

WIRELESS

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GEAR**

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ANTENNAS



- HyEndFed portable review
- Midsummer antennas
- Advice for half-squares
- Renovate your rotator



QRP RIG TEST

**Small, light and excellent value
three-band transceiver reviewed**

**Get on the air to care - an
RSGB and NHS campaign**

Details of this worthy project to improve
the wellbeing of UK radio amateurs

NHS

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We have launched a new video channel on YouTube - just key in 'WaterSStanton'. It covers a range of topics from transceivers to antennas. It also carries news items, hints and tips.

Presented by myself on a regular basis, it's a good way to keep in touch. Alerts to new videos are posted on Facebook and Twitter. Check it out now! You can use Smart phone, data pads or PC's.

Peter Waters G3OJV



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Antenna Time!

Hy-Gain AR-500X Rotator



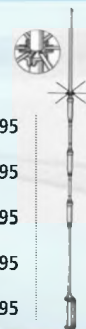
This rotator comes complete with infrared hand controller. Requires 3-core cable. Ideal for smaller VHF antennas

£184.95

Diamond VHF UHF Yagis from Japan's Exclusive UK Distributor



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6BTV 80-40-30-20-15-10m 1kW SSB Handling Height 6.52m	£269.95

ICOM TOP RADIOS

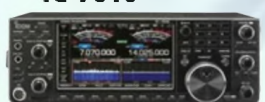
Each of these radios built from the ground up and featuring the very latest SDR technology. Now leading the design trends in Japanese Ham radio.

IC-7300



The IC-7300 has quickly become a piece of ham radio history. A marker by which the competition is judged. The fastest selling radio of 2017 and still going strong, replacing all those old radios that many hams gave clung to for years. It's a great performer and great value. 160m - 4m. 100W Max. £1195.95

IC-7610



The new IC-7610 transceiver is now a reality. Few can fail to be impressed with the advanced technical promises. And nobody should be disappointed once their new radio arrives. We have good orders in for this radio and so will be happy to bring your dreams to reality. And if you need any additional items to go with your new radio then we are sure that we can delight you. 160m - 6m. 100W £2999.95

IC-9700



The IC-9700 brings together the three popular VHF bands and puts them into one very high tech. box. The large screen, packed with information, will be a welcome addition and copies their HF range in presentation and flexibility. Top of the feature list is SDR employed on both 2m and 70cms, with all the benefits that go with this. And there is no extra charge for the 23cms down converter which will be the icing on the cake for many. The recent trade demonstration showed us just what a great radio this is. Call us today for a quote. £1795.95

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IC-R8600	10kHz - 3GHz Comms. Receiver	£2489.95
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- Access Mode
- Terminal Mode
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Peter Waters G30JV, operates the first FT-dx101 to come into the UK.

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Contents

PRACTICAL WIRELESS

July 2020 Vol. 96 No 7

On sale: 11 June 2020

Next issue on sale: 9 July 2020

ISSN 0141-0857

Practical Wireless

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Subscription Administration

Practical Wireless Subscriptions,
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Components for PW projects

In general, all components used in constructing PW projects are available from a variety of component suppliers. Where special, or difficult to obtain, components are specified a supplier will be quoted in the article.

Photocopies & Back Issues

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

Technical Help

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



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Timed to coincide with World Amateur Radio Day on April 18th, the Radio Society of Great Britain (RSGB) launched an unprecedented campaign with the NHS called 'Get on the air to care' to promote wellbeing and ease the effects of social isolation amongst the UK's 75,000 radio amateurs.

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Topics this month include Morse characters, pole supports, tales from a newcomer and an old timer, and more.



Well, it's been another month of lockdown but I did make a presentation to the Denby Dale club, via Zoom. The

big advantage (apart from not having to travel all that way, which would have been out of the question anyway), was that other non-members of the club were also able to join the presentation – Denby Dale have a licence for using Zoom, which allows up to 100 attendees on a call. So, for example, we were also joined by *PW* contributors **Tex G1TEX**, **Colin G6MXL**, **Tom ZS1AFS**, **Jef ON8NT** and **Ken G4VZV**.

Exams and New Booking System

As we report elsewhere, one effect of the lockdown has been a surge in those coming into the hobby and taking the Foundation exam. Indeed, in response to the demand for remote invigilation exams, the RSGB is launching a new, automated booking system. It will make each part of the process smoother for applicants and HQ staff. The new booking system was due to go live on June 1st in readiness for booking July exam slots. Please note that the RSGB is not accepting any new bookings via the old application form.

This upsurge is very welcome and I do hope that many of those who are joining our ranks stay with us once life returns to some semblance of normality. I do sometimes wonder what has happened to all those newcomers who have taken the Foundation licence in recent years. Repeaters are very quiet and I don't hear many of them on HF. While quite a few are probably using digital modes on VHF, linked into the internet, what are the rest doing? The number progressing to Intermediate and Full licences appears to be well down on the number actually taking the Foundation licence, which is somewhat worrying. They are certainly not building their own transceivers, unless by way of an approved kit (where do we find out which kits are approved, by the way?) because that's not permitted to Foundation licensees.

This Month

We have another packed issue for you, with three very different reviews, a great



article on the Half Square antenna and much more. For example, in this month's regular columns, **Colin Redwood G6MXL** welcomes those returning to the hobby while *Making Waves* columnist **Steve White G3ZVW** talks about the specialist topic of aircraft reflections. We also have an update on the RSGB's 'Get on the air to care' campaign. Quite a wide spectrum of material!

Another of the effects of the lockdown is that I have been receiving more articles than usual – people with time on their hands, maybe! This is great news and means there is a lot of good material to look out for in forthcoming issues.

Included in new material from next month is the start of a series *From the Ground Up*, which will present basic electronics in an understandable and practical way. I'm sure the series will prove popular, especially among new licensees.

Welcome

One of the effects of the lockdown is that we have brought a number of new subscribers on board, for both the paper and electronic versions of *PW*. Welcome to one and all. I do hope you stay with us. While we all long for WH Smith and others to open once again, a subscription is your guarantee that you will receive *PW* regularly.

Don Field

Editor, *Practical Wireless Magazine*

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Newsdesk

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



New from Nevada

Nevada Radio have announced the arrival this month of the new Daiwa CN-901G UHF Professional series SWR/Power meter. The CN-901G covers from 900 MHz to 1.3 GHz, reading both average power and PEP power in two ranges 2W and 20W.

Using a large cross needle meter, readings are easy to see, giving both Forward Power, Reflected Power & SWR readings in one view. The SWR sensitivity is 0.4W and of course at this frequency N-type connectors are used. This is a professional grade meter and sells for £249.95. Nevada Radio are also now stocking the BEKO Masthead preamplifiers from Germany. There are Preamplifier models for the 2m and 70cm bands, both having the ability to take up to 2.5kW of through-power. These preamplifiers are of high-quality construction using a pair of relays that contain ceramic and PTFE linings.

The HPP-144 (2m version) provides a noise figure of 0.5dB with the HPP-432 (70cms version) offering 0.8dB. Both preamplifiers have fixed gain of 20dB and IP3 of 22dBm. They are narrow-band with filters built in to reject FM broadcast and other services. Voltage can be fed through the coaxial cable via in-built T-bias system, or a separate feed to the unit. They sell for £669 each. Available from:

www.nevadaradio.co.uk



IC-705 QRP SDR Transceiver Update

Icom have announced details about the launch of the IC-705 QRP SDR ultra-portable transceiver. Available to the Japanese amateur community from the middle of June 2020, deliveries are planned to the rest of the world shortly afterwards.

Including its SDR platform, internal battery, GPS, Bluetooth and D-STAR, in a compact and lightweight body, the Icom IC-705 uses the same 4.3in colour touchscreen display as the IC-7300 and IC-9700 and features a real-time spectrum scope and waterfall display.

Icom UK expect the UK version of the IC-705 to arrive soon after the Japan launch and anticipate a price of around £1299.99, including VAT (subject to confirmation). They encourage readers to sign up to their newsletter or social media channels for news updates regarding this model.

For more details about the IC-705, including a video introduction to the product, visit the IC-705 QRP SDR transceiver Product Page.

www.icomuk.co.uk

[www.twitter.com/icom_uk](https://twitter.com/icom_uk)

www.facebook.com/icomukfanpage

Foundation Licence FAQ

Leigh Preece M5GWH says that he has prepared a 'Foundation Licence FAQ' during lockdown that is proving to be useful for those wishing to do their Foundation Licence via Online Remote Invigilation. It helps to clear up some of the misinformation out there. This is of particular relevance because the virus outbreak, country-wide lockdown and the RSGB's introduction of 'Remote Exam Invigilation' seems to have sparked a lot of interest in the UK's Foundation Licence. For example, figures have shown that over 300 candidates have recently signed-up for the popular Essex Ham online training course.

"The FAQ is growing and constantly evolving with training sources and a recently written alternative revision guide added", says Leigh, who's updated the FAQ five times since the start of May. "There's something new to add each day or sometimes remove and people are submitting additions and ideas too, which shows how amateurs are helping others".

The guide currently lives on Leigh's Google Drive at the URL below but may move to its own website and he's happy to e-mail the current copy out on request:

leigh@europe.com

<https://tinyurl.com/ukfffaq>

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Radio News



ESSEX HAM: Each year, Essex Ham descends on popular operating location Galleywood Common for a St George's Day field event. The COVID-19 lockdown scuppered plans for a Field Day, but the group was still able to get on air in support of the national day, with the callsign GB5STG active from Pete M0PSX and Sarah M6PSK's home QTH.

The station ran a busy 2m simplex net as well as contacts on 2m SSB and HF, and the activation also supported GB1NHS's #GOTA2C, 'Get on the air to care' campaign, helping to keep locals in touch during the lockdown.

G-QRP CONVENTIONS POSTPONED: Due to the ongoing uncertainty about restrictions on travel and large gatherings, and concerns about vulnerable people needing to shield for some time to come, the G-QRP Club has decided to postpone its 2020 Conventions. The Club had planned to hold two Conventions in September this year, one in Telford and one in Prestwick. Plans are now in train to host an online Convention in September. This is likely to include a series of QRP talks and maybe a virtual Buildathon. The Club will make further announcements as soon as the arrangements have been finalised.

EXPANDED ACCESS TO 6M IN GERMANY:

The German regulator (Bundesnetzagentur) has made a preliminary implementation of the WRC-19 results for the 6m band. Fixed amateur radio stations in Germany now have access to 50-52MHz on a secondary basis, with a maximum bandwidth of 12kHz for all modes and the use of horizontally-polarised antennas. Contest operations are also permitted. In addition, on the 50-50.4MHz sub-band holders of Class A licences can transmit with a maximum of 750W PEP, and Class E licensees can use a maximum of 100W PEP. The maximum permitted transmission power is still limited to 25W PEP elsewhere. These provisions will apply until December 31st 2020, or until a revised Frequency Ordinance comes into force, whichever is earlier.

PRACTICAL WIRELESS
BREAKING NEWS



News from SOTABEAMS

During the lockdown period there has been a major change at SOTABEAMS. **Richard G3CWI** has decided to retire and his colleague **Martin Jackson** (see photo) has taken over as Managing Director. Richard will still be around in the background of course, but the day to day running of the company will be done by Martin. After taking a bit of a break, Richard intends resuming his Radio Adventures video series.

Martin is an Engineering Graduate and has worked as SOTABEAMS Technical Director for four years. He has developed some of their most popular products, such as the

WSPRlite and the WOLFWAVE. You will hear more from him in the months to come. Martin can be contacted at martin@sotabeams.co.uk.

Please use support@sotabeams.co.uk for technical support.

Richard says, "On a more personal note, I have met, spoken to and corresponded with many wonderful customers over the years. I would like to thank you for your support and encouragement. I hope that you will continue to support the company as Martin takes over".

Old Timer News 134

RAOTA has got OTN 134 (Old Timer News issue 134) ready for publication on schedule despite the current virus situation.

OTN consists mostly of articles written by RAOTA members. Articles in this issue include:

- How to Twiddle your AMU or Why You Should Forget About Conjugate Matching
- My quest for a decent low-band antenna; final part – performance
- Power and SWR Measurement
- Problems with the Clock on the Yaesu FTDX1200
- A Fresh Insight into Doublets, Matching &

Standing Waves

Anyone with an active interest in amateur radio is welcome to become a member of RAOTA. They have two categories of membership – Associate and Full. Full members have a vote in the running of RAOTA whereas Associate members do not. Full membership of RAOTA is open to anyone (licensed or listener) with at least 25 years experience in amateur radio. Associate membership of RAOTA is open to anyone (licensed or listener) with an active interest in amateur radio regardless of how recently they came into the hobby.

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NanoVNA

Don G3XTT gets to grips with a handy and cheap piece of test equipment.

Don Field G3XTT

practicalwireless@warnersgroup.co.uk

What is a NanoVNA? Many of you will know but many may not. According to Wikipedia, a Vector Network Analyser is a form of RF network analyser consisting of a signal generator, a test set, one or more receivers and a display. Most VNAs have two ports, permitting measurement of four S (scattering) parameters (S11, S21, S12 and S22).

If that all sounds confusing, then you might also not be too pleased that a VNA also requires calibrating before use.

All of which sounds rather complex when you could simply buy and use a standard antenna analyser, which nowadays will show not only a plot of VSWR, but, typically, impedance data too.

It's certainly true that you can do a lot with a standard antenna analyser, including, for example, cutting coax to a resonant length, figuring out the velocity factor of coax and more, so not just actually measuring your antenna.

However, a VNA can do a lot more than that, enabling you to build and test baluns and RF chokes, check out filters, measure cable length (particularly useful if you have a break in your coax) and much more. Read on!

What You Get

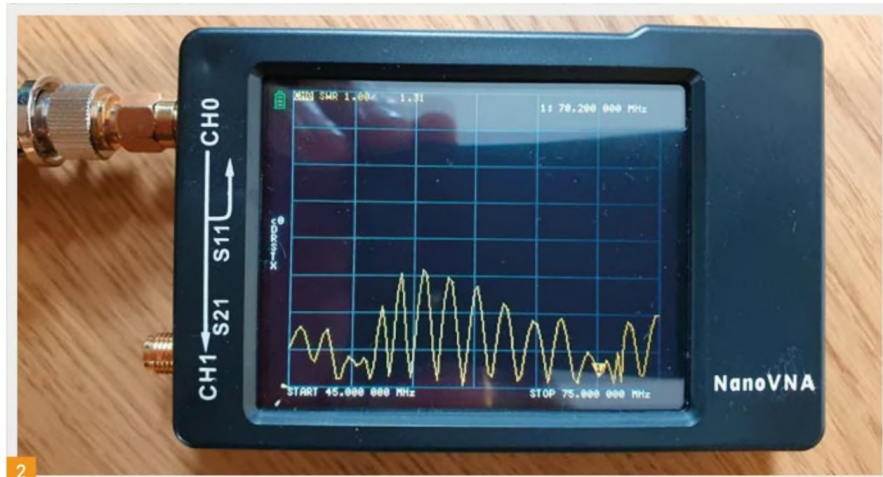
The NanoVNA arrives nicely packaged, **Fig. 1**, with two USB leads, a carrying strap, two SMA to SMA leads, a through connector and three loads – an open circuit, a short circuit and a 50Ω load. These latter are for calibration purposes. The only enclosed instructions are a sheet with the menu tree. However, the website (below) contains a wealth of information, including a user manual. It has to be said that the Chinese-English of the user manual leaves quite a bit to be desired, although that doesn't detract from the underlying information.

nanovna.com

However, when presented with the VNA for the first time, if you haven't come across one before, it can be somewhat intimidating. The trick, as so often nowadays, is to watch one or more YouTube videos, which will give you a far better understanding of what the device can do and how to use it in anger. Here are



1



2

a couple I found helpful although there are plenty to explore:

<https://tinyurl.com/y9kx8aqn>

<https://tinyurl.com/y7t37tab>

To give an example of the sort of

measurement that can be made, the plot, **Fig. 2**, shows a VSWR plot of the reviewer's 4m and 6m Yagi, from 45.5 to 70.5MHz. The two resonances, around 50MHz and 70MHz can be seen clearly.

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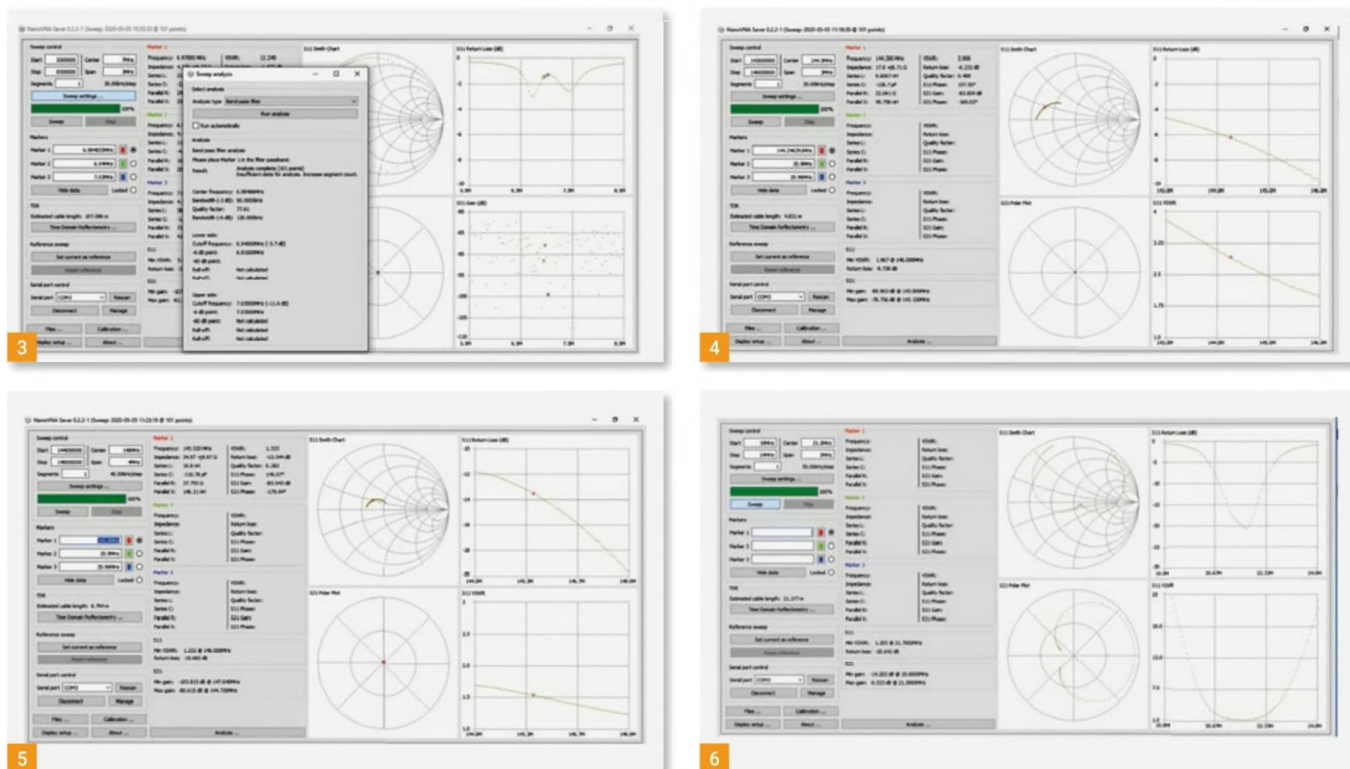


Fig. 1: The NanoVNA on arrival.

Fig. 2: VSWR plot of the author's 4/6m Yagi.

Fig. 3: Characterising a 7MHz bandpass filter.

Fig. 4: Plot for 2m vertical, on wooden cupboard.

Fig. 5: Plot for same 2m vertical but on metal filing cabinet.

Fig. 6: VSWR and return loss plot for 21MHz bandpass filter.

Specification

The NanoVNA covers a very wide frequency range, from 50kHz to 900MHz, far wider than all but the most expensive antenna analysers. It can measure a number of parameters, from showing a Smith chart, to phase and delay measurements and, of course, SWR. And, as you'd expect, it measures reactance.

In Use

The NanoVNA came ready-charged so I could put it to use immediately. I quickly came to the conclusion that the thumbwheel is a bit of a challenge to use, while the touchscreen controls are a bit on the small side for my chunky fingers. So, I resorted – successfully – to a stylus.

The first job is to calibrate the VNA. The videos make a point that measurements at the top of end of the frequency range are more sensitive than those at HF. Keeping the connectors clean, tightening the SMA connectors correctly and general attention to detail become important if you want accurate measurements in the hundreds

of Megahertz. I rather suspect, though, that the majority of *PW* readers will be using the device at more modest frequencies and that high accuracy is less important. But be aware that, despite its modest price, this is a semi-professional instrument in that it can, if properly treated, give accurate measurements across a very wide range of frequencies.

Calibration is quick and easy. But to use the NanoVNA, most of us will need to connect to N-type, PL-259 or BNC connectors so some sort of adapter will be essential.

With the PC

The NanoVNA is small enough to take out into the field with you although it is fairly fragile and certainly not weatherproof, so handle with care. But it really comes into its own if you use it in conjunction with your PC.

Indeed, for the sake of taking screenshots, I have resorted to the PC for some of the tests I did. The plot, **Fig. 3**, shows a 7MHz bandpass filter under test. The pop-up window shows an analysis specifically for a bandpass filter, telling me that it has a centre frequency of 6.98MHz and calculating the roll-off to either side.

I then decided to check out a 144MHz mobile antenna that I have, with magmount. Interestingly, the first plot, with the antenna on top of a wooden cupboard, **Fig. 4**, shows a high VSWR in the 2m band – a bit worrying. But as soon as I transferred the antenna to a metal filing cabinet the results, **Fig. 5**, were

much more what I would have expected, albeit the antenna seems to be resonant out of the top of the band. Maybe on a car it would come out OK!

Finally, and to check out measurements using both ports (which not all VNAs have), I measured the characteristics of a 21MHz bandpass filter. You can see the results in **Fig. 6**.

Relationship to VNWA

I ought to just mention that, according to the NanoVNA designer's blog (see below, select English), he used the same bridge and mixer circuitry as in DG8SAQ's well-known VNWA. The latter is, of course, a much more substantial beast, works up to 1.3GHz and costs considerably more than the NanoVNA. It is manufactured and sold by SDR Kits.

<https://tinyurl.com/yceyqra6>
sdr-kits.net

Conclusions

For its price, this is a remarkable piece of test equipment and a worthwhile addition to any shack. It lends itself to a wide variety of uses, from circuit analysis to checking antennas and feedlines.

While many versions of the NanoVNA are available from China on eBay and Amazon, the product reviewed here is sold and supported in the UK by Mirfield Electronics and sells for just £49.95. My thanks to Mirfield for the loan of the review product.
www.mirfield-electronics.co.uk

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The Midsummer Antenna

Mark Foreman G7LSZ/SA6BID

practicalwireless@warnersgroup.co.uk

Having lived for over a decade in Sweden I have learnt something of the language and customs of the Swedes. I think that their most important holiday in the year is midsummer, when they put up maypoles. In the town I live in (Vara) the people typically go off to the town's folk park where the Vara maypole is put up. Then the children and many of the adults of the town dance around the maypole although due to COVID-19 we may have to do things differently this year.

I would like to present to you a special pair of antennas, which will enable you to share in the pleasures of the Swedish midsummer and the maypoles. In the same way as you can enjoy a Swedish midsummer with multiple senses, you will see the dancing around the maypole, you hear the music, you smell the food cooking on the BBQ, you taste the coffee and you feel the touch of your partner as you dance. With this pair of antennas you can enjoy them in multiple ways.

There are two designs of maypoles in Sweden. In Vara we use one that is a long vertical element with a series of ropes, which are attached to a horizontal hoop part way up the pole. The centre of the hoop is where the central pole ascends into the sky. The other design has a vertical element with a cross beam. The cross beam is partly supported by two diagonal ropes and from the cross beam hang a pair of large rings. Needless to say, in Sweden these maypoles are decorated with greenery and flowers, **Fig. 1**.

If you are going to build a midsummer antenna, then you are free to scale it up or down. If you use a midsummer antenna for the second challenge tell us the dimensions of the antenna that you use. To help you build antennas here is a diagram and table of dimensions (**Fig. 2** and **Table 1**).

Now for the hardest version of the midsummer antenna contest, you need to determine the first ten resonant frequencies of the antennas and the impedance they will present at the feedpoint when they are at resonance. Assume that all parts of the antenna are made of a perfectly conducting 1mm wire if you simulate it. You are free to calculate it using any method you like. You can use a spreadsheet, a pocket calculator,

Mark Foreman G7LSZ/SA6BID has a fun challenge for the summer, to take our minds off lockdown.

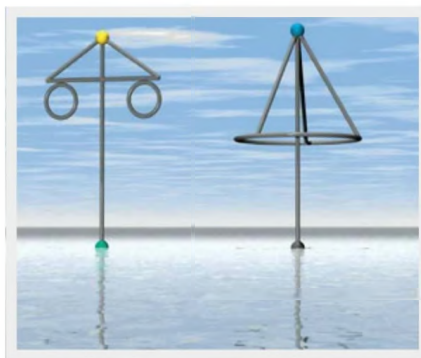
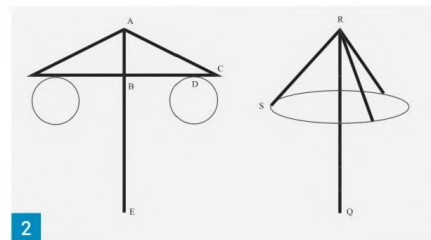


Fig. 1: Decorated Swedish maypole.

Fig. 2: Possible antenna designs (see Table 1 for dimensions).

a slide rule or even a pad of paper and a pen. Alternatively, you can build the antennas and make measurements from them. The person who makes the best predictions will be the winner. If two people make estimates of similar quality, then the one with the more elegant method will win. In the unlikely event that we have a draw at this stage, using a gamma ray spectrometer as a random number generator I will pick a winner. Please note that if you want to use modelling software, you have to write your own software!

The second version of the challenge is to make QSOs in the seven days after



Antenna 1	Antenna 2
Distance AB 2 m	Distance RQ 10 m
Distance BC 3 m	Distance RS 5.83 m
Distance BD 2.25	Hoop diameter 6 m
Distance BE 8 m	Height of hoop above Q 5 m
Hoop diameter 2 m	

Table 1: Dimensions

the Friday closest to midsummer. So, this year the contest will run from June 19th to midnight on the following Thursday. We want to make this fun contest, something that is based on trust and goodwill, but if you make an extraordinary claim we may ask to see the log or other evidence.

The contest will be judged using the following formula for each contact:

$$\text{Points} = \frac{A_s d}{\lambda P_1 \sqrt{P_2}}$$

You multiply the distance (**d**) between the two stations by the antenna score (**A_s**). For two stations using 'normal' antennas, then the multiplier is 1, if you use a midsummer antenna, then the multiplier is 3, if both use midsummer antennas, then the multiplier is 9. You divide the value by the wavelength in Metres (**λ**), your transmitter power (**P₁ watts**) and the square root of the other station's power (**P₂ watts**). The rules are designed to give QRP stations an advantage.

The third version is to make an antenna, put flowers in your hair and take a photograph of yourself dancing around the antenna. You can dance around the antenna on your own. Normally I would encourage you to get the whole radio club to join in but this year due to the virus that might not be a good idea. The photograph that is most pleasing to the eye will win this third challenge.

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Venus Information Technology SW-3B Three-Band CW Transceiver

Martin Peters G4EFE waxes lyrical about a QRP transceiver from China.

Martin Peters G4EFE
practicalwireless@gmail.com

Practically ever since my licence dropped on the mat, 45 years ago (blimey!), I've been an ardent fan of the magic that is QRP. Through early experimentation, with my 100W from an ageing Minimitter (huge, and weighed a ton) into a less than ideal antenna, I very soon realised that I was never going to compete with the big guns. And then there were the neighbours, who were complaining of TVI, so my Dad (I was 15) decreed that I stay off the air during until all three channels (!) had closed down, for the night.

I was beaten (not literally) and vowed to concentrate on low power operation, instead. My first foray into QRP was to build the now-famous G3YUQ Top Band AM/CW design. Comprising just eight components, it put out over half a watt, on CW. More exciting still, by merely plugging a carbon microphone into the key socket, you could produce 350mW or so of – sort of – AM, if you shouted. I was hooked. The idea of building and operating simple, low cost equipment, and the on-air challenges that this 'lifestyle' presented, proved irresistible. Since then, I've never run more than 10W, usually considerably less, using a panoply of commercial transceivers, kits and homebrew equipment.

QRP From China

Fast-forward to 2020 – and many QRP rigs, later – I spotted the Venus Information Technology SW-3B, three-band CW transmitter. For some years, my compact transceiver of choice for out-and-about, CW-only ops, has been the excellent Mountain Top'er MTR-2, which operates on 40m and 20m. But I missed not having any 30m coverage, and the ability to listen to SSB or monitor data modes. I also sometimes felt a little 'lost' missing, as it does, a digital frequency readout. So, I decided to treat myself to this little riglette,



from near Shanghai, China. I put in my order – US \$188, plus \$8 shipping (about £156, total) – and waited. Not too long, as it happened. Less than three weeks later, I had my package. No import duty, VAT or collection fee required (am I just lucky?).

Early Impressions

This was January; Covid-19's tentacles had not yet reached our shores, and was deemed to be 'over there'. I gingerly opened the box and gave the unit a good clean with an alcohol wipe. In with the transceiver were a printed operating manual (in English), a DC power lead, a BNC-to-SO239 adapter and a set of self-adhesive rubber feet.

The SW-3B is a thing of beauty; about the size of a pack of playing cards, not including protrusions, and weighing in at 180g. Unlike a pack of playing cards, you can't play Whist on the SW-3B but then, you can't work the world with a 52-card deck,

so I know which I'd rather have.

According to the specifications, the transceiver requires 8-15V DC and draws 40-45mA on receive, depending on whether the LCD's backlight is illuminated. On transmit, you can expect an approximate 800mA draw at 12V.

The transmit frequency range is 7.0 – 7.2MHz, 10.1 – 10.15MHz and 14.0 – 14.35MHz, CW only, of course. The transceiver delivers between four and five watts RF, for a 12V supply. Attempting to transmit outside these limits brings up an ERROR flag on the display. Note that under these circumstances, the sidetone will soldier on, allowing you to brush up on your sending skills while maintaining radio silence. In fact, the sidetone cannot be defeated.

The SW-3B not only provides CW reception, employing a 400Hz-wide filter, but also facilitates the monitoring of SSB and data signals, afforded by the inclusion

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of a 2kHz-wide filter. An excellent bonus. Even AM transmissions can be monitored – at a push – with careful, zero-beat tuning. The appropriate filter is automatically selected when switching between CW and SSB. You can even transmit CW back to an SSB station, so cross-mode QSOs are a possibility. The receiver's frequency range is 5 – 16MHz. Although optimised for the amateur bands, the wideband coverage is yet another useful feature. There's an RIT, with a ± 9 kHz range, and an XIT of ± 30 kHz.

The on-board keyer has a range of (rough guess) 5 to 30wpm, and can generate one short message, from memory, a preset CQ. It's impossible to configure an alternative message. You'll need to input your callsign, once. From thereon in, a quick push of the CQ button gives you (in my case) "CQ CQ de G4EFE G4EFE K". Unfortunately, a beacon mode – handy for repeated CQ calls – has not been provided, which is a shame. The rig runs full QSK, and flips silently between receive and transmit, while a red LED illuminates in sympathy with your dits and dahs. The pleasant-sounding sidetone is set to 600Hz and its audio level is fixed with respect to the receiver's audio. You can use hand-sent CW or an external keyer, as the transceiver recognises this at power-on.

Connectors are a 50 Ω BNC, to attach your antenna system, a 3.5mm socket for your 8-32 Ω stereo headphones and a 4mm/1.7mm DC socket (same as the FT-817 and Mountain Top'er). Reverse polarity protection is provided. Forgive me if I don't actually try this feature out! Finally, another 3.5mm socket, to accommodate your key(er) or paddle.

The AGC is simply audio-derived and the 'S-meter' is uncalibrated, providing an indication of relative signal strength. There are eight memory channels per band, which store frequency and mode.

Knobs, Switches and Buttons

So, what control do you have? The largest rotary knob, just to the right of the display (no legend) is the VFO tuning, memory selection and for rotating through the tuning step options. With repeated taps of this control, frequency steps of 100kHz, 1kHz, 100Hz and 10Hz can be selected. A small triangle appears above the 'tunable digit'. The rotary dial is of click-stop design, which I personally don't appreciate when tuning a VFO. That said, a smooth tuning action wouldn't feel right for selecting the memory channels!

The smaller rotary controls adjust the RF and AF gain. All the round knobs are



knurled aluminium, and – along with the metal enclosure – give the impression of a piece of equipment designed to take some knocks. A pity, then, that the front panel cut-outs for the slide-switches appear somewhat open to the elements and could all too easily allow the ingress of moisture while out on your adventures. One oddity. In common with many transceivers of this type, there is more than one band-change switch. This design has two. However, when you select another band with either of the sliders, the other one also moves across. So, they're physically linked. In which case, why not do away with one of the actuators and its associated cut-out? The legend on the band-change switches is '1 2 3'. Bearing in mind you can't customise the band coverage, why not '7 10 14', or '40 30 20'?

The only other controls are the three red plastic push-buttons beneath the LCD. Talking of which, the small (but perfectly readable) display indicates frequency, memory slot (or 'VFO'), reception mode (USB, LSB, CW or CW-R) or whether the RIT/XIT is engaged (and the amount of offset), the band in use (or 'TX') and the relative S-meter bargraph.

Back to those three red buttons. As well as enabling the memory keyer and the RIT/XIT, they facilitate switching between the VFO and the memories, saving memories, mode selection and backlight behaviour. The backlight can be set to 'always on', 'always off', or on for a period of 10 seconds following a setting change, saving you yet more of your precious battery power.

To adjust the speed of the internal CW keyer, press and hold the CQ button. Then, using your paddle, swipe right or left to increase or decrease the speed. There's no

indication of your sending speed on the display, so you'll need to do this by ear.

If you're using an external tuner with this transceiver, you'll want to send an uninterrupted carrier, to allow you to match the antenna. A handy hint, from **Richard** of SOTABEAMS, is to turn the unit off, unplug, then re-insert your paddle key. Then activate both paddles simultaneously, while switching the radio back on. Doing this fools the SW-3B into believing that a straight key is connected so for as long as you activate the dit paddle, continuous RF is produced. After tune-up, simply perform a power cycle, and you're back in business.

I ran the transceiver at various voltages, noting the power output on each band (see **Table 1**). Amazingly, the receiver didn't give up until I'd lowered the supply to under 6V, but the transmitter was still going at 4.74V!

The final paragraph in the *Users' Manual* is sub-headed 'Adjust' and then goes on to describe the functions of the internal preset potentiometer and preset capacitors. Spoiler alert: frequency calibration and receiver sensitivity peaking.

One minor disappointment is that the radio doesn't remember your last operating frequency. Whether you were previously using the VFO or one of the memory slots, power it back up and you'll be on memory slot 08 (40m or 30m) or memory slot 01, on 20m, so it's not even consistently annoying. With that knowledge, I'll be reprogramming the memories such that the QRP 'calling frequencies' match those 'power up' slots.

On the Air

The SW-3B is a joy to use. The receiver is nice and lively but doesn't appear to suffer from overload or out-of-band interference (the antennas here are a full-size 40m loop

for 7MHz and 14MHz, and a random ended wire, for 10MHz).

The encoder (20 clicks per revolution) refuses to allow rapid tuning. Once you discover this, and can tame your impatience, it's not a problem. You can tune up or down from any of the memory positions, which is handy. However, even when the unit is powered, it doesn't remember your last-used VFO frequency; you'll always need to retune.

Is it me? When I'm driving the car with the sun visor down, I can feel a little hemmed-in, so it's always a relief to move it out of the way and enjoy more of the sky. I get this same sensation when listening on the bands with a tightly filtered receiver. Yes, the filtering is providing a much-needed function but I find it quite fatiguing to listen to it for long periods of time. Just me, then? The 2kHz-wide SSB filter in the SW-3B I find is a little narrow for comfort but the 400Hz CW is a nice compromise between selectivity and 'audio claustrophobia'.

There's plenty of audio for headphone listening. It's even adequate for hooking up to a loudspeaker, when listening across a quiet room.



Obviously, this diminutive transceiver is intended primarily for portable operation. Since taking delivery, we've been in 'lock-down' but I'm looking forward to the day I can get out, and maybe even get down to a little SOTA-type operating. In the meantime, under an hour on the air netted reports from three continents, courtesy of the Reverse Beacon Network.

Can I recommend it? Yes, I can. Would I buy it again? In a heartbeat!

	7MHz	10MHz	14MHz
13.8 V	4.95	6.06	4.93
12.5 V	4.25	5.35	4.38
9.5 V	2.4	3.15	2.65
7.8 V	1.56	1.97	1.67
6.4 V	0.9	1.02	0.8
4.74 V*	0.18	0.12	0.05

*Receiver disabled

Table 1: DC supply vs power output (watts).

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AT-6666 Single band AM/FM/USB/LSB 10m radio (25.615-30.105MHz) 60 Watts **£199.99 £169.99**
AT-D578UV Pro FM/DMR mobile radio This AT-D578UV-pro is a true TWIN band radio for digital DMR radio systems, compatible to MOTOTRBO Tier 1 and 2. Traditional FM is of course equally supported. In contrast to many other DMR radios the AT-D578UV offers real VFO operations, which makes it much more suitable for amateur radio. Here you can adjust frequency and other parameters as you are used from traditional radios, instead of just using pre-programmed memories. Ofcourse the AT-D578UV offers these memories as well, quite a lot: 4000 to be precise. But you are not limited to those memory channels. **£349.99**

NEW GJ-0485 power supply for Anyone D578UV
£119.99

Handheld Transceiver

AT-D868UV handheld radio is a VHF and UHF radio with both Digital DMR (Tier I and II) and Analog capabilities. Includes GPS Offering a total of 4,000 channels (Analog and Digital), 10,000 Digital Talk Groups, and up to 150,000 contacts, as well as multiple DMR ID numbers (Radio ID's) for a single radio **£129.95**
AT-D878UV PLUS BLUETOOTH Digital DMR Dual-band Handheld Commercial Radio with Roaming and GPS VHF/UHF Dual-band Digital/Analog Part 90 DMR commercial transceiver with 1.77 inch colour TFT display and GPS. This model includes DMR Roaming, faster processor and larger memory for future enhancements. Ideal for Fire, Search & Rescue, EMS, Police, Sheriff, Forestry and Security operations. Frequency coverage 140-174 / 400-480 MHz **£199.99**

Accessories

CPL-02 Battery eliminator for AT-D868UV **£9.95**
CPL-01 Car charger for AT-D868UV **£8.95**
CPL-05 Speaker microphone for AT-D868UV **£19.99**



Vero Global Communications compant is a science and technology enterprise in Fujian Province, specializing in R&D, production and sales of electronic products and accessories such as radio communication equipment, alarms, radio frequency smart cards, and GPS equipment.

Mobile Transceiver

VR-N7500 is a brand new 50 watt VHF 40 watt UHF Headless mobile transceiver with a solid build quality. It is very different in design compared to any other radio used mobile or base. The VR-N7500 uses a smartphone as a control panel and the body is installed in the boot or similar with the mobile phone connected to the body through Bluetooth. The cars hands-free intercom can be utilised through the vehicle Bluetooth and PTT is by th esupplied Bluetooth PTT **£189.95**

BAOFENG

Started in 2001, Baofeng has always been aiming at creating user value and innovating products. From the first small factory of more than 30 people, Baofeng has developed into a high-tech enterprise specializing in R&D, production, sales and after-sales service of handheld wireless walkie-talkies as well as accessories.



Handheld Transceiver

UV-5RC PLUS Latest version of this ever popular dual band handie - and now with a 4.5W on 2m - Comes complete with desktop charger, antenna, belt clip & high power 1800mAh battery **£29.95**
UV-5RC PLUS TWIN pair of UV-5RC's as above **£55.00**
GT-3 MK2 is a great dual band Baofeng with human-oriented features. Large capacity Li-ion battery that can last for between 7-9 hours of continuous use. Small and lightweight, it is small enough to fit into your shirt pocket. Upgraded frame material makes it more durable and the great orange & black colour gives it a great appearance. It also comes with a more user-friendly user manual making it easier to understand and use **£39.95**
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BF-888S is a professional UHF transceiver with good performance and reliable quality. Extra functions such as Noise Reduction and Scrambler make it as a cost-effective transceiver covering 400-470MHz and including desktop charger for an amazing **£12.95**
DM-9HX DMR radio Tier II VFO digital & analogue dual band UHF/VHF handheld transceiver **£99.95 £69.95**

Accessories

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UV-5PC Branded software cable with USB for all listed Baofengs .. **£9.95**
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UV-5SC Original soft case for UV-5RC+ **£9.95**
BL-5 Original 1800 mAh replacement or spare battery for UV-5RC+ **£9.95**
GT-5 Original GT-5 2000 mAh replacement or spare battery for GT-5 **£14.95**
GT-3 Original GT-3 1800 mAh replacement or spare battery for GT-3 **£12.95**
BF-8 6 way charger for BF-888S **£44.95**

LEIXEN



Leixen having developed a full range of "LEIXEN" series of radios, widely used in transport, construction, telecommunications, security, restaurants, residential property management and other departments and areas, especially popular in the HAM's world.

Mobile Transceiver

VV-898 136-174/400-470MHz mobile transceiver. What a great entry level dual band rig, with only 10 Watts it is ideal for the new foundation pass holders. Comes complete with radio bracket and keypad microphone **£59.95**
VV-898S as above but with 25 Watts **£69.95**

Handheld Transceiver

NOTE is a rugged 400-480 MHz handheld transceiver with a massive 20W output! Comes complete with antenna, belt clip and drop in charger - are you ready to be heard! **£69.95**

SenHaiX

SenHaiX was established in 2012 and is in located in the located in the hometown of two way radio Quanzhou city, Fujian Province, China. The company is a high-tech enterprise specialising in radio communications R&D, manufacture of two way communications and accessories.



Mobile POC Network Radio

SPTT-N60 is a 3G network android mobile radio with wifi, bluetooth, zello, sos, phone function, gps function, with touch screen and large LCD **£249.95**
4G version **£299.95**

Handheld Transceiver

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Inrico



Inrico Electronics is a high-tech enterprise which focuses on the design, construction, production and sales of radio communication equipment.

Mobile POC Network Radio

TM-7 PLUS is the first 4G mobile network Radio. Great for amateur radio use with the new IRN platform, for Zello, Team Speak 3 and Echolink via 3G or WiFi. And it works as WiFi hotspot too! ... **£159.95**

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ICOM is an international manufacturer of radio transmitting and receiving equipment, founded in 1954 by Tokuzo Inoue with the company's original name being "Inoue". There products now include equipment for radio amateurs, pilots, maritime applications, land mobile professional applications and radio scanner enthusiasts.

Handheld Transceiver

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Mobile Antenna Mounts

TRIMAG-S Triple magnetic mount with SO239 antenna fitting with 4m RG58 and PL259 fitted – ideal for those larger antennas..... **just £39.95**
TURBO-S single 170mm magnetic mount with SO239 antenna fitting with 4m RG58 and PL259 fitted – will suit most antennas upto 5ft..... **£19.95**
HKITHD-S0 Heavy duty hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted..... **£32.95**
HKITM-S Mini hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted..... **£32.95**



Multiband Mobile

Why buy loads of different antennas when Moonraker has one to cover all! SPX series has a unique fly lead and socket for quick band changing
SPX-100 9 Band plug n' go portable, 6/10/12/15/17/20/30/40/80m, Length 165cm retracted just 0.5m, Power 50W complete with 38th PL259 or BNC fitting to suit all applications, mobile portable or base – brilliant!
..... **£44.95**

SPX-200S 6 Band plug n' go mobile, 6/10/15/20/40/80m, Length 130cm, Power 120W, PL259 fitting..... **£44.95**
SPX-300S 9 Band plug n' go mobile, 6/10/12/15/17/20/30/40/80m, Length 165cm, High Power 200W, PL259 fitting..... **£59.95**

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MR700 2/70cm, Gain 0.3/0.8dBd, Length 50cm, 3/8 fitting..... **£9.95**
MR777 2/70cm, Gain 2.8/4.8dBd, Length 150cm, 3/8 fitting..... **£19.95**
MRQ525 2/70cm, Gain 0.5/3.2dBd, Length 43cm, PL259 fitting (high quality)..... **£19.95**
MRQ500 2/70cm, Gain 3.2/5.8dBd, Length 95cm, PL259 fitting (high quality)..... **£26.95**
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MRQ800 6/2/70cm Gain 3.0dB/5.0/7.5dBd, Length 150cm, PL259 fitting (high quality)..... **£39.95**
MRQ273 2/70/23cm Gain 3.5/5.7/5.8dBd, Length 85cm, PL259 fitting (high quality)..... **£49.95**

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Save money buying in bulk – handy 50m as well as 100m drums at discounted prices

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RG58M-DRUM-50 military spec RG58 6mm 50m reel..... **£24.95**
RG58M-DRUM-100 military spec RG58 6mm 100m reel..... **£44.95**
MINI8-DRUM-50 military spec MINI-8 7mm 50m reel..... **£34.99**
MINI8-DRUM-100 military spec MINI-8 7mm 100m reel..... **£64.99**
RG213-DRUM-50 military spec RG213 9mm 50m reel..... **£64.99**
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GRP Fibreglass Base Antennas

Diamond quality – Moonraker pricing
These high gain antennas have been pre-tuned for your convenience, easy to use, easy to install, and a choice of connection ... look no further

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SQB5500P 2/70cm, Gain 6.8/9.2dBd, RX 25-2000MHz, Length 250cm, SO239..... **£74.95 SPECIAL OFFER £69.95**
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SQB2223N 2/70/23cm, Gain 4.5/7.5/12.5dBd, RX 25-2000MHz, Length 155cm, N-Type..... **£79.95**
SQB33000N Triband 2/70/23cm, Gain 4.5/8.3/10.7dBd Length 1.55m..... **£79.99**
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Our HF wire antennas are made with complete waterproofed baluns and high quality "original" flexweave antenna wire.

MDHF-80 3.5MHz balun matched mono dipole, length 40m..... **£59.95**
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MDHF-20 14MHz balun matched mono dipole, length 10m..... **£39.95**
OSHF-80 3.5-30MHz balun matched off set dipole, length 40m..... **£59.95**
OSHF-40 7.0-30MHz balun matched off set dipole, length 22m..... **£44.95**
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LWHF-40 7.0-50MHz unun match end fed antenna, length 10m..... **£39.95**

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Masts

GRP Fibreglass

Ideal heavy duty fibreglass masts for those antennas that need to be insulated from metal hardware or pole – convenient 2m lengths in a light grey

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Masts

Telescopic

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TMF-1 20ft open 5.6ft closed 50-30mm high quality GRP mast..... **£199.99**
TMF-1.5 30ft open 7.5ft closed 57-30mm high quality GRP mast..... **£299.99**
TMF-2 40ft open 9ft closed 57-30mm high quality GRP mast..... **£349.99**
TMF-3 50ft open 9ft closed 65-23mm high quality GRP mast..... **£399.99**

NOW IN STOCK
Compact Tri-Mag
JUST £25

QRP Antennas

The Moonraker Whizz range are great for getting on HF in a neat compact and totally portable way

Whizz Whip HF/VHF/UHF portable antenna with telescopic whip – ideal for any situation where a long wire or vertical antenna is just not an option – get on air today for **just £99.95**

Whizz Loop 20-60m compact loop is ideal for QRP Transceivers when space is limited or using portable with a Yaesu FT-817ND or similar. Can be used indoors with surprising results and handy for travelling due to its "pocket" size antenna ideal for indoor or out and can be packed away and all for **just £69.95**

Whizz Loop V2 (right) same as above but with a frequency range from 40-10m..... **£79.95**

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Simple plug and play HF antennas radial free and at a great price

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AMPRO-11 Slim line design 27MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-12 Slim line design 24MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-15 Slim line design 21MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-17 Slim line design 18MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-20 Slim line design 14MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-30 Slim line design 10MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-40 Slim line design 7MHz 2m approx. 3/8th fitting..... **£22.95**
AMPRO-60 Slim line design 5MHz 2m approx. 3/8th fitting..... **£24.95**
AMPRO-80 Slim line design 3.5MHz 2m approx. 3/8th fitting..... **£27.95**
AMPRO-160 Slim line design 1.8MHz 2m approx. 3/8th fitting..... **£59.95**

Other frequencies available. Call or see online for more details.

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300-20 Ribbon feeder 300 ohm high quality slotted, 20m..... **£17.95**
450-20 Ribbon feeder 450 ohm high quality slotted, 20m..... **£19.95**
DPC-W Wire dipole centre with securing clamps..... **£5.95**
DPC-S Wire dipole centre with SO239 socket for PL259..... **£6.95**
DPC-38 Dipole centre for 2 x 3/8th whips antennas to make dipole..... **£6.95**
DOGBONE-S small plastic insulator..... **£1.00**

Hardware

We offer all type of mounting hardware to help get you rigged up at home – if you cant see it listed chances are we have it. Check www.moonraker.eu or just give us a call

TRIP00-HDA heavy duty collapsible tripod to suit base mats up to 67mm..... **£149.95**
TK-24 wall bracket offers 18" clearance..... **£29.95**
TK-12 wall bracket offers 12" clearance..... **£19.95**
B82 mast base plate to suit up to 2" masts/pole..... **£22.99**
JOIN-200 clamp 2" poles back to back..... **£17.95**
PTP-20 2" to 2" mast clamp..... **£5.95**

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HyEndFed Portable Antenna

Tim Hier G5TM goes out and about with a 3-band antenna from HyEndFed.

Tim Hier G5TM

practicalwireless@gmail.com

In my quest to find a convenient multi-band solution to operating HF portable I have tried several configurations, including the venerable linked-dipole for 40/20m and full sized 20m long end-fed half-wave antennas. The selection of Ampro-whip antennas I own perform well from 14MHz and upwards but become a true compromise from 7MHz and below. My interest in using 40m portable has necessitated the need to use full-sized half-wave antennas in both of the above-mentioned configurations, which in turn requires the use of a good deal of space to accommodate a 67ft long antenna. The safety aspect, ensuring that high voltage end points are kept above head height, means that I often need 80ft or more of space to run an antenna portable for 7MHz.

Those of us who operate portable have probably experienced the difficulties faced with utilising this much space. Hilltops and beach-side locations are often used by other people and this leads to issues in obtaining the space needed and maintaining the safety of others on a hill-top or coastal car park.

My portable HF quest has therefore led me to considering antennas that use a smaller footprint. Enter the vertical antenna. Even here there are obstacles. Quarter-wave verticals, of course, require radials. The prospect of laying out sufficient numbers, or length, of ground radials brings us back to square-one. Using fewer raised quarter wave radials (even just two or three) still requires a wider space to tie these off. These considerations led me to consider the end-fed vertical half-wave.

I am no antenna construction expert, very (very) far from it! So, I have shamelessly proceeded to purchase an off-the-shelf solution – a HyEndFed three-band antenna. HyEndFed, based in the Netherlands, has a very good reputation in the field of end-fed half-wave antennas. Certainly, the eHam reviews (5/5 with over 50 submitted) seem to support a good deal of user/purchaser satisfaction with their



range of antenna solutions. So, I decided to pull the trigger and purchase their 100W three-band (40-20-10) portable version.

On Arrival

The antenna arrived extremely well packaged in a solid cardboard boxed and a great deal of bubble-wrap, **Fig. 1**. The antenna wire, 49:1 transformer and instructions were contained within a handy pouch. A useful item for portable operations.

The 40m coil, **Fig. 2**, is very well made and lightweight. This restricts the following 2m of antenna wire to become the much shortened second half of the 40m element only.

The first thing to note is that this antenna is a shortened version (11.85m) of a typical 40m EFHW antenna (usually around 20m in length). This is achieved by having a loading coil (**Fig. 2** again) providing approximately 34µH of impedance, positioned at the end of the 20m half-wave point (approximately 10m from the 49:1 transformer end of the antenna). This is followed by approximately 2m of wire until the end insulator. As you may well be

aware, having a coil in any antenna, while allowing for a shorter antenna length to achieve resonance for a given band, has the trade-off of a much narrower 2:1 SWR bandwidth compared with a full-sized half-wave. So, with this antenna it is necessary to decide if you wish 40m to work for you as a CW or an SSB antenna, although a rig's in-built tuner or external ATU should cover the mismatch. However, no such consideration is necessary for 10 or 20m. The antenna produces the same radiation pattern as a half-wave dipole for 20m and a full-wave pattern for 10m with a full 2:1 SWR band coverage. Please note that the manufacturers state that the longer full-sized half-wave covering 40, 20, 15 and 10m typically has a 6dB performance improvement over this three-band shortened antenna on 40m.

The photo, **Fig. 3**, shows the 49:1 transformer. This is a very small box, measuring barely the length of a disposable cigarette lighter and is very lightweight. Note that you can select either a BNC or SMA connector option.

The enclosed instructions, **Fig. 4**, provide a useful guide as to how to tune the

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Fig. 1: The package on arrival.

Fig. 2: The 40m coil.

Fig. 3: The 49:1 transformer.

Fig. 4: Extract from the instructions.

Fig. 5: The Spiderbeam pole, nestling within a cut-off piece of sewerage pipe, which in turn is strapped to the tree in the corner of my garden. Note the small block of wood between pipe and tree to get a fairly level upward trajectory!

antenna for 40m operation.

Being able to mount this antenna as a vertical would allow me to avoid the need to cover a large footprint when portable and provide, at least in theory, some low angle radiation for DX (propagation gods permitting of course). The plan was to mount the small transformer box at a fraction above ground level and run the wire up a 12m Spiderbeam fibreglass pole, with the pole itself strapped to a sturdy tree or fence post.

Following the mantra that you should test an antenna set-up at home or elsewhere before you venture with it portable, I set this antenna up at home, strapped to a small tree in the corner of my small postage-stamp garden (see Figs. 5 and 6).

The photos, Figs. 7a, b and c show the results of an SWR sweep during home test. This confirmed HyEndFed's assertion that the antenna is cut long for 40m. This suits CW operators but needs adjusting for SSB operation. The sweep also confirmed the 2:1 SWR coverage outlined by the manufacturer.

The 2:1 SWR bandwidth for 40m is around 100kHz. So, my aim was to adjust the length of the 40m wire by using the end tuning stub and reduce its length so as to centre the lowest SWR dip at around 7.140MHz.

20m SWR readings were within 1.5:1 for the whole band. 10m was well within 1.5:1 from 28.000 to 29.000 MHz.

The day (or should I say evening) arrived to test the antenna portable. I packed my car and headed up to a local hill with a modest height of 150m asl. I located a sturdy fence post, strapped the Spiderbeam mast and attached the antenna. Within five minutes the antenna was fully erected and the coax attached. The photo, Fig. 8, shows the base of the antenna.

The first thing I checked was the SWR. Following the home test I checked the instructions, which suggested that a 1cm change in length would alter the resonance on 40m by around 20kHz. With this in mind I adjusted the wire by shortening it,



40, 20 and 10 meter band				
40 m :	150 KHz	≤	1 : 2,0	
20 m :	350 KHz	≤	1 : 1,8	
10 m :	500 KHz	≤	1 : 1,8	
100 Watt PEP, SSB				
11,80 meter				
Stainless Steel, Teflon BNC Connector				
Enclosure: ABS IP65				
CU hard copper, 40 kg breaking force				
End insulator: Balunskontakt IIV resistor				



using the adjustable tuning stub (easy) and folding back on itself by around 7cm, with the hope of gaining a 1:1 or close sweet-spot at around 7.130-7.140MHz, thus allowing me to have a full 2:1 or better SWR coverage on the SSB portion of 40m. As I had to complete this at home, with no further opportunity to check before I ventured portable, I kept everything crossed.

The photos, Figs. 9a, b and c, show the SWR readings using my trusty MFJ analyser following portable set-up:

I was very happy with those readings. Now it was time to get on the air!

In Use

Let's cut to the chase, how well did this antenna perform? In short, remarkably well. Remember, the 40m portion of the antenna is much smaller than a full half-wave but even so I found making contacts into Europe very easy on my 50W. I gave myself the challenge of trying to make as many contacts as possible in a seven-

Frequency	Callsign	Time (UTC)	TX	RX
7153	YP19VW	1757	59	59
7172	HB9HLM	1800	59	59+20
7129	RL5A	1802	59	59+10
7177	IK6BGJ	1804	57	59+10

Table 1: Results of a seven minute operating period on 40m.

Enter our competitions at www.radioenthusiast.co.uk/competitions

Fig. 6: The antenna on the Spiderbeam pole, fully extended at my QTH. Almost straight too!

Fig. 7: Initial SWR sweep during home test.

Fig. 8: Feedpoint of Spiderbeam mast, coax yet to be attached.

Fig. 9: SWR sweep after adjustment.

minute burst on 40m using 'search and pounce'. The results are shown in **Table 1**.

Four consecutive 40m QSOs into Europe in seven minutes is not too bad. What is also worth mentioning is that on each occasion the contact was made on the first attempt and (with the exception of IK6BGJ) in competition with other European stations.

With the greyline approaching I switched quickly to 20m and enjoyed some good DX contacts including:

W8VLN in Ohio (TX 56, RX 57)

7X3WPL in Algeria (TX 58, RX 59)

PY5QW in Brazil (TX 56, RX 59)

PV8AL in Brazil (TX 58, RX 55)

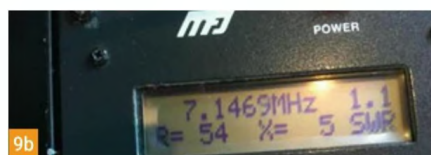
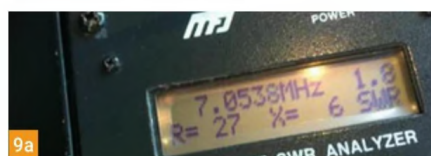
KP4EYT in Puerto Rico (TX 58, RX 59)

Other European contacts followed on both 20 and 40 (sadly 10 was closed), with my most pleasing contact on 40m rounding off the evening: J69MV (St. Lucia) TX 58, RX 55.

Overall, I think this antenna performed remarkably well. It ticks the boxes for portability and ease of operation. Simply get the wire up and plug in your coax to the rig. To get two new DXCC for me (Puerto Rico and St Lucia) was a big bonus and rounded off an enjoyable evening working portable with a small footprint. Sure, you can make one yourself and it would be a fun project. If, however, like me you need an off the shelf, extremely well made alternative, then give one a try.

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The HF Bands in Lockdown

Steve Telenius-Lowe PJ4DX
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With much of the world in lockdown due to coronavirus, it's been noticeable that participation in HF contests has increased. The increase is not necessarily in full-blown highly competitive entries, but more 'casual' operators seem to have been getting on the air to give away a few points, seeing what they can work and just having fun.

There are two popular international contests in July that readers of this column might like to have a dabble in. The first is the IARU HF World Championship, which this year is on July 11/12th, from 1200UTC on the Saturday for 24 hours. There are separate sections for single operator, multi-operator and IARU member society HQ stations. Needless to say all entrants must comply with whatever Covid-19 restrictions are in place in their country, a point made crystal clear by **Dave Sumner K1ZZ** on the IARU website:

<https://tinyurl.com/yadovnut>

Single operators may use CW, SSB or both modes, and there are high power, low power (100W) and QRP (5W) sections. In this contest, the multipliers are the ITU Zones, as well as IARU HQ stations and IARU officials worked, on each band. The UK is in ITU Zone 27, as can be seen from the map shown in **Fig. 1**. The full rules are at:

arrl.org/iaru-hf-world-championship

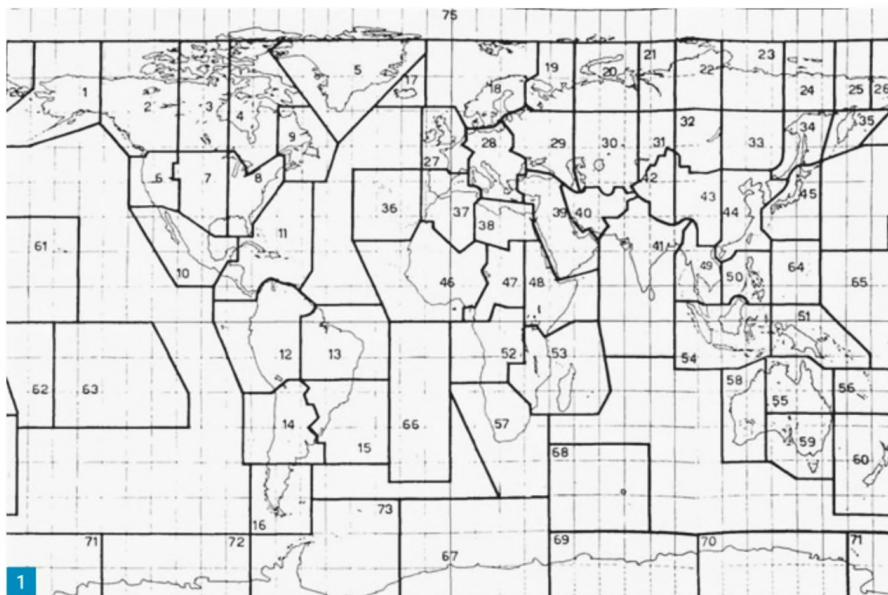
The second major event in July is the RSGB's IOTA Contest, which is on July 25/26th, again from 1200UTC Saturday for 24 hours. A note above this year's rules states that: "In line with 'Stay at Home' guidance, to minimise the impact of Covid-19, the IOTA Contest in 2020 is exclusively for Single Operators using their home stations; Single Operator Fixed 'Island' or 'World' Stations are eligible to enter." The full rules can be found at:

rsgbcc.org/hf/rules/2020/riota.shtml

More Activity from Bonaire

We welcome **Erwin Lemmers PE1NMB**, **Fig. 2**, to Bonaire. His arrival brings to a total of eight the number of amateurs resident on Bonaire. Erwin and his wife came on the very last flight from the Netherlands before the closure of passenger flights and were immediately placed into a two-week period

Steve Telenius-Lowe PJ4DX reports lots of activity despite, or perhaps because of, lockdown.



of quarantine. Emerging from his isolation in April, I met Erwin at the regular get-together of amateurs still held here (with no cases of Covid-19 on Bonaire confirmed at the time we're not in lockdown). Erwin will be applying for a local PJ4 callsign soon. Also pictured in **Fig. 2**, **Peter de Graaf PJ4NX** has recently returned to the air after a hiatus of a couple of years due to other commitments.

Gerard van de Reep PJ4GR received his licence last year but had been living in a place where the best antenna he could use was a mobile whip. He recently moved house and is now using a 10m mast to support various vertical wires, **Fig. 3**.

World Amateur Radio Day

World Amateur Radio Day takes place on April 18th each year and commemorates the founding in 1925 of the International Amateur Radio Union (IARU). Although the RSGB has been a leading light in the IARU for almost a century, World Amateur Radio Day seems to pass by with hardly a flicker of interest in the UK. That's not the case in other countries, with many special event stations sporting 'WARD' callsigns.

The Spanish national society, URE, really went all out during the whole of April to commemorate the 95th anniversary of the IARU. Multiple special event stations in

each of the nine Spanish call districts used callsigns AM1WARD to AM9WARD plus AM95WARD on all bands 160 to 6m using SSB, CW and 'Digi' (including FT4 and FT8).

Building on the success of its own 70th anniversary last year, in which an astonishing 1,196,359 QSOs were made by the AM70 special event stations then active (admittedly over a longer period), the URE once again organised a series of certificates, **Fig. 4**, and medals for making contacts on various numbers of bands with the AM*WARD stations. By the end of the month they had made 526,024 QSOs, including QSOs with no fewer than 4,003 different stations in England (plus more with the other UK entities), and 12,671 PDF certificates had been downloaded.

With the lack of DXpeditions to exotic places due to the Covid-19 restrictions, DXers can still get their 'fix' from chasing special event stations during such events. Congratulations to the URE for organising this one so well.

iaru95.ure.es

Readers'News

Reg Williams G0OOF wrote that "the month started by entering the Polish SP DX SSB Contest. Not a serious entry but was interesting for a first time in the contest and with plenty of time on my hands. Most

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Fig. 1: ITU Zones worked are multipliers in the IARU HF Championship contest in July.

Fig. 2: Erwin PE1NMB, Bonaire's newest amateur, with Peter PJ4NX.

Fig. 3: Multi-band vertical antenna at the new location of Gerard PJ4GR.

Fig. 4: Certificate issued by the Spanish national society URE for contacting AM*WARD stations celebrating the 95th anniversary of the IARU.

Fig. 5: The modest antenna of Kevin ZB2GI that allowed him to work China on 20m FT8.

contacts were made on 7 and 14MHz. Going on through the month I worked a mixture of SSB and FT8 modes with a Sporadic E opening on the 12th of the month on 28MHz FT8, a good number of European stations being worked...

"I saw a video from **Peter Waters** of Waters & Stanton about construction of a simple 14MHz 1/4-wave vertical antenna with a single elevated counterpoise. This was aimed at amateurs with small back gardens. I found it was easy to construct and made on air contacts with North America and Europe. The antenna was only up for a short period but I will give it a longer airing later in the year.

"Towards the end of the month I worked towards the IARU 95th anniversary diploma award by contacting the ten special event stations with the AM prefixes. It was the last three days of operation and I had time on my hands due to lockdown. It took those three days to work enough stations on SSB and FT8 to gain the Platinum award (Fig. 4). Luckily, I think there was a push by a good number of stations to be on air but it was not easy to get through pile-ups and trying to work some of the weaker stations. I just needed AM6WARD on 21MHz to get to that final goal. Time was running out on the last day. He appeared on 21MHz late in the evening. Easily workable thanks to 21MHz being open. A very pleasant three days to while away the time."

Owen Williams G0PHY reported that "There was plenty of activity at G0PHY chasing the Spanish special event stations for the 95th anniversary of the IARU, the Russian Victory special event stations, participation in the RSGB Hope QSO parties and not forgetting the Stay Home stations. I just missed out on the Gold diploma for working the IARU stations by one contact. I remember getting the Platinum diploma last year for the 70th anniversary of the URE but those special event stations were on the air for just over two months. The contacts with the Stay Home stations were all within Europe apart from CN20SH in Casablanca... I have used the time to start brushing up on



my CW using AA9PW's website to practice receiving the code and so far I'm managing to fit in at least one session a day."

<http://aa9pw.com>

Victor Brand G3JNB mused that "sitting at the rig on April 3rd, I was despairing at the lack of DX and the poor propagation on 20m. Switching to 17m, I came across a substantial CW signal that was running a pile of EU stations but not revealing a callsign at that moment. Intrigued, I 'reverse searched' the Cluster for the frequency of 18.074 and saw it might be ZS1ANF in Cape Town. Sure enough, a single call and Oleg replied for a full exchange. So much for my doubts, a proper DX QSO and one not to be sniffed at, if genuine! By contrast, on 30m, a weak signal from nearby Andorra's **Joan C31US** was logged against heavy QRN/QSB. Normally routine S9 contacts with **Robert T6AA** on 20m and **Murtada 9K2MU** on 40m were truly marginal with much repetition of my call. However, in the absence of real DXpeditions, we were royally entertained by a proliferation of exotic calls where the suffix was replaced by a mnemonic. The ubiquitous 'STAYHOME' and 'STAYSAFE' were plain enough but 'GAON' and 'WARD' needed some research. My favourite such contact was with 'OZ80QUEEN' celebrating the birthday of **HM Queen Margrethe** of Denmark. Then surprise, surprise, our own Ofcom joined the party and authorised us to break their long-standing taboo by [allowing] signing as G3JNB/NHS. And a truly unique experience occurred when I worked two of my namesakes, back to back within minutes, EC5K on 30m and 4Z5AD

on 17m.

"Sheffield ADRS, having upgraded local club nets for the duration, prompted me to pop up a longwire for topband. Reports received of only S3 when loading my 10m vertical, jumped to S9+30 for the wire! Finally, there is surely a certain irony in the fact that we DXers find ourselves in lockdown at a time when the sun is devoid of spots and all DXpeditions cancelled but we languish at home with ample shack time available!"

Kevin Stock M0YRX sent in news from the 10m UK Net group and its Summer Challenge. He says it was "a bumper month for 10m SSB so early in the season with 18 of the 30 days having propagation being recorded in IO81 square by Kevin M0YRX (4th), which led to the group as a whole working 53 DXCC in the month. Early leader **Keiron M0HKB** had 334 QSOs working 42 DXCC which included DX from CE, OD, FR, LU, PY, UA9 and ZD7." Keiron was closely followed by **Gary G0FWX** on 41 DXCC. See 'Around the Bands' for DX worked by Gary and other members of the 10m UK Net group during April. Kevin concluded with "a special mention for **Dave G4PDR**, who worked PY twice in April with a 40-year old (?) 18AVT/WB vertical antenna, which is ground mounted and up against a tree!"

Tony Usher G4HZW uses data modes FT8 and FT4 on 7MHz, where he has a home-made vertical with 16 radials, and 28MHz, on which band he uses a 4-element Yagi. He reports that 7MHz was open 24/7: "at times 7MHz FT8 frequencies are choc-a-block and I've had more response using FT4 where the frequencies are a bit less congested. 61

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3



5



4

contacts in 23 DXCC entities." Meanwhile, on 28MHz, "Good Sporadic E openings on many days with regular openings to South America. I believe the band has been open (after midnight our time) to the east coast of North America and on April 28th VK8 and YB stations were worked from the UK. 66 contacts in 20 DXCC entities."

Martin Evans GW4TPG says "Not too much to report this time around due mainly to poor propagation, lots of folks parked on FT8 causing congestion making it difficult/impossible to select a split frequency to call without QRM, lack of DXpeditions due to lockdown and last but not least nice weather making me 'QSY' to the garden! ... On the plus side Sporadic E has started to kick in this time around with a few openings to EU on 12 and 10m and a few fleeting openings to South America from here, so far no NA or Caribbean openings noted but hopefully I will have more to report next time." Finally, Martin noted that his "40m / 80m / 160m vertical is still in bits,

waiting some TLC when I get around to it, so nothing to report on 40/80/160m for me this time around."

Kevin Hewitt ZB2GI wrote to say that Gibraltar was still in lockdown so he only operated from home this month. He used a Yaesu FT-450 to an Outbacker multiband whip, clamped to a broom handle stuck out of the window, **Fig. 5**, with a counterpoise wire connected to an aluminium window frame. His best DX this month was BH8MDV on 14MHz FT8. See below for what else Kevin has been working with this modest set-up.

Around the Bands

Reg Williams G000F 10MHz FT8:

CO6ABP, JA5AQC, JI4JKQ, KG4NE, PY2AB, VE3NOQ, VK2WJ, VK5DG. **14MHz SSB:** 9Z4Y, J68HZ, ZW5STAYHOME. **21MHz SSB:** LU1JHD, PY4AZ.

Owen G0PHY worked **7MHz SSB:** R9LM. **14MHz SSB:** FG4SO, W1EU.

Kevin M0YRX, on behalf of the 10m UK Net group, reported **Gary G0FWX** on **28MHz SSB:** CE7VPQ, FR4QT, FR4SN, LU1YT, LU3PE, OD5TX, PU2UAF, PY4BZ, RV9WS, ZD7FT, ZP5DA. **Tony M0IQD** **28MHz SSB:** CE6CJB, CE7UPQ, FR4QT, OD5TX, PY4BZ, PY5YA, ZD7FT, ZP5DA. **Iain MM0TFU** **28MHz SSB:** CE6DBI, CE7VPQ, FR4QT, HC5DX, LU1YT, PY4BZ, ZD7FT.

Tony G4HZW, **7MHz FT4:** 8P6PE,

9Y4DG, CN20SH, E7STAYHOME, J68HZ, KC2MBV, KS4OT, N4RWG, VK7AP, W1FNB, ZL3IO. **7MHz FT8:** RP75J. **28MHz FT8:** CE2SV, CX5ABM, LU2DGZ, LU4DJB, LU6UBM, LU9DQ, NP3YL, PP5JR, PU1JSV, PU2YFR, PY3DXM, VP8LP, VU2OT, ZB2IF, ZP6ARO.

Martin GW4TPG offers **10MHz CW:** T77C. **10MHz FT8:** 3W1T, HB0HF. **14MHz CW:** 5H3DX, 9V1YC, A60WARD/4, VU3NXI. **18MHz CW:** JY5HX. TT8SN, TZ4AM. **18MHz FT4:** E20WXA. **18MHz FT8:** 4J7WMF, 4S7AB, CX1CAK, LU7FIN, PY5IP, TT8SN, ZP5DNB. **24MHz FT8:** 9G5GS, CE2SV, CQ82AS (Azores), PU2OOC.

Kevin ZB2GI: **14MHz SSB:** AM9WARD, CT3CK. **14MHz FT8:** BH8MDV, OE25IGP. **18MHz FT8:** DA2025C, K5JC, LY300GAON, W1GF. **21MHz FT8:** ZW5STAYHOME. **24MHz FT8:** CU2DX, PY5WW. **28MHz FT8:** 2E0CVN/NHS, AM1WARD, AM2WARD, AM3WARD, AM7WARD, AN100L, A0895W, CR2STAYHOME, EH7STAYHOME, FG8OJ, LU1EK, PU2UAF, PP5JR, PP6EW, VP8LP, ZP4KFX.

Signing Off

Thank you to all contributors. Please send all input for this column to teleniuslowe@gmail.com by the 11th of each month – photographs of your station or activity would be particularly welcome. For the September issue the deadline is July 11th. 73, Steve PJ4DX.

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In early May, satellite operators had something of a surprise, with the activation of a new satellite, DOSAAF-85, more commonly known as RS-44. **Dmitry Pashkov R4UAB** reported, "DOSAAF-85 is a small scientific satellite created by specialists of the company Information Satellite Systems (ISS) Reshetnev and students of the Siberian State Aerospace University (SibSAU) Krasnoyarsk.

"The satellite is named after the 85th anniversary of the Voluntary Society for the Assistance to the Army, Aviation and Navy, the organization responsible for the military training of Soviet youth.

"The DOSAAF-85 satellite is designed to provide amateur radio communications, as well as to develop promising technologies. This is the third satellite that was created by specialists of ISS-Reshetnev and is based on the Yubileyniy platform, which features a hexagonal prism structure with body mounted solar cells.

"The satellite was launched into orbit on December 26th 2019 from the Plesetsk Cosmodrome and is in an elliptical orbit with a perigee of 1175km, an apogee of 1511km and an inclination of 82.5°".

The transmitter power is 5W with a beacon on 435.605MHz transmitting the call-sign RS-44. RS-44 is an inverting transverter with an uplink between 145.935MHz to 145.995MHz and a downlink between 435.610MHz and 435.670MHz. Being an inverting transverter, you'll need to transmit LSB on the uplink to come out on USB (which is what you want to do) on the downlink of the satellite.

The satellite is in a good high orbit and affords some DX possibilities to satellite enthusiasts. This will take the pressure off the old AO-7 and FO-29 satellites which, it's fair to say, have seen better days! The only downside to RS-44 is that it is still attached to the booster rocket that took it to space and as it rotates, there is quite a lot of fading. However, if you persevere, some good contacts are possible.

Another new satellite is Huskysat-1, which is the first cubesat built by the University of Washington's Husky Satellite laboratory. It uses AMSAT's linear transponder module with a 145MHz uplink and a 435MHz downlink. It is another inverting transponder with a 1200 baud BPSK telemetry beacon on 435.800MHz. The downlink passband is between 435.810 to 435.840MHz and the uplink passband between 145.910MHz and 145.940MHz. There

New Satellites

Tim Kirby G4VXE reports on some new amateur satellites, urges uploads to LoTW and has all the latest operating news.



is also an experimental BPSK beacon in the 24GHz band, which should be interesting to hear more about in due course.

For some more information on contacts made with the new satellites, please see the satellite section.

Make sure you can hear the Downlink!

There's been a bit of an outbreak recently of stations calling on the FM satellites, particularly AO-91 and AO-92, when it's clear that they can't hear the downlink. Stations using vertical antennas, usually, do not hear anything when the satellite is directly overhead, think it is clear and transmit on the uplink. Unfortunately, this causes considerable disruption to contacts that are already taking place, unheard to the transmitting station.

So please, before you transmit, make sure that you can hear the downlink of the satellite reliably. On the FM satellites, you can pretty much assume that the satellite will be busy any time it is overhead. It's that busy, so if your antenna is working, you should be able to hear something. If you are tempted to use a vertical antenna, then please make sure that you understand that you will probably only hear the satellite when it is close to

the horizon – but the satellite may well hear you throughout the pass, so restrict your transmissions to when you are hearing the downlink!

Calling blind also causes frustration to the stations who may hear you and respond, only to have no response. Satellite operators are well aware that everyone misses the odd call owing to interference but if you become known as someone who has poor receive capabilities, you may well start to find that other operators 'work around' you and you will miss out on contacts.

All this having been said, someone who is making excellent use of the AO-92 satellite from his mobile station, using a vertical, is **Ian Harling G7HFS**, who I worked last night from a supermarket car park in Eastbourne!

Remember to upload to LoTW

Someone said to me the other day that they felt UK stations were particularly poor at confirming VHF/UHF/Satellite contacts through the ARRL's Logbook of the World system (LoTW). Is that true? I'm not sure, but it's a good opportunity to think about how often you upload your log to LoTW, or if you don't upload then maybe consider doing so. It's fun to see the electronic confir-



Fig. 1: Remote operating from the balcony using a tablet in a shoebox at ON8NT. **Fig. 2:** Rhodri MORHO uses this Racal VRM-5080 on 70MHz and hopes to try it soon on 50MHz. **Fig. 3:** The impressive antenna system of Derek Brown G8ECI. **Fig. 4:** Graham G3VKV's second system for QO-100



mations come through quickly and see your totals increase. Very often confirmations appear within minutes of the contact being made (quite a difference to waiting years for a paper QSL!)

The ARRL's VHF/UHF Century Club (VUCC) awards are quite expensive to apply for, but the website allows you to keep tabs of your totals for free, which is good fun. So, keep uploading your contacts. I've talked about LoTW, but the same is true for eQSL if you are a user of that system.

The 6m Band

Jef Van Raepenbusch ON8NT (Aalter) says that the article in the May *PW*, *Worldwide remote shack digital modes* by **Daimon G4USI** inspired him to try connecting to the shack computer from his Android tablet, **Fig. 1**, and says it worked first time. Jef's remote shack on the balcony consists of his Android tablet in a shoebox to keep the sun off the display and any 'surprises' from passing birds! Jef caught the Es opening on April 11th and made several contacts into southern Spain on FT8.

Phil Oakley G0BVD (Great Torrington) worked 34 stations on the band between April 12th and May 1st, all on FT8. Phil worked ZB2GI and ZB2IF as well as contacts with GW, EA, F, CT, YL, LY, EI and DL. Phil also saw a brief transatlantic opening to Brazil but wasn't able to complete a contact.

Andy Adams GW0KZG (Letterston), my radio neighbour, writes, "Since returning to 6m on April 25th, I have worked 80 new squares, 25 countries, and 120 stations, including EA8, EA9, CT3, CU2, CU3, 7X, LX, all on FT8. 6m has been open most days somewhere, which is a change from 2m! I started initially with a new 5/8 wave Sirio Tornado 5060 vertical for 6m approximately 7m above ground level. I was very impressed with this antenna, not only in the build quality, but its performance. The enclosed instructions were good, and it was easy to set up for minimum SWR. The only issue I have is that the antenna is designed to be pole mounted on a max pole diameter of 42mm. Unfortunately, here in the UK, the standard pole size (Galvanised or Aluminium) is 48.2mm, so the antenna wouldn't fit on any of my poles! I had to make up a temporary adaptor to suit and will drop the antenna and make a proper adaptor when the wind drops".

Andy and I are about 10 miles apart and it has been fascinating to note how much variation there is with the stations that we hear on Es. Even more so, comparing results between my V-2000 vertical, Andy's vertical and his three-element beam. Andy continues, "After using both for a week, and also comparing with what you are hearing on your 5/8 V2000, I can advise that signals with the three element + LNA, compared with the 5/8 vertical with the IC-9100 preamp generally appear on the S meter at the same value but, on my WSJT-X screen, wanted signals on the three-element are generally +3dB higher than the 5/8 or what you report. My LNA is boosting the signal, but also the noise! There are, of course, some strange anomalies in that you have been able to hear some signals on your 5/8 that I can't hear on either of my an-

tenna, and a big plus for the verticals is that they can listen for signals from 360°, where the three-element has a substantially smaller window of around 40°. At times when Es is present from Europe and the Americas, using the three-element means I sometimes miss the DX stations in a different direction. In marginal Es conditions, you can work DX stations that pop up for a very short space of time, while I am still trying to identify them, and turn the beam to the correct heading, and miss them. A point to consider for those contemplating changing from a vertical to a beam antenna!"

I am certainly very satisfied using a vertical for one and two hop Es – and it's an excellent monitoring antenna. It's also fair to say that Andy sometimes hears signals on his beam that I hear nothing of (J69DS is a case in point, the other evening). Despite being pleased with the performance of my vertical, I do plan to put up a beam to try to make the best of the transatlantic openings. It will be fun to see the differences. I have a feeling I'm going to need a remotely controlled antenna switch that I can activate from my computer!

Highlights of the **GW4VXE** (Goodwick) log, all on FT8 include ZB2GI (IM76), EI0CZ (IO52), GI4SNA (IO64), CU3EQ (HM68), EA8AQV (IL18), CU3AK (HM68), CU2CE (HM77), ZB2IF (IM76), TK5MH (JN41), CT3HF (IM12), ZB2R (IM76), CU2GI (HM77), EA9QD (IM75), CU2AP (HM77), CN8LI (IM63) and on May 14th FG80J (FK96). I had a near miss with PZ5RA on April 30th, but unfortunately the contact was not completed. During the opening on May 14th I was surprised to hear HK3PJ over a distance of in excess of 8000km. The setup is 100W to a V-2000 vertical.

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The 4m Band

It was good to hear from **Rhodri Morgan MORHO** (Ashurst) who wrote, "I've a passion for military radios and have recently fixed my Racal VRM-5080, **Fig. 2**. This would have originally been installed in a tank but now sits on my kitchen table. My XYL really appreciates this! Anyway, last weekend I powered it up and ventured out into the unknown territory of 70MHz. I very quickly made it into a local net and made contacts with several stations: G0GSF, G1JRU, G7RSO and G3KYD". Rhodri is also planning to use the radio on 50MHz – I look forward to hearing how it goes.

Simon Evans G6AHX (Twynning) caught his first Es contact of the season on May 12th when he worked CT1EEB (IN50) on SSB around 1400UTC. Simon was running his IC-7300 and five-element LFA Yagi.

The 2m Band

Jef ON8NT runs 25W to a five-element log periodic and lists stations over a distance of 400km and special event stations. On April 14th Jef worked G3NJV (IO70), EI20C (IO51), G16ATZ (IO74) and G7RAU (IN79). On April 16th, Jef worked G4LOH (IO70) and then on April 18th, G0JCC (IO82) and PA5X/MM in the English Channel. Johannes, PA5X will be known to many as the very active operator of 5T5PA from Mauritania. Next day on April 19th, Jef worked G1BHM (IO70). All contacts on FT8.

Derek Brown G8ECI (Louth) has been making some improvements to his 2m station and can now run 400W from a Sagra 600 (2x4CX250B) valve amplifier into a 12-element M2 Yagi with a PGA103+ masthead preamplifier, **Fig. 3**. Derek also has a dual-band G0KSC-designed but homebuilt 28/50MHz beam which he says works very well indeed.

Highlights of the 2m log at GW4VXE include EI4KP (IO52), EI9KF (IO64), GD3YEO (IO74), M0NPT (IO92), G4PDS (IO80), M0JDK (IO92), G0JEI (IO93) and 2E0MHG (IO81). I realise I have spent more time on 6m than 2m this month! All contacts on FT8 using either a V-2000 vertical or eight-element LFA Yagi.

Simon G6AHX reports that the Cheltenham Amateur Radio Association held a net, which was very well 'attended', to celebrate the 75th anniversary of VE day.

The 70cm Band

Jef ON8NT sends an impressive list of 70cm FT8 contacts – a reminder to me and perhaps others that there is plenty of interest in this band and mode. Stations worked include G4CLA (IO92), G4GFI (IO91),

M0NPT (IO92) and G4LPP (JO02).

Readers who were with us last month will remember that **Colin Fawcett G8YIG** (Manchester) had refurbished a venerable Jaybeam 18-element antenna for the band. During the May 432MHz activity contest, he put it to good use making some nice contacts around the North West and North Wales.

The 23cm Band

Phil G0BVD is looking forward to getting active on the band from North Devon and plans to run a Wimo 19-element driven by the Icom IC-9700 and will be taking delivery of the antenna and some Ecoflex 10 feeder shortly.

Satellites

Jef ON8NT has been active on the CAS-4A and CAS4-B satellites and his log includes EA1BNF (IN52), EA1GAR (IN52), IW3HRT (JN55), ON5PU (JO21) and IU1LBM (JN43). Through XW-2A, Jef worked EA1BNF (IN52) and EA4T (IN70).

It was good to work regular correspondent to the column, **Martin Mills M0MLZ** (Plymouth) via AO-91 recently. Martin is using a 2m/70cm dual-band beam at around 5m above ground using a Yaesu G5500 azimuth/elevation rotator. Martin's first contact was 2M0SQL (IO87) via AO-92, followed an hour later by VE1VOX (FN85), and he says that after that, he was hooked! Martin says that he is looking forward to trying out the linear satellites, but also getting the antennas higher once the lockdown is eased and he can get some help in!

Patrick Stoddard WD9EWK (Phoenix) writes to say that owing to the restrictions in place in Arizona as a result of the COVID-19 virus, he has not travelled to work satellites in over two months. He is looking forward to the situation changing and allowing visits to out of the way locations to put on some rare grids for satellite operators. At the moment, though, Patrick is still operating from home, with weekday operating being possible during breaks or lunch while working from home. Patrick also mentions the new RS-44 satellite and says that many contacts have been reported over distances of 7500km and more and some even approaching 8000km. Patrick says that to get the most out of the satellite he will need to operate away from home to avoid some local 70cm interference and is hoping to work some stations in the north of South America. Patrick also mentions the new Huskysat-1 satellite and says that it is now also known as HO-107, which is in a lower orbit than RS-

44. HO-107 has a telemetry beacon that can be decoded using AMSAT's free FoxTelem software and upload the telemetry to a data warehouse. Patrick says initial reports suggest that the satellite does not require a lot of power to work through it.

Highlights of the GW4VXE satellite log, all on the FM satellites AO-91 and AO-92, include AA8CH (EN62), K1ECU (FN41), KB1HY (FN31), R2ABH (K085), UR3PGW (K021), VE1VOX (FN85), RV9CHB (M006), OX3AH (GP44 and GP47), N2FYA (FN41), K1PAD (FN42), ES6SW (K037), OY1R (IP61), RP75GRO (LO16), 9H1GW (JM75), R4FCY (LO33), US5MAJ (KN98) and G7HFS/M (JO00). Depending on the pass, I either use 5W from a TH-D72 to an Elk periodic or 10W to an antenna with no elevation for passes closer to the horizon.

Graham Jones G3VKV (Cheltenham) writes, "I've just completed a second system for QO-100 comprising a 70cm prime focus dish, **Fig. 4**, with the usual modified Octagon LNB plus POTY dual-band feed and 5W from my main station transmitter (to be replaced by a nearly completed Pluto TX/RX very soon). First call, running on batteries in the garden, produced a reply from **RU0A0A Peter** located in Krasnoyarsk, Siberia, Russia. I used the RS44 satellite today and had nine contacts mainly into North America. The satellite seems very active at the moment with good possibilities for long distance QSOs".

Simon G6AHX writes, "I have been very impressed with the SDR Console program for receiving the narrow band transponder on Es'hail2. The ability to lock it to the middle beacon means all signals are stable and you get correct frequencies displayed. Shortly I shall be helping **Adrian G0VLG** when he tests his uplink".

DigitalTV

Graham G3VKV writes, "I have mended the Minitourner DATV receiver after last month's accident. I have been receiving TV from **Dave G4FRE** 30km away in Malvern on various bands. So far, 2m (146.5MHz), 70cm, 13cm, 9cm, 6cm and 3cm. 1.2cm was tried but although I could see Dave's signal on an SDR it was not strong enough for video. We have yet to try 23cm and I am sure we will have another go on 24GHz".

That's it for this month. Thanks to everyone who has been in touch and if you've been thinking of sending something in for the column and haven't got around to it yet – please do! There's always room. E-mail me at the address at the top of the column or find me on Twitter at @gw4vxe See you next month!

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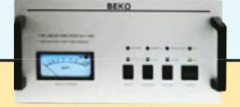
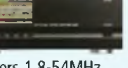
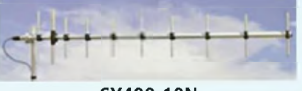
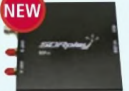
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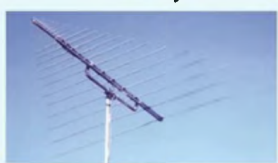
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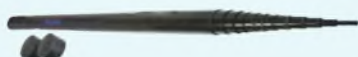


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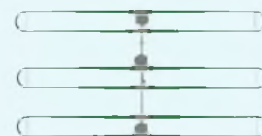
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Steve Telenius-Lowe PJ4DX
teleniuslowe@gmail.com

If you have a beam, you probably have a rotator and if you have a rotator, sooner or later it will need repair. If you're like me, and work to the principle of "if it ain't broke, don't fix it", you will leave it to the last possible minute to carry out any maintenance. This article describes a Yaesu G-800 rotator, **Fig. 1**, that had seized up and stopped working altogether and how it was brought back to life. Although specifically about the Yaesu G-800, the G-1000 is almost identical and other manufacturers' rotators are not so very different.

The Problem

I had used the rotator from new in 2006, first for seven years as 9M6DXX in Borneo and then for a further five years here in Bonaire. When I moved from Malaysia to Bonaire in 2013 the rotator was working fine, so I didn't bother to carry out any preventative maintenance. The G-800 had therefore been in use for 12 years in two very different tropical climates (the former very wet and humid, the latter dry and dusty, but both with year-round daytime shade temperatures around 30°C), with no maintenance whatsoever during that time. That it worked with no problems at all for 12 years in such conditions and with no maintenance is a testament to the build quality of the Yaesu G-800.

Here in Bonaire the rotator is mounted at ground level and turns a 14.5m Spiderbeam aluminium push-up mast, with a 5-band heavy-duty Spiderbeam Yagi antenna on top. The whole mast is turned, via guy slip rings. After around five years of almost daily use in Bonaire the rotator began to stick occasionally. At first this was not a major issue: by 'rocking' the rotator, first a little clockwise then a little anti-clockwise, the rotator would free itself. Then the occasions when it would stick became more frequent and eventually it became necessary to go outside to provide a little extra 'Armstrong' assistance to get the beam to the desired direction. Finally, it seized up altogether and I couldn't move the beam at all.

It was only at this stage that I reluctantly came to the conclusion that I really did need to take the rotator apart.

The Solution

I had never attempted this before because in the UK I had only ever used wire antennas and verticals, so I approached

Rotator Renovation

Steve Telenius-Lowe PJ4DX tackles the messy job of refurbishing an antenna rotator.



1



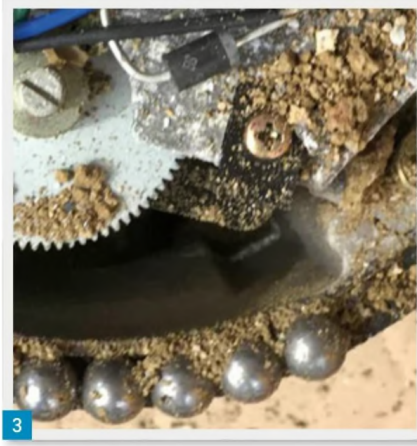
2

the job with some trepidation. Then **Bert van Oort PJ4KY** admitted that he had once repaired a rotator in the Netherlands, which made him an expert as far as I was concerned.

With the help of **Peter de Graaf PJ4NX**, the rotator was removed from the bottom of the mast. This proved to be easy. The bolts in the clamp on the top of the rotator had not corroded and it was simple to remove one side of the clamp altogether. Peter then lifted the whole mast a centimetre or two as I slid the rotator sideways away from it while Bert wedged a block of wood underneath to support the mast while the rotator was undergoing repair. We did not even have to lower the mast to remove the rotator.

The bolts holding the two parts of the rotator together also hadn't corroded and were easily removed. Beware when removing the top, though. If you're not careful, the numerous ball bearings can fly off in all directions, like shot from a blunderbuss. Fortunately, we had considered this possibility and opened up the rotator with it sitting in a cardboard tray (actually the bottom of a case of 24 x 33cl cans of Heineken, **Fig. 2**). All ball bearings were accounted for.

Inside the rotator was a lot of dirt and what looked like soil. With so much dirt in the gears and the ball bearing races, **Fig. 3**, it was immediately apparent why the



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rotator had seized up! Despite Bonaire's dry, dusty climate I have no idea how much dirt could have ended up inside a rotator that had been tightly screwed shut. Some serious cleaning was required.

Cleaning

This is one of the filthiest jobs in amateur radio so do it outside, not in the shack! You will get mucky, so before you start the job make sure you have some Swarfega or something similar. Living on Bonaire, sourcing some things is difficult or impossible, and Swarfega turned out to be one of those things. I found an antiseptic liquid soap made by Nivea to be a workable second best for cleaning yourself afterwards.

Fig. 1: The Yaesu G-800 rotator and control box.

Fig. 2: Remove the top of the rotator in a shallow cardboard tray to avoid losing ball bearings (photo: Bert PJ4KY).

Fig. 3: With so much dirt in the gears and ball bearing races it was clear why the rotator had seized up (photo: Bert PJ4KY).

Fig. 4: Paint thinner was used to remove the old grease and clean out the rotator. Almost all of this 3.8-litre bottle was used.

Fig. 5: Inside the rotator housing (photo: Bert PJ4KY).

Fig. 6: The cog wheels in the gear train had no grease left on them and one was corroded (photo: Bert PJ4KY).

Fig. 7: Lithium grease from an aerosol was used to lubricate the gears.

Fig. 8: Anti-seize compound used for lubricating the ball bearing races and the ball bearings themselves.

For cleaning the rotator, though, Bert recommended using paint thinner to remove all the old grease, which had largely solidified and to which the dust and dirt was adhering. I bought a 3.8-litre bottle, **Fig. 4**, and used most of it. I cut the top off a used plastic mineral water bottle, put in all the ball bearings, and covered them with the paint thinner. After a while the paint thinner had become totally opaque, so I poured it away through a coffee filter (so as not to lose any ball bearings) and then left them soaking in more paint thinner overnight. Other than being covered in solidified grease and dirt, the ball bearings were in good condition and didn't need replacing.

Paint thinner was also used to remove the dirt inside the rotator housing, **Fig. 5**. First, I poured in paint thinner and left it overnight. The following day kitchen paper removed most of the dirt and I found that a small paint brush soaked in paint thinner was the easiest way to remove what remained (mainly from the gear teeth).

Finally, the cog wheels in the gear train were also left soaking overnight, while ensuring that the paint thinner did not come into contact with the motor itself. One of the cog wheels had become corroded while the others were very dry with no sign of any residual grease, **Fig. 6**, so, even after cleaning, they remained very stiff.

Lubrication

Before starting the lubrication, ensure that all the paint thinner has evaporated and the inside of the rotator is dry. I bought an aerosol can of lithium grease, **Fig. 7**, from an automotive repair shop and this was



sprayed into the gear train and worked in by turning the cogs by hand. A lot of grease was required, but eventually the cogs started to turn more freely.

For the two ball bearing races and also the ball bearings themselves I used an anti-seize grease [1] that I had bought several years ago for use on aluminium-to-aluminium antenna joints. A tiny amount goes a very long way and a 500g tin, **Fig. 8**, will last most people a lifetime. This stuff is difficult to remove from clothes and also from skin but there is really no alternative to getting mucky and the easiest way to apply it is probably with your index finger. Just be sure you have plenty of paper towels and Swarfega to hand.

Reassembly

Check that all the wires are still properly connected. In my case the black (earth) wire had become disconnected and needed to be soldered back into place. The other wires were all sound.

The trickiest part of reassembling the rotator is holding the lower of the two ball

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bearing races in position while putting the housing back on to the working part of the rotator. You are bound to drop a few ball bearings so once again carry out this part of the operation in a shallow cardboard tray and don't attempt to do it by yourself – a second pair of hands is essential!

The hardware is stainless steel and although the nuts and bolts on the top of the rotator had not corroded it makes sense to grease them well when reassembling the rotator so that they should still be in good condition the next time you need to do this job.

However, in my case the bolts on the bottom of the rotator that fix it to the rotator plate were very badly corroded, **Fig. 9**. A major disadvantage of mounting the rotator on the ground is that acidic soil plays havoc with metal. Neither WD40 nor 3-in-1 penetrating oil helped with two of the four bolts, which simply sheared off but, surprisingly, two were salvageable.

Apologies for stating the obvious but do check that the rotator is working properly before re-installing it on the mast or tower! Also ensure that it is set to North (or South, whichever is your centre of rotation) so that when you re-install it you know where to orientate the antenna. With the Yaesu G-800 and G-1000, the pointer needle in the control box can be removed and repositioned, **Fig. 10**, so that adjustments can be made after the rotator has been re-installed, should you happen to get the antenna orientation a few degrees out.



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Fig. 9: The bolts on the bottom of the rotator that fix it to the rotator plate were very badly corroded (photo: Bert PJ4KY).

Fig. 10: Re-setting the pointer needle in the control box after re-assembly.

The rotator is now re-installed under the mast, **Fig. 11**, and is working as good as new again. What I had feared would be a difficult job with no guarantee of success, and so put off doing for as long as possible, actually turned out to be quite easy if occasionally rather fiddly and dirty. Thanks to Bert PJ4KY and Peter PJ4NX for their help in restoring my rotator to full working order (and also their help in emptying the Heineken cans so that the tray could be used!).

Reference

[1] 'Aluminium Graphite Anti-Seize Compound 2550' from Specialised Products Ltd:
<https://specialisedproducts.co.uk>



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Moonraker UK have been appointed UK dealer for the RFinder B1. This is a dual-band (VHF/UHF) DMR transceiver combined with an embedded powerful smartphone. Power output is 4W. Deliveries are expected in June and the price is expected to be £999.98.

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CAS-7C is a 2U CubeSat carrying a V/u linear transponder and a CW beacon. IARU has not yet coordinated frequencies for CAS-7C, which is to deploy a 1,080m (3,543ft) long, 1mm carbon fibre rope.

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PRODUCT



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Get on the air to care - an RSGB and NHS Campaign

Heather Parsons
RSGB Communications Manager
comms@rsgb.org.uk

Timed to coincide with World Amateur Radio Day on April 18th, the Radio Society of Great Britain (RSGB) launched an unprecedented campaign with the NHS called 'Get on the air to care' to promote wellbeing and ease the effects of social isolation amongst the UK's 75,000 radio amateurs.

Steve Thomas M1ACB, General Manager of the RSGB, explains: "We have 500 affiliated amateur radio clubs and groups across the UK. We know that many of them have set up special club nights on the air so that their members can keep in touch whilst enjoying their shared interest. In many cases clubs are seeing increased participation by members through these nets and other non-physical meetings. We wanted this campaign to inspire even more to get involved".

'Get on the air to care' (GOTA2C) covers a wide range of activities and initiatives and has seen a huge amount of support from radio amateurs and clubs.

Remote Invigilation

The Society introduced remote-invigilation exams in the middle of April to allow people to take their Foundation exam and get involved in amateur radio despite the current restrictions. Hundreds of people have applied and it has created a buzz of excitement among those who are keen to take their first steps into this diverse pastime. The RSGB looks forward to hearing the new amateurs on the bands and helping to support them in the coming months. **Dave Wilson M00BW**, the RSGB President and Exam Quality Manager, says: "We're planning to extend this to other licence levels in the future but currently our invigilators and HQ staff are working hard to provide access to the Foundation exams under very difficult circumstances".

www.rsgb.org/exam-faq

Beyond Exams

Passing the Foundation exam is just one step to discovering the great diversity of amateur radio. For those new to the



Get on the air to care
#GOTA2C



The National Health Service and the Radio Society of Great Britain
Working in partnership to improve the health and wellbeing of our communities

1

www.rsgb.org/gota2c

hobby but also for those who want to try something different during 'lockdown', the Society has launched Beyond Exams (BE). This is a group of resources brought together by the RSGB Learning Team as part of the RSGB's strategy to encourage participation in amateur radio and highlight the diversity of what it offers. Beyond Exams includes online guides to help you get started, copies of *RadCom Basics*, which explain different topics in an accessible way, as well as the BE Club and Individual Schemes, which can help you to extend your skills or develop new ones. Some of the activities aren't available at the moment due to social distancing but there are many that you can try:

www.rsgb.org/beyond-exams

These challenging times are an opportunity to discover different aspects of amateur radio and photos of some great 'lockdown projects' are being shared.

Board Director **Stewart Bryant G3YSX** leads the RSGB Operating Team: "We're encouraging people to use this time to try new things. For example, if you're a DXer, try talking to people on your local repeater. Whether you enjoy contesting or just chatting to other radio amateurs, there are ways for everyone to get on the air".

The RSGB Contest Committees launched two new initiatives which have gained interest from around the world as well as in the UK:

Hope QSO Party

This international contest started its second six-week series on April 18th and the first series saw 536 entrants from approximately 30 different countries, including USA, Canada, Japan and all over Europe. In the spirit of 'Get on the air to care', for some participants it has been their first attempt at an HF contest while for

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others they have tried CW for the first time. If you want to join in the fun, you'll find all the information online:
www.rsgbcc.org/hf

VE/VJ Day Radio Marathon

To commemorate the 75th anniversary of VE Day and VJ Day, this radio marathon runs on the HF bands and 6m using SSB, CW and digital modes. Three special UK callsigns GB75PEACE, GB1945PE, GB1945PJ are on the air from May 1st-31st and August 1st-31st 2020 and there are five awards to be gained. The special stations have their own QRZ.com pages that give details of the activation schedule. If you'd like to transmit using a VE/VJ Day radio marathon callsign, you'll find all the details on the RSGB website:
www.rsgb.org/ve-vj-marathon

Nets

The Society has seen a significant increase in the use of local nets as clubs keep in touch and also look out for radio amateurs who might be in need of help. **Paul Devlin**, NHS England Emergency Care Improvement Support Team and also RSGB District Representative, says: "Now, more than ever, we need to optimise all modes of communication to help reduce loneliness and isolation within communities. Amateur radio provides a wonderful, unprecedented opportunity to help make this a reality".

The RSGB's National Radio Centre (NRC) is just one example of that. After a fantastic year in which it welcomed over 97,000 visitors, the Centre had to close when the social distancing regulations

came into force. Since then, the RSGB NRC Coordinator and the 45 NRC volunteers have run a net to keep in touch and to welcome radio amateurs who would have been visiting over these months. The net has also enabled people to share knowledge and experience, as **John G4FZA** explains: "After joining the NRC as a volunteer I realised how much had changed with the hobby. With the encouragement of others on the NRC net I have managed to improve my wire antenna for 80m and it has rekindled my interest in the hobby. When things get back to normal, I will be a more capable NRC volunteer."

Martyn Baker G0GMB, the NRC Coordinator also put GB1NHS on the air for a special GOTA2C day (with appropriate social distancing in place!) and was busy with operators wanting to work that special NHS callsign.

The link with the NHS was strengthened when Ofcom, the UK radio spectrum regulator, said it was happy for radio amateurs to use /NHS after their callsign during the length of the GOTA2C campaign, to show appreciation for the fantastic work being done by the NHS and all key workers.

As well as receiving fantastic support from radio amateurs and clubs in the UK and across the world, 'Get on the air to care' has received significant media coverage, including a major BBC online news feature, interviews on Midlands TV and six local BBC radio stations as well as a British Forces Broadcasting Services interview and pieces in local newspapers. Take a look at the Society's media page:
www.rsgb.org/gota2c-media

The public is being shown that amateur

Photo 1: GOTA2C campaign logo.

Photo 2: RSGB's NRC radio station GB3RS.

Photo 3: Mark M5BOP and daughter supporting GOTA2C. Photo 4: Ed M3EMO in garage mock-up shack on 20m during Hope QSO Party.

radio is alive and well and the campaign is not only reaching new people but also drawing others back. RSGB Board Chair **Ian Shepherd G4EVK** says: "One of the core values of the Radio Society of Great Britain is to foster and develop a diverse community of like-minded people with interests in wireless communications and technology. It is pleasing that so many people who, perhaps, had a casual interest in wireless communications are applying for the examination to gain a transmitting licence. Similarly, those who had been active in the hobby in the past and whose interest has been rekindled by our recent initiatives, are now coming forward and supporting our community by joining the RSGB".

Get Involved

The Society's online regional news pages list local nets each week, so take a look and join in. The RSGB is sharing news from clubs and individual radio amateurs on its website (below) so send your updates and photos to comms@rsgb.org.uk or use the hashtag #GOTA2C if you use social media.
www.rsgb.org/gota2c-stories

'Get on the air to care' will continue to support radio amateurs during these challenging times so get involved, try something new, chat to radio amateurs over the airwaves and then share your stories and photos to inspire others.

Enter our competitions at www.radioenthusiast.co.uk/competitions



Base 240v Mains

BLA1000 1.8-55MHz All mode solid state base amplifier, can deliver up to 1000 watts on all main amateur bands between 1.8 - 50MHz, has instant start-up, no setup necessary, and has some very useful features too, including SWR protection and twin antenna outputs **£2799.95**
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Sharman have been totally focused on sourcing and distributing radio communications and hobby products for dealers, distributors, and retailers throughout the UK, Ireland and Europe for many years. They produce a lovely range of power supplies to complement their range.

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Mike Richards G4WNC

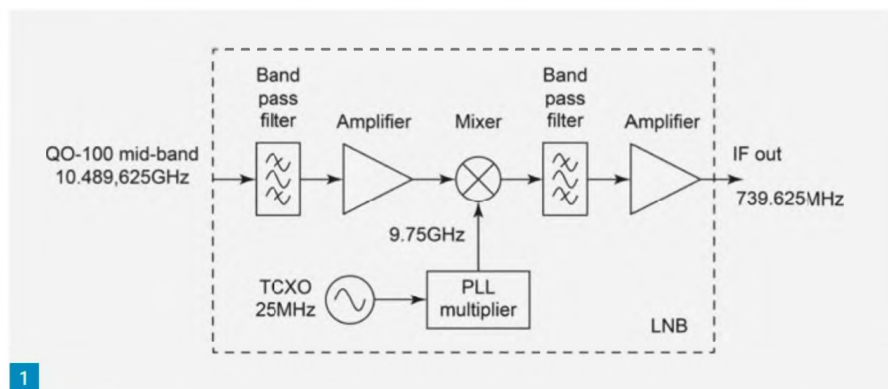
practicalwireless@warnersgroup.co.uk

As mentioned last month, I recently took delivery of one of the newly released Othernet Bullseye TCXO LNBs (Low Noise Block). This been designed with QO-100 (Es'Hail) satellite operation in mind. In addition to providing low noise, the marketing information for the device is focused on the improved stability due to the use of a TCXO (Temperature Compensated crystal oscillator) for the local oscillator. This is unusual in consumer grade LNBs because most use either a PLL (Phase Locked Loop) crystal oscillator or a dielectric resonator. Before I explain further, let's briefly revisit the QO-100 transponder operating conditions. The uplink or ground station transmit path, is in the 2.4GHz band, while the downlink, ground station receive path, is in the 10GHz band. For most stations, the downlink is handled using a 10GHz satellite TV LNB mounted on the dish that runs with a 9.75GHz local oscillator to produce an IF frequency of around 739.6MHz. Back in the shack, this can be handled in many ways because you don't need a high-performance receiver. This is because the LNB's 10GHz front-end defines the noise performance of the system and has a high (often verging on too much) gain. A receive only setup would most commonly use an RTL-SDR dongle, SDRplay or Aispy receiver. Those with transmit capabilities often use the Lime SDR or, better still, the Analog Devices Pluto transceiver.

One of the main problems with the receive chain is local oscillator frequency stability in the LNB. Most LNBs use a local oscillator device running at 25MHz or 27MHz. This is frequency multiplied or uses a PLL to produce a switchable 9.75GHz or 10.6GHz local oscillator for the LNB's first mixer, **Fig. 1**. As the reference oscillator is multiplied to get to the final frequency, any frequency drift is also multiplied by the same factor. When evaluating the stability of oscillators, measurements are usually quoted in ppm (Parts Per Million). For example, a 1MHz oscillator with a stability of 1ppm could be expected to remain within 1Hz of its nominal frequency over its specified operating temperature range. If we now transpose our local oscillator up to 10GHz or 10,000MHz, a typical TCXO tolerance of 1ppm gives us an allowable drift of up to 10kHz! That's a lot of drift that will be a problem for all amateur radio operating modes. As you might expect, operators have found ways to mitigate

A New LNB

Mike Richards G4WNC adopts a new LNB in his QO-100 system and also reports on logging software for the Pi4.



this and one of the most common is to modify the LNB to remove the internal local oscillator and replace it with an external feed from a GPSDO (GPS disciplined oscillator) such as the popular Leo Bodemar units. While this is probably the best overall solution, it does require some expertise in surface mount component removal and soldering. An alternate solution is provided by **Simon Brown G4ELI** in his SDR Console software. Simon has developed an impressive frequency tracking system that uses the QO-100 beacon transmission as a reference. Once the software knows the precise frequency of the beacon transmission, it locks the receiver tuning to that reference and automatically adjusts the main tuning to compensate for any frequency drift. Rather conveniently, the SDR Console beacon tracking system also keeps track of the corrections and this data can be used to plot the frequency drift of the system.

Using the Othernet Bullseye LNB for QO-100

I've shown a photo of the Bullseye LNB as delivered in **Fig. 2**. Here you can see that it's similar to most satellite TV LNBs with an integrated horn antenna to illuminate the dish. You may also notice that, although this is a single LNB, there are two, colour-coded, F-type sockets. The green socket carries the expected IF output, while the red socket has a sample of the 25MHz TCXO output. This enables measuring the TCXO stability and you could potentially build a custom compensation system based around this. This local oscillator output

socket could also be repurposed to carry an external GPSDO based reference. Like many QO-100 operators, I use the popular dual-band patch antenna designed by **Mike G0MJW**, **Remco PA3FYM** and **Paul M0EYT**. This antenna requires the LNB to be mounted on a 22mm copper pipe that acts as a waveguide for the 10GHz receive signal. That means that the Bullseye's integrated horn antenna has to go. The first task is to remove the plastic outer casing, starting with the front cap over the horn antenna. I found this quite hard to remove and had to cut through the edge in several places to release it. Hindsight is a wonderful thing and it might have been better to warm the cover before removal. With the covers off, the next step was to remove the horn antenna. As the Bullseye's 10GHz connecting waveguide is quite short, you need to take care to cut as close as possible to the horn, **Fig. 3**. When I tried to mount the Bullseye LNB on my antenna, I discovered that the wall thickness of the LNB was thicker than most, so it wouldn't fit into the 22mm plumbing coupling that I use to secure the LNB. My crude solution was to ream-out the coupling nut to fit the Bullseye and also cut the compression olive, **Fig. 4**. That did the trick, the system worked first time and the receive performance appeared to be similar to the Octagon LNBs that I had been using.

Measuring Bullseye Stability

When attempting to measure the drift of the LNB I had to make sure the other components in the receive chain were at least an order of magnitude better than the

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LNB. For my test setup, I used an Airspy R2 receiver that was locked to a 10MHz reference provided by a Leo Bodnar GPSDO. The receiver software was SDR-Console, which also provided the drift tracking. Initial results showed that the Bullseye was 10kHz off frequency, which corresponds to an error of 1ppm. There was also more drift than I was expecting. However, this was under worst case scenario as the LNB was operating naked (with no plastic covers) and out in the sun and wind. As a result, the LNB case was experiencing a lot of temperature variations. I've shown a plot of the results in **Fig. 5**. This clearly indicates that there were plenty of short duration frequency changes that could be quite difficult to correct. The next step was to insulate the LNB in an attempt to dampen the temperature variations and so provide a slower drift that's easier to track and correct in software. Just adding some bubble wrap around the LNB made a big difference and smoothed out the drift, as you can see in **Fig. 6**. When combined with the SDR-Console beacon tracker, the Bullseye damped drift was easily tracked giving a very good performance. The next step will be to find a suitable enclosure for the LNB that I can pack with insulating material to further dampen the drift. The slower drift is not a problem because Simon's beacon tracker easily keeps pace with that.

Modifying the Bullseye

For those that want to dig a bit deeper, there are two mods worth considering. The first is to replace the original TCXO with a higher specification device. My best guess is that the original TCXO is a Yoketant ST2520F device, with stability specified at 2ppm. As you can see from **Fig. 7**, the TCXO is relatively easy to access for desoldering, but it is a tiny 3.3V device measuring just 2.5mm by 2mm.



That creates a problem, as there is very little choice when looking for 3.3V, 25MHz TCXOs with a clipped sinewave output. The best I've found so far is the Connor-Winfield B32 series that offer 500ppb (parts per billion). I have yet to find any significantly better specified TCXOs in that form factor. I've ordered a couple of the B32's from DigiKey and I should be able to report on that next month. I've also gone ahead and removed the supplied TCXO. It was a relatively easy job but it did require a lot of heat. I think that's because the PCB is thermally coupled to the casing. To ensure I didn't disturb any of the tiny surrounding components, they were all held firmly in place with thin strips of Kapton heat resistant tape.

The second improvement option for the Bullseye is to modify it to accept an external GPSDO feed. I've measured the output from the existing 25MHz TCXO and it provides a standard clipped sinewave output at 283mV RMS or about 800mV pk-pk. I also measured the coupling between

Fig. 1: Block diagram of a typical TV satellite LNB.

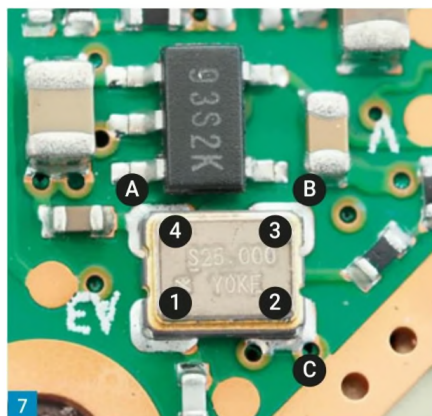
Fig. 2: The new Bullseye TCXO LNB.

Fig. 3: Bullseye with the horn removed - make sure you cut as close as possible to the horn.

Fig. 4: 22mm plumbing coupling used to mount the LNB.

the 25MHz monitor socket and the output pin of the TCXO. I thought it might be possible to drive an external reference in the opposite direction back through the coupling to the output pin of the TCXO. Sadly, the attenuation for the 25MHz tap is approximately 25:1 so you would need to apply a 20V pk-pk signal to see 800mV pk-pk at the output pin. I did look around the PCB to identify the components used for the tap but it looks as though they're on the underside of the PCB! It looks like the simplest solution would be to add a coupling capacitor from the 25MHz tap socket to the output pin of the TCXO, with the TCXO removed. I should be able to give you the conclusion to this next month.

Enter our competitions at www.radioenthusiast.co.uk/competitions



A. 3.3V supply; B. 25MHz output; C. Ground

Raspberry Pi Logging

The Pi-4 is proving to be a very capable unit that can handle all the popular data modes software with ease. It is also able to run HPSPDR-based transceivers so has the potential to be everything you need for a dedicated data modes station. However, looking back at my musings I see that I haven't really covered QSO logging on the Pi so I'll put that right here. The first hurdle to get past is that some of the popular Windows logging programs are simply not available on the Linux platform and you just have to accept that. However, there are some excellent logging programs available on Linux and they're all free! In my opinion, the best Linux logging software is CQRlog by **Petr OK2CQR** and **Martin OK1RR** (It's also available for Windows). It is very easy to install although I have seen some struggle with older versions and MySQL databases. I strongly recommend using the latest available Raspbian release and installing from the author's repository. This will automatically install CQRlog along with the newer Maria database software. Installation is a simple process and I've shown a step-by-step guide here:

Open a terminal session (Ctrl-T)
Enter the following commands:

```
sudo add-apt-repository ppa:ok2cqr/ppa
sudo apt-get update
sudo apt-get install cqrlog
```

Once complete, you will find CQRlog listed in the Accessories menu.

That's about all I've got space for this month so I'll finish off CQRlog next time.

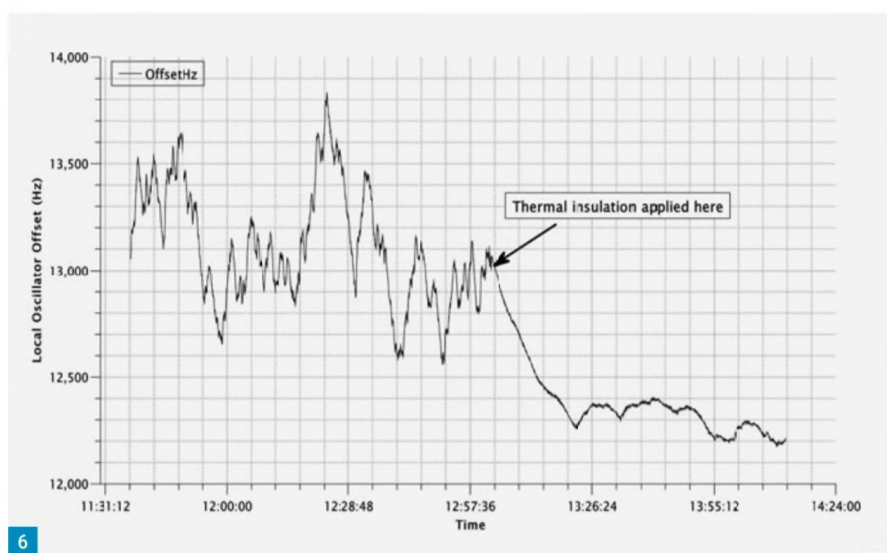
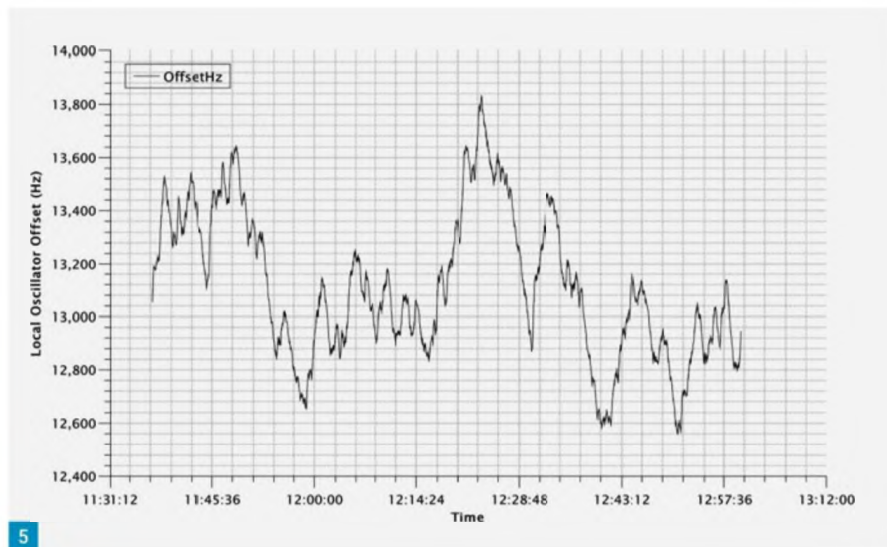


Fig. 5: Tuning offset due to local oscillator drift at 10GHz without insulation.

Fig. 6: Tuning offset showing the damping effect of thermal insulation.

Fig. 7: Magnified view of the TCXO in the Bullseye LNB.

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- The history & technology behind Spy Messages & Radio
- A glance at the Belgian Network Radio scene,
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Returning to the Hobby

Colin Redwood, G6MXL provides some guidance to those returning to the hobby after a break of some years – a noticeable trend during the coronavirus epidemic.

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It is clear from various Facebook amateur radio groups that a number of amateurs are returning to the hobby after a break of many years. This has become noticeable during the last few months and in particular during the Coronavirus lockdown. One of the nice things about amateur radio is that you can pick it up and put it down whenever you wish. Some find that it can be difficult or impossible to keep the hobby going during the years of bringing up a family. Many return to the hobby later in life when the children have flown the family nest. For others retirement brings with it an opportunity to pursue long abandoned hobbies, or to try something new. At my local club we have certainly seen many newcomers to the hobby in the latter category.

Where to Start

It is difficult to know what to suggest in terms of 'where to start'. Amateur radio has changed quite a lot in the last 20 or 30 years. Some returning amateurs will need some help to get back into the hobby. My advice falls broadly into five areas: licensing & bands, equipment, operating, clubs, and a visit to an amateur radio dealer.

Original Licence

Regardless of which organisation issued your licence in the first place, this is all handled by Ofcom now. The first thing to do is to reinstate your licence. If there's only been a gap of a few years, then you should be able to go to the Ofcom web site to revalidate:

<https://tinyurl.com/ycjcsbom>

If your callsign isn't recognised, then you've probably not revalidated your licence for over five years. In this case you'll need to contact Ofcom to get your licence reinstated. To do this you'll need to provide Ofcom with evidence that you've previously had a licence. This evidence will ideally be your original licence



1



2

documentation or a renewal letter from Ofcom. In the absence of this, try to find your details in a historical callbook. If you are in contact with other local amateurs or a local amateur radio club, they may be able to photocopy the relevant page out of an old Callbook. Another route is to contact the RSGB, as they keep copies of old Callbooks.

Depending on the exam you took, you'll now have either a Foundation, Intermediate or Full Licence. In **Table 1** I've shown the main ranges of callsigns that have been allocated over the years for stations whose main station location is in England. Those located in Wales (W), Scotland (M), Northern Ireland (I), Isle of Man (D), Guernsey (U) or Jersey (J) will need to add the relevant letter after the number in the callsign.



3

Current Licence

Once you have got your licence reinstated (for which Ofcom may levy a charge), you may be glad to know that there is no longer an annual fee to be paid to the licensing authority. You'll need to log on to the Ofcom website at least once every five years to confirm that your name and

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What Exam did you pass?	Morse Test	Your 2020 Licence Class	Main Callsign Prefixes (In England)
Radio Amateur's Exam	Yes	Full	G2xxx, G3xxx, G4xxx
Radio Amateur's Exam	No	Full	G8xxx, G6xxx, G1xxx, G7xxx, M1xxx
Novice Radio Amateur's Exam	Yes	Intermediate	2E0xxx
Novice Radio Amateur's Exam	No	Intermediate	2E1xxx
Advanced or Full	n/a	Full	M0xxx
Intermediate	n/a	Intermediate	2E0xxx
Foundation	n/a	Foundation	M3xxx, M6xxx, M7xxx

Table 1: The conversion of 'old' licence types to 'current' (2020) licence types.

address details remain unchanged. If they change, then you'll need to update them on the Ofcom website as soon as they change. You'll also be able to download a copy of your licence and the licence schedule. This schedule lists the rules for operating – the bands, power limits, etc. Normally there is no longer a need to keep a log, although most amateurs do.

Current Privileges

In Table 2, I've summarised the main privileges that go with each type of licence. The important point to note is that you'll get access to almost all the HF, VHF and UHF bands – regardless of whether you've ever passed a 5, 8 or 12 words per minute Morse test or no Morse test at all.

Bands

There have been a number of changes to the schedule in the last few decades. These are generally beneficial in terms of more bands becoming available. The schedule and bandplans have changed to reflect additional bands and the increasing popularity of various data modes. Current bandplans can be obtained from the RSGB website at:

www.rsgb.org/operating/bandplans

Transceivers

Modern transceivers are more sophisticated than even 20 years ago. You generally get a lot more for your money. VHF/UHF handheld FM transceivers can be obtained for well under £50. Many modern

HF transceivers incorporate the 6m (50MHz) band – indeed some also include the 4m (70MHz) band.

In recent years, Software Defined Radios (SDR) have started to challenge traditional analogue transceivers for space in our shacks. On receive, an SDR takes a large chunk of the radio spectrum and using sophisticated processing converts it into data that can be processed by the internal processor to select and demodulate signals (including SSB, FM, AM, CW) that you wish to listen to. The resulting audio signal essentially is the same as if it had gone through various stages of a traditional superheterodyne receiver. Software defined radios fall into two main types. One is essentially a black box with just a few connectors on the back, Fig. 1. Operation of this first type is reliant on a computer (a PC). The second type looks very much like a traditional transceiver, with controls that will be familiar to most amateurs. Many of these have a display that shows a chunk of the radio spectrum, with the frequency and strength of signals around the station you are listening to, Fig. 2.

ATUs

All types of modern HF transceivers have semiconductors in their power amplifier (PA) stages and are generally less tolerant of mismatched antenna systems than valve PAs. So before settling on a choice of HF transceiver, you might want to consider your antenna system. If you

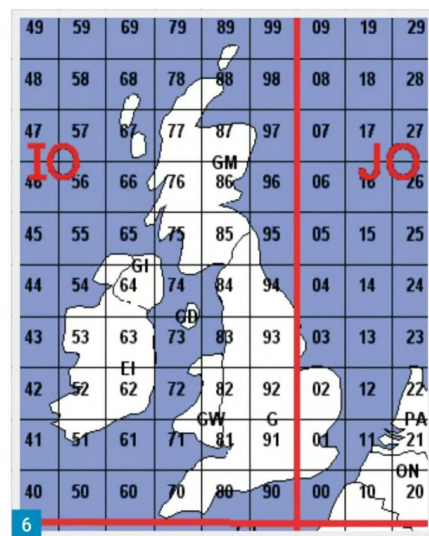


Fig. 1: A Flex Radio 6700 – an SDR transceiver for use with a computer.

Fig. 2: Icom's IC-7300 – an SDR transceiver that can be used 'stand-alone' without the use of a computer.

Fig. 3: A short patch lead can minimise the mechanical strain on the small centre pin of the SMA connector on hand-held transceivers.

Fig. 4: The Kenwood TS-940S – a popular HF transceiver from the 1980s.

Fig. 5: A transceiver from about 10 years ago (the Kenwood TS-2000X) covering the HF, 6m, 2m, 70cm and 23cm bands.

Fig. 6: The 'Maidenhead' Locator system is worldwide.

Fig. 7: A data modes interface with built-in sound card to enable a transceiver without a sound card to operate using a variety of data modes.

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Licence Type	Callsign Prefix	LF, MF & HF*	VHF & UHF**	SHF & EHF***	Max Power	Transmit using Home Design & Build
Foundation	M3, M6, M7	Most	Yes	10 GHz Only	Up to 10 Watts	No
Intermediate	2E0	Most	Yes	Yes	Up to 50 Watts	Yes
Full	M0	All	Yes	Yes	Up to 400 Watts	Yes

*Below 50MHz **6m, 4m, 2m, 70cm ***Microwaves. See Licence Schedule for full details and exceptions

Table 2: The main privileges linked to the three licence types in the UK.

have an antenna that is resonant on the band you want to operate on, then you'll not need an ATU. If you only have a small mismatch, then the built-in ATU that comes inside many, but not all, HF transceivers may be sufficient. If you aren't using a resonant antenna, then you'll need to look at a separate ATU. These are available in a number of different arrangements. Some can be remotely operated, and thus be placed at or close to the feedpoint of the antenna, while others are designed to be located in the shack.

VHF

On the VHF and UHF FM channels, I should also point out that the 'old' nomenclature for simplex channels (such as S20, SU20, etc.) has 'officially' been replaced with a 'new' nomenclature. However, the new nomenclature doesn't seem to have gained the general acceptance that the old nomenclature had.

Besides the 'traditional' modes (FM, SSB, CW and various data modes), there are three types of totally incompatible digital voice systems (DMR, Fusion, D-STAR) in use on the VHF and UHF bands. Before purchasing any transceivers for these bands, I'd check carefully on the level of activity in your locality. On the 2m band, 12.5kHz channel spacing has been adopted over the years for frequency modulated (FM) signals replacing the 25kHz spacing used in the 1980s, so that narrower filtering is needed. If you are tempted by a handheld transceiver, it will almost certainly come with an SMA connector. To use these with the feeder from an external antenna, an adaptor will be needed. These are readily available from amateur radio dealers. I'd suggest a short patch lead, **Fig. 3**, rather than an adapter, to minimise the mechanical strain on the small centre pin of the SMA connector.

Repeaters

Most 2m and 70cm FM repeaters have now adopted CTCSS sub-audible tones to access them. A few repeaters also continue to support the older 1750Hz toneburst access, but this is now quite

rare, so you'll probably want to avoid old FM-only transceivers that don't include CTCSS, although they could still be useful for simplex use such as club nets. Back in the 1980s 70cm repeaters only used +1.6MHz split operation. These days there are some 70cm repeaters using a 7.6MHz separation, although the majority still use the +1.6MHz separation.

In the early 1980s most transceivers covered either the HF bands, **Fig. 4**, or a single VHF or UHF band. Many HF transceivers were fitted with valves rather than transistors in their power amplifiers. Today there are transceivers covering all the HF bands, 6m, 2m, 70cm and even 23cm, **Fig. 5**. Now that all UK amateurs have access to the HF bands, I'd suggest looking at a transceiver that covers the HF bands as well as VHF and perhaps UHF. You'll find far more activity on the HF bands than the VHF and UHF bands.

Antennas

The importance of antennas has not changed. No matter what band(s) you choose, I'd suggest using a resonant antenna as high up as you can get it. For the HF bands, a simple 20m dipole is probably as good a starting point as any, particularly if space is limited.

Operating

For those keen on chasing DX on the VHF/UHF/SHF bands, the old European locator system has been replaced by a new worldwide locator system, **Fig. 6**, often termed the 'Maidenhead' system. On HF, split operation is frequently used by big DXpeditions. I would consider being able to operate split an important feature for any HF transceiver you are considering purchasing if you want to chase DX stations.

Data Modes

In the early 1980s it was rare to find a computer in a shack and while there was some data modes activity, it was mainly radioteletype (RTTY) with many amateurs using old mechanical teleprinters. While RTTY is still a popular mode, several other data modes have become very popular, all

of which are computer-based. The ones you are most likely to come across are SSTV, PSK31/PSK63 and, in particular, FT8.

Connecting a computer to a transceiver will depend on the facilities of your transceiver. Older models will need an interface. Some recent transceivers include a sound card within them, so just a simple lead is needed between the transceiver and the computer.

A simple interface can be bought or built to go between a transceiver and a modern computer, **Fig. 7**, which together with free software will allow Slow Scan Television (SSTV), RTTY, PSK31, FT8 and a host of other data modes to be used.

Clubs

Once the lockdown has been lifted I'd certainly suggest visiting your local club. There you'll be able to meet and talk to others and hopefully be exposed to various aspects of the hobby, so that you can see what interests you now. Many clubs have a station that you can operate and regain some forgotten operating techniques. You might also get an invite to visit one or two members in their shacks to see a 'modern' station. In the meantime, I'd certainly suggest getting in contact with your local club. Many are running extra nets at present, which you may be able to join in. Failing this there are a number of Facebook amateur radio groups that can provide a way of soliciting ideas. Over the years my local club has welcomed several amateurs returning to the hobby on to its training courses to bring them back up to speed but without sitting the exam at the end.

Dealers

Armed with some knowledge from members of your local clubs, I think a visit to an amateur radio dealer would be a good idea. There you'll be able to see and try a good range of transceivers. If money is limited, then a second-hand transceiver can be a good choice, provided the transceiver is not too old. A look through the pages of *Practical Wireless* will soon identify a number of reputable dealers who I am sure will be pleased to help you return to the hobby.

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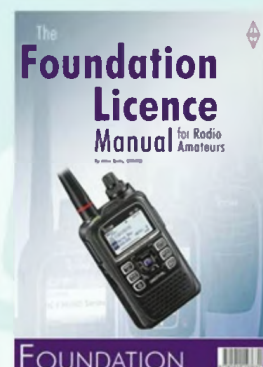
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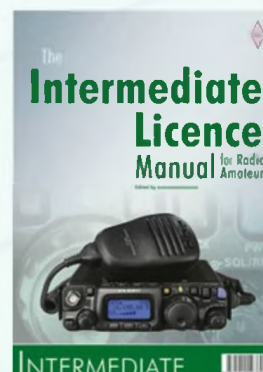
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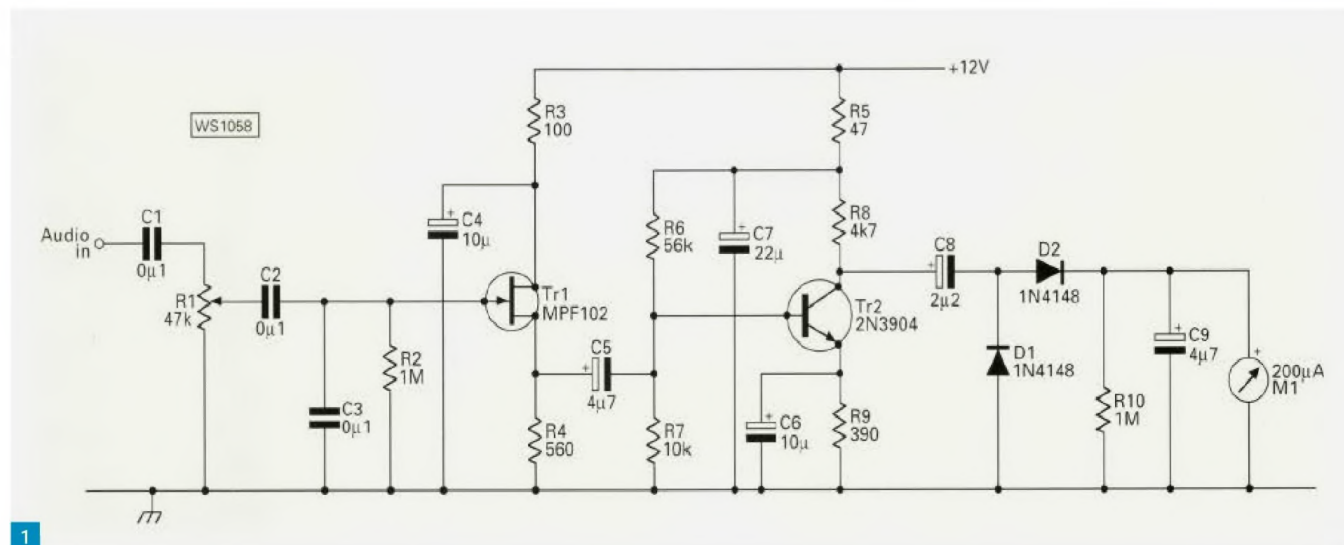


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Lee Aldridge G4EJB
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With a number of simple receivers in the shed, a project that had been sat languishing for too long was to sort out an audio-derived S-meter circuit. I had seen **George's** article in *PW* Jan 1999, revisited in March 2012, and considered it to be straightforward and flexible enough for several of my receivers.

I did smile at George's comments about the reassuring meter: "When operating a receiver, I think there's something reassuring about having a little meter needle dancing up and down in sympathy with the signal strength. The fact that it may not be doing much in the way of objective measurement seems to be of little importance!"

So, what makes this little circuit flexible? Again George: "The circuit for the audio derived S-meter is shown in **Fig. 1**. Since the circuit has to connect to the existing receiver audio stages, **it's important that it does not offer a significant load to these circuits at the point of contact**".

The rest of George's circuit description can be found in the original articles.

I built the audio-derived S-meter on a small piece of strip board – note the word 'small'. I had a cunning plan – more will be explained in the second part of this article. The construction started with the input potentiometer and working across the board gradually realising the word small meant too small. I finished up cramming components in and even had a little 'ugly construction' in the corner for the DC voltage doubler. Anyway, with the board complete, I then worked through

Two for the Price of One (again!)

Lee Aldridge G4EJB offers an audio-derived S-meter and complementary bargraph display.



the circuit to check that mine bore some resemblance to George's. Tracks had to be cut to isolate parts and I used a suitable drill to gently remove the track. Previously I had been using a burr drill but patience was in shorter supply with this board. I tend to check my track breaks with my bench magnifier to ensure there's no copper left. Even then, it's not foolproof as I found out this time. I connected my cheap audio oscillator to provide input signal and my treasured 100µA meter to act as the

S-meter. With 12V applied to the board, a quick check with my DVM around the two devices showed strange readings around Tr2 – there shouldn't be the same voltage on the collector and emitter. Switch off 12V. Yes, I'd missed a track to be broken. With that sorted, 12V was applied again and this time the voltages around Tr2 seemed to make sense. I turned up the input pot and sure enough the S-meter deflected. Success, **Fig. 2**!

I spent a fair bit of time assessing input

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Fig. 1: Circuit of audio-derived S-meter.

Fig. 2: The working audio-derived S-meter.

Fig. 3: Part of VSWR meter display circuit.

Fig. 4: The audio-derived bargraph display S-meter working with 60m receiver.

levels, potentiometer settings and even the frequency response of the circuit. Mine appeared to provide maximum output level around 750 to 1250Hz. I thought that was very commendable considering its use with CW and SSB.

There are some really useful additions to the original circuit in George's March 2012 article like the preamplifier (if required) and combining with a relative RF power meter.

Time for my cunning plan.

An LED Bargraph Display

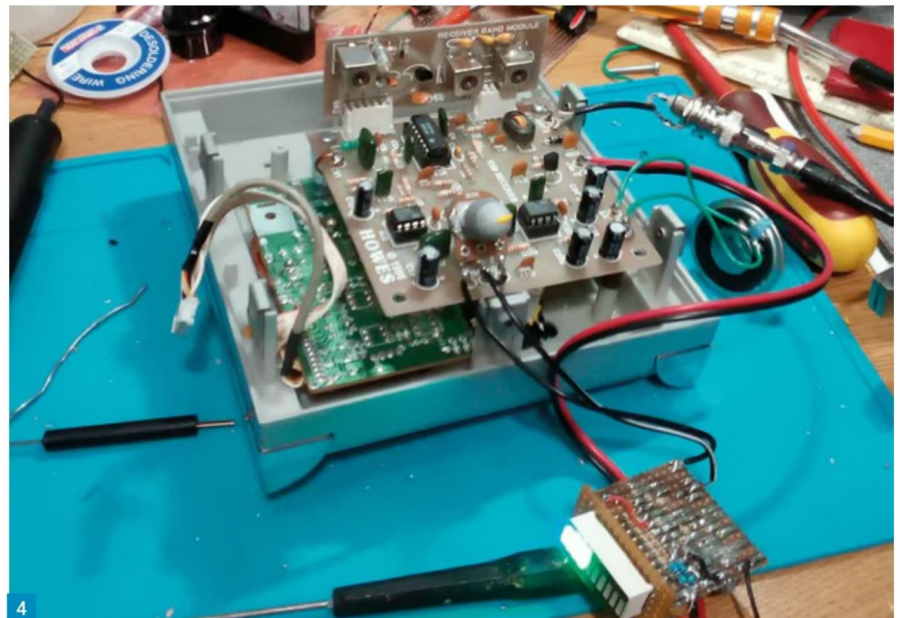
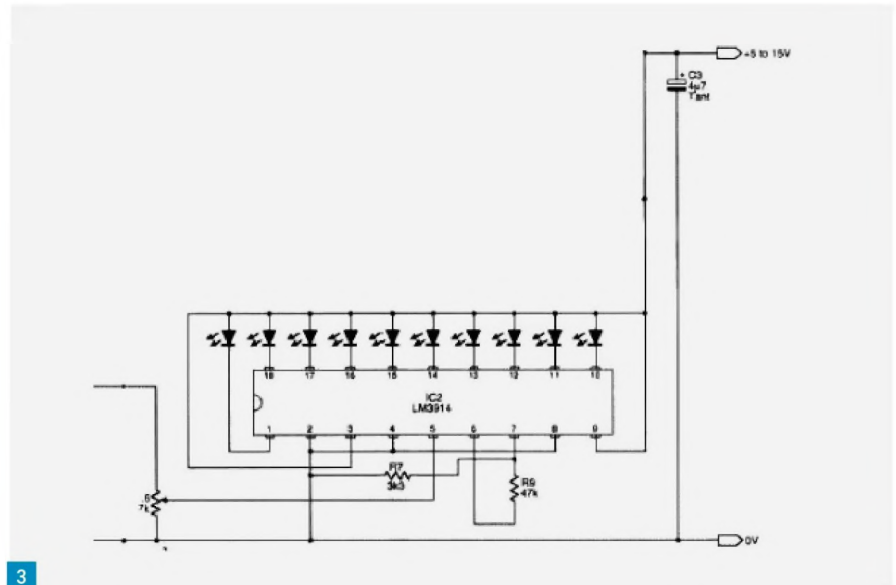
With meters being a little expensive and even old meters from CB radios not so readily available, I had always thought I'd finish up building a LED bargraph display. To that end I'd already bought a few LM3914 ICs and some rather impressive (well I'm easily impressed) multi-coloured displays quite a while ago.

Again, the basis of the circuit comes from one of George's other projects in *PW* Feb. 97 where he'd used it to fit bargraph displays in a VSWR meter. **Fig. 3**.

To keep things as simple as possible, I had decided the input potentiometer on the audio-derived S-meter circuit would suffice to adjust the range of the bargraph display. Now, I'd never delved into the depths of the workings of the LM3914 IC before but I was a little confused by George's circuit. There appeared to be a resistor added to the internal resistor chain across the internal comparators. After a delve into a few books and a good look online, I just removed it from pins 6 and 7, then shorted those two pins via the 3.3kΩ resistor to 0V. That kept the display from being too bright and the voltage reference simple. I'm sure George had a good reason in his application.

Anyway, I went on to build the bargraph display on a small piece of IC stripboard and then mounted it onto the edge of the audio-derived S-meter board. It took a couple of attempts to get the display at right angles to the other board. I only soldered a couple of strips to start with and then just applied a little pressure while re-melting one at a time.

I knew I would have to adjust C9 in the S-meter circuit because there was no longer a meter loading the voltage doubler. I wanted the display to have a



degree of decay rather than disco lights and found that a 1μF tantalum capacitor was ideal.

Once all of this fun and frivolity was complete, I connected the unit up to a recently modified 60m Howes receiver. I'd also used filter information from George's book *QRP Basics* (available from the RadioEnthusiast website) to modify and improve the input filtering of the receiver. It was just a case of getting a reasonable bargraph indication with differing signal levels by adjusting the input potentiometer and not worrying too much about extremely large signals – you're not bending a meter needle and the IC can handle much larger levels without harm, **Fig. 4**.

Now, I have learnt a little bit about the LM3914 IC while playing with this project.

For example, it might have been more sensible to use the LM3915 or LM3916 ICs as a logarithmic output might be a bit more accurate but the audio-derived S-meter circuit seems to work quite well with the bargraph display.

The final words from George: "So, if you wish to add a bit of movement or a little (pseudo) sophistication to your home-brewed receiver or transceiver, try one of these circuits. It might not mean much but it could look good!"

And as far as the bargraph display is concerned: "Go on ... have a go ... it's an 'illuminating' project this time!"

The **Carrying on the Practical Way** CD is available from the Radio Enthusiast website at:

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Steve Ireland VK6VZ/G3ZZD
practicalwireless@warnersgroup.co.uk

Most amateur radio enthusiasts these days think of wire antennas simply as a single length that is fed either in the centre or at its end.

Being brought up during the 1960/70s in what some regard as the golden age of radio broadcasting, living a few miles away from a shortwave transmitting station, I became familiar in my teenage years with what looked like curtains of wire hanging in the sky.

These broadcasting antennas were really called 'curtains' or curtain arrays and consisted of many dipoles suspended above and alongside each other in bays and tiers, phased in such a way as to obtain considerable gain (dBd) over a simple half-wave dipole. These antennas, whose design dated back to the 1930s, were often bi-directional, meaning they could exploit both short and long path propagation to particular destinations.

The gain of these wire antennas, often at least a hundred metres long in both horizontal and vertical planes, was much greater than that achievable by the Yagi or quad beam antennas commonly used by radio amateurs for long distance communication. For example, a three-bay curtain array with tuned reflectors could typically give a gain in excess of 20dBd on its optimum frequency and preferred directions [1].

Although it was impractical for radio amateurs to build this kind of antenna except on Field Days out in the country, some clever pioneers like **Woodrow 'Woody' Smith W6BCX** used elements of these broadcast antenna techniques in compact antennas that fitted into ordinary backyards. In 1948 W6BCX wrote an article in *CQ* magazine, which described the design of the Half Square and its close cousin the Bobtail Curtain [2].

The Half Square can be considered as the simplest curtain antenna that has vertical polarisation. It consists of two quarter-wave wire verticals, spaced a half-wavelength apart and connected together at their tops by a half-wavelength of wire. This connection means the two elements are driven in-phase (i.e. the radio waves produced by the separate vertical antennas add together to increase the radiation in a desired direction, while cancelling to suppress radiation in undesired directions).

The maximum radiation of the Half Square is broadside (i.e. at 90°) to the half-wave wire that connects the tops of the two verticals. As the overall length of the antenna is a full-wave, there will be a voltage maxi-

Making the most of the Half-Square

Steve Ireland VK6VZ/G3ZZD explains how to get the antenna gain and low radiation angle of a pair of phased verticals with a single piece of wire.

mum at the bottom of each vertical section, giving a potential advantage over a conventional pair of phased quarter wave verticals in that the maximum current point of each vertical is at their top rather than the bottom, which should mean there are less earth losses under the antenna (i.e. in its near field).

There is another way the Half Square has an advantage over convention. It has the same footprint/fits into the same space as a simple half-wave dipole that is a quarter-wavelength above ground, or as a single quarter-wave vertical with two quarter wave radials. Not only will the two quarter wave verticals that make up the Half Square provide a gain of 3dB over a single one, but also provide a much lower angle of radiation than the aforesaid dipole.

Note the Bobtail Curtain is effectively a two-bay Half Square, with three in-line phased verticals firing broadside instead of two.

Dean Straw N6BV, long associated with the famous *ARRL Antenna Book*, pointed out through propagation modelling in the early 1990s that the angle of radiation on the path from New England, USA to Europe was mostly between 17° and 24° [3]. As **Rudy Severns N6LF** went on to explain in his excellent article on using the Half Square for lowband DXing [4], the Half Square provides anything from 3dB to 10dB gain over a horizontal dipole at the same height (i.e. a quarter wave) at radiation angles between 10° and 20°, depending on soil conductivity and reflection, which are key to working DX farther than a couple of thousand kilometres away.

Practicalities

For most radio amateurs these days, the blocks our houses are built in have little enough space to put up a 7MHz half-wave dipole, let alone one for 80m. In the worst cases, even a 14MHz (20m) dipole can be struggle.

However, if you can manage to put up 14MHz dipole at around seven metres above the ground, this means you could put

up a 14MHz Half Square instead, which will give you very useful gain over the former, particularly on long distances. Not only that, but there is a simple but relatively unused way of feeding this antenna so it can also be used as a half-wave dipole on 7MHz and, with some success, on other amateur bands above this one.

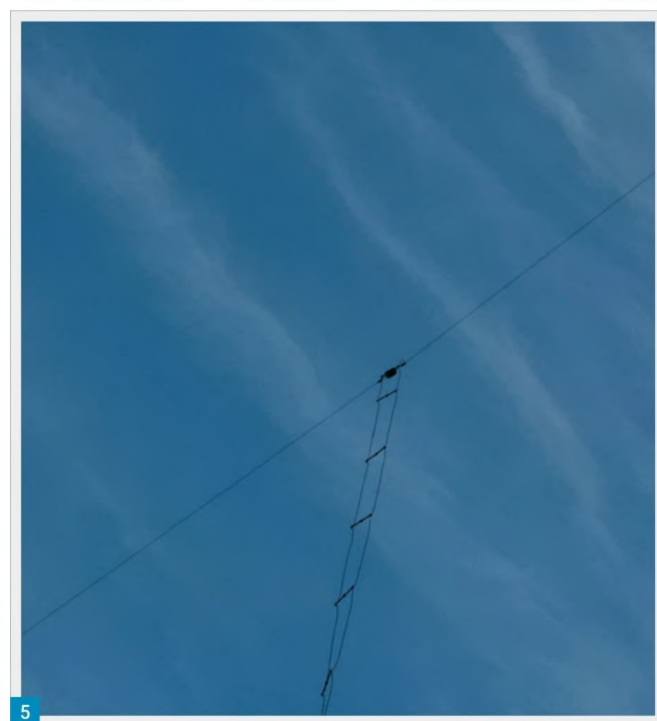
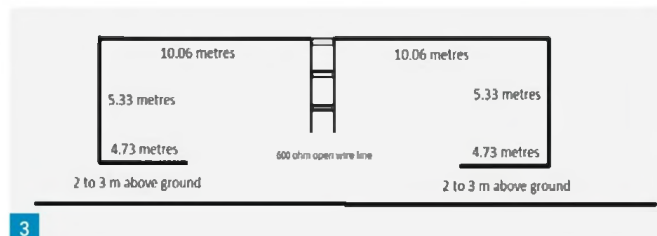
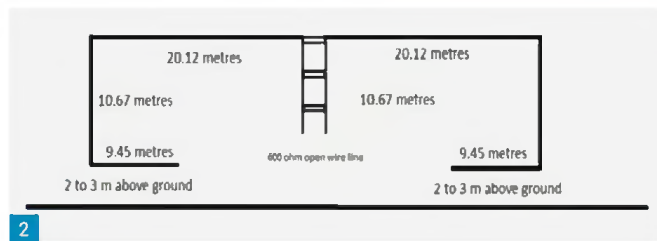
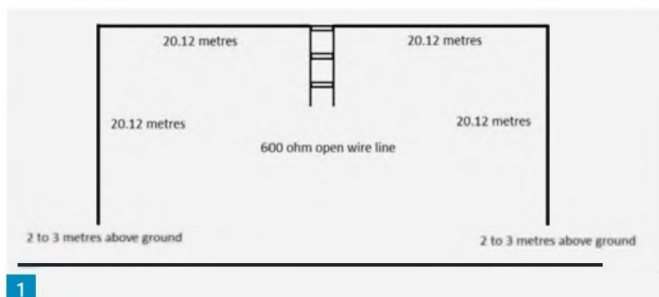
Almost all articles you will find on the Half Square treat it as an antenna that is either fed (at a high voltage point) at one end via a suitable antenna tuning unit (ATU) or at the top of one of the vertical sections with 50Ω coaxial cable. Feeding it in the first manner means the ATU has to be capable of matching very high impedance (with the associated problem of needing a very wide-spaced capacitor that can stand the high voltage). Also, the ATU needs to be placed remotely at the bottom of one of the vertical sections.

If the Half Square antenna is fed at the top of one of the verticals with coaxial cable via a choke balun – probably the most common feed method – then its operation is limited to a single band. Also, the necessary RG213/LMR400 coaxial feeder is likely to drop semi-vertically, thus potentially interacting with the vertical and affecting not only its performance but the Half Square's overall pattern.

The most efficient and flexible way to feed the Half Square is actually in the centre of the top wire with open wire line – in a similar manner to a doublet antenna – and taking the feeder initially vertically down towards the ground, where it is anchored on a two to three metre wooden post. From there the feeder is redirected towards the radio shack where it is fed using a balanced ATU. This is the feed method at VK6VZ – and the parallel tuned Link Coupled Tuner I described in *PW* July 2019 is used for this purpose.

It is very important to realise that the ATU functions as both an antenna tuner and a phase adjustment unit. The Half Square is a symmetrical array and needs to be fed by a truly balanced antenna tuner whose output is isolated from earth by a link coupling in order to work correctly. Both its vertical

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sections (which do the radiating) need to be fed with the same currents in order to give a symmetrical radiation pattern.

An unbalanced ATU, such as the L, Pi or T-Match circuits used in most commercially made tuners, is designed to feed antennas such as end-fed wires or vertical antennas against earth. Even if a tuner using one of these circuits has a current (choke) or voltage 'balun' transformer at its output, in my experience it does not give good results on balanced antennas that need to be independent of earth, often resulting in large amounts of electrical 'common mode' noise being coupled into the antenna.

My Half Square, shown in **Fig. 1**, is designed for 3.5MHz but also forms an excellent 1.8MHz half-wave dipole antenna in an inverted-U shape and works well on

the other HF bands as a general-purpose antenna.

As this antenna is used for long distance communications on 1.8 to 7MHz primarily around sunset and sunrise times, it is sited so it fires north and south. In the former direction the Half Square is broadside to the 'grey line' terminator between night and day, along which 1.8 to 7MHz signals seem to duct. However, if the Half Square was intended for use on 10MHz or above (i.e. HF) it would be orientated towards either Europe (short path/long path), or towards North America on the SP/LP.

In my case I am lucky enough to have a tower that supports one end of the Half Square at about 19m above ground, with the other end supported by a large pine tree at a similar height. This means the wire vertical

Fig. 1: Basic dimensions of VK6VZ 3.5MHz Half Square.

Fig. 2: N6LF-inspired compact version of VK6VZ 3.5MHz Half Square.

Fig. 3: N6LF-inspired compact version of 14MHz Half Square.

Fig. 4: Centre of VK6VZ 3.5MHz Half Square.

Fig. 5: Central support of Half Square open wire feeder.

sections of the antenna are sloped down at about 20° to 30° to the vertical to two to three-metre high wooden posts, which support each end of the antenna via an insulator and Dacron rope.

However, N6LF has found that a 3.5MHz Half Square can easily be reconfigured so it only needs end supports around 12m (40ft) high but still has a performance on par with

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Fig. 6: One of the Half Square end supports.

Fig. 7: Half Square feeder.

Fig. 8: Half Square feeder going into VK6VZ radio room.

Fig. 9: Comparison of the elevated radiation pattern of a 12.2m (40ft) high 3.5MHz dipole and a N6LF compact version of a 3.5MHz Half Square over average ground (5mS/m). As N6LF points out, "the Half Square outperforms the low dipole below 32°."

one at full height. This is done by bending the last nine to ten metres or so of each end of the antenna inwards, **Fig. 2**, which still allows this section to be 2.5m (8ft) above the ground and out of reach.

Now if we transpose these dimensions to 7MHz, this means the top section of the Half Square could be a mere 8.5m (28ft) high – and, again, the bent bottom sections of the antenna can be around 2.5m above ground. A 14MHz version of the N6LF Half Square is shown in **Fig. 3**.

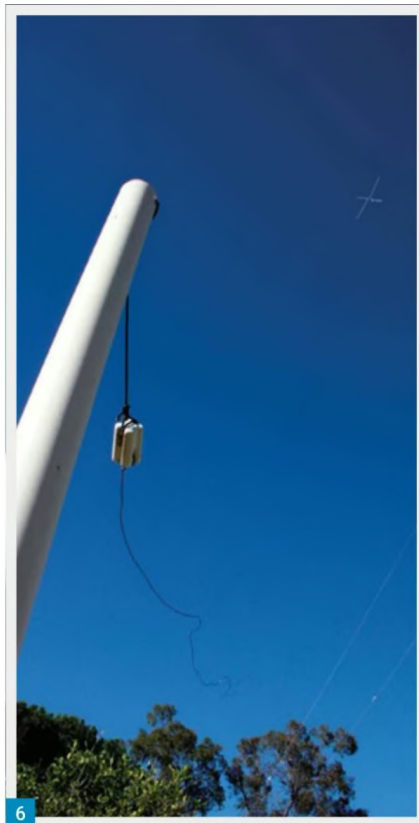
Why N6LF's version works is because the parts of the verticals that are bent and run horizontally carry relatively little current and thus contribute only a tiny amount of radiation. You can think of the vertical end sections of his reconfigured antenna as upside-down inverted-L antennas – the principle of operation is basically the same.

When it comes to supporting your Half Square, either wooden or fiberglass poles should preferably be used. Avoid anything that is metallic or is in any way conductive. That being said I support one end of my Half Square by a steel tower, but the adjacent Half Square vertical section is about an eighth-wave away from the tower and the latter is bonded to the extensive VK6VZ earth system.

Another advantage of the Half Square is it is much cheaper and easier to implement than a pair of phased verticals. Instead of having to build – and guy – two aluminium quarter-wave verticals, bury or elevate quarter-wave radials to provide the necessary ground system and then make a phasing system out of coaxial cable to feed the two verticals, all you have to do is support a full-wave long piece of wire!

Making your Half Square

The best material to construct your Half Square from is 1.5mm+ diameter hard-drawn copper wire, often called Copperweld. I buy mine from The Wireman in the USA [5], but recently noticed that the UK's Radioworld stocks it in 50m rolls [6]. Hard drawn copper wire – made from steel coated with a thin layer of copper – is very strong and the top span of the Half Square



needs to be able to support an open wire feeder without stretching.

When it comes to making open wire feeder, you could buy some Open Wire Line Spacers and a 50m roll of heavy-duty PVC-coated antenna wire from SOTABEAMS [7]. The proprietor **Richard G3CWI** has a nice video on his website showing how to do it. My open line feeder has a spacer every 900mm or so, which seems to work fine in terms of keeping the two feeder wires apart.

The only other critical factor in the construction of the open wire feedline is its electrical length. If the lowest band the Half Square is to be used on is 1.8MHz (i.e. work as a Half Square on 3.5MHz), then a feeder length of about 61m (200ft) should work fine from 1.8 to 28MHz. In my case, this is a much longer length than is necessary but keeps the feed impedance to a medium level on all bands so it is a relatively easy match for a balanced Link Coupled Tuner ATU.

In order to preserve the balance of the open wire feedline (and, consequently the Half Square antenna) as much as possible, it should be rotated in a barrel-roll manner through 360° every five metres or so when it is running parallel to the ground.

When I tried out my Half Square, it matched very well at 3.5 – 3.7MHz but not above this. All that is necessary to correct this mismatch is reduce the length of the feeder by a metre or two to drop



the impedance from 3.7 to 3.8MHz. Any difficulties you have in matching can be similarly corrected – if you have a poor match at a lower end of a band the feeder may need lengthening slightly, if it is at the upper end the feeder may need shortening.

In order to use up the feeder length (61m) necessary for matching my Half Square on several bands I simply ran this 'the long way round' to the radio room – see the photos, **Figs. 4** through **7**. Once again, this kind of technique comes from the heyday of short-wave broadcasting (I became a BBC transmitter technician for several years in the mid-1970s).

If 3.5 MHz is the lowest band the Half Square is used on (i.e. it works as a Half Square on 7MHz) a feeder length of about 30.5m (100ft) should provide a medium impedance at the ATU from 3.5 to 28MHz. The same feeder length should also work if you build a Half Square for 14MHz, but it could be halved to 15.25m (50ft) if more convenient.

The insulator at the centre of the Half Square should be one of the heavy-duty PVC or porcelain insulators used at the centre of a dipole – it is under a lot of mechanical tension so needs to be physically strong.

Performance

My soil here is a mixture of gravel and clay on top of granite boulders and its

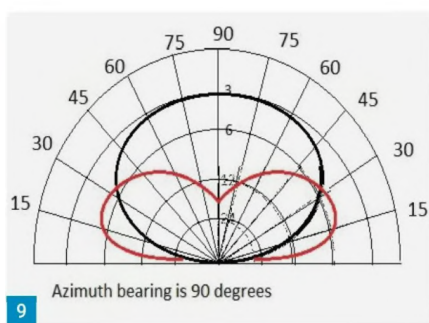


conductivity is very poor, so much so that a low horizontal dipole will outperform a vertical or inverted-L antenna on 1.8MHz. However, in the process of discovering this I put down a ground screen of thirty 30m-long radials where my wire antennas are sited, so the current 3.5MHz Half Square does receive some help from below.

That being said, back in the 1990s I had a Half Square in a virtually identical position, but no ground system of any kind under it. This was the best 80m antenna I've ever used until the current Half Square (and is why I put one up again). **Fig. 8**, derived from N6LF's work, shows you why this is probably so – even his 12.2m-high 3.5MHz compact Half Square performs better below 32° of elevation over average ground than a dipole at the same height.

As stated earlier, the ATU of the Half Square performs both tuning and phasing (i.e. symmetry). If you move more than 5 to 10kHz, the ATU needs to be readjusted for a 1:1 SWR, which means the antenna is both matched and its pattern optimised. During testing, when attempting to work DX stations who were at long distances (i.e. over 10,000km), I quickly found adjusting the ATU for a 1:1 SWR regularly meant the difference between the DX station hearing me or not.

I have never used an antenna before where a simple adjustment of this kind is so



critical to performance.

My first serious operation with the latest 3.5MHz Half Square was during the Commonwealth Contest 2020 back in mid-March. Living a few kilometres from me is arguably Australia's best contest operator **Kev VK6LW**, who in general terms has higher and better antennas than me, a better location, is a much better operator and on this occasion was using an 80m dipole at 23m (75ft) above ground. Kev outscored me comprehensively overall (5,200 points to 4,395 points) but on 80m I narrowly pipped him (32 bonuses and 66 QSOs to 28 bonuses and 71 QSOs).

Kev's friend **Graham G4FNL**, who operated the G6XX UK headquarters station, wrote afterwards: "Congrats on the first place of VKs to Kev in BERU... You certainly had an outstanding signal on all bands (maybe not so strong on 80 as VK6VZ – sorry to say – but on the other bands you were much better than Steve)."

As the saying goes, you can't win them all, but I'm very happy my Half Square has finally got me ahead of my cobbler VK6LW at least on one band. Right now, he is probably thinking about putting one up.

References

1. See **Tom Rauch W8JI's** curtain antenna page at his **w8ji.com** website. At the bottom are some designs from an old broadcast engineering handbook – see in particular the commentary about the three-bay curtain array with tuned reflectors used at the Radio Free Europe station near Lisbon (Fig 21-21).
2. *Bet my Money On A Bobtail Beam*, CQ March 1948. I first discovered the Half Square in a later article by **Ben Vester K3BC** in QST March 1974.
3. The ARRL *Antenna Handbook*, Chapter 23 in 17th Edition, 1994.
4. You can find Rudy's super, essential half square article at:
<https://tinyurl.com/lj2erwh>
<https://thewireman.com>
<https://tinyurl.com/yd2raeak>
<https://tinyurl.com/y87p6xvj>

Radio Round-up

CQ MAGAZINE HALLS OF FAME: The 2020 inductees to the CQ Contest Hall of Fame are:

Geoffrey Howard W0CG/PJ2DX, who purchased and restored the PJ9JT contest station in 2000.

Willard 'Bill' Myers K1GQ, a pioneer of computer-based systems for designing and switching antennas at contest stations, designed the Cushcraft Skywalker series of monoband Yagis and helped build the early PacketCluster network.

Gene Zimmerman W3ZZ (SK), was a major force in VHF contesting as well as an accomplished HF contester. He was a member of both ARRL's and CQ's contest committees, was QST magazine's VHF Editor for nearly a decade, and was CQ Contest magazine's VHF columnist as well. Gene took over the struggling CQ World Wide VHF Contest in 1999, reinvented it as a 6m and 2m only event and sparked its growth into a truly worldwide competition. He was also instrumental in organising the mid-Atlantic VHF contesting group that became known as the K8GP Grid Pirates.

The 2020 inductees to the CQ DX Hall of Fame are:

Tony Gonzalez EA5RM who has been an active DXpeditioner for 20 years, often organising and leading teams to operate from difficult and challenging locations.

Edward 'Ned' Stearns AA7A is an accomplished DXer, DXpeditioner (he's been on 32 of them and led eight) and technical innovator.

The CQ Amateur Radio Hall of Fame honours:

Chet Atkins W4CGP (SK), legendary musician and music producer (Note: Chet's call has subsequently been re-issued).

Les Barclay G3HTF (SK), propagation expert, leader of ITU propagation study groups and Chairman of the ITU's first Radiocommunication Assembly in 1993.

George Laurer K4HZE (SK), developer of the UPC (universal product code) or 'bar code' on merchandise.

Yasuo 'Zorro' Miyazawa JH1AJT, whose Foundation for Global Children helps fund educational and medical programs for children around the world.

Champ Muangamphun E21EIC is a DXer and DXpeditioner who has been a sparkplug for growing interest in amateur radio in Thailand and throughout Southeast Asia.

Sultan Qaboos bin Said A41AA (SK), Sultan of Oman from 1970-2020.

Tom Roscoe K8CX, a champion of amateur radio history who collects and makes available online his 'Ham Gallery' of old QSL cards and other historic photos.

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The Great Performance

Michael Marinaro WN1M talks about the creation (evolution) of wireless.

Michael Marinaro WN1M
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The last half of the nineteenth century is marked by great advances in invention. The principal English-speaking continents were still in darkness lighted weakly by gaslight. But, electricity was coming. And, enormous advances could be expected in other areas. Witness, wired communications had advanced rapidly. The telegraph had spread its strands extensively over both continents and was about to link both by undersea cable. The telephone was a natural extension, superseding code with voice by mid-period.

The existence of the invisible electromagnetic spectrum was suspected but not detected. It was scores of scientists and inventors – professional and amateur – who harnessed the phenomena and applied it for mankind. What did each contribute to this success?

Prior to the 1860s there was not much scientific activity that concerned the transmission of information through the atmosphere. Transmission over wires was the great excitement and captivation. By the 1860s the fundamentals of electricity and magnetism were becoming known and refined. Successful applications abounded with the most conspicuous being the ubiquitous telegraph. So revolutionary and successful was this mode of communication that little thought was given to alternative means. It was almost 40 years later that an alternative method of conveying information was successfully demonstrated and its practicality accepted.

Who did What?

These early days of wireless are clouded by disputes as to who did what first and how. Some individuals stand out and are clearly recognised as contributors. Others are mentioned as facilitators or accomplices. The question that arises is who were the major contributors to the evolution of wireless conveyance, the alternative to the wire telegraph? We the beneficiaries stand to judge from a perspective almost a century and a half later. These are some of the many individuals who participated in the first phases of the wireless era.



One of the earliest recognised contributors to the scientific knowledge that was to form the basis for electromagnetic theory was Englishman **Michael Faraday** (1791-1867), **Fig. 1**. Known today as 'the physicist's physicist', his experiments beginning in 1821 established the existence of the magnetic field and the phenomenon of magnetic induction. He applied these concepts to invent the electric motor, dynamo and transformer. His work was continued by others.

As an experimenter **Mahlon Loomis** (1826-1886), **Fig. 2**, a Washington DC dentist, is chronologically an initial contender. In 1872 he was granted a patent for what was inexplicitly claimed to be a system to telegraph, without wires, through the atmosphere. He demonstrated his system by transmitting ciphers 18 miles or so between two mountain peaks using kites to support copper wires connected to ground through a galvanometer. When the kites were at about equal height, he was able to excite the meter at the end of the receiving line. Due to the poor prevailing financial conditions and other hindrances he had the misfortune of never being able to put his system to practical use. The photo, **Fig. 3**, shows the apparatus he used. He should be minimally recognised for sending magnetic waves travelling through space. He is a major contender for the controversial title 'Creator of Radio'.

As a scientist **James Clerk Maxwell** (1831-1879), **Fig. 4**, was a principal leader in the surge of wireless discovery. The Scottish Professor of Physics at Cambridge University published in 1865 his concept of alternative means of transmission by electromagnetic waves of radiation. Dr Maxwell synthesised all previous scientific thought, observations and experiments concerning electricity and magnetism into one formulation – a concept expressed as equations. A principal component was the theories of Michael Faraday. These equations established that electric and magnetic fields can be created and that they travel in space in waves at the speed of light. This is considered to be one of the great theories of physics. Experimenters and inventors were driven to apply these theories and put them to practical use. This ushered in the period of adaptation and implementation that resulted in the creation of wireless.

The curtain of silence is about to be lifted as scientists and inventors begin to send signals into the ether. Prominent among those is **David Edward Hughes** (1831-1890), **Fig. 5**, the American experimental physicist who constructed a spark gap transmitter and detected its output by listening to a carbon microphone that he designed. With this communications system he was successful in sending a code signal 500 yards. He improved on this sys-

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Fig. 1: Michael Faraday.

Fig. 2: Mahlon Loomis.

Fig. 3: Equipment used by Loomis.

Fig. 4: James Clerk Maxwell.

Fig. 5: David Edward Hughes.

tem and developed several other unique devices – the carbon microphone (which was the basis of the future telephone) and the coherer (which eventually evolved into the crystal radio receiver). The invention of the coherer, so critical to the development of wireless, is also credited to two foreign physicists, Frenchman **Eduard Branly** (1844-1940), and Britain's **Sir Oliver Lodge** (1851-1940). Dispute and controversy concerning inception arise for not the first time and certainly not the last time, in the new world of invention. But, the first wireless receiving stations were all constructed around a coherer.

The work of the Scottish Professor Maxwell and American inventor David Hughes were fused with his own concepts by German Physicist **Heinrich Hertz** (1857-1894), **Fig. 6**, who conclusively demonstrated and proved the existence of electromagnetic waves. The professor traversed space in his laboratory using a high voltage induction coil and condenser producing a spark gap emission. He also used a rudimentary receiving dipole antenna to create and detect electromagnetic wave pulses that were visible at the receiver as sparks. These transmissions were extended to greater distances as the professor pondered the character of the waves. He later proved that electromagnetic wave radiation travelled at the same velocity as light and that the nature of the invisible wave's reflection and refraction was the same as those of light. Contrary to light, however, these electromagnetic waves could travel through many different types of material. Hertz, with his experiments and theoretical conceptualising, including X-rays, brought science close to the recognition of the existence of the electromagnetic spectrum. The scientific community honoured this innovator by naming the scientific measure of frequency (cycles per second) the 'hertz'.

Electromagnetic waves existed and could be generated and received! Professor Hertz ushered in the 'wireless age', which hereafter will be shaped and perfected by the great scientists, inventors and implementers of the twentieth century.

The aforementioned gentlemen may be considered the major contributors to the 'age of wireless'. However, there were other contributors who scientific historians include in the development of this time of



progress among them:

Joseph Henry (1797-1878), American scientist who independently discovered electromagnetic self-induction.

Berend Wilhelm Feddersen (1832-1918), German physicist who proved that oscillating electric sparks could be produced by a coil, capacitor and resistor in combination.

Wilhelm von Bezold (1837-1907), also a German physicist, who experimented with the oscillations produced in conductors.

Temistocle Calzecchi-Onesti (1853-1922), Italian physicist who demonstrated the basic concept of an electromagnetic wave detector by placing iron filings in a glass tube, which conducted an electric current when exposed to a wave source.

Eduard Branley (1844-1940), French physicist who enhanced the work of Temistocle Calzecchi-Onesti and demon-

strated a more sophisticated and sensitive version of the electromagnetic wave detector, **Fig. 7**.

Oliver Lodge (1851-1940), British physicist who coined the term 'coherer' for the device developed by the two aforementioned scientists. He improved on the device by adding a vibrator, which broke up bunched filings and maintained the sensitivity of the device uniformly. He demonstrated the generation of electromagnetic signals and lectured on their potential use for communication.

Communicating Progress

At this stage one may wonder how, in that age, scientific knowledge was communicated from one scientist to another, in different countries, across different seas, in different institutions, and in different lan-

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guages. How did the work of Professor Hertz in Germany come to be known by one **Professor Augusto Righi** at the University of Bologna in Italy where it inspired a young Italian inventor within a decade of its evolution? Academia provided the principal channel for the propagation of scientific theory and results. Scientists were encouraged to record their concepts in papers and books and lecture notes and these were exchanged by institutions of learning and scientific societies. Some important findings and the work of inventors found their way into technical journals and magazines.

Word of Professor Hertz's work affected the futures of a number of inventors who experimented with means to put electromagnetic waves to practical use for communication. Most prominent a Serb, a Russian and an Italian applied themselves independently and virtually simultaneously to developing the methods and apparatus to apply the work of Hertz and his predecessors in a practical manner. As was the case with other great inventions of the time, the telegraph, the telephone and the electric light, there is controversy as to who did what first. However, what is clear is that these three inventors were successful in creating, transmitting and receiving electromagnetic waves over greater and greater distances around the same time at the turn of the century. Accordingly, it is reasonable to conclude that no one individual invented or created radio and that each of the three principal contenders was an inventor of radio. Distinctions lie not so much in the apparatus used but, in their motivations and personal objectives, and in the proliferation of their inventions.

What is known of **Professor Popov** (1859-1906), **Fig. 8**, comes to us filtered by pre-revolutionary period Russian historians, inflated by nationalism and imbued with an aura of religious mysticism. The son of a Russian Orthodox priest Professor Popov's early education was religiously founded. However, he concluded with studies of physics and mathematics at the secular Faculty of Physics at Saint Petersburg University where he earned his professorship in 1882. Subsequently, he taught at the Russian Navy's Torpedo School. Due to this affiliation, publication of his work was limited and his later more sophisticated work with wireless was kept secret.

Professor Popov sought a method of detecting approaching lightning and thunderstorms. He assembled a receiver consisting of a coherer of Branley-Lodge design with the embellishment of a device to automatically tap the glass tube to keep the

filings loose and the first use of an antenna in his system. Integrating a Hertz design transmitter, he demonstrated his system to the Russian Physics-Chemistry Society at Saint Petersburg University on May 7th 1895. Later, this date came to be celebrated in the Russian Federation as 'Radio Day'. In 1896 he transmitted wireless telegraph signals between increasingly distant buildings on the University campus. These exercises coincided with Professor Popov's affiliation with the Russian Navy and his creation and installation of a two-way signal system between radio stations at the Hogland Island naval base and aboard the battleship *General-Admiral Apraksin*. This communication link resulted in a publicised rescue of the grounded and icebound battleship in 1900.

Contrary to his two inventor colleagues, Professor Popov did not patent any of his devices. A true scientist, he was not motivated commercially. His rewards were a Grand Gold Medal for research at the Paris International Exposition, appointment in 1901 as director of the Saint Petersburg Electro-Technical Institute and acknowledgement of the importance of his work by the US Navy in their *History of Communications-Electronics in the United States Navy* published by the Bureau of Ships and Office of Naval History in 1963.

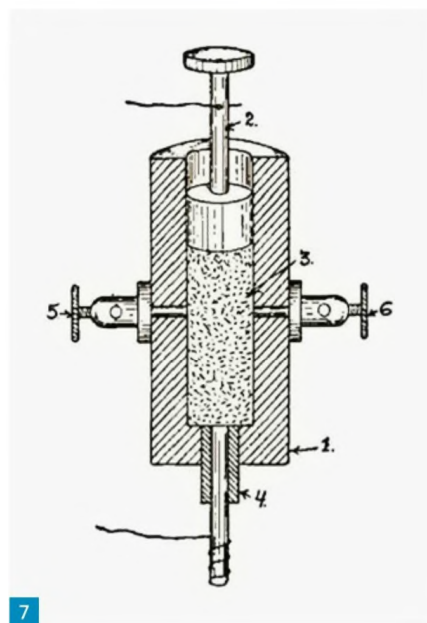
Coincidentally, Serbian-American **Nikola Tesla** (1856-1943), **Fig. 9**, master of many professions and genius of many inventions, among a myriad of other devices, developed and patented apparatus to generate electromagnetic waves. His principal achievement was the concept of AC power transmission and the invention of the AC induction motor and transformer. Tesla's interest in electromagnetic wave technology emanated from his preoccupation with the idea of the wireless transmission of a power grid.

As early as 1893 Engineer Tesla lectured on the principles of radio communication and demonstrated wireless communication utilising a unique spark gap transmitting and coherer receiving apparatus system with an antenna working against ground. He was later granted patents on the system and its components. These grants were the basis for Tesla later contesting some of Marconi's patents. A 1904 court decision favoured Marconi's rights. (In 1943 the Supreme Court reversed the 1904 decision and upheld Tesla's patents.)

Tesla demonstrated the generation and reception of electromagnetic waves to support his idea to build a super powerful (200kW) wireless facility for trans-At-



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lantic commercial communication around 1904. His idea was not only to transmit and receive radio waves but also to transmit power. This facility called the Wardenclyffe Tower and built near Shoreham, Long Island, New York never became fully operational and was demolished in 1917. Tesla went on to build a strictly wireless station for Telefunken in West Sayville, Long Island, New York in 1911-1912, which became a component of a US-Europe Network and included his concepts. This facility, which was confiscated by the US in 1917, was operated by the Navy, the Mackay Company and lastly the FAA until 1995 when it was decommissioned.

Tesla is credited with some 278 patents issued in 26 countries and obviously was commercially oriented and highly entrepreneurial. Of the trio Tesla was surely the most colourful, having become an item

of popular culture currently recognised in popular media as a dark, driven, brooding character.

Marconi Comes on the Scene

Di-di-dit, S, was the Morse code letter that **Guglielmo Marconi** (1874-1937), **Fig. 10**, used to preface and identify his experimentally transmitted signals. Continually improving his apparatus starting with a basic spark gap transmitter and a coherent receiver and grounded antenna he was able to complete transmissions at further and further distances from 1895 onward. In 1901 he awed the world by claiming that he had spanned the Atlantic with signals from Poldhu, in Cornwall, to St. John's, Newfoundland, Canada (2,200 miles) on a wavelength of approximately 366m. This accomplishment was contested by some because at this frequency, during daylight hours any signals would be absorbed by the atmosphere. Did he hear S's or atmospheric noise? Regardless, he crowned this feat in 1902 by transmitting from Glace Bay, Nova Scotia to Poldhu and in 1903 from South Wellfleet (Cape Cod) Massachusetts. Marconi's phenomena captured the imagination of the world.

The entrepreneurial young man envisioned the commercial market for his wireless apparatus and services encompassing two overlapping markets – marine and communications. Beginning with the founding of The Wireless Telegraph & Signal Company in Britain in 1897 Marconi grew a communications empire. This company was expanded into the Marconi Wireless and Telegraph Company with incorporations in many countries and still exists in some form in some of them. For example, after the WWI American Marconi merged and became the Radio Corporation of America.

Early in his career, in 1909, Signor Marconi shared the Nobel Prize in Physics for his work in the development of wireless telegraphy. Among other acknowledgements in his lifetime, in 1924 he was made a marquis by **King Victor Emmanuel III** of Italy, being titled Marchese Marconi.

Marchese Marconi continued his research throughout his life, extending the distance and frequency of his transmissions until they reached around the world, transmitting at shorter wavelengths and developing the fundamental concepts for radar and microwave.

Of the trio of scientists that I have been discussing, Marconi received the most notoriety and impacted the lives of the most people because of the rapid proliferation of



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his applications on the sea as well as between continents.

Other Pioneers

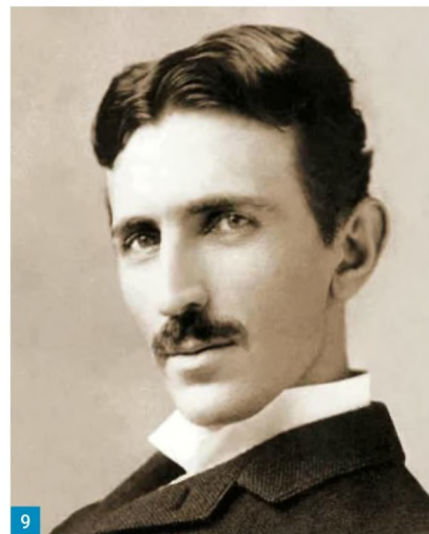
The trio were not the only masters of the art at this phase in the development of communication by electromagnetic waves. Concurrently several others are also recognised by historians as achievers and broaden our perspective.

Roberto Landel De Moura, (1861-1928), Brazilian scientist and priest, demonstrated wireless telephony transmissions to 8km in Sao Paulo, Brazil in 1900. He was awarded US patents, including one for a wave transmitter, which was the forerunner of today's transceiver.

Karl Ferdinand Braun (1850-1918), German physicist, improved on existing wireless devices by introducing close-tuned circuitry, crystal diode rectification, and inductive coupling. Mostly known as the inventor of the cathode ray tube he shared the Nobel Prize for physics with Signor Marconi in 1909.

Jagadish Chandra Bose, (1858-1937) multi-talented Indian physicist who in 1895 demonstrated electromagnetic wave generation. Professor Bose developed all the components for his microwave system 100 years ahead of today's microwave communication systems.

As the twentieth century begins we arrive at an intersection. Likely never before in history has the work of so many great minds cumulatively produced a product of such universal impact. The world is awed and the inventors move to implementation. Marconi rapidly expands his installations at sea and on land and Tesla builds radio stations. Signals flash across the spectrum albeit at short distances. And, to accelerate the progress and improve performance a



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Fig. 6: Heinrich Hertz.

Fig. 7: The Branley coherer.

Fig. 8: Professor Popov.

Fig. 9: Nikola Tesla. Fig. 10: Marconi.

new group of scientists added their wealth to the art.

John Ambrose Fleming (1849-1945), English electrical engineer and physicist, in 1904 invented the two-electrode vacuum tube rectifier – the first vacuum tube (valve).

Lee DeForest (1873-1961), American inventor, in 1906 added a controlling grid to the Fleming valve thus creating a vacuum tube RF detector, which was called the Audion – a triode that amplified signals. This was a major contribution to the art.

Edwin Howard Armstrong, (1890-1954), American electrical engineer and prolific inventor, in 1914 invented the regenerative circuit, which he followed with the super-heterodyne receiver in 1918 and the super-regenerative circuit in 1922. These devices

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Aircraft Reflection

Steve White looks at how radio signals can be bounced off high flying aircraft, to enable a contact to take place that wouldn't normally be possible.

Steve White G3ZVW

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I have mentioned before in this series that it is possible to reflect radio signals off of objects such as hills and buildings. In one instalment I even detailed how radio signals can be reflected off the moon. In this instalment I am going to detail how signals can be reflected from high flying aircraft. It's known as Aircraft Reflection or Aircraft Scatter.

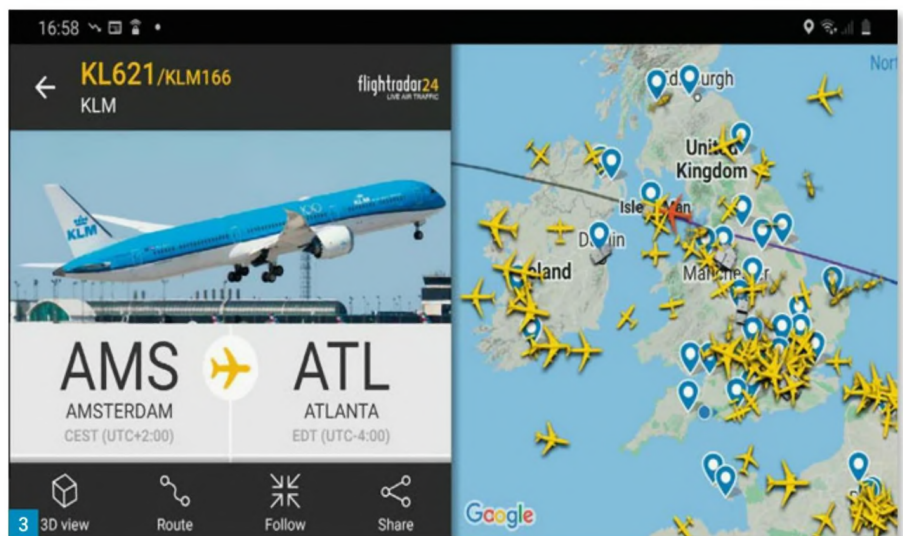
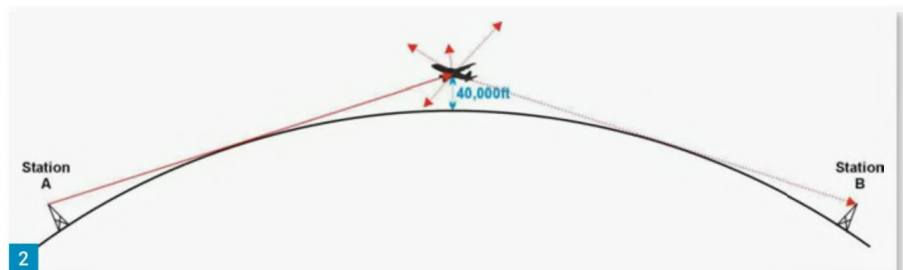
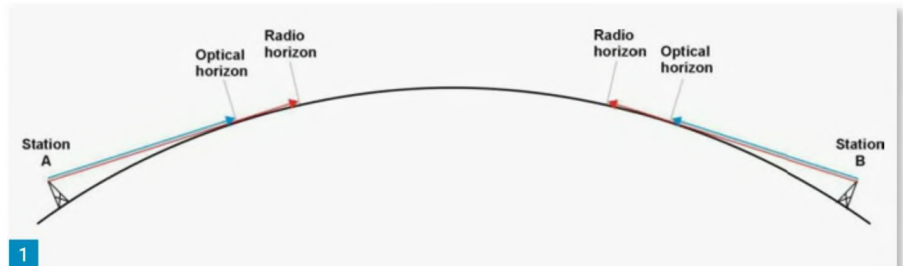
The Horizon

First of all I need to tell you that the horizon as we see it is not the horizon as far as radio is concerned. Here are two terms you may not be familiar with; the Optical Horizon (the maximum distance you can physically see) and the Radio Horizon.

At Long Wave frequencies, radio waves tend to hug the curvature of the Earth. Consequently, Long Wave signals can travel great distances by what is known as Ground Wave propagation. The Radio Horizon for really low frequency signals can be many thousands of miles from the transmitter. Interference permitting, Long Wave broadcast signals can be heard at thousands of miles range, with the ionosphere (the refracting layers of gases about 80-500km above our heads) playing no part in the process.

As frequency increases, the effects of Ground Wave propagation gradually become less and less. By the time we get to the upper part of the Short Wave frequency spectrum, say 20MHz, Ground Wave propagation is generally no more than a few tens of miles.

Ground Wave propagation isn't relevant at VHF and above, but something else comes into play. Effects which take place in the atmosphere (which is much lower than the ionosphere) cause VHF, UHF and microwave radio signals to bend a little. The mechanism is known as refraction. It takes place a lot, but not always to the same extent. At UHF – which is basically what this feature is about – there is a 'rule of thumb', which says the Radio Horizon is about four thirds (or 1.33 times) the Optical Horizon. This assumes no enhancements



to a signal by some other means.

Something to be aware of is that the Optical Horizon (and consequently the Radio Horizon) aren't the same for everyone, or the same in all directions. The Optical Horizon of a station located on top of a mountain is going to be much further away than it is for a station in a valley. By extension, the Radio Horizon for each station will be about four thirds the distance of the Optical Horizon.

In Fig. 1 you can see two UHF stations, A and B. Not only are they way beyond one another's Optical Horizon, they are also beyond one another's Radio Horizon. Under

normal conditions they are not going to be able to hear one another. No QSO!

Geometry

Don't panic, I am not going to get mathematical with you. Instead, take a look at Fig. 2 to see what's going on. It shows the same two stations, but now there is a commercial aircraft flying about half-way between them. Be aware that the illustration is not to scale; it is just to show how things work.

Most commercial aircraft are rated to fly at a bit over 40,000ft, although slightly lower would be the normal cruising

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Fig. 1: Two stations that will not be able to communicate at VHF or above.

Fig. 2: How radio signals can be reflected off an aircraft to a station way beyond your Radio Horizon.

Fig. 3: Typical Flightradar24 screen on a smartphone.

altitude. The plane shown in Fig. 2 is flying at 40,000ft, which is about 7.5 miles, or 12 kilometres. The Optical Horizon and the Radio Horizon of each station is less than it is to the aircraft, but each station can 'see' the aircraft.

Aircraft are made from metal, which – assuming the aircraft is not a stealth plane – reflects radio signals. When a radio signal is reflected off an aircraft it gets scattered in all directions. Only a little of it is likely to go in the right direction to reach a far more distant station, but some of it will. The question is, will that signal be strong enough to be heard?

At this point we should think a little about frequency. At UHF, a commercial aircraft is going to be fewer wavelengths long than the same aircraft is at microwave. This means it is effectively a bigger reflector at microwave. Also, antenna gain per metre of boom length is greater at microwave, making for a better chance of getting a signal through.

Radio signals reflected from aircraft follow a characteristic pattern. Over the course of just a few minutes they fade in, then fade out again. There can also be some flutter on such a signal, although you may not notice it on SSB and CW.

Practicalities

People who use aircraft reflection to make a radio contact don't expect to receive strong signals. That's not to say it never happens, but it would not be usual.

If you want to give aircraft reflection a try, do everything you can to make the contact viable. Even if you get everything right, a path cannot be expected to last very long, because a plane will fly into and then out of the useful region for reflection. Any more than a couple of minutes and you should consider yourself lucky.

As regards modes, FM would not be suitable. SSB and CW would be. Modern digital modes should also work.

Quality equipment can easily make the difference between hearing or not hearing someone, and newer equipment doesn't necessarily mean that it is better than old equipment. What's important is that the receiver has a low noise figure.

Antennas at each end of the link need to

be beams, and within reason the greater the gain the better. Masthead receive preamplifiers will certainly help overcome losses on coaxial cable, which can become excessive at UHF (and above) if cable lengths are long.

As frequency increases, it becomes practical to use beam antennas with higher gain. The upshot of this is that microwave signals reflected off a plane can be stronger than UHF signals, but the downside is that more antenna gain at microwave means less beamwidth, so at microwave frequencies a plane will fly into and back out of the area where reflection takes place quicker, meaning a contact has to be completed faster.

Helping Hands

So, when should you try to hear a distant station by aircraft reflection? Well, if you listen for a beacon station (a station which transmits its callsign 24/7 on a known frequency), any time is good. Otherwise you could try to arrange a sked with someone who has a suitably equipped station.

Flightradar24 is a really useful tool. It can be run on a web browser, or download the app for use on a tablet or smartphone. It shows in real time the positions and flight paths of commercial aircraft, such as the one shown in **Fig. 3**. Moreover, it tells you which are the big planes (likely to be better for stronger reflections) and what height they are flying at (higher gives a greater maximum distance path). Airscout from DL2ALF is also a very good tool. It is more technical to use, so probably not ideal for the beginner.

Distances

So, what is the maximum distance you can expect to hear another station (or be heard yourself) via an aircraft reflection? For a plane flying at 40,000ft, the answer is 245 miles to the aircraft and another 245 miles to the distant station. 490 miles is approximately 785km, so that's about the maximum distance. It will be a little more if the plane is flying higher and less if it is lower, but contacts aren't always going to be at the maximum range anyway.

Finale

In the days of analogue television, flutter and/or interference on terrestrial TV caused by aircraft reflection was commonplace if you received TV from a long way away, i.e. you lived in a weak signal area. These days broadcast TV is digital, so the effect isn't seen any more.

Valve & Vintage

Continued from page 59

improved receiving sensitivity enormously.

Reginald Fessenden (1866-1922), Canadian-American inventor of an alternative to the rotary-spark transmitter that utilised a high-speed alternator to produce a steady radio signal when connected to an antenna. He placed a carbon microphone in the transmission line to impress audio on the radio frequency carrier wave, thus amplitude modulated voice radio was created. He successfully demonstrated his telephony system beginning in 1906.

The Onset of Adolescence

At this point the era of radio had grown from infancy to the adolescent stage. New developments were applied daily and usage was expanding rapidly. In this environment centres of interest with vaguely defined or currently non-existent authorities begin to emerge. These beneficiaries were each concerned with the optimum utilisation of the art of wireless to fulfil their immediate needs. One must consider that at the time the radio spectrum was thought to be very narrow with not much room for competing services. The marine industry, which benefited most immediately, had a strong voice. Governments and their military components, particularly the Navies and the commercial communications organisations, split to pro-cable and pro-wireless also had protectionist concerns. And there was also another voice emerging although feebly – that of a later to be well-defined group – amateurs.

Signor Marconi is purported to have said that, *"I too am but an amateur"*. Inquisitive, ingenious individuals intrigued and inspired were anxious to explore the new world of wireless. Their efforts were encouraged by 'do-it-yourself' articles in books, magazines and journals, their signals began to be heard and they began to hear each other. Manufacturers appeared, offering the more difficult to create station components. The amateur's reward was the thrill of success and the sound of those raw toned notes in their earphones parting the ether. Amateur radio began at this time and in this manner and its history and that of the ARRL is ably presented by **Clinton B Desoto W1CBD** and my preservationist predecessor at the ARRL, **Jim Maxwell W6CF**. Both are now silent keys but wrote well of the circumstances and events surrounding the establishment of the League and amateur radio's subsequent years of development. Their work is readily available. I defer to these gentlemen to bring the reader through the tumultuous formative years of the league and the shaping of the hobby.

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Joe Chester MW1MWD
mw1mwd@gmx.com

Last year I ran a project which involved using 80m with a short vertical during daylight hours (the Marconi Footsteps Project). At that time I asked around for advice about the likelihood of success. I was quite discouraged by some of the replies. But I remember one very clearly: *"it's always good to test propagation, even if the theory says it's unlikely to work"*. And I did make QSOs, but relatively few, and it was hard work at times.

A year later, and the new worldwide health emergency has driven everyone into their homes, and transceivers that haven't been powered up for a while are being dusted off and put on the air. If you want to see this in action, then just look at the Hack Green SDR (available online at hackgreensdr.org:8901). The image, Fig. 1, shows the 80m band on one morning this week. There are QSOs going on right across the band. There are other web based SDRs around – you will find more details of these on websdr.org. However, the one at the old RAF base at Hack Green seems particularly well placed for 80m coverage of the UK.

The 80m band is normally the preserve of groups such as AFORS, WAB, G2OT, and others. There is also a group of DX chasers who live just below 3.8MHz, in the early morning hours. On Sunday mornings, to the regularly daily nets are added the AMSAT group, and various others, and of course, the more or less local RSGB news broadcasts. At night, the band lights up. I have myself worked into Europe, as far as Russia and the Ukraine in the evenings on 80m, with just my inverted-L.

All Change

But that has all changed now. From early on every morning the 80m band is full of activity. Now I'm not going to list everything and everyone I heard in the last few days. But I do want to compliment those who are making a huge effort here. Clubs, who have closed due to Government advice, are now setting up weekly, and sometimes even daily nets. Others who call CQ end up running informal nets. A specific example is **Callum M0MCX** who has started an informal daily net on 3780kHz, just to allow people to call in and say hi. He calls it informally the 'Lockdown Net'!

A few net controllers are struggling a bit instilling net etiquette (you know who you

80m Activity

Joe Chester MW1MWD asks, "has 80m daytime propagation suddenly returned?"



1



2

are!) – but it's all good fun, and some of the jokes are classics! It's been fascinating to hear how many people are operating remote, some just to an adjacent room, and others to shacks out at the bottom of the garden (or even further!). Being 80m, there is lots of talk about various noise cancelling devices. Many people 'chained to the radiator' are talking about getting out and putting that broken antenna back up (don't drag that radiator with you!). And, of course, the virus also gets airtime. It's been very heartening to hear stories of communities organising themselves to deal with this emergency – it makes a nice change from the wall-to-wall doom and gloom of the main broadcasters.

A Useful Service

And these nets are performing a very useful service. At least I think they are. With national broadcasters so focused on the goings-on in London, the 80m band is a great way to hear from people all over the country about what is going on in their village or town. From Norwich to Devon I hear stories of neighbours setting up shopping clubs and other support groups. One operator told us that he had a worrying knock on the door, and when he finally opened it (on the key chain of course) there was a young policeman there: *"just checking up that you're OK; we'll be around if you need help"*.

Finally, I would like to compliment

Radio Round-up

Fig. 1: Signals copied on the Hack Green SDR.
Fig. 2: Those logged into the Hack Green server.

the guys who run the Hack Green SDR – great bit of kit, and a very good antenna (which **Tony G1HMO** tells me is a double sized G5RV, with one end up about 30m). There is a document at the reference below that describes the SDR construction – again Tony says this uses cheap RTL dongles as front ends, with the software running on computers running the MINT operating system. It's a great website for anyone who wants to just listen to the QSOs in progress. But it's more than that. My setup here is not the greatest. But using Hack Green, I can hear everyone in these nets, and then use my setup to call in whenever I can. If I say something to someone who is not hearing me direct, then someone else in the group will relay for me. I have even heard about someone who has designed a DIY kit to make an automatic switch to mute the sound from the online SDR to avoid audio feedback problems. This is a whole new way of using an online SDR! Using Hack Green's online SDR I can hear everyone in the net, and if I can hear and contact someone in the net with my antenna, then my comments can be relayed if necessary. But I would ask for the net controllers to pause regularly and ask for new callers, in case weaker stations (like me, and many others too!) want to join.

Finally, the second image, **Fig. 2**, shows the screen below the first image. On this, you can see the callsigns of people who are logged into the server and the frequency to which they are listening. The entries starting ffff: are the IP addresses of listeners who have not identified by signing in with their callsign.

I wrote this short piece to highlight the huge increase in radio use on the 80m band due to the medical situation. We are still at solar minimum. Classically, daytime propagation on 80m should be rubbish. But it's not. This also highlights once again the problem operators complain about all the time – the lack of stations on the air, usually blamed on the poor propagation. But suddenly, poor propagation is no longer a problem! The issue up to now was simple the lack of people with either the time or inclination to call CQ! The so-called 'lockdown' has sorted this. I suggest it is the same on all the other bands. So, get on the air – any band – and call CQ! Do it now!!

<https://tinyurl.com/m5ptn6e>



GB9NHS: John G3UCQ reports that to show appreciation for NHS staff he used the callsign GB9NHS from April 15th to May 12th and will be using it again until June 10th. During the first period he made over 3,000 QSOs, best DX being Taiwan, Hawaii and Alaska. More information on qrz.com and he has also made a short video of the operation:

<https://tinyurl.com/ya8pxjq8>

ROTARIANS AND AMATEUR RADIO: Rotarians of Amateur Radio (ROAR) was founded in 1966 by their first President, Byron C Sharpe W9BE and is one of the oldest Rotary fellowship organisations. Today 50+ years later ROAR members keep in contact via the airwaves on a Sunday and a Tuesday. They have a DMR, 80m, 40m and 20m nets (get together) when conditions allow.

ROAR is open to any Rotarian who is licensed or has an interest in shortwave communications. One of the goals of the group is to promote international understanding and fellowship. Included in the Rotary mission is that they serve and in times of disaster ROAR members can assist by giving up their time to provide communications, which in some instances is in areas where mobile phones and normal communications do not function.

For more information please look at the website (below) or e-mail G3LUW (e-mail details qrz.com) or G4HCK

admin@rotaryclubofgraysthurrock.co.uk
www.ifroar.org



BBRC NEWS: While suffering from the lack of DXpeditions, members of the Burnham Beeches Radio Club (BBRC) put their 3D printing skills to use. The photos show the results!

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A Low-Cost Microphone Processor

Eric Edwards GW8LJJ
ericgw8ljj@outlook.com

This is a low-cost project with not many parts but the results are very good, providing quality and controlled frequency response from a microphone. It is desirable, and a legal requirement, to keep the modulation within limits to prevent any unnecessary wide transmissions causing splatter and problems for other band users. The ideal bandwidth of an SSB signal is provided with a low frequency roll-off at 300Hz and a high frequency cut-off at 2.9kHz. This should also be the bandwidth limitations for AM as well although wider bandwidth signals are often heard.

Microphone Preamp Module

The unit uses a microphone preamplifier module, **Fig. 1**, with compression. It is available from our Oriental friends and consists of a 10-pin surface mount IC and all the components pre-fitted to provide a microphone preamplifier with selectable noise gate and compression ratio. It is sent with the default noise gate set at -48dBV and the compression ratio is set at 2:1. If you want to change these, it can be done by changing one fixed value resistor for each operation, **Fig. 2**. I have used the default settings and it performs well.

The Circuit

The circuit, **Fig. 3**, comprises the microphone preamplifier module, a high-pass filter (HPF) and a low-pass filter (LPF). The microphone preamplifier module is described above and the output is connected to the HPF with zero gain to remove or attenuate the unwanted frequencies (below 300Hz). The capacitors (47pF) and the 4.7kΩ resistor connected between the two capacitors and pin3 of the NE5534 provide the HPF. This op-amp has a potential divider connected to its non-inverting (pin 3) input via a 10kΩ resistor. Op-amps usually work with a split supply (plus and minus voltage with 0V connected to ground) but it is often practical to power op-amp circuits from a single polarity supply. The problem is that an op-amp is a dual supply device so some type of biasing, using external components, must be used to centre the op-amp's output voltage at mid-

Eric Edwards GW8LJJ is back, this time with a low-cost but effective microphone processor.



supply. This bias voltage is supplied by the two 10kΩ resistors, one connecting to the 5V supply rail and the other to ground. This is a potential divider and provides the half voltage at pin 3, producing the bias. This allows the maximum input and output voltage swing for a given supply voltage.

The output from the NE5534 is connected to an LPF (MAX7426), which is a 5th-order, low pass, elliptic, switched-capacitor filter (SCF) that can be adjusted to define the low-pass cut off. This device is designed to operate from a single +5V supply so no potential divider is needed for this one. The output from the MAX7426 is isolated so there is no need for a capacitor in the output. The level is 1V pk-pk so is at line-level.

Low Pass Filter

The high frequency sharp cut-off is provided by selecting the capacitor value at pin 8 of the MAX7426. An audio signal generator was connected to the input of the processor and the output was connected to an oscilloscope. Selecting different capacitor values connected to pin 8 provided different cut-off frequencies. The signal was at full amplitude shown on the scope for frequencies between 300Hz (approx.) and up to the cut-off frequencies. To give some examples,

a 56pF capacitor placed between pin 8 and ground will provide a 3dB (half voltage output) at 2.55kHz as measured on my test equipment. Replacing it with a 47pF the 3dB point was at 3.3kHz and a 33pF produced 4.35kHz as the sharp 'elbow' 3dB attenuation. Increasing the frequencies after the 3dB points the output level dropped quite rapidly to zero output.

Electret and 'Condenser' Microphones

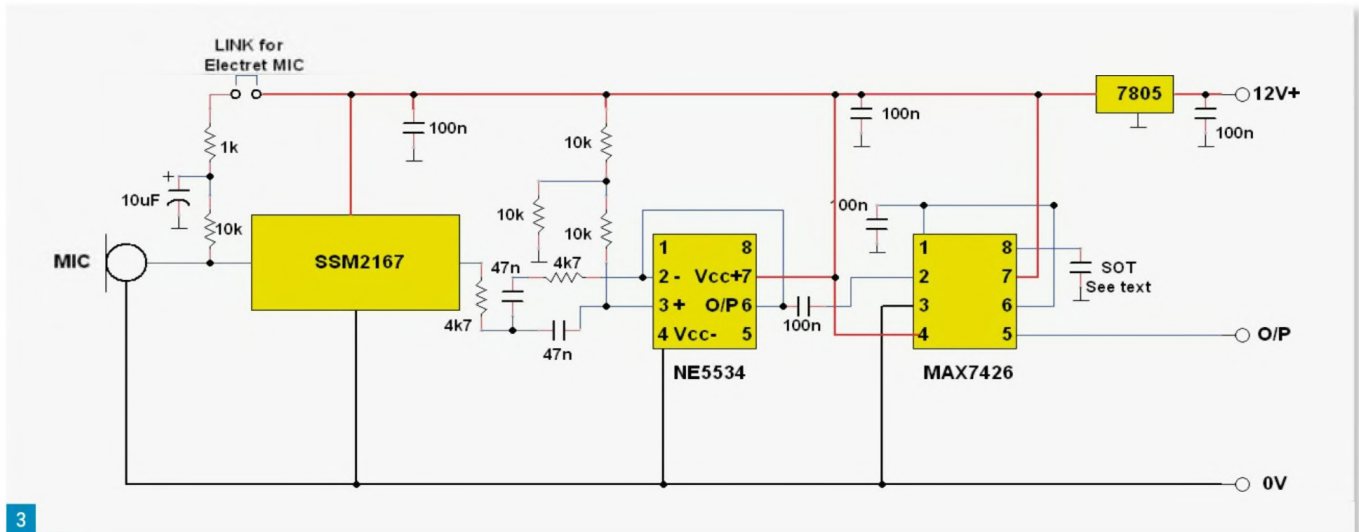
The microphone input to the SSM2167 can be the normal moving-coil type or, with the link in place, an Electret microphone can be used. Note that the link supplies low voltage, but high impedance, for the FET, which is built into the electret microphone module. It cannot supply the voltage required for a capacitor (condenser) microphone because these need up to about 50V. The electret microphone is different and is a type of electrostatic capacitor-based, which eliminates the need for a polarising voltage that is required for the 'condenser' microphone. With the electret type there is a permanent charge built in on the electret diaphragm, which is sufficient to produce a retrievable voltage across it.

There is an FET in the module, which is a high impedance buffer to provide a suitable output when a small voltage is applied to its drain, **Fig. 4**. This voltage in the circuit is provided by the resistor arrangement connected between the 5V supply and the microphone input connection when the link is made. It is decoupled at the junction of the two resistors by a 10μF electrolytic capacitor. Condenser microphones require an electrical current to charge the plates. This is usually provided either by a battery or is sent down the microphone cable itself, known as phantom powering. Most condenser microphones can operate with voltages up to about 50V.

In Use

There are no controls and therefore no setting up is needed. The output should be connected to the line input of the transmitter's modulator and the 1V output from the processor should be sufficient

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3

GATE: (R2)

Noise Gate (dBV)	Value of RGATE
-40	0 Ω (short to V+)
-48	1 k Ω
-54	2 k Ω
-55	5 k Ω

R2 default 1K resistance, can be modified as needed.

COMP: (R1)

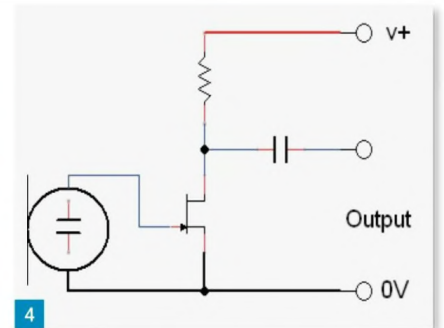
Compression Ratio	Value of RComp
1:1	0 Ω (short to V+)
2:1	15 k Ω
3:1	35 k Ω
5:1	75 k Ω
10:1	175 k Ω

R1 default 15K resistance, can be modified as needed.

2



1



4

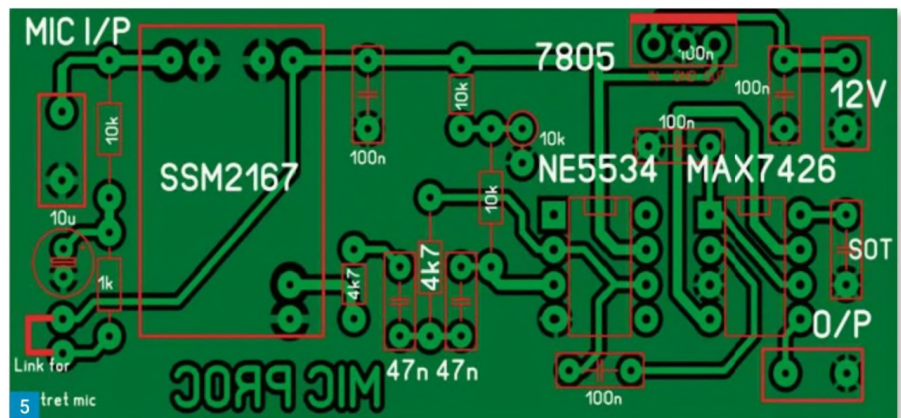
Fig. 1: The preamplifier module.

Fig. 2: Resistor values to change settings.

Fig. 3: The circuit.

Fig. 4: The high-impedance buffer, based on an FET.

Fig. 5: PCB (not to scale).



5

to fully modulate the transmitter. If it is to be connected to the microphone input of the transmitter, then attenuation will be needed to reduce the level to suit the microphone input of the transmitter. The microphone input in this unit has provision for an electret microphone and this is provided by the link as shown in the circuit diagram and on the PCB layout diagram.

PCB

The PCB is single sided FR4 type, Fig. 5, and has a ground plane on the copper side. The microphone module (SSM2167) is provided with a set of PCB pins to enable fixing to the PCB. Two are used

for the power supply, another two for the microphone input and a third pair used for the output. The PCB is drilled to take a pair of pins for the electret supply with a linking socket. A pair of pins for connecting the microphone with a screened lead should be soldered to route to a microphone socket to suit the microphone to be used. Another set of four pins is used for the 12V power supply and the output connections. An on-board 5V regulator (7805) is used to supply all the active components. The PCB is small enough to be fitted in a slim diecast box or it can be fitted inside the housing of a modulator or the transmitter. The 7805 regulator has a metal tab that is

grounded (connected to 0V) and can be used to secure the processor to the wall of the box or other suitable grounded place.

Is there a Kit?

I am providing a 'picking' list with all the parts and PCB listed. Send an e-mail for a list from me.

ericgw8ljj@outlook.com

My acknowledgements to Ray G7BHQ for checking over the written word.

References

SSM2167: Usual auction site for data.

NE5534 data: Internet search.

MAX7426: Internet search.

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Morse Characters

Dear Don,

Here in York I teach at the local radio club, G4YRC. Morse instruction is one of my subjects and I use the sound of characters in my teaching. I can't claim originality for this method but some of your readers may find it helpful? The more common sight of dots and dashes works fine in print but I think the actual sound of a letter is more beneficial. e.g. F = di di da dit, where a dot is a dit only if it's the last dot of a character, otherwise it is sounded as a di (see attached chart). With some letters they may sound a word viz, F = does it hurt you. Q = God save the queen. D = he did it. Then famously V = Beethoven's fifth. There will be others that catch the imagination.

Tony Skaife G4XIV

LETTERS	NUMBERS	
A di da	1 di da da da da	
B da di di dit	2 di di da da da	
C da di da dit	3 di di di da da	
D da di dit	4 di di di di da	
E dit	5 di di di di dit	
F di di da dit	6 da di di di dit	
G da da dit	7 da da di di dit	
H di di di dit	8 da da da di dit	
I di dit	9 da da da da dit (N) da dit	
J di da da da	0 da da da da da	
K da di da		
L di da di dit		
M da da		
N da dit		
O da da da		
P di da da dit		
Q da da di da		
R di da dit		
S di di dit		
T da		
U di di da		
V di di di da		
W di da da		
X da di di da		
Y da di da da		
Z da da di dit		

CHARACTERS

.	di da di da di da	aaa
?	di di da da di dit	imi
/	da di di da dit	dn
error	Eight Dots	
	One dash = 3 dots	

wavelength on top band. ('Aerial' is used instead of 'Antenna' in keeping with the times.) The highest point of the aerial was at about 65ft, as I took the maxim 'lots of wire, high up' as gospel.

A homebrew transmitter using the wonderfully robust 807 valve in the PA in class C (the control grid having a high standing negative voltage), easily handled the 10W DC input to the PA that was allowed in the first year of operation (CW, of course). This rack-mounted unit had an open tank circuit inductor wound of open copper wire with short lengths of wire soldered at intervals sticking out to take a croc-clip connected to the aerial via a variable capacitor (See diagram).

Adjustment consisted of disconnecting the aerial and tuning the PA for minimum anode current, and at resonance the anode current was close to zero (valves were very tolerant creatures!). Reconnecting the aerial, adjustments consisted, at very low power, of varying the capacitor and trying different taps of the PA coil until the resonance obtained was at the same frequency as that with the aerial disconnected, an indication that the aerial was loading properly. If the anode current at resonance now had only a small dip, it meant that (hopefully) most of the RF power was being radiated. Plenty of contacts were achieved on topband and 80m, so it all seemed to work, and there were no bad comments about the signals I put out. With 10W input to the PA, I worked the Shetland Islands and Czechoslovakia on Top Band, and many more local stations.

No SWR meters were available then, and I did not know anyone who had made one, so all transmitting was a somewhat 'poke and hope' procedure. It would be interesting to evaluate with modern techniques what was actually happening.

Robert Dancy G3JRD
Gillingham, Kent

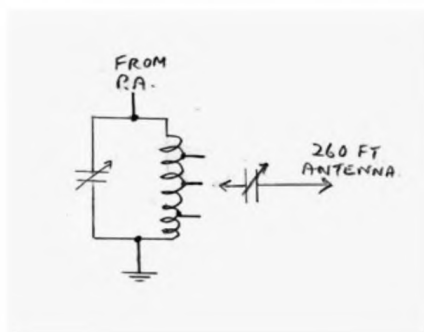
(Editor's comment: 'Primitive' maybe Rob, but I suspect a lot of our readers would be more than happy to put up such an antenna nowadays. Modern gardens are, typically, so small that any sort of horizontal wire is a challenge!)

A Newcomer's Journey

Dear Don,

Back in January I wrote to you to say that as a new beginner, I wasn't in favour of a Beginner's Licence. I felt that Ofcom had already made provision for untrained amateurs with CB Radio and PMR446. I wanted to update you on my journey. I have joined the good people at G4BRA (Bracknell Radio Club) and have enjoyed meeting with them – most recently by zoom – and also listening in to their weekly 'nets'. I've continued my studies, and yesterday I sat the Foundation Exam, using the new online invigilation that the RSGB have made available so quickly. I'm pleased to say that I passed and have already ordered the Intermediate Book! The whole experience has been entirely positive.

I would like to thank Rob Cridland G7LAS, everyone at G4BRA and the RSGB for making this possible, even in lockdown. My views on a Beginner's Licence haven't changed. The training for the Foundation Licence isn't too arduous, and with online invigilation, taking the test is relatively easy. I'm sure that my local club will help me in the bits I've missed out on by not doing the practical test. It seems to me that all the bits are in place, and there is a renewed interest in amateur radio. All we need to



do is to promote it better outside our own community. And this should be the focus of discussion – how do we take what we already have and make people more aware of the benefits of our hobby.

73 (I think I can say that now).

Tim Jinkerson
(waiting for a call sign)
Wokingham

A Primitive Aerial and Tuner in the 'Old days'

Dear Don,

When I was first licensed in 1953 I had plenty of room for aerials, way out in the Kent countryside, but we had no mains electricity, which at least meant no TVI problems. An 80ft oak tree and a mature yew served as supports for an end-fed inverted-L aerial, 260ft long, about a half

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Pole Supports

Dear Don,

Following your article about using fibreglass poles as antenna supports, I thought that you may be interested in the pole fixing solution that I've adopted. The pictures explain it all; a tanalised fence post with a galvanised steel fence post ground mount driven into the ground. The post is fitted with two large cable clamps (found on eBay) secured with 8mm coach head bolts to hold the pole vertical and a galvanised steel 90° bracket to carry the vertical load. The pole is strapped in place with two adjustable quick release straps. A few turns of self-amalgamating tape around the pole protect it from wear at the securing points.

This arrangement has been in use with an unguyed 12m Spiderbeam pole for over five years with no signs of degradation.

Ron Taylor G4GXO
Penrith



Do Transistors Wear Out?

Dear Don,

I have just bought a Zenith 7000 radio made in about 1970 although carriage, p+p and import duty bumped up the price to have it shipped from America. I always wanted one after seeing them in my Dad's *Readers Digest* so it's only taken 50 years to get one.

It was advertised as working but the VHF band wasn't working nor the BFO. However, it was from a charity shop so I couldn't expect them to know too much. The other bands all worked.

My question is, after seeing a few of these being repaired on YouTube and replacing a transistor or two gets the set working again, do transistors wear out? Is 50 years about the limit for transistors? Even nuclear fuel rods are not an unlimited source of energy and have to be replaced so you could say they wear out.

I remember this was first raised in the late 60's or early 70's as transistors became popular in equipment and people were asking if they wear out like valves and lose electrons. Is it that they wear out or fail due to less stringent manufacturing processes in transistors in those days? None of the videos shows anything else going faulty to cause them to fail and in my radio simply swapping transistors brought the VHF band back to life, which is easily achieved because they are in sockets.

They must have been expensive to produce as everything is hard wired – think of black and white televisions with the

turret tuner and tag strips. In my opinion they are a beautiful design to look at, and heavy. When I unpacked it, I thought there was a brick inside and that was without the nine D cell batteries. And this was supposed to be a portable radio!

I just tried two BC173's in the FM RF and FM oscillator mixer stages and they work fine.

Bill Kitchen G4GHB.
Ashton-under-Lyne

(Editor's comment: I've never heard of transistors wearing out Bill but, as you say, nothing is forever and perhaps, for example, there is a gradual deterioration of the junction. But maybe one or more of our readers can shed light on the topic?)

Early Days

Dear Don,

Following **Geoff, G3JUL's** letter in the April issue, I have stirred myself to peck out these words.

In 1956 I met a pretty girl at Luton College of Technology and dared to phone her. Brass neck paid off and we began walking out – a better description than 'Dating'.

When first I arrived at her Mother's house, the home wireless – as it was called then – was the famous Natalie Kalmus rig, the 1155. Fast forward to after our wedding, the furnishings were mostly donated. One was a domestic radio with a Trawler Band, on which with my Wife's encouragement, I began listening to radio amateurs. It then transpired that my Wife's late Father, while not licensed, was a keen listener and had been one of the Secret Listeners, which explained the 1155.

As, by then, I was a member of the

Admiralty Ferry Crews, I saw the benefit of becoming licensed, which I did.

Working at Marconi in Basildon I bought a marine receiver at a nominal price, so now I had a trawler receiver and could listen on Topband.

Having passed the RAE, I went to GNF for the Morse test. This was taken in the transmitter hall and I failed. In my defence, I could have done with an hour in freezer to warm up after the Transmitter Hall. Also, I suspect that the last time the examiner had sent at 12wpm was when he, himself, was moving from 11 to 13wpm.

I persevered, with help from friends, and tried again at PO Headquarters in London.

There were two of us. The other was a teenage lad and we sat and listened to the receiving test and it was beautiful Morse. At the end we asked the examiner if that was really 12wpm or was he going slow. He said that he had sent at 14wpm because as he started at 12 wpm, we seemed to be coping well so he cranked it up.

He then said only one could be in the room for the sending so, as the older, I volunteered to sit it out. When I did go in, I was invited to get comfortable and practice a bit, which I did. And then said I was ready. When I got to group number three a fellow in white overalls came in and would not be hushed and demanded to know what colour did they want the walls painted.

After some sailorly language he left and I asked if I should continue or start again. The examiner then said that he had heard enough and gave me a pass slip. I went downstairs and presented the pass slip and RAE pass to get my call sign. The lady put a hard-back foolscap book on the counter and said I could choose any unallocated

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Various

Dear Don,

It is so nice to see *PW* arrive on my doormat (I am a subscriber). It brought a bit of normality to my QTH in this otherwise very abnormal world. My local WH Smiths is closed for the duration so a benefit of my subscription is that I don't have to take a 25 minute bus trip into Nottingham to buy a copy (and, of course, your subs rates are also less than I'd pay for an over the counter copy).

Thanks very much for running ZF1AFS's articles on soldering coax connectors. I'd add a final step to the process – check for open and short circuits on the coax. I've a good reason for this. In my early days in amateur radio I was shown the 'pig tail' technique to fit coax onto a PL259. The braid was teased into two pigtails. The coax was then very carefully pushed into the PL259 so that each pigtail could be pulled through the holes in the body of the PL259 and, after the centre pin had been soldered, these pigtails would be soldered to the exterior of the body. Need I say that it wasn't difficult to get a short from pigtail to centre conductor (it took only one short strand of wire from the braid)?

I gave up on this method and followed the instruction in the **Bill Orr** books (which I've read from cover to cover).

Thank you also for your article about using fibreglass poles. Malta and Gozo have lots of village fiestas and they use poles in sockets from which to hang flags, bunting and lights, etc. The sockets are usually permanent and are usually a tad oversize, which means they use lots of wedges to position the pole vertically. These poles are usually 15 to 20ft (guesstimate), but some are much longer.

Letters about *Titanic*, Feb: **John Ashmore** mentions that **Howard Littley's** callsign was 2NV (which became G2NV). 2NV is a post-WW1 callsign, issued sometime in or after 1920 and he would not have had it in 1912 when the *Titanic* sank. The RSGB's *The Bright Sparks of Amateur Radio* includes a copy of the *Directory of Experimental Wireless*

Stations published by AW Gamage in 1924 (anyone remember the Gamage's shop in London?). There are two call letters assigned to H Littley. LBX was held by H Littley at West Bromwich, 13 Lodge Road, which is in line with the info in John Ashmore's letter. LBX was transmit on 300-500m and receive on 50-8,000m and its Usual Times of Working were 7.30-10.30pm.

LSX was held by H Littley at West Bromwich, Pheonix (sic) Works, Swan Village. Transmit was 200m, receive was 50-2,500m and Usual Times of Working were 'Various for experiments'. The next entry is LUX, which was held by **J Scott Taggart**, and it took me a while to search through this directory because of noting all the famous names in it. Imagine if we'd need a separate licence for each band on our radio's bandswitch.

I have a 1937 Flying Horse callbook which shows G2NV at Radiohm, Bridgnorth Rd, Stourbridge, Worcestershire. G2NW is shown as 'same as G2NV', which I assume is a continuation of his two pre-WW1 licences. G2NV is in the RSGB's 1968 callbook, which shows his address as The White House, Steephill, Ventnor, Isle of Wight. He isn't in the subsequent three RSGB callbooks.

I smiled when I saw that his 2NV callsign became G2NV when country prefixes were added because 2NV could now be a valid UK callsign given that the UK has the '2' prefix block.

While browsing the Gamage's directory I also saw an entry for VXA, which was held by **Magnus Volk** at Selborne, Hants. Volk's Electric Railway at Brighton claims to be the world's oldest operating electric railway. I was in Brighton some years ago and couldn't resist going for a ride on this railway. Selborne is in East Hampshire between Alton and Petersfield. Might be the same Magnus Volk though he seems to be associated completely with Brighton.

Trio and Kenwood, March: In your article about the 930/940/950 transceivers (p.48) you wrote that Trio later became part of the much larger Kenwood stable. I heard an alternative version from a retailer, which was that

Kenwood badged its products as Trio for the UK market because Kenwood was already in use as a trademark (**Mr Kenneth Wood's** kitchen machinery). I might have got this from Lowe's at Matlock when it started to import Trio into the UK. I have a niggling feeling that a Lasky's catalogue shows Trio equipment some years before Lowe imported them. I think that Lasky's had a wholesale company named BH Morris and this might have been an importer of Trio.

Lasky's were a London based company with several shops selling audio/hifi equipment. I think the flagship shop was on Tottenham Court Road not far away from the Heathkit shop. They also had a shop on Edgware Road near to Henry's and Smith's and extended their shops around the country. We had one in Nottingham. Its main competition was a shop called (I think) Ace Audio. Lasky's didn't mind too much if it lost a sale to Ace Audio because Lasky's owned Ace Audio.

One exam or three, April: G4DTD's letter suggests that newcomers would like a single licence rather than a three-tier licence (might he mean 'exams' rather than 'licence'?). I agree with your comments.

A single exam would probably not be a challenge to someone who is already involved in electronics and radio. For someone who is coming 'cold' into the hobby or who wants to establish a station and talk by wireless to other people (HF for me, I'm a short wave enthusiast at heart) then the three-tier structure has an obvious attraction.

Amateur radio involves a range of skills including electronic and electrical engineering, mechanical engineering and some understanding of the legal structure underpinning our licences.

Put yourself in the place of someone who has retired and is looking for a hobby to occupy some of their spare time (yes, I know that for some retirees this is a purely theoretical concept). You've limited time and you have a choice of interesting hobbies, including amateur radio, photography and model railways, so which of those three hobbies might be the most challenging for a newcomer to enter? It's not only retirees; what of the teenager going to university or college? They may have similar constraints on

Continued on page 70

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Continued from page 69

time and the same choice albeit with a lower budget.

My guess is that amateur radio is usually the one of those three hobbies perceived as being the hardest to get into because of the exams and perhaps also of the cost of equipment (second-hand cameras are comparatively less expensive than second-hand radios and model railways have a low cost entry level for simple layouts).

It's not only our exams/licences that are tiered. I'm shopping around for a new HF transceiver and the tiers seem to be:

- up to £600 for an FT-818 or FT-450;
- up to £1k for an FT-1200 or TS-480SAT or small Elecraft;
- up to around £1.5k for an FT-3000 or Elecraft or IC-7300 or IC-705;
- up to £4k for an FTdx101 or TS-890;

I find it hard to make a choice because for my purposes they don't differ greatly. I wandered around the National Hamfest last year, card at the ready, and didn't find a radio that appealed to me more than its competitors. I looked at the FTdx101 on the Yaesu stand and was tempted to put in a bid for the FT-101E alongside it. I'm not a serious DXer and I'll probably be happy with any radio that

gets me some HF contacts. I've dithered over an IC-7300, an IC-705 and an FT-3000 but if I needed to buy one tomorrow, I'd probably go for an FT-450D. Of course, I might take the covers off my FT-757GX and see if I can get it working again.

In April's *Letters* page **Bob G4PVB** says he puts fuses into both positive and negative power lines. The advantage seems to be that if the negative line's fuse blows, then other connected equipment can't use that line. The disadvantage seems to be that if the negative fuse blows it does not disconnect the positive line from the radio, which means that the radio appears dead but it does still have volts attached to it.

I remember this two fuse technique becoming popular with my friends' mobile installations in the 1970s. I think it was liked, because it could disconnect the negative/chassis lead, until they realised that other paths through the radio to chassis might be available via the coax and antenna.

Might be one for **Harry G3LLL** to write about. I think he has mentioned common grounds/chassis/earthing in several of his articles.

Ian Brothwell G4EAN
Nottingham

line on that page. Now XOI rolls of the key nicely so I chose that.

I then bought a Codar AT5 and set up a long wire so was on the bands. Later came a Sommerkamp transmitter and matching receiver. I then got a 2m converter and bought a 2m receiver.

Later I was asked to help a friend, Joe (not then licensed), to help take down a flagpole used by a local amateur and having done so, he said "take it away, it's yours".

With the heel on a boat launching trolley we wheeled it along luckily quiet roads and Joe made me a bracket and a tabernacle at the bottom of the garden while I made a mast. Then a talk at the local Vange club on trap dipoles so I made one leg and put it up. 3.5MHz trapped for 7MHz but, as I once wrote, "If you use thick wire it is too thick to know it cannot radiate, so it does", and as it worked well on topband, I took down the long wire. My best contact was a NZ aeronautical amateur.

I bought a 6-over-6 and that went on top of the 40ft flagpole. So, to two metres.

My 2m rig worked well and one evening I stepped my way across Holland and France to mid-Germany. I also had regular skeds from Essex to Portsmouth and Essex to Holland. Mind you, being at 70m asl may have helped.

Alan Gordon G3XOI
Shoreham-by-Sea

Next Month

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



REVIEW: DX COMMANDER 10mABV MULTI BAND VERTICAL: Steve Telenius-Lowe PJ4DX reports on a multiband vertical suitable for both home and portable operation.

REVIEW - VE3NEA HAM COCKPIT: Steve Ireland VK6VZ reviews an exciting software program from VE3NEA.

REVIEW - THE MCR COMMUNICATIONS G5RV ANTENNA: Vince Lear G3TKN checks out this commercial version of the popular G5RV antenna.

MAKING A START ON 630m: John Adams G3ZSE explains how to get started on the 630m band.

VALVE & VINTAGE: A look at the Eddystone S750, by Dr Bruce Taylor HB9ANY.

There are all your other regular columns too, including Carrying on the G3RJY Way, HF Highlights, World of VHF, Notes from a Small Station, In the Shop, The Morse Mode, Making Waves, What Next and Data Modes.



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