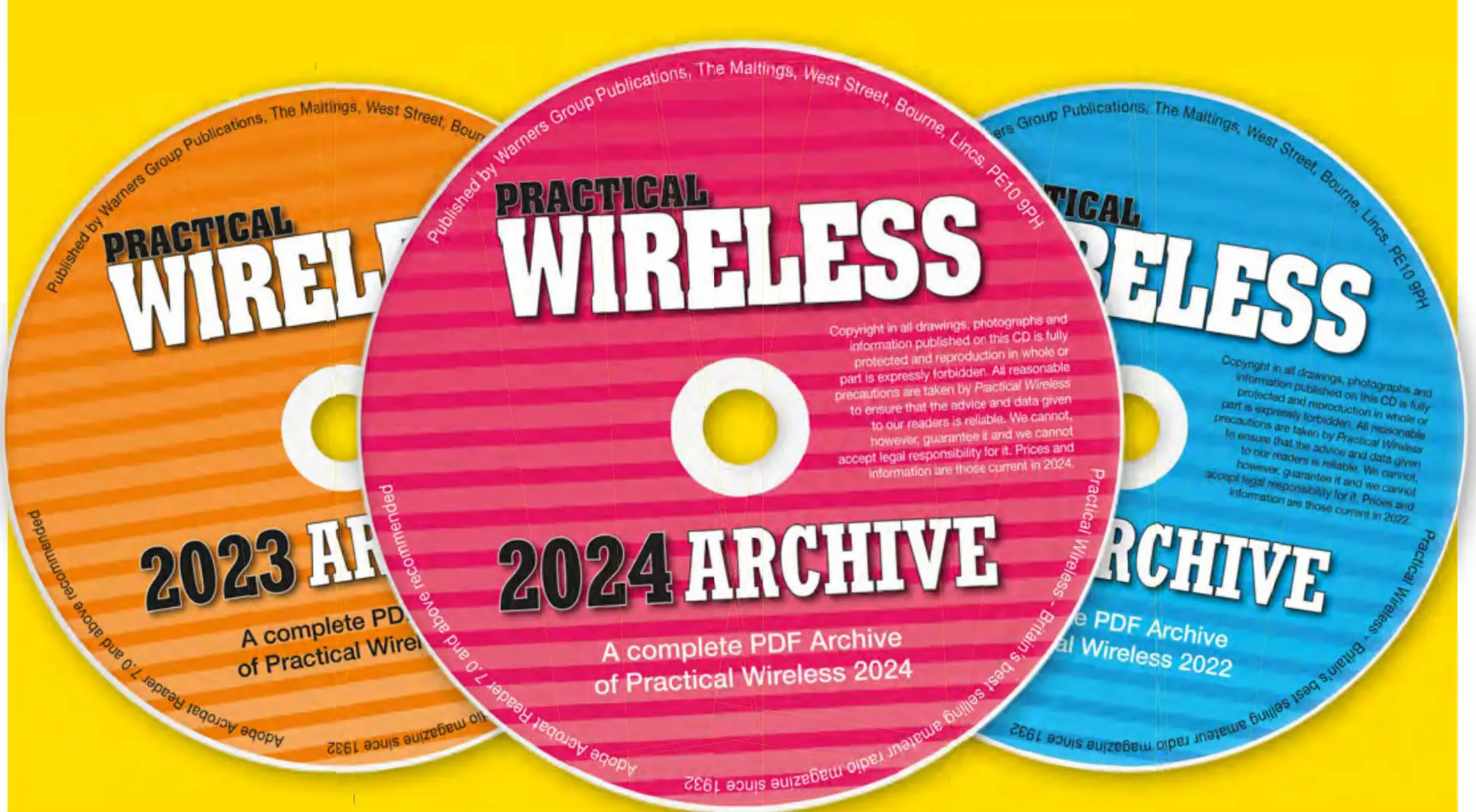


- **CIRCUIT BOARDS:** Tony Jones G7ETW reviews various options for home construction.
- **VERTICALS & VELOCITY FACTOR:** Tom Morgan G0CAJ builds a two-element vertical array.
- **LET'S MAKE 270 CW GREAT AGAIN:** Ian Cortina EI3LH makes a plea for using CW on the VHF bands.
- **A LAB TUTORIAL:** Jeff teaches Natalie about impedance.
- **THE RANDOM COPPER STICK:** Frank M. Howell, PhD K4FMH describes a Lightweight Portable Multiband HF Vertical.
- **TAKE 20:** Steve Macdonald has a design for a low-cost Morse beacon for VHF.

There are all your other regular columns too, including HF Highlights, World of VHF, Data Modes, Antennas, The Morse Mode, Vintage TV & Radio, What Next and Amateur Radio on a Budget as well as your Letters, the latest News and more.



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