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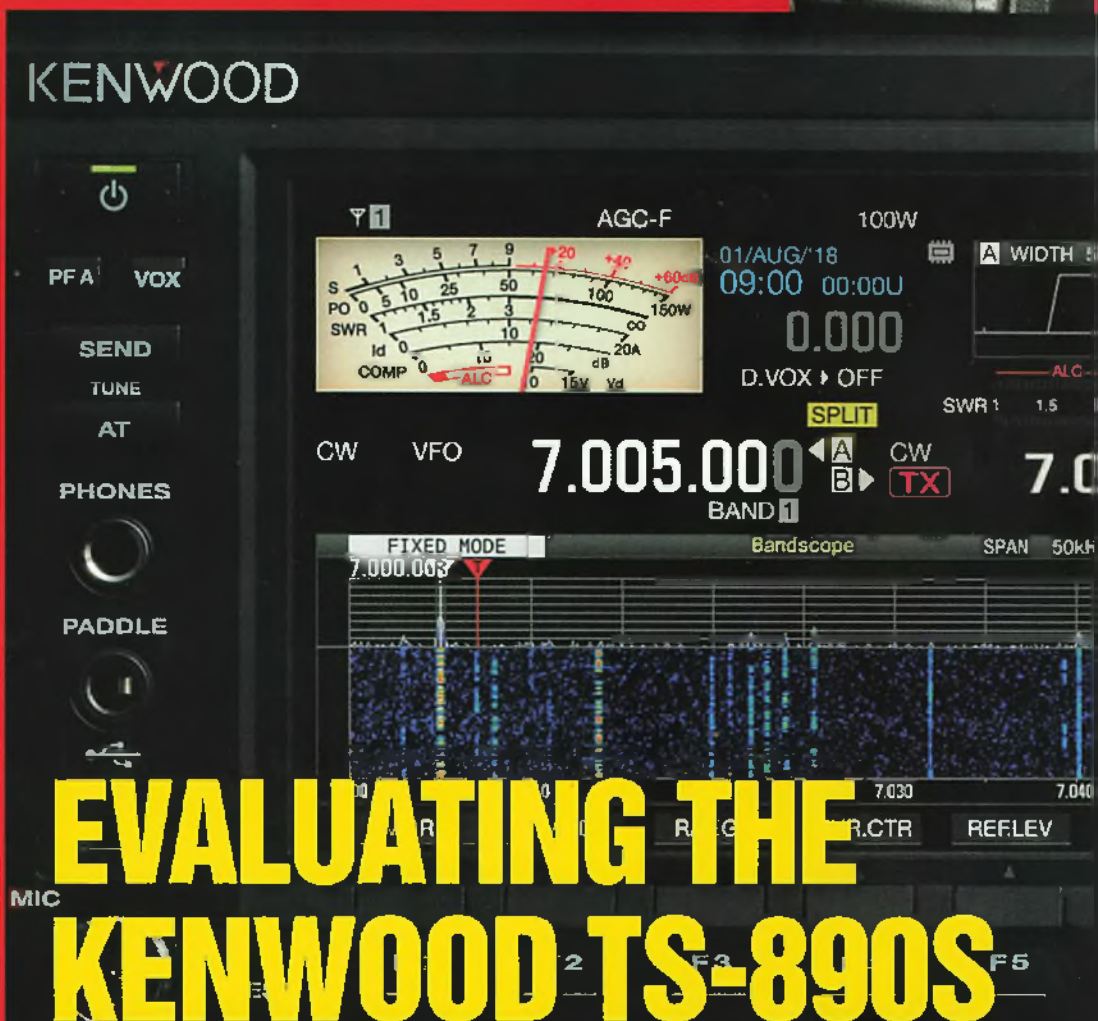


# EVALUATING THE KENWOOD TS-890S

Practical Wireless REVIEW

**A HANDS-ON REVIEW BY AN EXPERIENCED DXER AND CONTESTER**

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Peter Waters G3OJV

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Peter Waters G3OJV, operates the first FT-DX101 to come into the UK.

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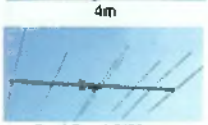
New!

2/70cms

4m



Dual Band 2/70cms

2m

70cms

23cms

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| PA144-432-19-3-2C | 2m 7 element 70cms 12 elements | £199.95 |
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| PA144-8-3 | 2m 8 element Yagi 3m boom | £125.95 |
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All antenna are rated at 1kW

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No ATU Needed
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40-20-15-10m
**EFHW-8010** 132ft
80-40-30-20-17
15-12-10m

Peter Waters G3OJV says, this has to be the perfect wire antenna solution for many. End fed makes installation easy. No ATU is a big plus. I use one myself and it beats the pants of the old G5RV.

MyAntenna EFHW-4010 .....£149.95
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Diamond CX-310V .....3 Way N .....£116.95
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Watson CX-SW2PL .....2 Way PL .....£34.95
Watson CX-SW3N .....3 Way N.....£59.95
Watson CX-SW3PL .....3 Way PL .....£54.95
Watson CX-SW4N .....4 Way N.....£79.95
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RCS-8VNX..5 Way standard VHF N .....£193.95
RCS-12X.....8 Way auto band sensor....£334.95
RCS-12LX...As above + static protect..£377.95

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| TO1104 Plus | 100MHz | 4 Ch |
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# Keylines

**Don has been on his travels again, marks the passing of George Dobbs and reflects on some topics in this issue.**

**I took a week out in March to return to the Gambia, primarily to operate in the RSGB Commonwealth Contest (as C56DF).** I always find that contest more fun from outside the UK because you can then work UK stations. Indeed, I was delighted to work regular contributor **Victor G3JNB** on 20m and our previous HF columnist **Carl GW0VSW** on two bands (40 and 20m), the significance being that both Victor and Carl are QRP operators, running 5W to modest antennas. I was running 100W with my Icom IC-7300 to a dipole on the rooftop of a three-storey apartment block. I made just over 400 QSOs in the contest and a similar number prior to the event, all on CW. All good fun.

While in the Gambia I paid a visit to PURA (the regulatory authority) and met the folk who had issued my licence. **Rodine Renner**, the senior person, wanted to know more about amateur radio, having previously attended a seminar at the ARRL in Connecticut, where the benefits of the hobby, especially for emergency communications, had been explained. He asked for background material and enquired of me whether second-hand or subsidised gear might be available, given the lack of resources in the Gambia. I promised to follow up with the RSGB and the IARU and, in any case, left copies of *PW*, *RadioUser* and *RadCom*. I'm hoping I can follow this one up although from previous experience in West Africa, I know how hard it can be to achieve any sort of continuity.

## G3RJV SK

As I've said before, I tend not to run obituaries because, sadly, there would be too many. But I couldn't let the passing of the **Rev George Dobbs G3RJV** go by without a mention. George was an icon of QRP operation, recognised internationally, and for many years a welcome contributor to *PW*. See our *News* pages for a little more background. RIP George.

## Making Waves

**Steve White G3ZVW** talks this month in his *Making Waves* column about broadcast antennas for HF operation. His article reminded me of a memorable 40m QSO I made in the 1983 CQWW CW Contest, with AH0C in Saipan. I had never worked Saipan on 40m but this station was a huge signal from early afternoon onwards. I couldn't understand why until, later, I discovered that the team had managed to gain access to the curtain array of a broadcast station, putting even the largest amateur radio antenna installations into the shade. As is often said, it's all down to the antennas!

## Staying QRV in Old Age

Many radio amateurs find the hobby a lifeline as they age and I know of at least one very elderly amateur who remains active from his old people's home with a bit of wire out of the window as an antenna (presumably they feel his radio activities benefit his welfare). But for others, it's a problem. One reader asked recently what, if anything, can be done to help those who want to stay on the air but are too infirm to take care of the logistics themselves.

There is no single answer though I'd welcome reader thoughts. In some cases, a local club will rally round and help, especially if the amateur concerned has been a long-time member. For some, the internet-based alternatives (Echolink, Network Radio, or perhaps D-STAR, DMR or Fusion with a local hotspot) will provide a way of remaining in touch. Indeed, some clubs go further, and set up a station that members can access and use remotely over the internet. Sadly, this is rare, if only because few clubs can boast a permanent station.

## Japanese Morse

**Roger Cooke G3LDI's** mention in last month's *Morse Mode* of Japanese Morse reminds me of a wonderful anecdote I heard on a tour of Bletchley Park (BP). I was there with my family and our tour guide was **Ray Goff G4FON**. He told us that on one of his tours there was a family that included a very elderly grandmother who had asked to be taken to BP while she was still able to get about. They thought it a curious request but obliged. It was only when there that she admitted, having never previously mentioned a word, that she was fluent in Japanese and had worked on Japanese codes and cyphers at BP during the war. Needless to say, her family were somewhat open-mouthed at that revelation!

Don Field
G3XTT


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**E-mail:** practicalwireless@warnersgroup.co.uk

## JVCKENWOOD UK appoints Martin Lynch & Sons as sole UK Distributor

Established in 1990, Martin Lynch & Sons Ltd (ML&S) is Kenwood's largest amateur radio distributor/retailer in the UK and from April 2019 becomes its sole UK distributor for Kenwood Amateur Radio products.

**Mike Atkins**, Director, Communications Division, JVCKENWOOD UK, comments: *"We are committed to the amateur radio market where we have been a major driver of technological and product advances since 1958. The appointment of Martin Lynch as sole distributor for the UK reflects the continued support and commitment from Martin and his excellent team over the years, while the specific focus and increased flexibility they bring, I'm confident, will prove to be of great benefit to UK retailers and the Ham Radio community alike".*

Managing Director **Martin Lynch** commented, *"I've been selling Kenwood transceivers since the late seventies and witnessed incredible products, including the TS-830, TS-930, TS-940, TS-950, TS-990 through to their current benchmark performance transceiver, the TS-890S. Kenwood continue to design and manufacture equipment that is respected around the world by serious operators who value performance and reliability. My team and I are delighted to have achieved this appointment for sole distribution through our hard work promoting and supporting the Kenwood brand."*

## Hereford Morse Code Bootcamp

**Andy G0IBN**, **Sandy G0VQW**, **Bob G3IXZ** and **Rich G4FAD** are hosting a Morse Code Bootcamp near Leominster in Herefordshire on May 4th, 0830 to 1630 local. The cost will be £10 per person. There will be different groups for sending and receiving Morse; under 12WPM, up to 20WPM, and 20 and above. They want to help develop practical CW skills and look at different types of key and how to adjust and send with them. They will discuss and demonstrate different ways of using a computer to practice receiving Morse; also logging and contesting.

The event is open to all but places are limited. To book, please contact Rich G4FAD via his e-mail address, which is on QRZ.COM.


## WOLFWAVE Advanced Audio Processor

SOTABEAMS report that they are now stocking the WOLFWAVE audio processor: WOLFWAVE is an audio processing system that includes sophisticated bandpass filtering, noise reduction and even age-related hearing correction. All these facilities have been designed to help users increase their enjoyment of voice, data and CW communications.

WOLFWAVE also includes a useful low-distortion audio test generator that can generate one or two tones for transmitter testing. Another novel feature is an experimental CW Regenerator that gives noise-free CW reception.

WOLFWAVE features a bright OLED spectrum display and on-screen help, all powered by the latest ARM low-power processor with a 20-bit CODEC. There are separate audio outputs for headphones and a loudspeaker.

WOLFWAVE firmware is upgradable so users will always benefit from the latest developments. Such is the flexibility of the WOLFWAVE hardware that other enhancements are sure to follow.
Details at:
**https://tinyurl.com/y3axkm7j**

## DUAL Antennas from Nevada

Nevada Radio have announced the introduction of a new range of VHF/UHF high-quality beams from DUAL, a Serbian company owned by **Goran YU1CF**.

Goran uses a professional 3D EM design package that allows him to accurately predict the influence of the boom, feed, balun and connectors. This results in a real-world design that ensures the antennas are perfectly optimised, predictable and very reliable. The Dual Yagi range covers from 50MHz up to 23cm and will be available from May at both Nevada and Waters & Stanton, exclusive UK dealers.

## Falkirk & District Exam Successes

Falkirk & District Amateur Radio Society were very pleased with the results from their latest Foundation course. The two candidates, **Shaun** age 11 and **Bob**, recently retired, show first-hand the attraction of amateur radio across the generations.

Shaun, son of **Steve MM0SAJ**, is now the youngest licensed member in the history of the club.

The photo shows Shaun MM7CFC and Bob MM7PCO with **Ken GM4NTX** (centre), Lead Instructor for the club.

## George Dobbs G3RJV

**George Dobbs G3RJV** passed away on March 11th. George was a pioneering figure who made QRP (low power – 3W at first but now usually considered to be 5W or less) operation an important aspect of amateur radio in its own right, founding the G-QRP Club (in 1974), giving talks, developing projects and writing constantly for a range of publications, including this one.

Many radio amateurs unknowingly had George as an early mentor because he was author of the popular Ladybird book *Making a Transistor Radio*, a great six-step journey from crystal set to three-transistor TRF set, all built on a piece of wood with wiring secured using wood screws.

George was a retired vicar in the parish of Sudden near Rochdale. According to a posting by *PW*'s last editor, **Rob G3XFD**, on the *Southgate Amateur Radio News* website, his death was attributed to pneumonia that failed to respond to antibiotics. **Jo**, his wife, was with him when he passed.

The link below is for the obituary and tributes on the RSGB website. **Georg Wiessala**, *RadioUser* editor, was due to attend the funeral on behalf of *PW* and *RU*.
https://tinyurl.com/y4ha8y54

## HMS Belfast

**Doug Goodison G0LUH** reports that GB75DDAY Will be run from HMS Belfast from June 1st for 28 days. Over the years a number of commemorative callsigns have been activated from onboard HMS Belfast. A full list appears on the GB2RN entry on qrz.com

## New Headphones from bhi

bhi report a new addition to their accessories range. This is the HP-1 wired 'over ear' folding stereo headphones. The bhi HP-1 headphones are suitable for radio communications as well as general purpose use. They are comfortable to wear due to the lightweight design, adjustable headband and the soft leatherette padded ear cups. This helps to eliminate the uncomfortable pressure feeling that can be created by closed over-ear type headphones, allowing you to listen for longer. The cable is 1.9m long terminated with an integral 3.5mm stereo jack plug. The headphones are supplied with a 1/4in stereo-to-3.5mm stereo adapter. Order code HP-1, price £19.95 inc. VAT. Available direct from bhi on 01444 870333 or from one of their authorised dealers.
**https://tinyurl.com/y2gf6y8y**

## Special Event Station GB2ORM

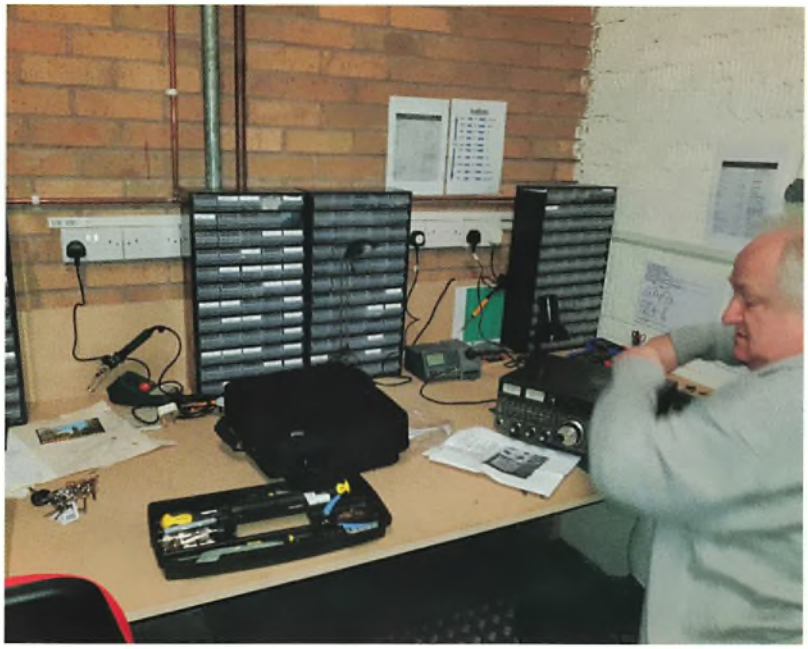
**Tony Mottram MW6TMQ** reports that the North Wales Radio Society will be running a special event station from June 7th to 9th to commemorate the 75th Anniversary of the D Day Landings on June 6th 1944. The location will be from the Great Orme, near Llandudno. This location played a vital role in WW2 with its Gunnery School positions, RAF radar station and the famous Mulberry Harbour Construction site, all within view of the Great Orme Country Park.

The station will be run in conjunction with fellow members of the Dragon Amateur Radio Club, who are providing their antenna system plus valuable manpower to help run the station throughout the weekend.

A small party of Air, Army and Sea Cadets will also be involved to help educate them into amateur radio and to join in remembering and respecting all those who fought and lost their lives during the D Day operations.

In conjunction with the Llandudno Branch of the Royal British Legion, a dedication ceremony at the on Llandudno Promenade will also be held for the Saturday, and various Cadets and members of the RBL will also be present to conduct a short service of remembrance.

Further details at:
www.nwrs.info/special-event-station.html



# Newton le Willows New Shack

Newton le Willows Amateur Radio Club are going from strength to strength. With some careful money management, plenty of enthusiastic volunteers, and a little bit of blood sweat and tears, they now have some shack space.

The club concentrated efforts last year on clearing out an unused storeroom at the current locations (Derbyshire Hill Family & Community Centre) and preparing it to be transformed into a fully functioning shack, complete with HF, and VHF/UHF stations, and a large workbench area complete with solder stations for construction.

Now that the shack is up and running, the club is hoping to return to field events this year, operating from Winter Hill, Penmon Point and possibly some other areas as well.

The club is now set for continued growth and is actively seeking new members to help it continue its expansion. They meet every Thursday evening from 1845 to 2100, as well as the first Sunday in the month (other Saturdays are on a week to week basis).

If you would like to know more, e-mail **enquiries@nlwarc.co.uk**, or feel free to visit on Thursday evenings.

# Alpha Antenna from Moonraker

Moonraker have announced two new antennas from Alpha Antenna:

The Hexstick Deluxe is an HF, VHF, UHF portable antenna for 20 through 10m, plus 440MHz. The HexStick™ is described as "a high-performance and full-sized resonant vertical that forms the first building blocks for what can later be transformed into the Hextenna™ with just a few added components. No tuner is required, as you simply adjust the length of the telescopic whip and counterpoise when changing bands.

*"Expand your HexStick™ into the Hextenna™, which adds a full-sized 2-40m dipole to your antenna toolkit. This would also include a user configurable option to deploy the HexTenna™ as a 2-15m HF Delta Loop (with a user supplied jumper wire between the tips of the dipole elements) or HF/VHF Yagi beam (by using multiple Hextenna™ systems).*

*"The whip for the HexStick™ is telescopic, so as to enable you to adjust the whip and counterpoise to make the HexStick™ resonate as close as possible for the band you are using. This is not a 'no tune all-band antenna' but is a full-sized high-performance antenna system".*

Further details about the HexStick and Hextenna can be found on the Moonraker or Alpha Antenna websites. Prices are expected to be around £250.

**www.moonraker.eu**
**https://tinyurl.com/y25my5a4**

# SOTA News

**Neil Griffiths G0WPO, from Rochdale in Lancashire, has attained SOTA (Summits on the Air) Mountain Goat status for reaching 1000 activator points.**

**Neil first became aware of SOTA when hiking over Moel y Gamelin GW/NW-042 in North Wales and bumping into an activation in progress. His first activation was on Cyrn-y-Brain GW/NW-043 in 2015, and Mountain Goat was achieved in the Lake District, on Stony Cove Pike G/LD-018.**

**As with many people, SOTA has inspired Neil to brush up on the CW and use that mode in his future activations. In the photo, Neil is pictured with one of SOTA's founders Richard Newstead G3CWI, up on the summit of Cyrn-y-Brain GW/NW-043. For more information about the SOTA awards programme, please visit:**

**www.sota.org.uk**

**The highest referenced peak in SOTA at the time of writing is Aconcagua LUM/PH-001, 6962m ASL, in the relatively new Argentina (Mendoza) association.**

**This was activated on February 16th by Tom Rudzinski SQ9FVE, operating as LU/SQ9FVE. Tom is an experienced and skilled mountaineer and as required for such an undertaking, planned the expedition carefully, including all necessary support.**

**The climbing to the summit began some 13 days ahead of the activation and included several camps and acclimatisation strategies. The actual activation took place at 1747UTC and comprised five QSOs on 2m FM, all with Argentinian chasers located around 90km away.**

**Review** by Ron Stone GW3YDX

• E-mail: gw3ydx@yahoo.com


1

# Kenwood TS-890S

**Veteran DXer and contest operator, Ron Stone GW3YDX puts the Kenwood TS-890S through its paces.**

**This radio arrived well packed and with a comprehensive user manual.** A minor quibble that I have is that there is no index to the manual, and it can be lengthy to search it for a particular item. It would have been helpful perhaps to include a CD version of the manual, with searchable database. Meantime a useful workaround is to download the manual from the Kenwood website in pdf form and search the pdf document by opening a search of the document with Ctrl+F.

## Overview

The TS-890S, **Figs. 1** and **2**, is the latest top-of-the-range transceiver offered by Kenwood. It covers all bands from 1.8 to 70MHz, with 100W output (50W on 70MHz) There are very many configurable options and features in this transceiver as reflected by the thick user manual. This review cannot possibly cover more than a fraction of them, so I've outlined some that I found particularly of note. The sidebar, from the Kenwood website (below) highlights some of the features but I would also recommend downloading and studying the PDF brochure, available on the same site.

https://kenwoodcommunications.co.uk

The first impression of this radio is that is solidly built and beautifully finished. For a radio without an internal power supply – it requires an external 13.8V DC supply – it is quite heavy at 16.8kg. All controls are solid in feel and logically laid out. The controls to which the operator most needs access are correctly placed on the bottom row of control knobs.

This contrasts with the rather odd placement of controls on other radios (the strange placement of the main receiver AF/RF gain well above that for the sub-receiver on the Icom IC-7610 comes to mind).


2

It's possible to receive outside the amateur bands without decreased performance, retaining all receive features, including the spectrum display. However, the radio is locked to the Region 1 bandplans for transmit. There is even a special screen displaying the broadcast bands for those who like to listen to those bands, simply accessed by pressing the F [SWL] button.

Three bandstacking registers per band are available but that may be menu-expanded to five. Additionally, Kenwood have implemented something common on Icom and some other radios for a long time – an option of a faster tuning rate as the VFO tuning knob is spun faster. This is really a boon when the radio is set to a slow tuning rate and the user wants to move more quickly around a band.

## Bandscope

Part of the big touchscreen display can be devoted to a most wonderful bandscope, as depicted in **Fig. 3**. Unlike with some others, there is no slewing of the signal traces as you tune the band, as the bandscope tries to catch up with the tuning speed. The reason for this is very simple. At the default setting, the Kenwood designers stop the trace until the VFO or RIT tuning has stopped. The bandscope is a great aid, particularly for honing in on those faint traces that are often good DX. However, the traces do not identify the signals as the guy down the road or that elusive Pacific DX. Maybe it will be possible with enhancements to

Fig. 1: The TS-890S. Fig. 2: Rear panel view.
Fig. 3: The waterfall display.


have the traces labelled with the callsigns on CW by interfacing the radio with the internet. This is alreacy possible with other radios using an external IF coupler in conjunction with software such as NaP3, which, on CW and RTTY, takes callsigns from DX spots and the RBN to label the traces. Theoretically it should be possible to use the USB link from the radio to do this but an IF output socket would have been a nice idea anyway. I'm no PC expert and didn't go further down the road of attempting to interface other panadapter display software with the radio. If any of our *PW* readership find a way of doing it, please let the editor know and the rest of us will benefit.

The Bandscope's finest definition is ±2.5kHz of the central frequency while the coarsest is ±250kHz, cycling through intermediate scan ranges. However, the cycling only goes one way, pressing plus for the next scan range, but it is impossible to cycle it in the reverse direction. Instead of 'SPAN' for changing the ranges, it would have been better to have 'SPAN +' and 'SPAN –', given that there are unassigned buttons, which could have been used for that. The bandscope is very sensitive. Weak signals in the noise have an easily visible trace and many times good DX has been found like that. There is an option of a regular 'moving needle' or bargraph display for RF Power, SWR, S-units and so on. Although it's a virtual display, the 'moving needle' display looks very much like a real meter. The display also shows a lot of other parameters, most of which can be user-configured. The 'vital statistics' – the frequency display for both A and B VFOs, and RIT – are displayed in large easy-to-read characters that I can read without glasses.

One little quibble is that if slow tuning is selected (e.g. 1kHz per turn of the main tuning knob), then the RIT becomes very slow indeed, at 50Hz per revolution. That's far too slow. I'm going to contact Kenwood about a couple of firmware changes. Fast RIT tuning while in slow main tuning is one of them. During the recent ARRL CW contest, constant rapid cranking of the RIT control got very tedious, particularly as I was doing a single-band 80m entry and had had about four hours sleep all weekend. Then I had a light-bulb moment. There is an excellent and very sensitive 'CW-T' button that when pressed automatically brings the signal into the centre of the filter passband. I used that for the remainder of the contest, meaning there was no need to use the RIT again.

## CW, Memories, Split Operation

Various display colour options are available but I found that the default option was as good as any, so remained with it for the duration of the review.

CW can be used in FULL-BK (full break-in) but the internal switching relays are quite noisy in that mode, even while wearing headphones. In transceivers of this class, silent solid-state switching should really be the standard.

Although this radio hasn't got two receivers, split frequency operating is very well thought out. A bold SPLIT appears in yellow on the screen, with a 'delta frequency' marker also appearing to the right of the display. In other radios I've forgotten to turn the split off because it is not so obvious. The way the TS-890S indicates split is very clear. Listening to the transmit frequency is easy, by pressing the XFC button.

CW memory functions could have been better implemented. There are two methods of entering text into memory. The first is by paddle. A paltry12 seconds is provided for paddle entry. This is totally inadequate, especially as the memory does not accept characters reliably. At 30WPM there is barely enough memory to enter CQ DX DE GW3YDX twice. The other method of text entry is by text input. That works well but instead of eight 50-character memories, it would have been better to provide four 100-character memories instead.

## PC Interfacing

Interfacing to a control PC is everything we have come to expect of modern top-of-the-range radios. A single USB cable back to the host PC can not only provide frequency information for logging programs, but also control for the data modes and CW. I set up the link for both FT8 and for regular RTTY via my logging program, Logger 32, and for RTTY and CW through my favourite contest program, N1MM+ Logger. Setting up of this link is complex, and needed recourse to the manual, which allowed me to complete setup without any mistakes.

As well as using a PC to decode RTTY – and, with the appropriate program, CW – it is possible to do both (and PSK31 and 63) on the TFT touch-screen display. The decoding works very well on those modes with the decoded text displayed in a window, with a helpful tuning aid in another window beside it. Even weak signals were rapidly decoded. **Fig. 3** shows the CW decoding screen. Outgoing Morse is also decoded and displayed, allowing a check of your own character spacing.


**Fig. 4: Morse decoding on screen.**

## Other Features

Although this is a multi-mode transceiver, I used it only on SSB, CW and RTTY. I prefer a 300Hz low beat note for CW. This is possible within the range of 300-800Hz available.

Kenwood seems to have thought of every operator's needs in this radio. As well as being able to record speech for CQ calls and the like, there is a facility to record both received speech and CW for later playback. That can be done both internally and on to an external thumb drive inserted into the front-panel USB connector. Recording that way is only limited by the capacity of the drive and can be many, many hours.

As with a few of the top-of-the-range radios, an external screen may be connected but oddly, instead of the HDMI or SVGA connector you might expect, a DVI socket is provided on the rear of the radio. All the reviewer's monitors are 15-pin D-sub connectors for SVGA, so I had to buy a cable adaptor. On a 17in external monitor, the display was very clear.

Connected to N1MM+ for contests, and Logger 32 for regular use, the transceiver was a dream to use. I'm lucky insofar as I have a good antenna farm, including phased verticals on 80m, Yagis on 40m and above, and a high 160m dipole. As well as regular use around the bands, some time was spent in the CQ WPX RTTY contest, the RSGB 160m CW contest and the ARRL DX CW contest. The transceiver handled all contests very well. In particular, there were some massive signals around in the 160m contest. There was no sign of overload, or the transceiver AGC being driven by even close-in strong adjacent channel signals. The spectrum waterfall display was extremely useful when trying to find a CQ spot on busy bands. Received signals on CW were clear and not mushy in any way. I'm a bit of a fusspot about the CW sidetone arrangements and have been known to use an unpleasant-sounding sidetone as an excuse for poor Morse! No excuses with this transceiver. The sidetone is lovely.

There was no SSB contest during the review period and most of my SSB operation was on 40m. With the Yagi, European signals can be massive. There were no signs of the receiver struggling to receive weak DX close to them unless, of course, their transmission was dirty. That was easy to establish because dirty transmissions showed up as spiky messes (a technical term!) on the bandscope. It was indeed amazing how often two equally strong signals were very different in the bandwidth they took up.

## A Comparison

My standard of comparison for receiving is the excellent Ten-Tec Orion 2, sadly no longer made. Long testing on CW showed that the filter shape of the TS-890S seems tighter in the skirts. Without using the TS-890S CW peak filter, the Orion is slightly ahead on receiving very weak signals in the noise. This is probably due to AGC issues in the TS-890S DSP, which cannot be overcome by menu changes.

Without the audio peak filter, there were some occasions when the Orion would copy weak DX when the TS-890S struggled. However, when the peak CW audio filter was engaged on both radios, it had the Orion beat nearly every time. Given that I've found my Elecraft K3 to be inferior to the Orion with weak signals, the TS-890S really is a superb radio for digging out the weak ones on CW.

On SSB transmit, the audio quality both with and without the processor was among the best I've ever experienced. That wasn't with a super-expensive studio microphone but the basic fist microphone supplied. I have a fairly bassy voice and the 17-band (!) graphic equaliser was extremely useful in giving greater emphasis to the higher voice components. A monitor for both audible and graphical-display may be used to check the quality of the transmitted signal. This graphic equaliser, by the way, can also be used to tailor the received audio on each mode, and automatically switches to your preference depending on mode selected.

No tests were possible on the bands above 21MHz, conditions at the time I had the TS-890S being pretty grim.

The transceiver also covers 70MHz. The reviewer has no dedicated antennas for that band, so a 3-element SteppIR was pressed into service, with the centre dipole element being shortened accordingly. The local 4m beacon was copied quite adequately and a quick test also showed that the 50W available on 4m could be generated with no drama.

### Brief specification (from Kenwood website):

- Four kinds of built-in roofing filters: 500Hz / 2.7kHz / 6kHz / 15kHz (270Hz Option)
- 7in Colour TFT Display:
- Roofing Frequency Sampling Band Scope
- Band Scope Auto-Scroll Mode
- Multi-Information Display, including Filter Scope
- Clean and Tough 100W* Output
- 50W/70MHz
- Built-in High-Speed Automatic Antenna Tuner
- 32-bit Floating-Point DSP for RX/TX and Band Scope
- Remote operation via LAN port, no PC required

## Conclusions

My overall conclusion is that this is an excellent transceiver, particularly for CW operators who demand absolutely top performance. However, some will find the absence of a full sub-receiver troubling because very good transceivers with sub-receivers are available in the same or lower price range. Having said that, the TS-890S has a wider range of configurable options than any other transceiver your reviewer has ever used, and very good basic performance.

[*It should also be noted that, although Ron was unable to check it out, Kenwood have included a facility to use the TS-890S alongside a TS-590, working seamlessly together to offer the same facility as an included second receiver* – **ed.**]

As ever it is up to prospective buyers to evaluate the features/performance/price balance for those transceivers available on the market before making a choice.

The TS-890S is available from all major UK amateur radio retailers and the price was recently reduced to around £3500 (from a launch price of £4300).

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**Feature** by Steve Telenius-Lowe PJ4DX

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# Brexit and the British Radio Amateur

**In a very timely piece, Steve Telenius-Lowe PJ4DX discusses operating from mainland Europe under CEPT licence conditions and what impact, if any, Brexit will have.**

**Summer's coming soon...** and that means holidays. For many radio amateurs it also means taking a rig and antenna with them in order to operate abroad under the terms of the so-called 'CEPT Licence'. Before this came along you had to apply for reciprocal licences in each country visited, **Fig. 1**, a time-consuming and sometimes tedious business. For more than three decades the CEPT Licence has taken all the hassle out of licensing when operating from abroad – but will UK amateurs have to start applying for reciprocal licences again after Brexit?

## But First, What is 'the CEPT Licence'?

The official name of the CEPT Licence is *"Recommendation T/R 61-01 CEPT Radio Amateur Licence"*. CEPT stands for *Conférence Européenne des administrations des Postes et des Télécommunications* or 'the European Conference of Postal and Telecommunications Administrations' (for the purposes of this article, the terms *"T/R 61-01"*, *"the CEPT Licence"* and *"the document"* are used interchangeably).

This all sounds very bureaucratic and full of 'EU speak', so what happens after Brexit? Will it still be possible to operate from your beachside hotel in Spain or Greece, or from your holiday home in France or Tuscany (should you be lucky enough to have one)?

## The Good News

First, the good news. The CEPT is not an agency of the European Union and, even before Brexit, CEPT included a number of non-EU countries such as Albania, Turkey, Ukraine and the Russian Federation. Brexit therefore makes no difference at all to the terms of T/R 61-01: British radio amateurs with a Full licence will still be able to operate from the 49 (at the time of writing) other political countries that have signed


1

up to T/R 61-01 – as well as many more DXCC entities besides – without the need to apply for a reciprocal licence.

The full list of those countries can be found in the T/R 61-01 document itself. The document can be viewed on, and downloaded from, the CEPT European Communications Office (ECO) website at the URL below by clicking on *"ECC Recommendations"* at the top of the page, then scrolling down the page to *"CEPT Radio Amateur Licence"*. The document can be saved in either Word (.docx) or PDF formats.

**www.ecodocdb.dk**

Or you can go straight to the PDF version by using this URL:

**https://tinyurl.com/yajh624h**

## The Less Good News

The not such good news is that, as the International Amateur Radio Union (IARU) Region 1 website makes clear on its 'Operating Abroad' page, *"T/R 61-01 bears no relation to the import and export of amateur radio equipment, which is subject only to relevant customs regulations."*

**www.iaru-r1.org**

In other words, although T/R 61-01 exempts you from having to apply for an overseas amateur radio licence it confers no exemption whatsoever from customs duties. Here, Brexit may well have an impact on overseas operation by British radio amateurs.

In the past there were no customs checks when visiting any of the other 27 EU member countries. When entering an EU country from another EU country, whether travelling by air or sea, you simply walked or drove through the 'Blue' customs channel. Unless there is a deal that keeps the UK in the Customs Union (unclear at the time of writing, but this has repeatedly been ruled out by the Prime Minister) that won't be the case after Brexit. After Brexit, you will need to check what the regulations are in the country you are visiting, and then take the decision whether to go through the 'Red' or 'Green' customs channel.

If you go through the Red channel, you may be asked to provide a bond, which should be refunded to you when you leave the country with all the equipment that you took in. Having said that, most countries will probably permit a small amateur radio station (such as a mobile or portable transceiver, 13.8V switch-mode power supply, antenna wire and coax, and a fibreglass 'fishing rod' type antenna support) to be considered as part of your 'personal effects'. If that is the case, it should be permissible to go through the Green ('Nothing to Declare') customs channel.

In either case I would recommend you take receipts for the purchase of the equipment to show at customs if you are stopped for a check. It should also help to show your home licence and a print-off of the T/R 61-01 document.

RECOMMENDATION T/R 61-01 – Page 5

ANNEX 2: TABLE OF EQUIVALENCE BETWEEN THE CEPT LICENCE AND NATIONAL LICENCES IN CEPT COUNTRIES

Countries wishing to modify their entries should send a letter to that effect to the Chairman of the ECC with a copy to the Office.

Table 1: CEPT countries

| CEPT countries | Call sign prefix(es) to be used in visited countries | National licences equivalent to the CEPT licence |
|---|---|---|
| 1 | 2 | 3 |
| Albania | ZA | CEPT[1] |
| Austria | OE | 1 (old also 2)[2] |
| Belarus | EW | A[3] and B |
| Belgium | ON | A |
| Bosnia and Herzegovina | E7 | CEPT 1[4] |
| Bulgaria | LZ | Class 1 |
| Croatia[5] | 9A | CEPT |
| Cyprus | 5B | Radioamateur Authorisation |
| Czech Republic | OK | A |
| Denmark | OZ | A |
| Faroe Islands | OY | A |
| Greenland | OX | A |
| Estonia | ES[6] | A[7] and B[8] |
| Finland | OH | L, P, T, Y |
| Aland Islands | OH0 | L, P, T, Y |
| France | F | HAREC, class1 and class 2[9] |
| Corsica | TK | HAREC, class1 and class 2[9] |
| Guadeloupe | FG | HAREC, class1 and class 2[9] |
| Guyana | FY | HAREC, class1 and class 2[9] |
| Martinique | FM | HAREC, class1 and class 2[9] |
| St-Barthelomew | FJ | HAREC, class1 and class 2[9] |
| St-Pierre/Miquelon | FP | HAREC, class1 and class 2[9] |
| St-Martin | FS | HAREC, class1 and class 2[9] |
| Réunion (Glorieuse, Jean de Nova,Tromelin) | FR | HAREC, class1 and class 2[9] |
| Mayotte | FH | HAREC, class1 and class 2[9] |
| French Antarctica (Crozet, Kerguelen, St. Paul & Amsterdam, Terre Adelie) | FT | HAREC, class1 and class 2[9] |
| French Polynesia & Clipperton | FO | HAREC, class1 and class 2[9] |
| New Caledonia | FK | HAREC, class1 and class 2[9] |
| Wallis & Futuna | FW | HAREC, class1 and class 2[9] |
| Germany | DL | 1, 2 and A |

[1] The existing (old) licence classes 'A' and 'B' have become the new licence class 'CEPT'. For the licence holders with Morse proficiency (old licence class A), which is from now on (as of 03 December 2010) an additional option, the information regarding Morse proficiency is added as remark.

[2] The existing (old) licence classes '1' and '2' have become the new licence class '1'. For the licence holders with Morse code proficiency (old licence class 1), which is from 15 September 2003 no longer a requirement of T/R 61-01, information regarding Morse code proficiency is added as remark (for countries still retaining Morse).

[3] Morse code proficiency is required for use of HF bands. To obtain the Class A licence, a radio amateur is required to have Morse code proficiency.

[4] National radio amateur regulation is under review. Morse proficiency is not required.

[5] For the time being the national licence and CEPT licence are separate. The national licence includes more data.

[6] The call sign prefix has to be supplemented with the digit designating the region where the amateur station is operating.

[7] The national A and B licences correspond to CEPT licence and allow the access to HF bands. Foreign CEPT licence holders can operate in Estonia for up to three months with rights granted by Estonian national B class without any additional verification. For A licence the confirmation of Morse code proficiency (min 5 words per minute) is required.

[8] In France from 23 April 2012 there is only one licence class 'HAREC'. Old licence class 1 and 2 holder keep the benefit of their class and their personal call sign.

Edition of 2 January 2018

**Fig. 1: Three pre-T/R 61-01 licences from the 1980s: top Sweden, middle Finland and bottom the Netherlands. (The Netherlands licence came with a small sticker that you had to attach to your transceiver to show that it was properly licensed!) Fig. 2: Jamie Williams MOSDV used the CEPT Licence to operate as PJ4/MOSDV from Bonaire in 2018. Fig. 3: Annex 2 of T/R 61-01 lists the countries you may operate from, and the prefix you should use when operating from abroad.**

And, assuming the UK does leave with some sort of a deal, there will be an 'implementation period' until at least December 31st 2020 during which the UK's relationship with the EU will stay largely the same, so for the moment at least there should be few difficulties.

An alternative to taking your own equipment abroad is to use an existing station, **Fig. 2**, if you know of one available. This is also permitted by the CEPT Licence and circumvents any potential issues at customs.

## What to Do?

The 49 other countries that accept the CEPT Licence can be determined by referring to pages 5 to 10 of the document, **Fig. 3**. If you plan to operate from any of these countries, you should download and print a copy of the latest version of the document and take it with you, along with a copy of your home licence, and make both available for inspection if so required.

The document is updated from time to time, so ensure you have downloaded the most recent version shortly before your overseas operation. The date of the latest update can be found at the bottom of the title page, **Fig. 4**. But beware – there are several older versions of T/R 61-01 available to download from various other sites on the internet, so you should only ever use the official CEPT ECO site as listed above.

When operating, you simply use your own callsign preceded by the prefix of the country concerned. You can check what this is from the second column in the tables on pages 5 to 10 of the document. You may add the suffix /P after your own callsign although this is not mandatory, but you should add /M if operating mobile.

It is generally accepted that the CEPT Licence can be used for periods of up to three months at a time. If you plan to operate from abroad for longer than three months, you should apply for a recipro-


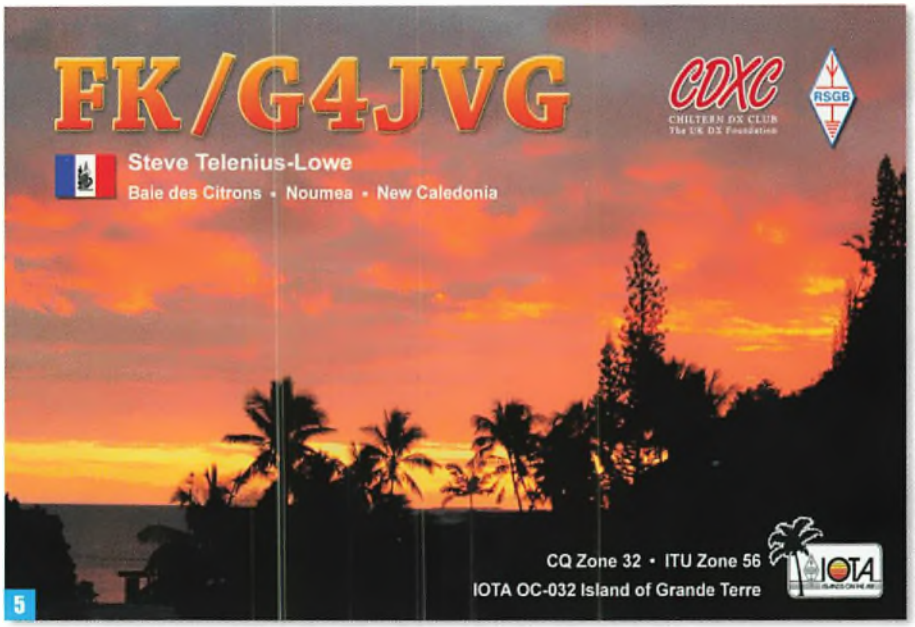


**Fig. 4: Check the bottom of the title page of the CEPT Licence to make sure you download the latest version of the document.**
**Fig. 5: While living in the Far East I took advantage of the CEPT Licence to operate from New Caledonia during a holiday in 2009.**

cal licence. If you have a Full UK licence, in many countries it is possible to get an equivalent full licence abroad by first obtaining a 'HAREC' (Harmonised Amateur Radio Examination Certificate) from Ofcom. This is also an option if you make frequent visits to a particular country, for example if you own a holiday home or if you often visit family living abroad, even if it is for periods of less than three months. The HAREC has come about as a result of another CEPT Recommendation, T/R 61-02, and full details can be found in that document, see:
**https://tinyurl.com/yahyuz5g**

## What's In and What's Out?

Unfortunately, there still seems to be a lot of confusion about what is, and what is not, allowed under the terms of the CEPT Licence, even though it has been in existence since 1985. For example, last summer a Russian amateur operated as HV/Rxxx from the Vatican, even though the Vatican has not signed up to the CEPT Licence. The Vatican City State is, however, a CEPT member country, which may go some way to explain the confusion. There are five more CEPT member countries that have not signed up to T/R 61-01 – Andorra, Azerbaijan, Georgia, Malta and San Marino – so if you intend to operate from any of those six countries, you will need to apply for a local licence from the relevant licensing authority.

On the other hand, there are quite a few more countries and territories that are not members of CEPT but which have nevertheless accepted the terms of the CEPT Licence. These are Australia, Canada, Israel, the overseas countries and territories of the Kingdom of the Netherlands (Aruba, Curaçao, St Maarten and Bonaire, St Eustatius & Saba), New Zealand, Peru, South Africa and the USA.

Within all these 'political countries' there are many more DXCC entities from which you may operate under the terms of the CEPT Licence. Just as England, Scotland, Wales, Northern Ireland, the Isle of Man, Jersey and Guernsey are all separate DXCC entities but for the purposes of the CEPT Licence are listed under the United Kingdom, so several other countries also have 'bonus DXCC entities' included within them. For example, Greece includes the separate DXCC entities of Crete and the Dodecanese Islands (Rhodes, Kos, etc), Italy has Sardinia, Spain includes the Canary Islands, the Balearic Islands (Mallorca, Minorca, Ibiza, etc) and the Spanish North African territories of Ceuta and Melilla, France includes Corsica, and there are many more such entities covered by T/R 61-01 both within and outside the EU area.

## What About Intermediate and Foundation Licensees?

Because T/R 61-01 only applies to the UK Full licence, those with Intermediate or Foundation licensees are unable to take advantage of this privilege. Despite this, a number of other countries also have their own beginner or novice licence schemes and some of them will grant a reciprocal licence to UK Intermediate or Foundation licensees. The difference between this and the CEPT Licence is that you do first need to apply to the licensing authority of the country concerned, with a copy of your UK licence, requesting permission to operate – and usually well before your date of travel.

A list of countries that have a CEPT Novice licence can be found by downloading the *CEPT Novice Radio Amateur Licence* document from CEPT's European Communications Office website. Click on *"ECC Recommendations"* at the top of the page and scroll down to *"ECC/REC/(05)06 CEPT Novice Radio Amateur Licence"*:
**www.ecodocdb.dk**

These countries are the ones most likely to issue a reciprocal licence to holders of UK Intermediate or Foundation licences, though they are by no means the only ones – it's always worth asking, they can only say no.

## Summing Up

I have personally operated from around a dozen DXCC entities under the auspices of T/R 61-01 over the last 30 years or so, **Fig. 5**, and, incidentally, have never had a station inspection or had to show my licence to anyone during that time.

Before you go, it is well worth reading the advice about operating abroad on the IARU Region 1 website (URL listed above). But the bottom line is, don't let Brexit put you off operating from abroad: give it a go, it's fun!

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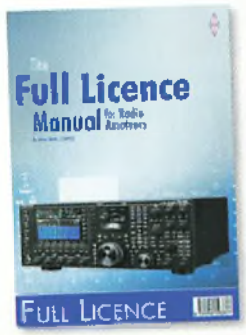


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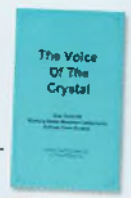


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# Baofeng UV-5RC Plus 144/432MHz handheld transceiver

**Tim Kirby G4VXE wonders just what you can expect from a dual-band handheld that costs less than 30 quid! And we give you a chance to win the review radio.**

**Chris Taylor G0WTZ asked us the other day if we'd like to have a look at the latest version of the ubiquitous UV-5RC transceiver from Baofeng.** Since the transceiver was originally released there have been various versions, each with a few changes. What does the latest version bring to the table? We thought we'd take a look.

The key thing about this and other Baofeng products is the price. The UV-5RC Plus retails at £29.95 from Moonraker, delivered from the UK and coming with a two-year warranty. At that price, even if it were just a receiver, you'd probably consider it good value! But, of course, it's a transceiver, with up to 4.5W output on 2m/70cm. The main features are summarised in the sidebar.

In some quarters, Baofeng is not popular and indeed, in the US now the rigs are actually illegal to use if they are capable of transmitting outside the amateur bands. But, although they are not the same quality as a handheld from the big three, they are, after all, a fraction of the price. So, is it worth having one in your shack?

## First Impressions

The review model arrived from Moonraker, well packaged. The transceiver itself comes with a battery (1800mAh), antenna, charger and cradle (fitted with a UK plug), earpiece/microphone and instruction book. Chris had also supplied a speaker/microphone, a battery eliminator and a programming lead with the Baofeng software, which are optional extras.

Having used a UV-5 before, I fitted the battery and the antenna and switched on. The first thing to do was to switch off the keypad beep and the voice announcements, which I have to say I find annoying – but your mileage might vary!

Programming from the front panel is fairly straightforward once you get used to it, so I changed one of the VFOs to the frequency of the local 145MHz repeater, GB3RD, set the repeater shift and CTCSS tone and was pleased to find that I could access the repeater, from inside the house at a distance of 20 miles or so. Although it's reasonably easy to do this, the best thing is to program up the memories with the channels you want to use, repeaters and simplex. You can do this from the front panel, if you are brave, but I have always used either the Baofeng programming software or the excellent CHIRP software on a PC.


The first challenge though, was getting the programming cable to work. Because most of the programming leads from the Far East use fake Prolific chips, if you use the latest Prolific drivers, the cable won't work! I found an excellent article on how to deal with this (see URL below), which recommends using an earlier driver. I tried this and found that the cable worked – as did a cable for a Yaesu rig that used a genuine Prolific chip!

https://tinyurl.com/y5nruab7

Having got this working, I fired up CHIRP on my PC, having found out that the programming cable was operating as COM3, and did a quick download from the radio to the PC. This is the easiest method, I feel. Download the file from the radio, work on it on the PC and then push the file back to the radio. It's probably worth saving a copy of the configuration on your PC as a backup. I quickly programmed up five or six memories with some local and not so local repeaters as well as 2m and 70cm FM calling channels.

Something that is specific to the UV-5RC Plus supplied by Moonraker is that it only covers the 2m and 70cm bands and you cannot program an out-of-band frequency. Should you wish to do that for any reason, it's a simple matter of changing a couple of parameters in the configuration in CHIRP and you can then program a much wider range of frequencies – but Moonraker took the view that with a number of countries taking a tougher stance on what frequencies can be covered, they would supply the rig as an amateur bands only transceiver.

## On the Air

The morning after I'd programmed up the rig, I was surprised to switch it on and find that the GB3UK repeater on the Cotswolds, some 40 miles away, was coming through well. I found I could just access it from inside the house but popping outside, **Ken G0PPM** reported that my signals were a bit scratchy but quite readable. Not bad at all.

Transmit audio from the UV-5RC Plus seemed quite acceptable although I found I had to talk the rig up a bit more than I would normally expect to. The Baofeng speaker/mike produced slightly more tinny audio on transmit, I found, but in situations where a speaker microphone is useful, it seemed acceptable. On receive, the audio

had a slightly more bassy tone than the rig's internal speaker, which I thought was quite pleasant. If you have any Kenwood handheld speaker microphones, you will be able to use them with the UV-5RC Plus.

The battery eliminator allows you to slip the battery out of the UV-5RC Plus, slide in the 'fake battery', which is connected to the power cable and 'cigar lighter' style plug to fit into a car's accessory socket. Should you wish to listen to the rig in the car, this will save you worrying about the battery running down. The rig's antenna socket is SMA-Male so you'll need an SMA-Female adapter to your car's mobile antenna if you're using one.

At one point, I forgot the rig was scanning and fired up my 2m FT8 transmitter, running around 50W only a few metres from the UV-5RC Plus. To my surprise, the Baofeng receiver didn't protest and kept working on both 2m and 70cm without any intermodulation issues being apparent.

The scan speed of the rig is relatively slow but is useful to keep an ear on the active channels around you.

## Conclusion

It's hard to argue against a dual-band handheld for under £30! The first dual-band handheld I ever owned was a Yaesu FT-470 and I'm pretty sure I paid around £400 for it. Some people complain that the Baofeng's receiver is prone to intermodulation although I didn't note any such issues during the review period. Others have found it hard to program from the front panel, which I think is fair. However, once you have sorted out the issue of the drivers for the programming lead, it's easy to program from the computer.

As a handheld to go with you when you are walking the dog or walking on the hills, or even out in a small boat, you can't go wrong. If you lose it or get it soaked, you will be annoyed but at least you will only be £30 out of pocket. It's also a very simple and cost-efficient introduction to the world of VHF/UHF FM if you want to see what activity is like around you. You could do a lot worse than take a UV-5RC Plus up a local hill to see what you can hear, or have it scan the local repeaters and calling channels when you are at home.

Very many thanks to Chris Taylor of Moonraker for the loan of the review model and accessories. The UV-5RC Plus costs £29.99, the Baofeng UV-5SM Speaker Microphone costs £9.95, the Baofeng UV-5BE Battery eliminator costs £9.95 and the Baofeng UV5-PR PC Software and USB Cable also costs £9.95. All are available from Moonraker UK Ltd.

### Features/Specifications

- Frequency Range R Key Features/Specifications (as supplied)
- Frequency Range RX: 136-174/400-480MHz
- Frequency Range TX: 144-147/430-440MHz
- Channel Capacity: 128
- Channel Spacing: 2.5/5/6.25/12.5/20/25kHz
- Operating Voltage: 7.2V
- Standard Battery: 1800mAh
- Communication System: Single/Double Simplex
- Frequency Stability: 2.5ppm (–20°C to 60°C)
- Operating Temperature: –20°C to 60°C
- Antenna Impedance: 50Ω
- Dimensions: 110x58x33mm
- Weight: 220g
- LCD Menu Operations
- 50 CTCSS, 105 CDCSS
- 128 Channels
- Time-out Timer
- OFF/15/30/45/.../600s
- Voice Prompt
- FM Radio Built-in 65.0MHz-108.0MHz
- Torch Illumination
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- Call Tone 1750Hz
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- Backlight ON/OFF
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**MFJ-948** 1.8-30MHz 300W deluxe Versa tuner..... **£189.95**
**MFJ-949E** 1.8-30MHz 300W deluxe Versa tuner with OL..... **£209.95**
**MFJ-934** 1.8-30MHz 300W tuner complete with artificial GND..... **£229.95**
**MFJ-974B** 3.6-54MHz 300W tuner with X-needle SWR/WATT..... **£229.95**
**MFJ-969** 1.8-54MHz 300W all band tuner..... **£249.95**
**MFJ-962D** 1.8-30MHz 1500W high power tuner..... **£349.95**
**MFJ-986** 1.8-30MHz 300W high power differential tuner..... **£399.95**
**MFJ-9890** 1.8-30MHz 1500W high power roller tuner..... **£439.95**
**MFJ-976** 1.8-30MHz 1500W balanced line tuner with X-Needle SWR/WATT..... **£549.95**

### Analysers

**MFJ-259C** 530 KHz to 230MHz..... **£329.95**
World's most popular SWR analyser is super easy-to-use. It gives you a complete picture of your antenna's performance. You can read your antenna's SWR and Complex Impedance 530 KHz to 230 MHz continuously with no gaps.

### Power Supplies

**PS30SWIII 30A** peak switching power supply provides 13.8 VDC at 20 Amps continuous, 30 Amps surge. The output voltage is adjustable from 9 to 15 VDC. Red and black terminals on are the rear panel (30A)
SPECIAL OFFER ~~£79.95~~ **£69.95**

**PS30SWIV** switching power supply provides 13.8 VDC at 20 Amps continuous, 30 Amps surge. The LCD digital panel meter simultaneously displays voltage and current. There is a Noise Off-Set control that can be adjusted to eliminate pulse noise from the power supply.
SPECIAL OFFER ~~£79.95~~ **£69.95**

**PS30SWII 25A** continuous switch mode PSU with variable output voltage and cigar socket also includes noise offset function
SPECIAL OFFER ~~£99.95~~ **£89.95**

**QJE30SB 30 AMP Linear PSU**, no noise issues with the great old school power supply unit, nice digital display and heavy as you like so you feel like you bought something and on offer this month
SPECIAL OFFER ~~£129.95~~ **£119.95**

**QJE QJPS30II** 30 AMP Switch Mode Power Supply Unit
Includes noise offset control to eliminate the pulse noise of the switching circuit. This patent pending function is specially designed for communication equipment use. Its effectiveness may vary depending on the frequency and mode.
SPECIAL OFFER **£79.95** ~~£89.95~~

**QJE QJPS50II** 50 AMP Switch Mode Power Supply Unit
Same as above but in a 50amp version
SPECIAL OFFER **£129.95** ~~£119.95~~

## Inrico® Official Distributers

**INRICO T320 4G/WIFI Network Handheld Radio** ..... ~~£229.99~~ **£169.99**
This radio is cellular so works like a walkie talkie but uses the cellular network as a repeater! This means hand held to hand held or handheld to mobile comms around the world Companies like ID offer a suitable sim with EU roaming from £3.99 a month or if you are in the UK Freedompop is available otherwise you can use it on Wifi Using Apps like Zello & Teamspeak you can talk privately for just the cost of your sim!

**Key Features:** Intelligent Global Interpom ■ More than 80 Hours standby time ■ Dual chamber speaker to give Enhanced audio ■ GPS built in ■ Micro 5 pin data line ■ Supports MP3 & MP4 ■ 2.4 Inch High Quality Screen ■ Extended memory up to 32GB ■ Waterproof IP54

**INRICO T199 Network Handheld Radio** ..... ~~£109.99~~ **£99.95**
The Inrico T199 network radio transceiver is a hand held portable "screenless" network radio device with programmable rotary channel selection knob, side mounted PTT button, two programmable function buttons, "dual port socket" for external speaker-mic or separate external headphone & mic. The external GSM/3G antenna works well but can be replaced with a high gain antenna to extend operating range.

**INRICO TM-7PLUS 4G/WIFI Network Mobile Radio** ..... **£159.95**
The Inrico TM-7plus 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!

## SenHaiX

**SenHaiX SPTT-N60 3G Network Mobile Radio** ..... **£249.95**
SenHaiX SPTT-N60 is a 3G network android mobile radio with wifi, bluetooth, zello, sos, phone function, gps function, with touch screen and large LCD.

**Key Features:** 100% Compatible with PTT4U and Zello ■ Palm Size Mini Mobile Radio ■ Support 3G:WCDMA 2G:GSM network ■ Support Group Call, Single Call, Intelligent selective call ■ 180 Degrees Rotatable Screen ■ LCD Display ■ GPS Built in ■ 500hm 1W loudspeaker ■ Mobile Phone Call/SMS function ■ Requires a 13.8V Power Supply

**4G Version** ..... **£299.95**

## BOXCHIP

**BOXCHIP S700B 4G/WIFI Network handheld Radio** ..... **£368.95**
Boxchip S700B is an advanced professional handheld 4G LTE radio All-round means of communication, real-time control for the industry customers to bring a strong business ability, stable and reliable real time communication response, and more excellent integration experience is the best communications partners for industry customers!

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All registered retail customers can now earn and redeem free product credits known as WATTS. It's simple the more you spend the more WATTS you receive. You will also receive bonus WATTS when you refer a 'New Customer', 'Write a Product Review', 'Share' a product' or 'Refer a Friend'

**Don't miss out – Register now and start enjoying free WATTS**

## Yagi Antennas

All Yagis have high quality gamma match fittings with stainless steel fixings! (excluding YG4-2C)

**YG27-35** Dual band 3/5 element 3.5/12.5 dBd gain with one feed! ..... **£79.95**
**YG4-2C** 2 metre 4 Element (Boom 48") (Gain 7dBd) ..... **£29.95**
**YG5-2** 2 metre 5 Element (Boom 63") (Gain 10dBd) ..... **£69.95**
**YG8-2** 2 metre 8 Element (Boom 125") (Gain 12dBd) ..... **£99.95**
**YG3-4** 4 metre 3 Element (Boom 45") (Gain 8dBd) ..... **£79.95**
**YG5-4** 4 metre 5 Element (Boom 104") (Gain 10dBd) ..... **£99.95**
**YG3-6** 6 metre 3 Element (Boom 72") (Gain 7.5dBd) ..... **£99.95**
**YG5-6** 6 metre 5 Element (Boom 142") (Gain 9.5dBd) ..... **£119.95**

## ZL Special Yagi Antennas

The ZL special gives you a massive gain for the smallest boom length ... no wonder they are our best selling Yagis!

**ZL5-2** 2 Metre 5 Ele, Boom 95cm, Gain 9.5dBd ..... **£69.95**
**ZL7-2** 2 Metre 7 Ele, Boom 150cm, Gain 11.5dBd ..... **£79.95**
**ZL7-70** 70cm 7 Ele, Boom 70cm, Gain 11.5dBd ..... **£49.95**
**ZL12-70** 70cm 12 Ele, Boom 120cm, Gain 14dBd ..... **£59.95**

## HB9CV

Brilliant 2 element beams ... ideal for portable use

**HB9-2** ..... **£34.95**
**HB9-4** ..... **£49.95**
**HB9-5** ..... **£59.95**

## Halo Loops

Our most popular compact antennas, great base, mobile, portable, or wherever!

**HLP-4** 4 mtr (size approx 600mm square) ..... **£44. 95**
**HLP-6** 6 mtr (size approx 800mm square) ..... **£49.95**

## 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**

## Base Antennas

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

**GP2500** All Band 80-6M Vertical TX 80-6M RX 2-90MHz, Power 250W Length 7.13M ..... **£199.95**
**GPA-80** budget version of GP2500 80-6M Length 6.0M ..... **£99.95**

## Portable HF Kits

Great dual band kits for portable use, two compact dipoles on an upto 14ft mast just requires coax

**PK1217** HF Kit for 12/17M ..... **£149.95**
**PK1520** HF Kit for 15/20M ..... **£149.95**
**PK3060** HF Kit for 30/60M ..... **£154.95**
**PK4080** HF Kit for 40/80M ..... **£159.95**
(please note each kit requires two feeds)

## 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 ..... **£89.95**

## VHF/UHF Mobiles

**GF151** Glass Mount 2/70cm, Gain 2.9/4.3dBd, Length 78cm complete with 4m cable and PL259 ..... **£29.95**
**MRM-100** MICRO MAG 2/70cm, Gain 0.5/3.0dBd, Length 55cm, 1" magnetic base with 4m coax and BNC ..... **£19.95**
**MR700** 2/70cm, Gain 0/3.0dBd, 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**
**MRQ750** 2/70cm, Gain 5.5/8.0dBd, Length 150cm, PL259 fitting (high quality) ..... **£36.95**
**MRQ600** 6/2/70cm Gain 3.0dBi/5.0/7.5dBdBd, Length 150cm, PL259 fitting (high quality) ..... **£39.95**
**MRQ273** 2/70/23cm Gain 3.5/5.5/7.5dBdBd, Length 95cm, PL259 fitting (high quality) ..... **£49.95**
**MRQ900** 10/6/2/70cm Gain 10m (2.15dBi) 6m(2.5dBi) 2m (2.8dBi) 70cm (5.5dBi) **Length:** 125cm PL259 fitting ..... **£49.95**

## Coax Switches

**CS201** 2 Way Switch 3 X SO239, 2500W 1-1000MHz ..... **£19.95**
**CS201N** 2 Way Switch 3 X N-Type, 2500W 1-1000MHz ..... **£24.95**

## Lightning Arrestors

**ST-1** SO239 to PL259 adapter with earth wire connection ..... **£4.95**
**CDX-1** Lightning Arrestor 2 X SO239 sockets 400W ..... **£19.99**

## Dummy Loads

**DL-1S PL259** DC-800MHz 15W CW 20W 50 Ohms ..... **£24.95**
**DL-1SN** N-Type DC-800MHz 15W CW 20W 50 Ohms ..... **£29.95**

## SWR Meters

**SWR-100** Frequency 26-30MHz 100W 50 Ohms ..... **£16.95**
**SWR-270** Frequency 120-500MHz 100W 50 Ohms ..... **£29.95**

## Ferrites

High quality ferrites to suit all the popular cables

**FCS-S** to suit 6mm cable such as RG58 ..... **£1.95**
**FCS-M** to suit 7mm cable such as MINI8 ..... **£2.95**
**FCS-L** to suit 9mm cable such as RG213 ..... **£3.95**

## GRP Fibreglass Base Antennas Diamond quality – Moonraker pricing

Diamond quality – Moonraker prices ! 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

**SQBM100P** 2/70cm 3.00/6.00dBd, RX 25-2000MHz, Length 100cm SO239 ..... ~~£49.95~~ special offer **£39.95**
**SQBM200P** 2/70cm, Gain 4.5/7.5dBd, RX 25-2000MHz, Length 155cm, SO239. ..... ~~£54.95~~ special offer **£44.95**
**SQBM500P** 2/70cm, Gain 6.8/9.2dBd, RX 25-2000MHz, Length 250cm, SO239 ..... ~~£74.95~~ special offer **£69.95**
**SQBM1000P** 6/2/70cm, Gain 3.0/6.2/8.4dBd, RX 25-2000MHz, Length 250cm, SO239. ..... **£84.95**
**SQBM223N** 2/70/23cm, Gain 4.5/7.5/12.5dBd, RX 25-2000MHz, Length 155cm, N-Type ..... **£79.95**
**SQBM4010P** Quadband 10/4/2/70cm Gain 2.5/3.2/3.6/5.5dBi Length 120cm ..... **£69.95**
**SQBM6010P** Quadband 10/6/2/70cm Gain 2.5/3.0/3.6/5.5dBi Length 120cm ..... **£69.95**
**SQBM4060P** Quadband 6/4/2/70 Gain: 2.5/3.0/3.6/5.5dbi Length 120cm ..... **£69.95**

## HF Wire Antennas

All our HF wire antennas are made with complete waterproof potted baluns and high quality "original" flexweave antenna wire.

**MDHF-80** 3.5MHz balun matched mono dipole, length 40m ..... **£59.95**
**MDHF-40** 7.0MHz balun matched mono dipole, length 20m ..... **£44.95**
**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**
**OSHF-20** 14-30MHz balun matched off set dipole, length 11m ..... **£38.95**
**LWHF-160** 1.8-50MHz unun match end fed antenna, length 42m ..... **£49.95**
**LWHF-80** 3.5-50MHz unun match end fed antenna, length 20m ..... **£44.95**
**LWHF-40** 7.0-50MHz unun match end fed antenna, length 10m ..... **£39.95**

Get great results with the Moonraker range of HF mobiles! From as little as £22.95!

## HF Mobiles



**AMPRO-10** Slim line design 28MHz 2m approx. 3/8th fitting ..... **£22.95**
**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.**

## Baluns & Ununs

High quality TX, RX baluns, and Ununs all fully potted and weather protected with SO239 socket

**MB-1** 1-30MHz 1:1 Current Balun 400W 50 Ohms ..... **£29.95**
**MB-4** 1-30MHz 4:1 Current Balun 400W 50 Ohms ..... **£29.95**
**MB-6** 1-30MHz 6:1 Current Balun 400W 50 Ohms ..... **£29.95**
**MB-1X** 1-30MHz 1:1 Current Balun 1000W 50 Ohms ..... **£39.95**
**MB-4X** 1-30MHz 4:1 Current Balun 1000W 50 Ohms ..... **£39.95**
**MB-6X** 1-30MHz 6:1 Current Balun 1000W 50 Ohms ..... **£39.95**
**MU-9** 1-50MHz 9:1 Unun 500W 50 Ohms ..... **£29.95**
**LWB-1** 0-40MHz Receive only 50 Ohms ..... **£24.95**


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## YAESU

### Base

FT-DX3000 HF/50MHz 100W Transceiver ..... ~~£1449.00~~ **Now £1299.00**
FT-DX1200 HF/50MHz 100W Transceiver ..... ~~£929.00~~ **Now £819.00**
FT-991A HF/50/144/430 MHz All mode field transceiver ..... ~~£1199.00~~ **Now £1150.00**
FT-450D HF/50MHz entry level transceiver ..... **£599.99**

### Mobile/Portable

FT-857D HF/VHF/UHF 160-70cm 100W SSB/AM/CW/FM Transceiver ..... **£699.95**
FT-891 HF/50MHz 160-6m 100W all mode transceiver ..... **£589.00**
FT-818 HF/VHF/UHF 160-70cm 5W backpack transceiver ..... **£574.99**
FTM-400XDE Dual band 2/70cm digital mobile transceiver ..... ~~£479.00~~ **Now £379.00**
FTM-100DE Dual band 2/70cm digital mobile transceiver ..... **£299.00**
FT-8900 Quad band 10/6/2/70cm mobile transceiver ..... **£269.00**
FT-7900 Dual band 2/70cm mobile transceiver ..... **£249.00**
FTM-3200DE 2m digital mobile transceiver ..... **£179.00**
FT-2980E 2m FM 80W mobile transceiver ..... **£149.00**
FTM-3100DE 2m analogue transceiver ..... ~~£129.00~~ **Now £124.99**

### Handheld

FT-2DE Digital dual band 2/70cm handheld transceiver ..... ~~£379.00~~ **Now £299.00**
FT-70DE Digital dual band 2/70cm handheld transceiver ..... ~~£199.00~~ **Now £159.00**
VX-6E Dual band 2/70cm handheld transceiver ..... ~~£189.00~~ **Now £150.00**
FT-65E Dual band 2/70cm entry level handheld transceiver ..... **£89.95**
FT-25E Single band 2m band transceiver ..... **£69.00**
**'NEW' FT-4X Dual band FM handie** great value ..... **£62.95**

## DMR Dual Band Transceiver

MOONRAKER

Dual Band DMR has arrived with twice the fun with the MOONRAKER HT-5000 Dual Band DMR Digital & Analogue hand held Radio!
The HT-5000 takes the experience of DMR to a new level with features designed for the amateur radio user.
**Now just ~~£199.99~~ £150.00!**

## MT-270M

Dual band mobile transceiver 136-174/400-450MHz 25W
**Amazing value £79.95!**

**MT-SC** Software cable ..... **£9.95**
**MT-CC** Cigarette lighter and power cable ..... **£9.95**
**MT-RM** Replacement microphone ..... **£12.95**

## PRESIDENT ELECTRONICS

### Ronald

10/12m mobile transceiver
AM/FM 50W+ PEP
**Amazing value £169.95!**

**Lincoln II Plus** 10/12m mobile transceiver AM/FM/LSB/USB/CW 35W ..**£239.95**

## TYT

**New GPS Version**

**Now you can go digital on the road with the TYT MD-9600GPS Digital Mobile Two-Way Radio!** The MD-9600 gives you crystal clear, noise-free audio of over-the-air digital communications in your vehicle, full analogue transceiver capabilities and bundles it all together at a price you can afford! ..... **£299.95**

## AnyTone

### AT-D868UV

VHF/UHF DMR Handheld

**£139.95**

The AnyTone D868UV radio was developed to conform to the DMR Tier I and II requirements. The radio offers 4,000 Channels, 10,000 Digital Talk Groups with 150,000 Contacts. The large colour display offers clear information about the radio operation and function, including displaying who you are connected to. The powerful transmitter is very reliable and offers up to 7 Watts of power for a hand-held.
The Anytone AT-D868UV has been designed for radio amateurs and has the ability to take the radio outside of the code plug in VFO mode (Single button press) So it is a dual band Hand held with DMR rather than a DMR radio with a dual band handy!

**£139.95**

### AT-D878UV

DMR & Analogue Handheld Transceiver

**£199.99**

The AnyTone D878UV radio is a VHF and UHF radio with both Digital DMR (Tier I and II) and Analog capabilities. All the features of the excellent Anytone 868 with the addition of Roaming & Analogue APRS support (includes GPS as standard) 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. This enables Moonraker to supply it pre-programmed with all UK DMR and analogue vhf/uhf repeaters Supplied with a 3100 mAh battery the radio will give a good working days performance.

**£199.99**

**Includes:** • Latest Moonraker Code Plug • Antenna • Charger • AC Adaptor • Li-Ion Battery Pack (3100mAh) • Belt Clip • Instruction Manual • Programming Cable • Software (download)

### AT-778UV

Dual band 136-174/400-490MHz 50W FM mobile transceiver **Amazing value £99.95!**

## WHISTLER

Moonraker have worked with Whistler to customise a UK band plan for the scanners! This ensures the radios cover UK bands in the correct steps and the correct mode. When a user does a service scan it will search in the correct steps for the selected band ensuring maximum received stations. The radios will receive both amateur and commercial DMR transmissions, as (apart from the frequency) they are fundamentally the same mode. The radio is supplied with software and users can select mode when writing memories or select auto and it will work out the mode itself!
**TRK-1** 25-1300MHz Digital Handheld Scanner (left) **£419.95**
**TRK-2** 25-1300MHz Digital Base Scanner (right) ... **£479.95**

## ICOM

### Base

**IC-7610 HF/50MHz SDR base transceiver** ..... **£3499.95**
Following on from the technology incorporated into the IC-7300, the IC-7610 adopts the same RF direct sampling system for signal processing. By converting the analogue signal directly to a digital signal and processing it within the FPGA (Field Programmable Gate Array) it provides improved transmission phase noise and receiver DANR of 106 dB (at 1 kHz detuning)

**FREE SP38 speaker worth £149.00**

**IC-7300 HF/50/70MHz base transceiver** ..... **£1199.00**
The IC-7300 is a revolutionary compact radio that will excite HF operators from beginners to experts. This new model has a high-performance real-time spectrum scope and employs a new RF direct sampling system.

### Mobile

**IC-2730E** Dual band mobile transceiver ..... **£289.00**
This stunning new dual band mobile transceiver features a large high-contrast LCD screen with backlight, VW and UL simultaneous receive capability and optional Bluetooth® connectivity for hands-free and remote control communications.

## LEIXEN

**VV-898 £59.95**
Dual Band 136-174/400-470MHz 10W mobile transceiver
**VV-898S** Dual Band 136-174/400-470MHz 25W mobile transceiver ..... **£69.95**
**VV-898SP** Dual Band 136-174/400-470MHz 25W mobile backpack transceiver, this mobile backpack transceiver you can take virtually anywhere you need it! Leixen combined their micro-compact, 25 watt Dual Band UHF/VHF Mobile Radio with a powerful 12A Li-Ion rechargeable battery and put it all in a sturdy chassis you can fit in your pack or emergency bag for use anytime, anywhere! ..... **£149.95**
**VV-85C** software and cable for all Leixen transceivers

## BAOFENG

New version of this ever popular handie - and now with a 4.5W on 2m - Comes complete with desktop charger, antenna, belt clip & high power 1800mAh battery and now with FREE earpiece all for less than £30!

**UV-5RC+** Dual band 136-174/400-480MHz 4.5W handheld transceiver ..... **£29.95**
**BL-5** Replacement 1800mAh battery ..... **£12.95**
**UV-5SM** Fist speaker microphone ..... **£9.95**
**UV-5BE** Battery eliminator ..... **£9.95**
**UV-5SC** Soft case ..... **£9.95**
**UV-5PC** Software cable ..... **£9.95**

**Baofeng DM-9HX DMR Digital & Analogue Transceiver** ..... ~~£89.95~~ **Now £69.95**

Another great product from Baofeng making DMR affordable to everyone. Comes complete with: high gain antenna, belt clip, hand strap, desktop charger, 3800mAh battery, user manual and earpiece

- Text receiving and sending with at most 64 characters.
- Frequency editing under Channel mode
- Digital Monitor Mode: support communication when frequency, time slot and colour code is paired, regardless of Contact ID, RX Group list

Customize shortcut keys: including long-press and short-press with Side Keys. Edit shortcut keys with Programming Software.

- Support analog repeaters and digital ones
- Dual-standby and dual display
- Driver-free programming cable: plug and play

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MOONRAKER

# IC-9700

VHF/UHF/23CM ALL-MODE SDR TRANSCEIVER

Be one of the first to get this exciting new rig with a retail price of

## £1795.95 INC.VAT

We are taking deposits now, for this long-anticipated transceiver!


## PLANNED FEATURES FOR THE IC-9700 INCLUDE:

- ALL MODE, TRI-BAND TRANSCEIVER COVERING 144 MHZ, 430 MHZ AS WELL AS 1.2GHZ
- SUPPORTS CW/AM/SSB/FM/RTTY AND D-STAR DIGITAL VOICE AND DIGITAL DATA MODES
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# Using PICs in Homebrew Projects

**Barrie Raby G8GTV offers a beginner's guide to the use of programmable chips (PICs) in your homebrew projects.**

**Looking back in my logbook I notice that my first QSO as a new licensee was in December 1972.** Prior to that my interest in amateur radio had taken the usual path of my generation: one-valve receivers as a boy, followed by early transistor radios and so on until taking the Radio Amateurs Examination (RAE) in 1972. I have always been a keen constructor. All my HF and VHF equipment is home-made, as are most of my test instruments. I have a 20MHz oscilloscope, a very basic signal generator, a capacitance/inductance meter and the usual multimeters, but apart from these everything is home-made. However, I have tried to keep up-to-date with emerging technology, embracing large scale integration and surface mount (SMD) components in recent projects. But one area I was reluctant to enter was the trend towards projects involving PICs with their essential software. Given that many modern projects appearing in *Practical Wireless* now use PICs, I thought it might be useful to relate how I grasped this nettle and got started. I would like to encourage other home constructors to do the same. After all, PICs open up a whole new and fascinating world and with so many PIC-based projects published it would be a shame not to give them a go. But beware, you may get hooked!


1


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**Fig. 1. ECL/TTL-based 500MHz Frequency Counter, footprint: 13 x 28cm. Fig. 2: PIC-based 1.30GHz Frequency Counter, footprint: 4 x 13cm.**

## What is a PIC?

So, what are PICs? The initials stand for Programmable Interface Controller or, if you prefer, Peripheral Interface Controller (take your pic!) and they have been around for several decades. PIC is a trademark of the Microchip Technology Inc. based in Arizona. They are complete microprocessor-controlled systems on a single chip and include input and output ports, a microprocessor to manipulate data, onboard oscillator, timer circuits, special function registers, EPROM memory, RAM for storing program data, an instruction set and even on-board A-to-D (analogue-to-digital) converters on some devices. They are designed to be embedded in commercial applications requiring programmed functions such as automation, automobile engine management systems and even washing machines and similar. This wide-scale use means they are very well supported and documented.

In themselves PICs are just a useless chunk of silicon until we program them and tell them how to behave, and that is the bit that daunted me. Stick with me, however, and I will show you how to get started. I am not going to show you detailed programming techniques because that would require a whole book. Hopefully, though, you will be encouraged to try one project at least and fortunately most published projects have downloadable code for the constructor to 'blow' into his PIC. Some even provide a fully coded PIC, which merely needs to be inserted. However, while that is fine for an introduction, you are stuck with the author's features and much of the fun and usefulness of PICs comes from the ability to tailor their functions to your requirements. Datasheets for individual PIC types are readily available on the internet and these will prove useful as you gain experience. Be aware, though, that they are very detailed and run to tens of pages. You won't need such detailed information to get started.

My desire to learn how to use PICs

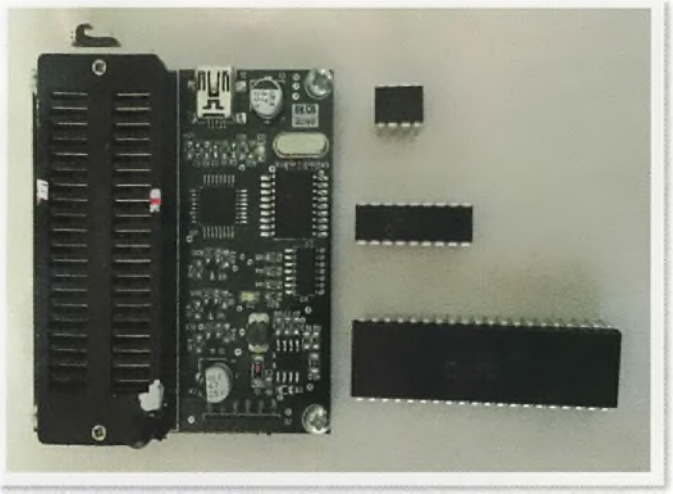


Fig. 3: K 150 Programmer. The PIC to be programmed will be placed in the ZIF socket.


Fig. 4: PICKit3 Programmer showing in-circuit programming leads.

stemmed from a need for a portable frequency counter capable of working up to 1.30GHz. About 35 years ago I built a 500MHz counter based on ECL/TTL logic devices, **Fig. 1**, the then available technology. It has 18 chips and a massive footprint. I wanted something with a much lower component count and compact size. A PIC-based solution seemed obvious, **Fig. 2**. However, I needed to learn the fundamentals first, and these are what I want to pass on.

While the old counter has some additional functions compared with its modern counterpart, I think you will agree that the PIC -based counter is a dramatic improvement both in size and its capability for easy modification, to incorporate frequency offsets, for example, just by modifying the software. It consists of two transistors, two chips, one PIC, one crystal and one LCD display plus a few resistors, capacitors and a voltage regulator, socket and case. And counts to 1.30GHz!

## Getting Started

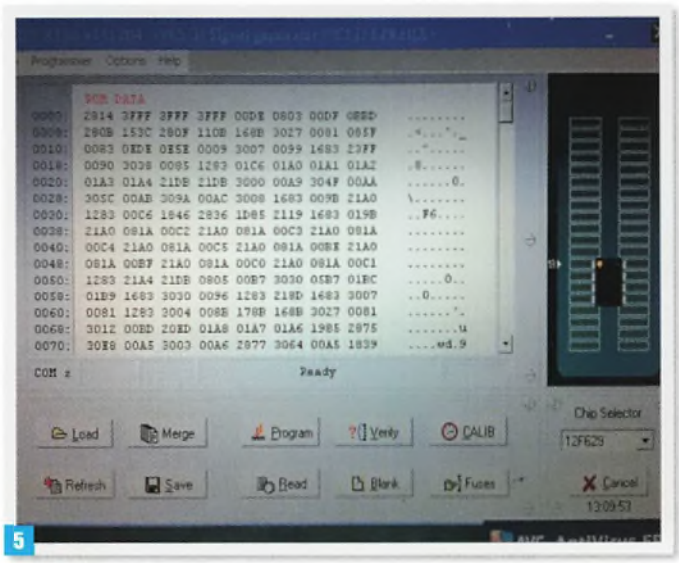
Constructing a published and proven project would be your best introduction to the use of PICs. There have been several in *PW* and there are many more on the internet. Once you have gained experience and yes, learned from your mistakes, you will probably wish to develop your skills and modify programs for your own needs. Let's assume you have a project in mind and have assembled all the necessary components.

The PIC has to be programmed and the author has detailed the website from which it can be downloaded. (Make sure you have procured an appropriate IC socket for your PIC – it is best to be able to remove it easily.) When programming a PIC it is usual to write a set of instructions using a text editor such as Notepad or onto Microchip's development software called MPLAB IDE (Integrated Development Environment), downloadable for free and of which more later. If using Notepad, save as type 'All Files'. The program instructions are then converted by a piece of software called an assembler into machine code, which is stored in specified memory locations on the PIC. This machine code, which is in hexadecimal format, is what the PIC uses to perform its required functions in a predetermined order. The PIC can be reprogrammed many times over. Sometimes the software for your project is provided as instructions that will need to be assembled into machine code and sometimes directly as machine code. If you are following a published design, the type of PIC will have been specified. They come in widely varying degrees of functionality, from 8-pin devices up to 40-pins and more, ignoring SMD types. Most popular amateur projects use relatively simple PICs and the choice usually depends on the number of input/output ports, memory capacity and cost. Supply voltage requirements are 5V DC. I am amazed at the amount of functionality that can be bought for so little cash – cheap as chips, dare I say?

What do you need to program a PIC? This was a major stumbling block for me. I hadn't a clue how to get started and I couldn't find sufficiently detailed yet easily understandable information on how to proceed. I had vague ideas but fortunately a fellow club member was a big help. Relating this aspect of the process is my main objective. Clearly a computer or laptop on which to store the instructions is the first requirement. I am using a laptop running Windows XP, so nothing modern or fancy here! The next hardware requirement is a programmer, which will actually input the machine code into the PIC. These are readily available at low cost. I have two. One I obtained from a well-known internet auction site and is called a K150, **Fig. 3**. The other is a Microchip product called a Pickit3, **Fig. 4**, which interfaces well to Microchip's assembler software. Programmers connect to a USB port on your computer via a provided USB lead and mostly need application and driver software to be downloaded from the internet. Having used both these programmers I find I have no particular preference except to say that all Microchip products have lots of supporting information available. There are many other types available but I advise buying from a supplier who can give guidance on where to find the relative application/driver software.

A fundamental difference between the Pickit3 and the K150 is that the Pickit3 connects directly to your project board, which enables on-board programming of the PIC. But it does mean you have to provide this connection point, which the project you are following may not include. It's not difficult but you do need to know how, so perhaps the best option for a beginner is to use a K150, which enables the PIC to be programmed off-board by inserting it into a zero insertion force socket on the programmer.

We are almost ready to go but still need some software to assemble our program instructions into machine code for the programmer to 'blow' into the PIC. As mentioned, Microchip produce an excellent suite called MPLAB IDE, which enables you to either download a program and assemble it or prepare your own pro-

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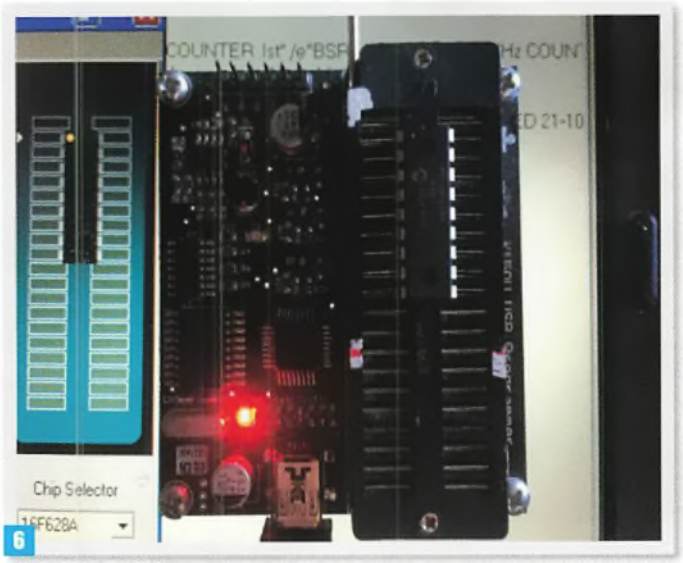


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**Fig 5: Screenshot of K 150 application software showing where a 12F629 PIC should be placed in the Programmer's ZIF socket. Fig. 6: Screenshot showing positioning of a 16F628A PIC in the K 150 Programmer in the ZIF socket as instructed by the application software.**

gram separately and use MPLAB to edit it, check it out and then assemble it ready for your programmer. MPLAB is a very versatile tool. Your completed program can be loaded into Quickbuild, which will check it for syntax errors and indicate where they are thus facilitating correction. A succesful build will be indicated before proceeding to assembly into machine code for 'blowing' into your PIC via your chosen programmer. But we may be getting slightly ahead of ourselves here.

To recap. By using a ready-programmed PIC from the project designer you will get a good basic introduction to a PIC's capabilities. If you also buy a PIC of the same type and download the project software to program the PIC yourself, you will learn a great deal. Learning to use MPLAB in a simple form is recommended at this point to enable you to programme your own PICs. There is a wealth of information on the internet but my own preference is to buy a book in which a phased introduction to PICs is presented and in which the chaff has been sorted from the wheat. One I particularly like and thoroughly recommend, is *PIC in Practice* by **D W Smith** (Newnes) because this gives useful basic information on PICs, their instruction sets, using MPLAB IDE and simple programming.

## Learn by Doing

There is nothing like actually getting involved to learn new skills, and PICs are no exception. A common way of learning about PICs is to write and execute a simple project to flash an LED at defined intervals. A simple program is given in the above-mentioned book or easily found on the internet. Not very exciting you might think but be assured that such a project will teach you a great deal, particularly as you learn to understand how the program instructions are actually working. You will learn how to set the configuration of the PIC, write headers for your program so that ports, memory locations and so on are defined. A simple project would typically require the following few components: 1 PIC, 1 IC Socket ,1 cheap crystal, 3 capacitors, 1 resistor, 1 LED, a small piece of Veroboard and a 5V DC supply. The cost, say, under £5; the amount of learning – priceless!

From this point you would be able to develop your skills by modifying the program to change the flash rate or maybe include another LED. Once you've done that and have become more familiar with the PIC instruction set, you are on your way to writing your own simple programs or modifying other published programs. I don't want to minimise the skill required to write programs for, say, a frequency counter with a Liquid Crystal Display. I would struggle to do that from scratch but I have developed the ability to modify programs for my own needs, for example by including frequency offsets to allow for a transceiver's intermediate frequency. There are many standard routines for software macros available on the internet, for example to drive an LCD or perform mathematical functions, and learning to incorporate such macros to customise your programs will enhance your skills enormously.

When writing or adapting a program, no matter how simple, start with a flowchart and number each line of instruction while including plenty of comments about what is actually happening. This makes problem solving much easier. A typical instruction might be: 'MOVF', i.e. the contents of File F are moved into the W (working) register. PICs have reduced instruction sets, which means there are about 40 different instructions available to program a PIC. The interaction of the instructions enables great versatility to be achieved. A very simple program may have ten lines of code, while a very complex program may have several hundred. PICs have totally changed the way modern circuits are designed in that functionality is determined by changeable software rather than rigid hardware. The effort required to learn how to use them will be repaid many times over by the sense of achievement. I am a firm believer that amateur radio is all about progressive learning and while PICs have been around for some time now, you can use them to develop your skills in software driven projects which are, after all, the current direction of the hobby.

I haven't produced a list of websites because all the relevant ones are easily accessed by entering, say, Microchip, MPLAB IDE, Pickit3 or K150 into your search engine and it can be interesting to peruse some of the alternative but still relevant sites that will be displayed. There are many forums that deal with specific PIC topics and they can be very helpful in solving problems. Experience will guide you to those that are reliable. Good luck with your journey into this fascinating world.

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# Early Results on 432MHz FT8

**Tim Kirby G4VXE reports on his own efforts and those of others to try out FT8 on the 70cm band and the satellites have been busy this month too.**

**Last month, I wondered whether it was time to try some FT8 activity on the 70cm band.** I set to, calling CQ on 432.174MHz when I had a moment or thought conditions or activity might be reasonable as well as trying to e-mail a few regular 2m contacts along with trying the odd 'QSY 432.174?' message on 2m.

Although activity is notably lower than on 2m, results were actually a lot better than I expected both in terms of distances achieved and the amount of activity I encountered. What did become apparent though, quite quickly, is that paths that work really well on 2m don't necessarily work on 70cm. I thought, for example, when I worked GW1JFV on 2m with good signals, that we ought at least to be able to hear each other on 70cm, but this was not the case and so far, we've not managed to work on the band. On the other hand, another path that I work regularly, to **Steve Norman M0MVB**, seems to work quite consistently on 70cm, albeit with distinctly variable signal levels.

As expected, dispersion and other effects sometimes mean that you can see signals but the FT8 will not decode (in practice, it would probably be better to use one of the JT9 Wide modes, which would cope with these effects better). I made an interesting test with **Paul Pasquet G4RRA** (Crediton) and although we saw each other most periods, it took quite a while for us to complete a QSO, waiting for the messages to decode. It was Paul's view that we'd have worked more easily on CW. I'm not entirely convinced but we didn't have an opportunity to try at the time, which was a shame.

A period of good conditions during the month enabled some nice contacts into the continent, including DL, ON, PA and F, all made using my regular setup of 50W and a V-2000 vertical at around 10m above ground – admittedly with a fairly good location.

So, it's definitely well worth giving 70cm FT8 a try. Hopefully you will find some activity and make some interesting contacts. It does seem to me that signals are rather more down on 2m than I would have expected, but that might just be the system here – when I put up the vertical antenna I had not really worried about losses, so didn't particularly use the best coax and connectors. That's a lesson learned for next time. I'll hope to see you on 432.174!

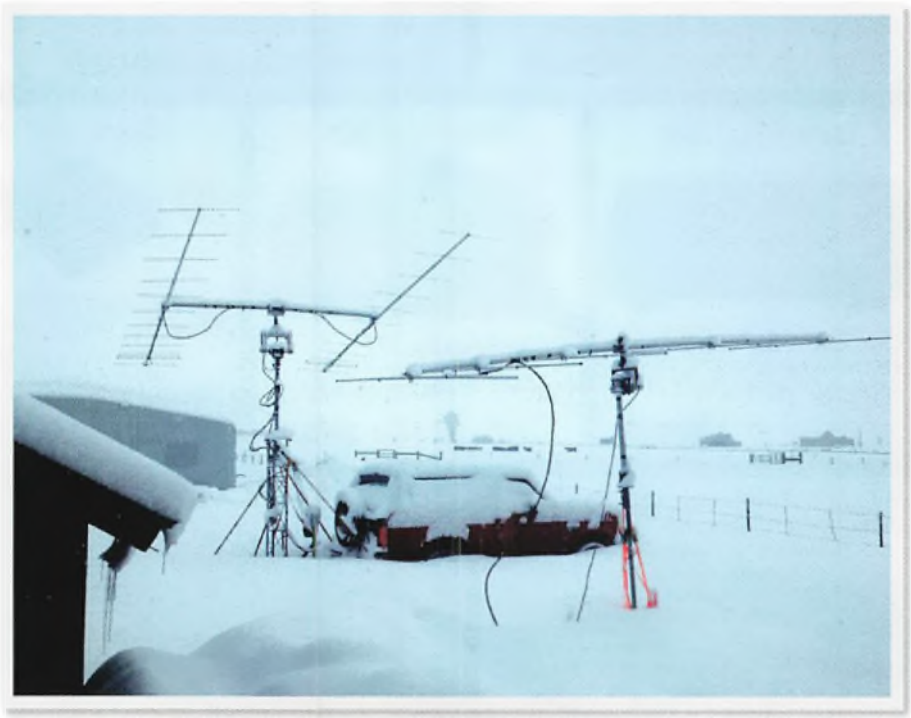

**Fig. 1: Snow on the antennas! Mike White K7ULS's EME station in Utah.**

## Baofeng BF-888S Safety

Readers may remember that some months ago, I included a piece on the Baofeng BF-888S 70cm handhelds, available for around £10. These rigs, once programmed with amateur 70cm band frequencies, work pretty well and provide a great value way of getting on 70cm simply.

**Graham Nuttall G8XRS**, who encouraged me to think about using these rigs on 70cm, wrote the other day with a safety issue that he had noticed with the charger supplied with his rig. Although the plug had a sticker that declared, 'fitted with a 3A fuse', when Graham happened to look in the plug, he found that it was fitted with a 13A fuse. If you have one of these rigs with a mains charger, it would be worth checking what value fuse is fitted to your plug and changing it if necessary. As it happens, the charger that came with my BF-888S Plus is powered from a USB socket, so there appear to be a variety of charging options. Do check your charger though, to ensure safety, and very many thanks to Graham for getting in touch to mention this important safety issue.

## The 6m Band

**John Wood G3YQC** (Hereford) writes, *"February saw short bursts of 6m FT8 activity with several longish distance G stations worked from time to time. Feb 28th produced a QSO with GI6ATZ and on March 2nd F4VPC was worked at 510km from here in Hereford. On the last day of*

*February, I saw G stations calling or working DL4FCS, F4VPC, GI6ATZ, 9A4ZM, LA9NKA, OZ3K, SM5EPO, DF4UE and DK5SF".*

## The 4m Band

**Simon Evans G6AHX** (Twyning) has taken down his 4m beam for now but has left his vertical up for monitoring FM activity on his IC-7300.

## The 2m Band

**John Hemming G0UYT** enjoyed the good 2m conditions on February 14th, making some nice QSOs. He worked ON5NY and ON6DV on SSB and PD0HLA, ON8KW and OZ1BEF on FT8. John says that the QSO with OZ1BEF was his first into Denmark. John runs 30W to a 4-element beam.

**Mike While K7ULS** (Utah) e-mailed a picture of his 2m and 6m EME antennas following a recent fall of snow, **Fig. 1**! Despite the poor weather, Mike managed a nice 2m EME QSO with R3PA (KO93).

**Jef Van Raepenbusch ON8NT** (Aalter) says that his FT-736 is back from repair, but unfortunately cannot be fixed owing to the lack of parts. The problem on CW and SSB is getting worse by the day, although on FM it's still fine. Jef's therefore thinking about a new IC-9700! Jef did work G4CLA during the UK Activity Contest on February 5th.

**Robert van der Zaal PA9RZ** enjoyed the mid-February opening. On the evening of February 13th, he worked 2E0NEY (IO81) and then the next day around lunchtime, worked 2W0JYN. For both QSOs, Robert was using his IC-202 running 3W to a 5-element Yagi at around 50ft ASL. Robert says that the beacons were loud but activity was minimal and wonders if everyone was on FT8. The opening was, indeed, pretty busy on FT8!

**Roger Daniel G4RUW** (Newbury) has his main beam down and is using a 4-element beam fixed to the east. He made a nice series of contacts using 10W of FT8 on February 13th with PB0AHX, ON4SV, ON4WX, DG1KDD, PE1LJS, ON8KW and DL3TW (JO44) and on February 22nd with MX0CNS (JO01), PE2AEX and EI19RE (IO51) off the back of the beam.

Simon G6AHX used the space freed up by his 4m beam to erect a home-made 8-element ZL special for 2m. With the TS-790 and 100W linear he took part in a couple of RSGB contests. During the contest on March 2nd/3rd, Simon's best DX was DL0WX (JO30) and during the UK Activity Contest on March 5th, his best DX was ON4KHG (JO10).

John G3YQC says that 2m FT8 has been quite lively at times. He enjoyed the mid-February tropo opening, which filled a couple of log pages, mostly with UK stations but also F8BZU.

Here at **G4VXE** I have found plenty to work on FT8, including regular contacts with a number of stations, which really help build up a picture of how the band changes from day to day. Other log highlights include F4CHB (JO00), F1UFX (JN19), ON7EQ (JO10), DC6KI (JO30), F6DBI (IN88), F5BZU (JO00), EA2XR (IN83), ON4WX (JO20), EA1MX (IN73), F5CT (JN08), DL5EBS (JO31), PA1VW (JO22), PF2JV (JO22), PA3FMP (JO22) during the mid-February tropo; F6APE (IN97) on February 28th and F4DJG (JN09) on March 1st. All contacts using 50W and a V-2000 vertical.

## The 70cm Band

**Jim Edgar GM4FVM** (Eyemouth) has been spending some time on the 70cm (432MHz) band, mostly on FT8 with a bit of SSB during contests. Jim says that he too finds FT8 tricky on the band and perhaps finding people is the hard part because antennas with narrower beamwidths are the order of the day. Jim says that the during the month he worked 24 stations in seven DXCC countries and 13 squares. His best DX was DK0HAT (JO53) at 818km while GI0OTC (IO65) was a new square. He has struggled to work the Netherlands but after a few tries, Jim worked PE1PIX (JO23) for a new country. Even better, Jim has been trying out EME on the band, running around 95W and a 12-element beam with no elevation. Best DX so far has been NC1I (FN32) as well as several European stations.

John G3YQC made a few contacts during the mid-February lift, including G4VXE (IO91), G7RHF (IO82) and G3YDY (JO01). John says that distances on the band seem harder to conquer and thinks he needs a beam.

At G4VXE the log includes G3YQC (IO82), F4HRD (JO00), M0NPT (IO92), M6DRS (JO01), ON8KW (JO20), F6DBI (IN88), PH4X (JO22), G0GRI (IO80), G4GFI (IO91), DL5EBS (JO31), M0MVB (JO02), MX0CNS (JO01), M0CDL (IO82), G3TCG (JO00), G0MBL (JO01), G4RRA (IO80), F6KBF (JN18), G4GSB (IO82), G4FUF (JO01) and G4EFE (IO91). Gear here is 50W to a V-2000 vertical.

## Satellites

**David Smith M0OSA** enjoyed listening to a schools contact from the International Space Station (ISS). David used a simple setup, while parked up in his car, using a Uniden UBC125XLT scanner connected to a Moonraker Sky Scan antenna on the car roof. You can see how well it worked on a short video that David made: **https://youtu.be/IG1ZTODKFwc**

John G3YQC enjoyed listening for the SSTV that was transmitted from the ISS during two weekends in February. He says that during the first weekend there seemed to be a fault but during the second weekend of February 16/17th signals were strong. John used an FT-991A transceiver and a Diamond vertical collinear antenna, using MMSSTV to decode the images. He says that peak signal strength was S9 on the meter with only small amounts of fading on the images received on passes that were close to the horizon. John also writes, *"I have been receiving good signals from the narrow transponder on Es'Hail-2 satellite using my existing domestic satellite system with 90cm steerable dish. Reception of the wideband ATV transponder is OK although, having only just completed a BATC MiniTioune receiver, I think I am a bit short of signal so may have to invest in a larger dish. Having said that, I have received the TV beacon transmission very well and also took good pictures from a Dutch station during testing".*

Jef ON8NT did manage to receive some SSTV signals from the ISS during the February 9th session although he says that signals were not strong. Jef applied for the special award for the event and received it by e-mail the following day. He says that the SSTV signals were much stronger the following weekend.

**Peter Goodhall 2M0SQL** (Elgin) had a busy month on the satellites making around 200 contacts and was kind enough to send a summary of some of the more interesting QSOs: February 2nd WB8RJY (EN72), KC9ELU (EM79) on AO-7; February 5th OY1R (IP62) via AO-91; February 10th OZ/DJ8MS (JO45), K9UO (EN70), K8YSE (EN91), VE4AMU (EN19) and LX1BB (JN39); February 15th MM0EDZ (IO87), R9LR (MO27), OH8MBN (KP25), M6GAN (IO91), N3GS (EM28), WB8RJY (EN72) all on AO-7; February 16th K2CKA (FM06) and N9EAT (EN41) on AO-7, DM19LGS (JO60) on AO-92, N1AIA (FN43) on AO-91 and 3A/EA4NF (JN33) on CAS3B; February 17th GB3RS (IO91) and VE4AMU (EN19) on AO-7,

N1AIA (FN53) and N1CMD (FN42) on AO-91, CT3FM (IM12), VE4AMU (EN19) and WB8RJY (EN72) on AO-7; February 23rd K3SZH (FN10), K8YSE (EN19) on AO-7 and OH2HOT (KP10) on FO-29; February 24th G7OGG (IO80) on AO-91. Pete also says that he has been planning his QO-100 ground station and has just put up a 1.2m offset dish in the garden, which is connected to an SDR Play for receive. The next job is to build the transmit side. Thanks, Pete, for a really interesting and inspiring report.

Simon G6AHX writes, "*I too have been monitoring activity through Es'hail-2. My setup here uses my broadcast satellite dish and LNB. I have a DC isolated feed from the LNB, which normally goes to my spectrum analyser. I have further split this to my Icom IC-R8500 scanning receiver. Here I can monitor the narrowband transponder output. Most of the SSB traffic is European but I have heard a Brazilian station using it. My dish is a 1.2m offset dish, which is way too big for the task but works well*".

**Kevin Hewitt ZB2GI** (Gibraltar) used a Yaesu FT-817 connected via a data interface to a Win7 Notebook PC running MMSSTV and a manually tracked 2m/70cm Log Periodic to receive and decode the SSTV images from the ISS during the two sessions this month.

On March 5th, Kev heard astronaut **David St-Jacques (KG5FYI) OR4ISS** make a schools contact with EG7NSC and reply to 20 questions during the 53° westerly pass over the Rock. The downlink was S9+ and fully quieting throughout the pass using the same setup. Kev worked FO-29 and AO-7 low elevation westerly passes, again using the same setup. N9EAT, KO4MA and K8YSE all reported receiving him with good audio, but unfortunately Kev only heard a part call during one of the AO-7 passes over the Rock. He also monitored activity on Es'hail-2 QO-100 (via the WebSDR located at Goonhilly earth station in Cornwall.

**Patrick Stoddard WD9EWK** (Phoenix) writes, as usual, with lots of interesting news about satellite operation in the USA and more generally. He writes, "*After my day-trip to the Organ Pipe Cactus National Monument in southern Arizona in early February, some operators mentioned that they missed me. I was able to make a quick trip to that location in rarely-heard grid DM31 a couple of weeks later, a detour on the way to the Yuma Hamfest in southwestern Arizona, also serving as the ARRL Southwestern Division Convention for this year.*


**Fig. 2: Patrick WD9EWK waiting for AO-92 in the desert.**

"*Unlike my earlier DM31 trip, I did not look to work lots of passes. I was able to spend a few hours in the national monument but not the entire day. Other than one FalconSat-3 pass at mid-morning, I focused on the AO-91 and AO-92 passes, **Fig. 2**. Four FM satellite passes were busy, and I was able to put grid DM31 into more logs. Between the two February trips to DM31, I worked 50 different grid locators around North and Central America. Combined with previous trips to that area over the last several years, I obtained a satellite VUCC award for my activity from DM31.*

"*As I normally do at hamfests, I carried out demonstrations of satellite operating at the Yuma Hamfest. I used my Kenwood TH-D72 HT, Elk log periodic, and an external speaker. A simple setup, which allowed everyone to hear the satellite downlinks, yet not cause feedback during my transmissions. The AO-91 and AO-92 passes worked from Yuma saw contacts with stations all over the continental USA, Canada, Mexico, and Alaska.*

"*We on this side of the Atlantic are following the activities of hams all over QO-100's large footprint, and listening with WebSDR receivers. I have especially enjoyed following a Chinese ham on Twitter, **Zhao Feng BG0AUB** (@ZhaoFen37759626), who cobbled together a station and has worked Europe through QO-100.*

"*The world traveller and satellite operator **Gabe Zeifman AL6D** (now **VE6NJH and** previously NJ7H and other calls from the USA and a few other countries) has been in eastern Europe recently. Gabe has operated from Poland, Latvia, Lithuania, Russia, and the Russian territory of Kaliningrad. As I write this, Gabe still plans on visiting Finland and the Aland Islands before returning to the States. Many in Europe, and a few in North America, have been able to work Gabe in these different countries via satellite. I am well outside the footprint of those passes to work Gabe from Arizona, but it is still fun to hear about his satellite activities.*"

**Graham Jones G3VKV** (Cheltenham) says that recovering from an operation has kept him away from QO-100 somewhat. However, he has managed to get the receive side going well using a 60cm Andrew dish. He hopes to get the transmit side sorted out shortly. Get well soon, Graham.

That's it for this month – thanks for a very varied 'postbag'. See you next month – perhaps with the first of the Es on 50MHz? I was thinking it would be nice to have some pictures of readers and their stations to feature in the column so do send any you may have.

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# Marconi's use of QRP!

## Joe Chester MW1MWD continues his quest to replicate Marconi's early experiments.

**It's been 120 years since Marconi, to wild enthusiasm at the time, reported reception of radio signals, in daylight, from DIY equipment powered by spark gap transmitters.** I'm spending 2019 repeating Marconi's experiments, using the same places he used, to see what can be done with modern equipment. We now know that his claim of transatlantic success was probably dubious. I'm wondering about some of the other stuff he claimed.

Last month, I spent some time discussing antennas and in particular, the spectacular inefficiency of short verticals on the low bands. Little wonder then that Marconi tried erecting the odd monster pole or two. I've had to settle on something more modest for my portable tests (see *PW* last month) but I'm still in broad alignment with the general aspects of what Marconi did 120 years ago. Now it's time to talk about power and the frequency issue.

**Fig. 1: Wreckage at Poldhu 1901.**

### Marconi's Transmitters

Not much of Marconi's equipment survives – a few museum pieces here and there. Understanding what he used depends on drawings and technical analysis based on these, as well as his patents and the few publications he authored. Let's start with his transmitters.

I don't intend to use spark gap transmitters for my experiments. We now know that the spark gap is a broadband emitter of radio waves. In general, the strength of the transmissions depends on the size of the spark. Marconi used capacitors to generate his sparks. The plates of those in Poldhu and Clifton were house sized. Nevertheless, he had a way to generate radio waves, at least for the duration of the sparks. Every transmission was followed by a pause while the banks of capacitors recharged. The generation of continuous waves was several years away and even after these were discovered (by **Fassenden**, operating out of Macrihanish in Scotland), Marconi persisted with sparks for many years.

As a transmitter, in the current understanding of that word, the spark gap wasn't very efficient. As a broadband device, most of the energy generated would have been dissipated across the RF spectrum and in heat. The only tuning that occurred was through the natural resonance of the antenna wire he used. Later, Marconi learned to use a coil at the base of his antenna wire to effect a rudimentary tuning. Resonant transmitter circuits, or tank circuits, came very much later. In a sense, the spark gap transmitter was just a source of broadband RF noise. The result was that the output of his transmitter on any given frequency was a tiny fraction of the power he used to generate the spark. Low power? Must mean QRP then! So, much to M's dismay, I won't be needing that brick of an amplifier of his! He wasn't happy when I told him this.

For my experiments, I intend to use a modern transceiver – my KX3. I'm using this for convenience but it is still a reasonable match, in output power, to the kind of output Marconi would have got out of his early transmitting devices.

### Marconi's Receiver

At the dawn of radio communications, the transmitter and receiver were different boxes. Indeed, this practice continues to this day (we don't use transceivers to listen to Radio 4!). Most amateurs today use transceivers. The key to Hertzian wave receivers back in 1899 was the coherer. This was a glass tube containing a small quantity of iron fillings, with an electrode at each end. In the presence of RF this completed a circuit, triggering a bell or other sounder. For many of us, our first radio experiments were probably with a crystal set, using a 'cat's whisker' (today we'd call it a diode) – the same kind of thing but with the signal fed to headphones.

The coherer was connected directly to the antenna wire. No tuning circuit, no amplification – just a bell. But it worked, even if it had no selectivity, and its sensitivity to RF must have been close to that of a brick!

The thing I want to emphasise here is that Marconi's equipment – transmitter, antennas, and receiver – were probably the most inefficient communication system ever invented. The transmitter wasted most of its input power in RF noise, very little getting out on any particular frequency, and what did escape into the ether was

due mostly to the natural resonance of the antenna. As a base-loaded vertical on low frequencies, the antenna itself was very inefficient, even though he did ground it. His receivers were connected to random lengths of wire, not in any way tuned to the transmitter's frequency, and whatever this antenna pickec up went to a ridiculously insensitive receiving apparatus.

So, do you not wonder that Marconi achieved anything in his experiments? I do, and that is why I'm going to try them again. Now I don't doubt that when Marconi set up all his equipment in the same room, he demonstrated something. But that's a common experience for all of us. We imagine (well I certainly did) that we can simply take our stuff outdoors and it will all work just the same as at home. You've only to read the past few months' *PW* to see how badly I failed.

## The Frequency Problem

Marconi was reluctant to discuss the frequencies he used in his early work. Partly this was to prevent copying by rivals but it's also possible that he just didn't know. There was no way, back then, to measure frequency. It was not until he addressed the Royal Institution in 1908 that he mentioned a wavelength of 1200ft (369m, equivalent to a frequency of around 813kHz). Several radio engineers have since tried to determine what he used but the problem is not fully resolved. **Belrose** and others (URL below), from their own analyses, say it was probably about 850kHz. However, this frequency is not available to radio amateurs. I could try to use one of the LF bands we now have but this would present a formidable challenge for a portable operation.

**https://tinyurl.com/6w6qz5t**

I trawled the net for a design for a groundplane for Top Band (1.8MHz), only to discover what I already knew. It would need to be 40m high! There are more creative solutions to this problem but there are still huge construction issues. So 160m is rather impractical for portable operations, without a massive team of volunteers to help. Longer wavelengths, such as 630m, create even worse problems.

Marconi also had his difficulties. In Poldhu he erected a ring of poles, each one 200ft high, for the low frequencies he was using. Of course, he made a common mistake – he didn't put enough effort into guying the poles, so they ended up in a heap after the wind had its say, **Fig. 1**.

**Fig. 2: Pepperbox Hill, where it all began.**

Another equally formidable challenge will be daylight operation on the low frequency bands. There is scant evidence that Marconi operated at night, especially in the early days. With our current knowledge of propagation, we now know that the low frequency bands propagate badly during daylight hours.

I think the most important part of keeping as close as possible to what Marconi did is the use of a vertical, on a relatively low frequency, one with similar characteristics to the frequencies he used (i.e. a frequency with similar daylight propagation characteristics). I therefore think that 80m is probably the best I can do. I described my attempt to solve the 80m portable antenna problem in the last piece.

## Summary

Marconi, in the early days, used very imperfect equipment. His transmission system wasted most of its power, his receiver was ineffective and his antennas were also inefficient. He was operating on a very difficult frequency, both operationally, and from a propagation viewpoint. This reinforces the scepticism about the reliability of the results he reported 120 years ago.

I'm still going ahead with this project. The first expedition will be to Pepperbox Hill, **Fig. 2**, in Wiltshire in April on International Marconi Day. I've sorted out the equipment I will be using, which is a good match for Marconi's system. Unfortunately, this means using a very inefficient antenna, and QRP – no amplifier. My system will only radiate about 2 to 2.5W from my KX3 and vertical antenna. But Marconi could not have done much better than this. I'll be using the callsign GB9GGM; you can find activity times on the QRZ.com page. Do please listen out for me, otherwise I will end up like our esteemed Editor, who 'failed to make any QSOs' on 80m recently with a commercial vertical! (*PW* February, page 26). Or maybe that's the whole point of this project?



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# The News from Bonaire

**As well as the usual reader reports, columnist Steve Telenius-Lowe PJ4DX shares some of his own operating experiences from Bonaire.**

**At the end of February the CQ 160m SSB contest took place.** For the first time, a group of Bonaire resident amateurs got together to operate portable in this contest from a sea-front location. Using a hired generator and a beach hut (literally a 'shack') for shelter, **Bert PJ4KY**, **Peter PJ4NX**, **Rinse PJ4RF** and I operated as PJ4DX in the multi-operator high-power section. We put up a 23.5m (77ft) high quarter-wave inverted-L antenna with the feedpoint inches above the saltwater and the far end of the 'L' tied off to a fibreglass pole erected in the middle of a saltwater lagoon on the east coast of the island. Two in-line quarter-wave radials were located 50cm above the sea. The hut and antenna are shown in **Fig. 1**. Due to the high levels of thunderstorm static QRN we also used the K9AY receive antenna that was described in the March *PW*, which gave considerable improvement to the readability of weak signals. Visitors to the station included **Gerard PJ4GR**, who received his licence a few days earlier, as well as **Paul PA0SON** and **Jan PD0HOT** who were visiting from the Netherlands. We worked 52 DXCC entities plus a combined total of 49 US States and Canadian Provinces. By no means a winning total, but great fun was had by all.

**Fig. 1: The location and antenna used by PJ4DX in the CQ 160m SSB contest in February.**

## Bonaire Report

Every month I report what our faithful regular correspondents have been working on the HF bands but I rarely report on the contacts I have been making here on Bonaire. It may interest some UK readers to see what is possible from Bonaire, even though this will not necessarily be a reflection of what is being heard or worked in the UK.

Bonaire is 12 degrees north of the equator, which seems to be something of a 'sweet spot' for HF propagation. Working North America is easy as you'd expect, as is Europe. Most of those rare Pacific islands are also fairly easy to contact from here – but only when there is any activity, of course! Australia and New Zealand are a bit tougher: Brisbane is around 16,500km away, just about the same distance as it is from the UK. The most difficult parts of the world to work from Bonaire are east and south-east Asia: Vietnam (XV/3W), Cambodia (XU), Laos (XW), China, Hong Kong and Macao (BY, VR2 and XX9), Taiwan (BV), Borneo (East Malaysia 9M6/9M8, Brunei V8 and Indonesian Kalimantan YB7), the Spratly Islands (9M0) and the Philippines (DU) are all really tough from here. There are exceptions: the Indonesian islands of Java and Bali (YB0-3, YB9) and Christmas Island (VK9X) are almost antipodal to Bonaire and always come in well even when the surrounding areas are completely inaudible (see *Antipodal Focusing*, *PW* December 2017).

In view of the above, this month I was really pleased to make a contact with the V84SAA Brunei DXpedition, and to have two QSOs with the German DXpedition to Macao, XX9D.

Having only ever used verticals and wire dipoles in the UK, it's a real treat now to have a beam on the HF bands. While not in the 'big gun' category, I can usually work most of what I can hear. My station consists of Yaesu FT-2000 and Icom IC-7300 transceivers, an Acom 1500 linear when necessary, to a 5-band Spiderbeam at about 10m/33ft high. On 40m I use a combination of verticals and a dipole, on 80m a quarter-wave vertical based on a Spiderbeam 18m fibreglass pole, and on 160m a 22m/72ft high quarter-wave inverted-L.

**Fig. 2: 40m portable operation from Slapton Sands in South Devon (Photo: Andrew G0CWH).**

My wife and I moved to Bonaire at the end of 2013 and I was issued with the

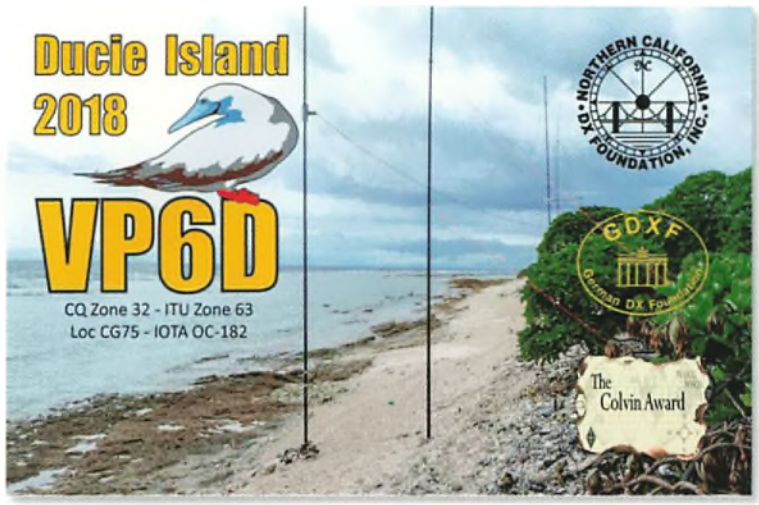


Fig. 3: The attractive VP6D QSL card.

Fig. 4: The ZB2GI/MM station in the Bay of Gibraltar.

PJ4DX licence in December of that year. Since then I have made 83,000 QSOs, 36% of which were made in 2014, when there were still plenty of sunspots about! 98% of my QSOs have been on SSB and only 2% on CW, although that figure is rising and since 2018 I have been making about 10% of contacts on CW. I don't use FT8 or, in fact, any of the datamodes. I have been particularly active this month, especially on 40, 80 and 160m because, in addition to the CQ 160m SSB contest reported above, I am also taking part in the CDXC (Chiltern DX Club, the UK DX Foundation) 'LF Challenge', which runs from March 1st to 31st on those three bands. Please see the band reports for my own HF Highlights worked between February 12th and March 11th.

## Readers' News

We always like to hear from new contributors to the column, so I was pleased to receive e-mails from not one, but two, new correspondents this month. First up is **Nick Garbett M1DDD** from the Derbyshire Dales in the Peak District, who wrote: *"Just reading your great columns in the March* PW *– the simple K9AY looks good for me as a (mainly) portable operator and the 'what's been and what's coming' section is equally enthralling! Thanks. Been dipping in and out of a few HF contests, mainly ARRL SSB and BERU* [the RSGB Commonwealth Contest – PJ4DX] *plus 80m RSGB-sponsored events... Thanks for the reminder re. WPX SSB at the end of March – my diary looks clear but it depends on the XYL!"*

Our other new contributor this month is **Andrew Carden G0CWH**, who sent in the photo shown in **Fig. 2**. He wrote, *"Driving back to my home QTH at Start Point, South Devon, I came across two amateurs (old friends from the Plymouth Radio Club) two miles up the road at Slapton Sands, doing 'real radio': operating on 40m with a wire suspended by a kite. Operators were* ***Dave 2E0DTC*** *and* ***Brett G6URM****, with me observing, logging and taking photos. We had QSOs with HB9/IW3AGO/P and OY1OF before the wind dropped and the mobile mast and dipole option had to be employed."*

The arrival of the splendid VP6D QSL card, **Fig. 3**, for **Victor Brand G3JNB** brightened up his February as DXing was in the doldrums, though things soon improved. On 30m he logged OH10X on Inakari Island, a new IOTA (EU-192), where **Nigel G3TXF** was part of the team out on the sub-Arctic ice. Victor worked the V84SAA Brunei DXpedition team on 40m CW; a timely test for the hurried repairs made that morning to his doublet, *"torn asunder by an overnight gale. Their 40m 4-Square antenna right on the beach was a great help, and their operating superb!"* Just before dusk the next day, he worked them again, on 30m, slipping past the pile-up by calling just a smidgen below their '1 up'. His FT-818's QRP was used exclusively to work 40 stations in the ARRL CW contest. *"I just had a little paddle in the deep ends of 20 and 40m and loved the reaction of the 'mega' Stateside operators, kindly adjusting their ears to read my 6W... The bands were packed layers deep with DX activity!"* Following the contest weekend, Victor reports that it went quiet again. But DX was still around as he heard VE7DG calling CQ on 20m from British Columbia and made the QSO and, at 1700UTC on the 22nd, FH/UA4WHX on Mayotte was strong on 20m. Victor broke the pile-up at 5.68kHz up. Down a bit and PJ2ND on Curacao was also in his log.

**Kevin Hewitt ZB2GI** wrote *"Good to work you on 20 metres"* following an SSB QSO with PJ4DX while he was operating portable. *"The 10m wire at the Top of the Rock lasted three weeks before the rock apes pulled the wire off the balun – again. Operating with* ***John King ZB2JK*** *after reconnecting the wire, 20m was open into the States"* (see band reports). Kevin also listed one of his highlights of the month as operating Maritime Mobile from the Bay of Gibraltar, **Fig. 4**.

**Tony Usher G4HZW** commented that *"Some time ago I said '10 metres continues to bump along the bottom of the sunspot cycle'* [HF Highlights, February 2019 – Ed]. *I've seen this quoted many times now in online forums – so someone must read the column! No sunspots during the last period, so 10m is now officially running on empty! Plenty of DX on 40m though: even with my modest setup I managed some VKs and ZLs. I watched one of the better-equipped G stations last night working strings of W6 and 7 stations. This morning he was at it again with VK, ZL, JA, UA0, KH6 etc. So, there's plenty of DX about on 40m for those who have built up a decent station. Something to aim for!"* Tony makes an important point: while the higher-frequency HF bands may appear to be dead during the sunspot minimum years, there is often excellent propagation on the low bands, which was also reported in the February 2019 *HF Highlights*. As mentioned above, I am taking part in the CDXC 'LF Challenge' and in the first 11 days of March I worked 83 DXCC entities on 40, 80 or 160m using SSB and CW. Those using FT8 had worked up to 115 entities in the same timescale so, as Tony says, there is still plenty to aim for even when the higher bands are 'hibernating'. Tony's log is in the band reports but he added *"Getaways on 40m* [FT8] *(heard but not worked) include VK0AI* [Macquarie Island], *FO5QB* [on Tahiti] *and A5A* [Bhutan]."

**Terry Martin M0CLH** wrote *"Gosh, a few sunspots in the last few days! Not that there were many knocking about in February, as can be seen by the paucity of contacts higher up in the spectrum. Nice to get a few*


**Fig. 5: Russian operator Raisa at OH73ELK (Photo: qrz.com/db/oh73elk)**

*more slots confirmed in Brunei* [V84] *and 9M2* [West Malaysia] *on 40m. So, in summary, mostly European contacts with the odd excursion further afield."*

**Owen Williams G0PHY** wrote *"Here's my DX report for February. Another quiet month on the bands. However, there was the excitement of a new IOTA (OH10X on EU-192 in the Gulf of Bosnia),* ***Vlad UA4WHX*** *was on his travels again, and plenty of special event stations. I worked Vlad on Mayotte as FH/UA4WHX on both 17 and 20m; the 17m contact was a new band slot."* Owen also worked a number of special event stations during the Antarctic Activity Week (see band reports).

## Band Reports

Steve PJ4DX worked the following (the list reflects what is rare from Bonaire): 160m SSB: CT2ITR, CU4DX, DP6A, E7CW, EF1RKF, ES5RW, EW6W, G4IIY, GI4T, GW3YDX, HA3DX, HB90CKZ, HC5DX, HH2AA, KH7XS, LX1ER, LY4A, OH3RB, OL1R, OM5RW, ON7HLU, RA2FV, S57DX, SN8B, TG9AJR, UA7K, UX1UA, XE1RCS, ZL2OK (all in CQ 160m SSB contest). 160m CW: EA6NB, HH2AA, KG4AS (Guantanamo), OH0Z. 80m SSB: KH7XS, TG9AJR, VK6APZ. 80m CW: HZ1TT, TG9AJR. 40m SSB: 5T5PA, A5A, C5YK, GP0STH, YB3VO, ZL1AYH. 40m CW: 3B8XF, 4JT5A, 7P8LB, 9G2HO, A52IC, D2EB, HD8M, S01WS, V84SAA, XW3DT. 30m CW: 3B8XF, HD8M, TG9AJR. 20m SSB: 5J0JC (Providencia NA-049), 9J2MM, 9U4RI, 9X9PJ, FH/UA4WHX, FK8GU, GP0STH, HD8M, KG4AS, T31EU, T77LA. 20m CW: 7P8LB, C56DF (*PW* Editor Don G3XTT), E51AUZ, ET3AA, HD8M, T2AR, T31EU, XX9D. 17m SSB: 7P8LB, 9Q6BB, T31EU. 17m CW: 4U1ITU, 7P8LB, FH/UA4WHX, FR/UA4WHX, HD8M, T2AR, T31EU, XX9D, XR0ZRC (Juan Fernandez Is). 15m SSB: 7P8LB, T31EU. 15m CW: 7P8LB, PY0F, T31EU. 12m CW: HD8M.

Kevin ZB2GI – also operating as ZB2GI/MM from the Bay of Gibraltar and ZB2GI/P from the Top of the Rock – worked these stations. 20m SSB: AA8DC, AB4JI, AC7VA, G4AKC/M (pedestrian mobile), GD1JNB ,K2ANZ, K5XS, KB1ZBA, KN9C, KP4NU, N1RPH, N5AQ, N6TA, PJ4DX, PY5DK, WB-3BGK, VO1UK, UR5EH, YO2019EU. 17m FT8: 4U0R (World Radio Day), 5Q2J, HB-9SOLAR (Solarstratos solar-powered flight), OZ2SPACE (Sub-orbitals space project), VA4EEE, VE1GG, WW1WW, WB6EWM, YO2019EU.

Tony G4HZW managed some good DX on 40m FT8: C5YK, CE2SV, HI8S, HK2AQ, HP1RY, P4/K3DMG, VK1, 2 and 3, ZL3XDJ, ZL4CJF. Whereas on 10m FT8: *"I called CQ most days and only managed three contacts, G and GI."*

**Etienne Vrebos ON8DN/OS8D** offers 40m SSB: 4K6AG, HI8RD, ZF2IN. 20m SSB: 8P5A, C5YK, EL2EF, EP2C, FH/UA4WHX, PJ2/K8PGJ, PJ2/W4EN, TR8CA, UN7RM, UN7TE, VP2MQX, VU3WEW. 17m SSB: FM5DN. 15m SSB: PJ0DX (Sint Maarten).

Terry M0CLH provided a big log of mainly Europeans, plus: 40m SSB: OL100ZH. 40m CW: EV30AFG, LZ818PT, V84SAA. 40m FT8: 9M2TO, DU6/PE1NSQ, UA9CJM. 30m CW: V84SAA. 30m FT8: JA4FKX. RX9JX, SE19SKI, V84SAA, YB7SKM. 20m SSB: LZ391MW, R120MG. 20m FT8: 4Z4DX, A41ZZ, UA2FAK, YC1APR. 17m SSB: FH/UA4WHX. 17m CW: LZ391MW. TZ4AM. 17m FT8: SV5AZK, UA2FF, VK8ZI, WE9V. 15m FT8: 4S7AB.

Owen G0PHY reports the following: 40m SSB: AO1WAP, AO3WAP, EA9ABC, EM16UAP, OE16AAW, RA9DK, TM16WAP. 20m SSB: EM16UAP, FH/UA4WHX, FR4QT, OH10X, OH73ELK, **Fig. 5**. 17m SSB: FH/UA4WHX.

## Signing Off

Thanks 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 July issue the deadline is May 11th. 73, Steve PJ4DX.

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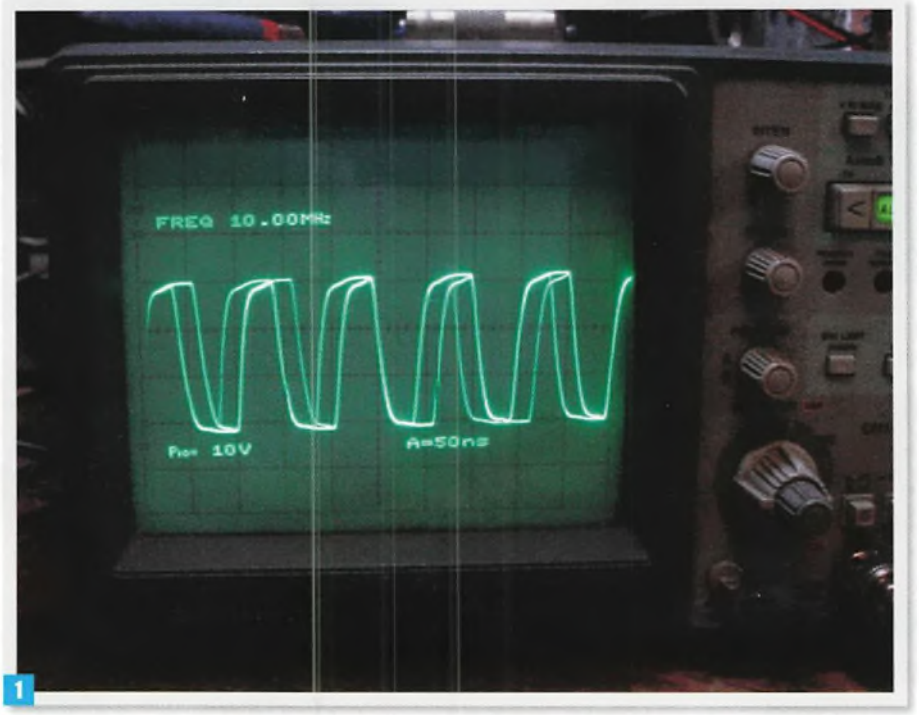
• E-mail: ericgw8ljj@outlook.com

# A GPS-disciplined 10MHz Frequency Standard

**Eric Edwards GW8LJJ describes a highly-accurate 10MHz frequency standard, handy for a number of purposes around the shack, for example when setting up for Es'Hail 2 as described**

**A known accurate frequency source is a very useful addition to the shack because it can be used to calibrate frequency counters (frequency meters) and also used as a reference for the counter and for transceivers that have a reference input.** The frequency chosen is 10MHz because that seems to be a popular frequency to use for reference.

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## How Accurate is it?

The accuracy of the project described is governed by the GPS signals that are being sent out from many satellites. There are two settings, one with the GPS antenna connected and another that relies on the internal TCXO (temperature compensated crystal oscillator). The frequency selected is stored in a 'flash' memory so no back-up battery is required.

## The GPS device

The device used is the GPS receiver and the type used is the Ublox NEO-7N, which suits the purpose very well for this application. My first attempt was using the NEO-7M, a larger module, and it worked as long as a battery backup was used to enable it to be powered down and back up some time later. There is a small battery fitted on the module but a bigger one would be better if I was to use that device. I chose the -7N type because it has an SMA GPS antenna socket fitted, a pps (GPS output) pin and a flash memory. The -7M has none of these easy access parts and because the memory of the -7N is a flash type it doesn't need a back-up battery.

## The Concept

There are several designs using the Ublox GPS modules where the output frequency is taken directly from the module. This is acceptable for lower frequencies but above 2MHz there is phase distortion. The photo, **Fig. 1**, shows this distortion when the 10MHz is taken direct from the GPS module. I have chosen to use 2MHz as the base frequency and multiply to 10MHz by using a frequency multiplier integrated circuit (ICS501) set to multiply by times five. This produces a stable 10MHz signal and I have used an Op-Amp to adjust the output level and change the impedance to 50Ω. This is done with a high frequency Op-Amp (LT1221) and then it goes into a simple three-pole lowpass filter to produce a clean 10MHz sinewave, **Fig. 2**, with no appreciable harmonics, **Fig. 3**.

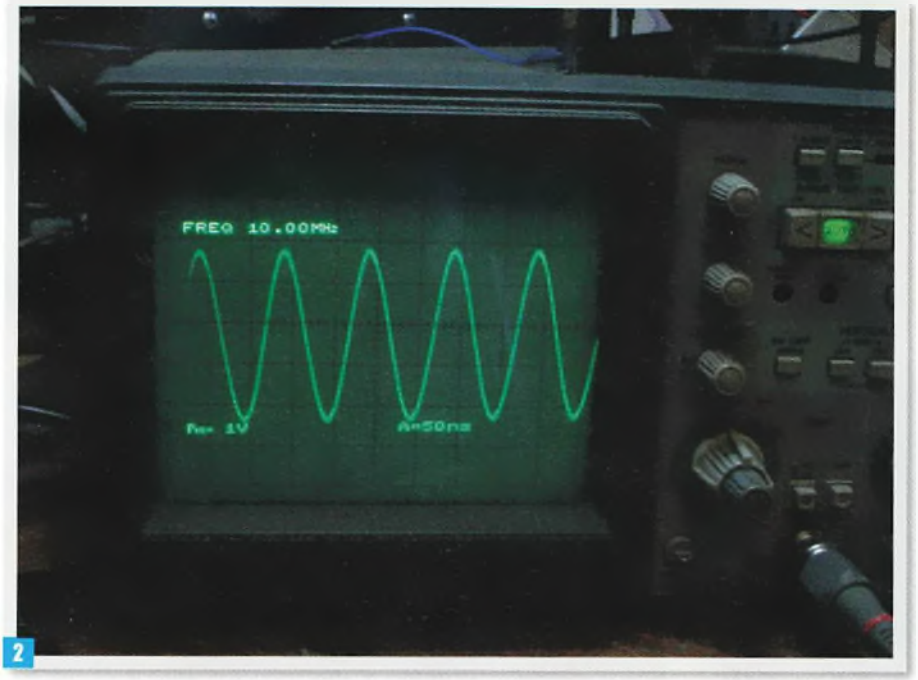
## Placing the Required Frequency in the GPS Module

Loading the required frequency to the GPS module requires software but once the frequency is loaded into the module's memory with the UART (Universal Asynchronous Receiver/Transmitter), this interface is no longer required in order to use with the frequency standard. Those of you that want to load the GPS module can download the software at the U-blox u-center. It will be pre-loaded if obtained from me.

## The Circuit Diagram

The circuit is shown at **Fig. 4**. The main component is the GPS module and the type used is a Ublox NEO-7N for the reasons described above: flash memory, no back-up memory battery needed, the GPS antenna (SMA) connector is pre-fitted and there is a dedicated pin for the PPS (GPS output signal). None of these are on the NEO-7M version.

The PPS signal from the GPS module has been programmed to provide a 2MHz square-wave with a duty cycle of 50% at

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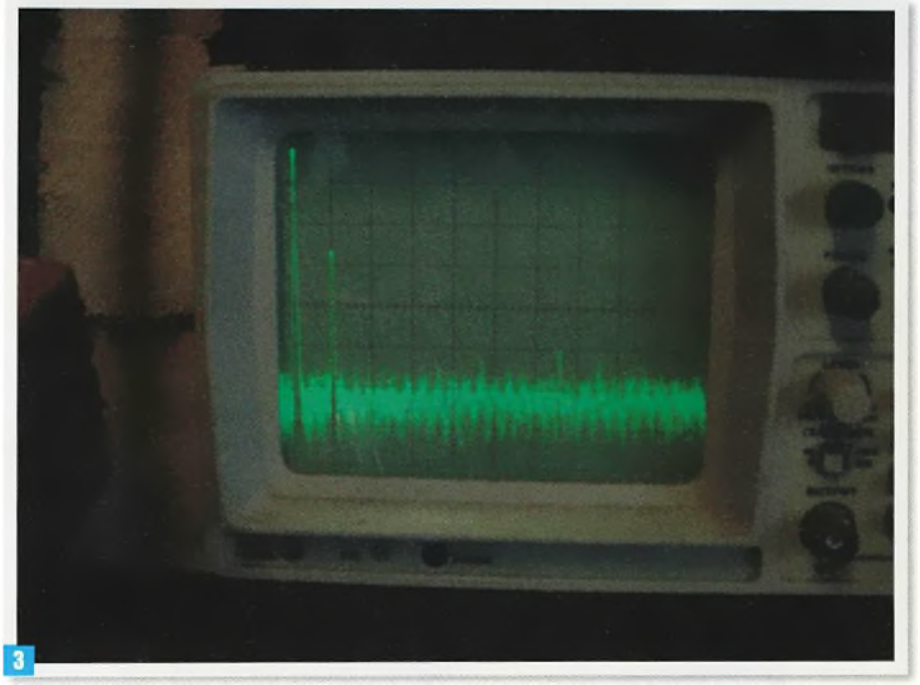

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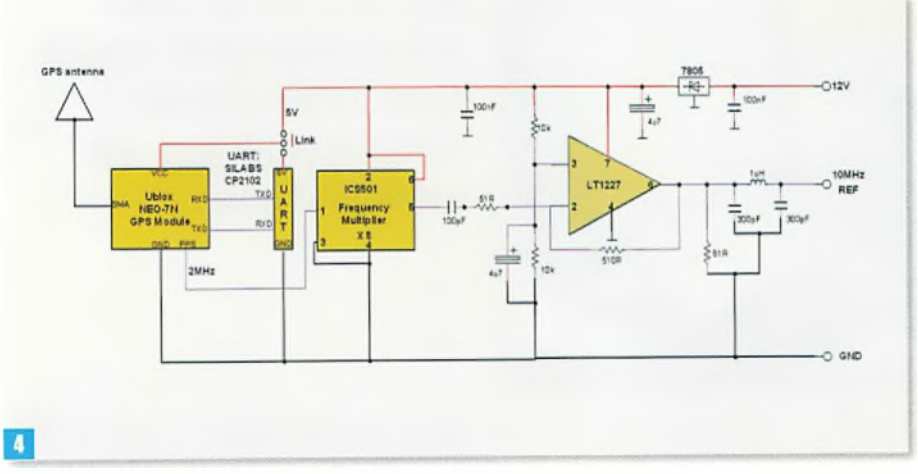


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**Fig. 1: 10MHz phase distortion on signal taken direct from GPS module.**
**Fig. 2: Cleaned up 10MHz signal.**
**Fig. 3: Spectrum of cleaned-up 10MHz signal.**
**Fig. 4: Circuit diagram.**

4V pk-pk (peak-to-peak). It is connected to a frequency multiplier (ICS501). This integrated circuit is a PPL (Phase Locked Loop) and is an SOP8 type that I have placed onto an adaptor to convert to DIL (Dual In Line) so it can be used with the standard through-hole PCB footprint. The output with 2MHz applied provides a 10MHz sinewave at 5V pk-pk waveform. Because a filter is required to remove, or greatly attenuate any harmonics, the signal output from the multiplier needs to be converted to low impedance and the gain adjusted. This is carried out by the next stage, which is an Op-Amp (LT1227), and although set for a gain of ten (510Ω/51Ω) it can be set for any other gain by changing the resistor combination. This is a high frequency Op-Amp and used for video applications. The output from this amplifier is placed at 50Ω for the sending impedance to the three-pole lowpass filter to provide a clean 5V pk-pk sinewave with no appreciable harmonics.

## PCB Layout

The PCB layout is shown in **Fig. 5**. The NEO-7N GPS module is shown on the left of the PCB and next to it is a six-way DIL socket that is used for placing a UART for programming the NEO module (once programmed, the UART can be removed). Below the NEO module is a three-way DIL socket and a link is supplied that selects either 5V for the NEO module from the external 12V power supply for normal use or the 5V supplied from the UART when programming. A UART can be obtained from me if you want one but if using your own, the type has to be a SILAB CP2102 type because of the pin labelling for interfacing with the NEO module. Others can be used but their pin positioning may be different. The IC (ICS501) is the frequency multiplier to bring the 2MHz square-wave output, **Fig. 6**, from the GPS module to an almost pure 10MHz sinewave, **Fig. 7**. This output is taken to an Op-Amp (LT1227) chosen because it is a high frequency type usually used in video circuits. The gain has been set for times ten and the output impedance to 50Ω. The output at pin 6 is taken to a simple three-pole lowpass filter to provide a clean 1MHz sinewave.

## Is There a Kit?

A full kit of parts, which includes the PCB and all the parts that are to be fitted, will be available. The UART is not part of the kit because it is not normally needed but can be obtained from me. A 'picking list' will be supplied on request and all parts are priced at the cost of the parts and input postage to me (I can be reached at the e-mail address at the top of the column).

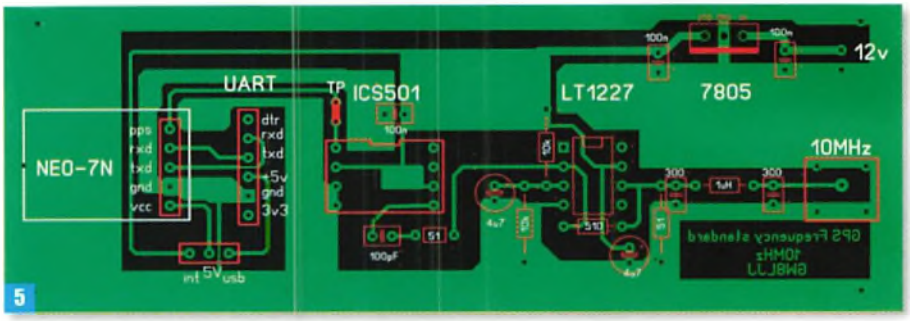
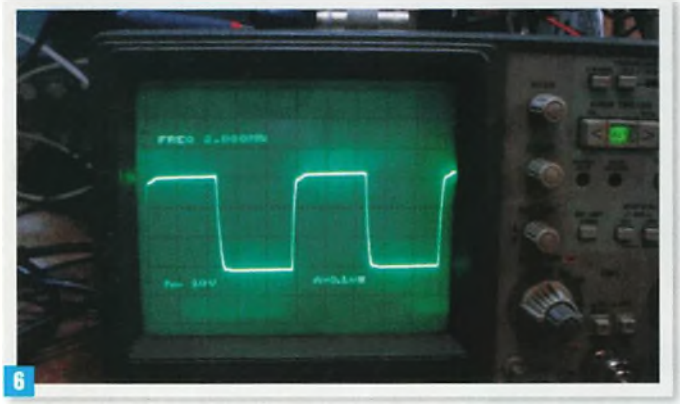
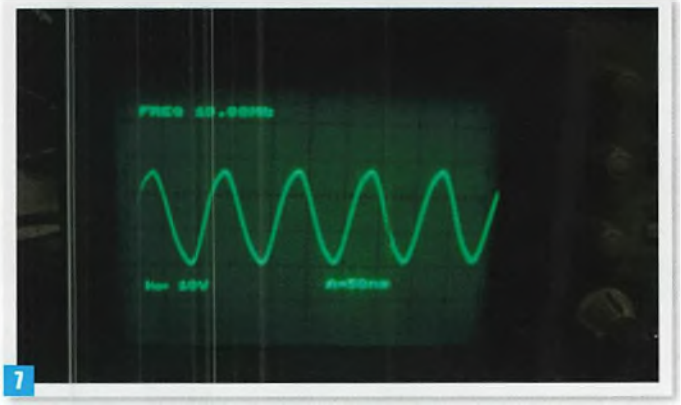



Fig. 5: PCB layout. Fig. 6: 2MHz base signal. Fig. 7: 10MHz output from multiplier.




An antenna will be needed and the connector may need to be changed to an SMA plug. For the GPS module, Google 'U-blox 7 GNSS modules' for sourcing and datasheet. For the GPS software, Google 'U-blox u-center'. The UART is the SILAB CP2102. Finally, my thanks to Ray G7BHQ for help with software and proof reading.

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# The Yaesu FT-1000 Series

**Don Field G3XTT offers a guide to the ever-popular FT-1000 series of transceivers from Yaesu, along with their major accessories.**

**Sadly, with the passing of Chris Lorek G4HCL, our bi-monthly *Buying Second-hand* column went into abeyance.** However, there were a few topics that Chris and I had discussed as suitable for the column and I really didn't want to let them slide because I feel they will be of interest to readers.

The first, and close to my own heart because I have owned and used most of them, is the Yaesu FT-1000 series of rigs. Each of them was undoubtedly a top-of-the-range transceiver at the time they appeared but the first FT-1000 was launched close to 30 years ago and the last was made over 10 years ago so they certainly qualify as second-hand buys. However, each and every one is still an excellent basis for an HF station.

## The Range

Let's start with an overview of the various models. The first was the FT-1000D, a radio that I consider a true classic nowadays. Then came the FT-1000MP. Finally, the FT-1000 MkV and the FT-1000 MkV Field (commonly referred to simply as the Field). I'll cover all of them here, along with their principal accessories and add-ons.

## FT-1000D

The FT-1000D, **Fig. 1**, was introduced in 1990 to wide acclaim and was Yaesu's answer to the very successful TS-930/940/950 from Kenwood (I hope to cover that series of transceivers on a future occasion). Indeed, I bought mine, **Fig. 2**, to replace a Kenwood TS-940 that had served me well for several years. This was a high-end fully analogue radio to complement the FT-990 (single receiver, 100W output) and the first to have an element of digital signal processing (hence the 'D').

What the FT-1000D offered was 200W output with an internal power supply, a second receiver with separate VFO knob (very useful for chasing DX and in serious contest operation) and the facility for adding a wide selection of additional filters of various bandwidths, both for the main and sub-receivers. By fitting an additional bandpass filter (BPF-1) unit, the sub-receiver could monitor a different band to that of the main receiver, something we consider normal nowadays but unusual at the time. It meant, for example, that when used in HF Field Day (as I did with the Reading club over several years), the operator could run on, say, 20m but easily check for openings on the 10m band where contacts scored double-points.

The FT-1000D also included a computer interface, albeit you needed to buy or build an external level converter to interface to RS232 (the Yaesu unit is designated FIF-232C and you will still see them for sale second-hand from time to time). Given that computer logging was becoming popular in the late 80s/early 90s, this was an important feature. And as well as the main antenna input(s) (normally one but two with the added BPF-1 unit), there was a separate receive antenna input, handy when using, say, a small loop

or other dedicated receive-only antenna. The FT-1000D also featured a built-in ATU, which handled VSWRs of up to 3:1.

The main receive architecture was a quad-conversion superhet (triple conversion for FM) with intermediate frequencies (IF) of 73.62 and 8.215MHz then down to 455 and 100kHz. The sub-receiver had three IFs at 48.64MHz, 7.66MHz and 455kHz. The main reason for introducing such a high first IF was to enable Yaesu to offer full general coverage receive over the whole HF spectrum, something that customers were increasingly demanding (earlier generations of transceiver had tended to be amateur bands only).

The Yaesu range of after-market filters (for the 455kHz IF) included 2.4 and 2.0kHz SSB filters and 600, 500 and 250Hz CW filters. However, once the FT-1000D's popularity became assured, high-quality filters were also available from other suppliers such as the Fox Tango Corporation (and, later, IRC and then INRAD).

Other Yaesu options included the DVS-2 digital voice synthesiser, useful in voice contests if you are repeatedly calling CQ, a high-stability temperature-controlled crystal oscillator, the TCXO-1, normally only needed for data mode applications and the SP-5 external loudspeaker (which incorporated some further audio filtering).

Other third-party modifications and additions included a modification to round off the CW keying, which could be somewhat 'clicky'. I recall adding this mod to my own rig (which I owned for well over ten years from 1992 because nothing came along during that time to tempt me to change until I eventually weakened and bought a second-hand FT-1000 MkV).

The FT-1000D was certainly not a budget radio. I recall that in its basic form the list price was £2995 and the addition of options such as filters and the DVS-2 could take this to well over £3000, which would equate to around £5000 nowadays. And adding filters (something that we generally don't have to do with modern rigs, where the filtering is all done by clever algorithms in the DSP software) was certainly a worthwhile investment, especially for CW operators wanting the best selectivity. Mind you, it took very many years, in my opinion at least, before digital signal processing offered the same clean filtering that crystal and mechanical filters produced. I do recall reviewing an early DSP rig for the magazine *Ham Radio Today* and noting that a weak DX station was 100% copy on my FT-1000D whereas on the DSP rig all I could hear was splatter from the pile-up calling the DX station, even though that pile-up was 1kHz or so higher in frequency. With current radios, that wouldn't be the case, I should add – DSP has come a very long way since then.

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Good second-hand FT-1000Ds don't come up that often and still command prices of several hundred pounds, especially if they have a full set of filters. The downside is that spares are unlikely to be available nowadays but my own radio bore some rough treatment over the years I owned it (being taken several times to the Channel Islands for contest operations, for example) and never faltered. I eventually sold it to a fellow club member who, so far as I know, still uses it.

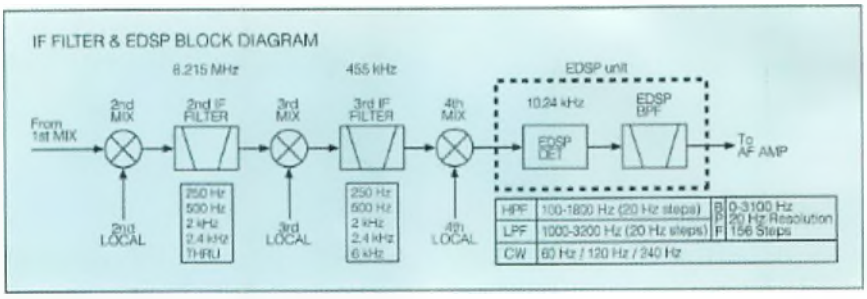
There is lots of additional information on the internet (Google is your friend), including the original manual, and the rig was reviewed by **Peter Hart G3SJX** in the June 1991 issue of *RadCom*.

**Fig. 1: A modern classic, the original FT-1000D. Fig. 2: The author's station in 1992 – FT-1000D, Kenwood TL-922 amplifier, Kenwood monitor scope, FT-726 (for 6m, 2m and 70cm) and (out of sight on shelf above) Icom IC-735 for expedition use. The keyboard connects to a 286-based PC (out of shot) – yes, I had already been computer-logging for several years at that time. Fig. 3: The FT-1000MP.**

## FT-1000MP

The FT-1000MP, **Fig. 3**, was introduced in 1995 to replace the FT-1000D. This was a 100W rig with (AC version) or without (DC version) an internal power supply. Either could, though, be run from an external 13.8V supply for mobile or portable operation. It covered the same frequency bands as the FT-1000D and, again, featured a second receiver. However, it introduced what Yaesu called Enhanced Signal Processing (EDSP) technology, **Fig. 4**, taking the use of DSP a step beyond what had been included in the FT-1000D. It still had traditional filters but the EDSP added a

**Fig. 4: FT-1000MP EDSP, taken from the 1998 Yaesu catalogue. Fig. 5: The FT-1000MP MkV along with FTV-1000 6m transverter. The MkV is distinguishable by the large heatsink to deal with the 200W power level.**




**EDSP™** operates in transmit and receive modes, producing enhanced signal-to-noise ratio and improved intelligence recovery on both ends of the communication path. EDSP provides 4 random-noise reduction settings, enhanced audio intelligibility with 4 voice response equalization programs, razor sharp CW band pass filters, and an automatic notch filter which identifies and attenuates carriers or heterodynes. Band pass selectable contour filtering offers high, mid, and low cuts.

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further level of selectivity and noise reduction. I recall the first time I used one, at a friend's station in an SSB contest, being impressed by the way the FT-1000MP could 'take out' an interfering carrier in the middle of the passband without causing much distortion to the received SSB signals, something that would be impossible with traditional filtering.

Other new features included shuttle/jog tuning – an outer ring around the main tuning knob, which allowed the user to rapidly tune the band rather than having to tediously spin the tuning dial. The other obvious difference compared with its predecessor was that a number of the functions were now accessible by menu control – I do recall that this gave us some issues on a major DXpedition because team members who owned one of these radios would change some of the menu settings to whatever their particular preference might be. The next operator to sit at the radio would then wonder what was going on because the radio felt 'different'. We had to make it a team rule to leave everything alone!

For computer interfacing, the FT-1000MP incorporated an internal level converter so had a direct RS232 connection. A Band Data port also allowed ready access to band information for, for example, remote antenna switching or interfacing with the VL-1000 linear amplifier. The front panel, rather than featuring a traditional moving coil meter, had a bargraph display for signal strength and other measurements. The frequency display also carried a lot more information than its predecessor. The various add-on options were much as with the FT-1000D – high stability crystal oscillator, various additional filters, external loudspeaker and DVS-2. The optional FH-1 remote keypad also allowed direct access to various menu features, to permit rapid selection of features pre-programmed by the user. The FT-1000MP also had a low-level transverter socket for driving external VHF transverters and could have the display mapped to the transverter frequency.

The FT-1000MP quickly achieved popularity and many are still in use. They frequently appear second-hand too and make an excellent basis for a high-performance HF station. Second-hand prices vary from around £500 to £700 depending on what filters are fitted, the general condition of the rig and, indeed, whether the original packaging, microphone and so on are still to hand.

The FT-1000MP was reviewed in the January 1996 issue of *RadCom*.

## Yaesu VL-1000 Linear Amplifier

Before moving on to the later models in the FT-1000 series, I wanted to mention the VL-1000 Quadra linear amplifier. This was introduced to complement the various Yaesu rigs although it could equally be used with transceivers from other vendors and covered a wide frequency range from topband to 6m But it did and does interface very nicely with Yaesu equipment, allowing two transceivers and up to four antennas to be left connected, switching conveniently between them (the antennas can be set up to connect automatically when the relevant band is selected on the transceiver and the transceiver is selected by way of a switch on the front panel). The Quadra runs up to 1000W out (500W on 6m), rendering it very comfortable (cool) at the UK 400W power level, even when in use for data modes or for extended operation in contests or on a DXpedition.

The VL-1000 comprises two separate units, the RF deck and power supply. The power supply can conveniently be located away from the operating desk if required.

## FT-1000MP MkV

The FT-1000MP MkV, **Fig. 5**, introduced in 2000, as its names suggests, was a successor to the FT-1000MP. However, don't be fooled. There was never a Mk2, 3 or 4. The 'V' designation referred to five areas of improvement/enhancement compared with its predecessor (I suspect 'not a lot of people know that'!). These were:

- Improved electrical performance.
- Integrated Digital Bandwidth Tracking, IDBT, **Fig. 6**.
- Higher Transmit Power.
- Class-A PA.
- Separate 30V power supply.

It could be argued that most of these enhancements were irrelevant to many users. If you already use a linear amplifier, for example, the increase of transmit power from 100W to 200W doesn't add anything (but the MkV is readily distinguishable by the large heatsink fins, top rear, to deal with the higher power level). I also always wondered (I did own a MkV for several years) how many owners took advantage of the Class A PA facility

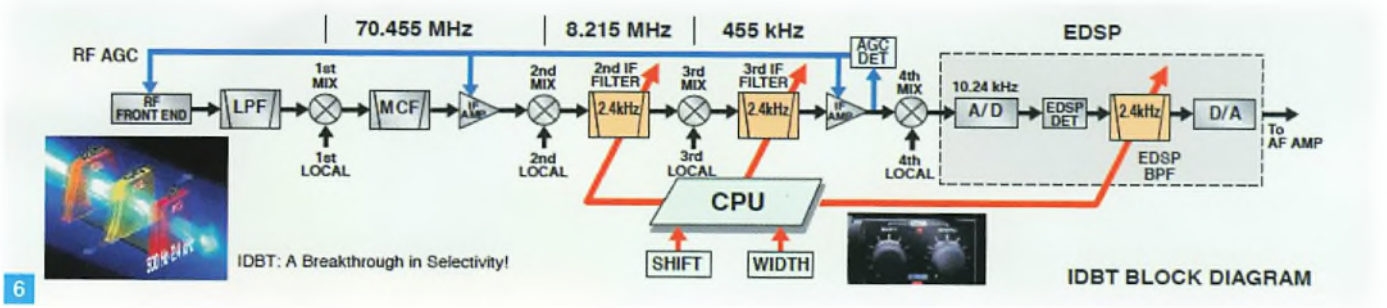



**Fig. 6: Block diagram of the IDBT feature, introduced in the FT-1000MP MkV. Fig. 7: The FT-1000MP MkV Field alongside the VL-1000 Quadra linear amplifier.**

(offering improved IMD – intermodulation distortion) and the external power supply was a necessary change simply to accommodate the higher voltage and current requirements of the 200W PA. The improved electrical performance and digital bandwidth tracking, though, were a result of the transceiver coming along five years after the FT-1000MP and therefore benefiting from better DSP capabilities (our amateur radio transceivers tend to follow military and commercial DSP by several years, as the capabilities improve and the prices fall).

Again, the main features are very similar to the previous transceivers in the FT-1000 series, offering a main and sub-receiver with a superhet architecture, mixing to a high first IF. Yaesu also included a so-called high-Q VRF (Variable RF Filter) preselector, shades of Q-multipliers of old! (This feature of a Hi-Q VRF pre-selector was further developed in the later FT-2000, FTdx5000 and FTdx9000 transceivers as the μ (Mu) Tuning Kits for the 160, 80/40 and 30/20m bands). The purpose of all this additional filtering was to prevent very strong signals (for example, from a local broadcasting station or, in the case of a big contest station, from adjacent high-power transmitters operating on other bands) from getting into the receive path and affecting the weak signals that the user was trying to hear.

Once again, accessories included various additional filters, external loudspeaker, FH-1 remote keypad and two TCXOs, depending on just how stable you needed the frequency to be (The TCXO-4 offering ±2ppm stability and the TCXO-6 ±0.5ppm).

The FT-1000MP MkV was reviewed in the October 2000 issue of *RadCom*. Second-hand models in good conditions with a full set of filters still sell for close to £1000.

## FTV-1000

Introduced alongside the FT-1000MP MkV was the FTV-1000 transverter for the 6m (50MHz) band, see Fig. 4 again. This interfaced seamlessly with the FT-1000MP MkV, drawing its power from the shared external power supply to put out a very handy 200W of transmit power on 6m.

## FT-1000 MkV Field

The MkV Field, **Fig. 7**, came along after the MkV and, I suspect, was a recognition that not all users wanted a 200W radio. The Field offered 100W output with an internal AC power supply but which could also be run off an external 13.8V DC supply, for use, for example, on remote DXpeditions or Field Days where the only supply was a car battery or similar. In all other respects, as far as I am aware, the Field was essentially the same as its bigger brother. However, when using the optional FTV-1000, it was necessary to use a suitable higher power PSU, because the internal power supply of the Field had insufficient capacity (thus, the FP-29 PSU that came with the FT-1000MP MkV was also sold separately for use in this situation).

## Roofing Filters

One of the limitations, at least as far as the more demanding operators were concerned, of the FT-1000 architecture was the high first IF. While this was chosen for good reasons, when the early FT-1000 models appeared filter technology was such that no narrow filters were available to work at that frequency. Thus, the first filters allowed in strong adjacent signals, which could then cause problems further down the receive chain. Later, filter manufacture improved and various third parties sold narrow filters for that first IF. These were originally sold as just that – first IF filter – but have, over the years, become colloquially known as roofing filters because they put a protective 'roof' over the following stages. For the best performance on narrow-band modes (CW and data modes), having such filters fitted is definitely worthwhile.

## FTdx5000

To bring the story up the present, the FT-1000 line was eventually discontinued by Yaesu, to be followed by the FT-2000, FTdx9000 and, in 2010, by the excellent FTdx5000 range of transceivers. The latter has many of the same features as the radios I have been describing and, for the time being at least, will remain on sale in parallel with the recently-launched FTdx101 series so that buyers have the choice between traditional superhet and SDR architectures. The FTdx5000 can also be a superb second-hand buy but, at £2000+, is probably beyond what most amateurs would consider as a second-hand purchase, albeit that is half of what they originally sold for (but the new price has been discounted somewhat in the last two or three years).

Finally, my thanks to **Paul Bigwood G3WYW** of Yaesu UK for putting me right on some of the history of this classic series of radios – any errors are entirely mine!

• E-mail: practicalwireless@warnersgroup.co.uk

# The 6m (50MHz) Band

**With the imminent arrival of the summer Sporadic E season in the northern hemisphere, Colin Redwood G6MXL encourages readers to try the 6m band.**

**For the last 20 or more years, almost all HF transceivers have come with the 6m (50MHz) band included.** Yet I frequently hear amateurs saying that they never hear any activity on 6m and therefore no longer even listen on the band.

While it may be true that with the current sunspot minimum, there is very little activity on 6m most of the time, this is not always the case. Over the next few months, there will certainly be more activity in the northern hemisphere as we benefit from the main annual Sporadic E (sometimes abbreviated to Es) propagation season.

Sporadic E propagation is most likely to be encountered during the months from May to August in the northern hemisphere. As its name suggests, it is sporadic and largely unpredictable. The good news is that when it does occur, the 6m band along with 10m is usually one of the first to benefit. It certainly occurs more often at 6m than at 2m. **Steve White G3ZVW** discussed Sporadic E propagation in more depth in his *Making Waves* column in the May 2017 issue of *PW*.

During a 6m Sporadic E opening, strong signals from stations typically about 1500km away suddenly appear (as the Sporadic E increases in intensity, stations closer than this may also be heard and worked). For those of us in the UK, the stations are often from Scandinavia, Italy, Spain or Portugal. Usually any opening will be limited to a fairly narrow geographic area. For example, an opening to northern Italy may also extend into Slovenia. Sometimes multiple-hop Sporadic E can occur, enabling contacts further away, even across the Atlantic to North America or into the Middle East on 6m (hence why it is often dubbed the Magic Band).

## Antennas

Antennas for 6m are much smaller than their HF equivalents, so that a dedicated resonant antenna for the band should be feasible for almost all situations.

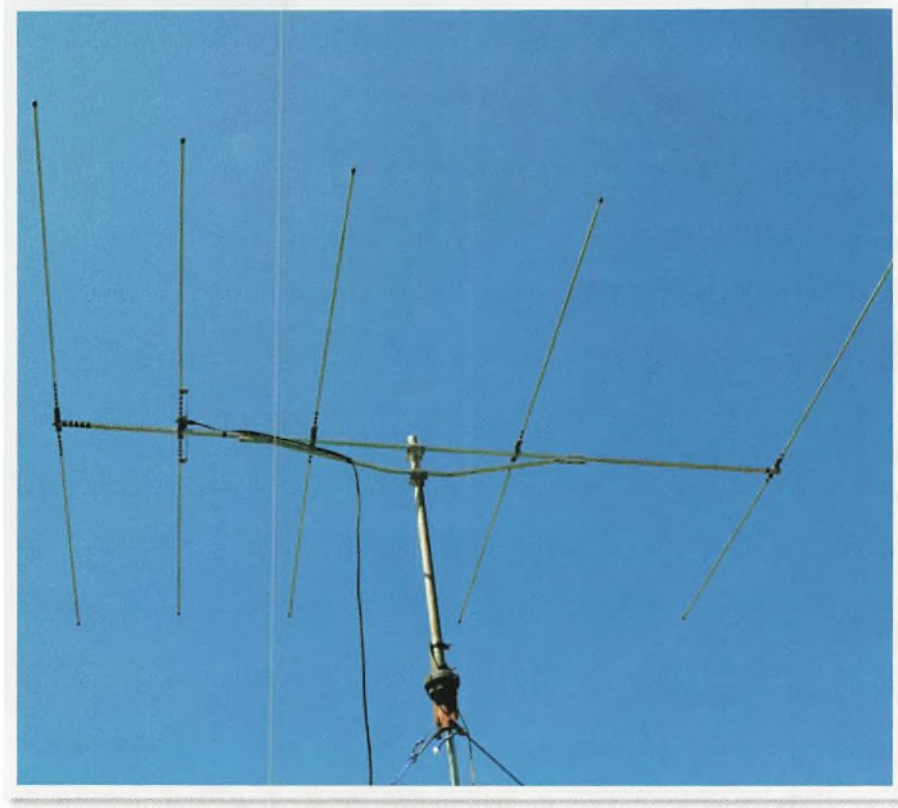

**Fig. 1: A fairly compact 5-element Yagi antenna for the 6m band.**

If you have a choice, I would suggest using a horizontally polarised Yagi, **Fig. 1**, or dipole. I've certainly had a lot more contacts with these types of antennas than using one of the 6m/2m/70cm omnidirectional vertically-polarised antennas. However, the latter are fine for local FM contacts and will enable a few contacts with really strong stations further afield.

Don't underestimate how effective a dipole can be on 6m. I made my first transatlantic contact running just 10W into a wire dipole strung between a couple of windows in adjacent first-floor bedrooms, so that the wire was almost touching the brickwork of the house – far from ideal!

## ATUs

If you have no choice and need to use a non-resonant antenna, then you'll need to consider an antenna tuning unit (ATU). I'd check this carefully because not all ATUs are designed for use at 50MHz. In particular, some ATUs built into transceivers are only designed to operate up to the 10m band. Without an ATU, you'll at least be able to listen but I would really recommend a resonant antenna for transmitting.

## Feeder

In comparison with the LF and HF bands, feeder losses start to become significant at 6m. If you have a choice, I'd suggest avoiding RG58 except for short runs. RG213 would be a better choice for most stations with feeder lengths of more than 10m or so.

## Power

Some older transmitters produce less power on the 6m band than they do on the main HF bands. The Kenwood TS-690S is a case in point, producing 50W on 6m

| Mode | Frequency (MHz) |
|---|---|
| PSK | 50.305 |
| JT65 | 50.310 |
| JT9 | 50.312 |
| FT8 | 50.313 |

**Table 1: Usual 6m frequencies for popular data modes.**

and 100W on the HF bands. 10W is quite sufficient to make some long-distance contacts during a Sporadic E opening, so all UK amateurs should be able to make some contacts.

## Other Propagation Modes

Besides Sporadic E, the 6m band exhibits some characteristics of the higher HF bands and also some features of the VHF bands. No matter whether you are more familiar with HF or VHF propagation, you'll find some propagation with which you may already be familiar.

Looked at from an HF perspective, there can be some F-layer propagation, but realistically this is unlikely to occur during a sunspot minimum such as we have at present.

From a VHF perspective you can get some tropospheric enhancement on 6m, but this is generally less frequent and less pronounced than on 2m and 70cm, for example.

Other propagation modes that can be encountered include meteor scatter, which I discussed in the April 2018 *What Next* column. Some stations have made some moonbounce (EME) contacts but, as **Steve White G3ZVW** showed in the March 2019 issue, this is a real challenge on any band. With the larger antennas needed for 6m in comparison with 2m or 70cm, getting high ERP (effective radiated power) on 6m is not easy but even with high power, a lot of antenna gain is required to overcome the 243dB path loss.

Besides the various modes I have mentioned for long-distance contacts, it is also possible to have local contacts on 6m – often using FM.

## Repeaters

There are a number of 6m repeaters in the UK. Their outputs (the frequency you listen on) range between 50.72MHz and 50.86MHz. The input frequencies are 500kHz higher. A list of these with their current status can be found at:
https://tinyurl.com/y35axfb5

## Transmission Modes

You can encounter just about every amateur transmission mode on the 6m band. Historically CW and SSB have been the most popular modes. These days various data modes, FM, digital voice and even narrowband fast-scan digital television can also be found on the band.


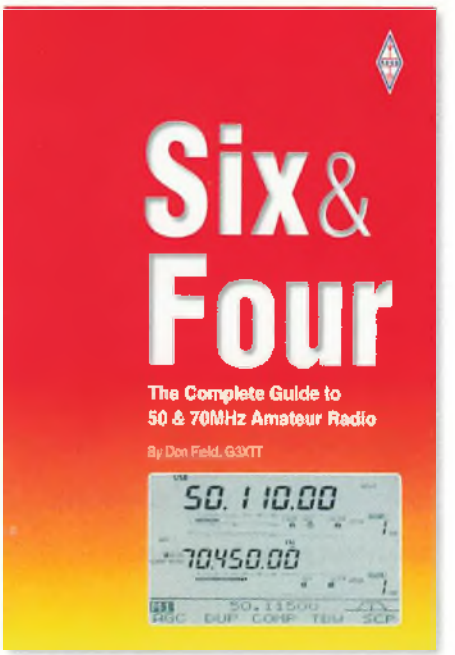


**Fig. 2: Six News published quarterly by UKSMG.**
**Fig. 3: The Six and Four book by Don Field G3XTT is a complete guide to the 6m and 4m bands.**

## Operating Techniques

No matter whether you are making contacts via Sporadic E or the F layer, most of the time the band is unlikely to remain open for long periods. I would therefore suggest exchanging callsigns and reports as early in a contact as possible. Before going on to longer exchanges, remember the band might close at any moment and the station at the other end may be keen to work other stations besides yourself. Likewise, other stations may be keen to work you or the other station during the brief opening, so long ragchews are probably not going to be popular!

## Openings

Given the nature of Sporadic E, it is important to know when the band is open. In no particular order, I would suggest making use of the DX Cluster (see *What Next* October 2018), leaving a receiver tuned to a beacon frequency that is only audible during an opening, and perhaps making use of the ON4KST Chat facility (See *What Next* December 2014):
www.on4kst.com/chat/start.php

You could simply try tuning across the band periodically. If you prefer a graphical presentation of band conditions, I would suggest having a look at the dxmaps website, selecting 50MHz and Europe.
www.dxmaps.com

If you are returning to the 6m band after some years away, you'll note that just about all the Band 1 broadcast television stations have vacated the band, so the noisy buzzing sounds that used to be encountered during openings have largely disappeared. This certainly makes operating on 6m a lot easier than 20 years ago.

Finally, many of the latest transceivers include a spectrum display. This is ideal because you can leave it displaying the key parts of the 6m band (DX calling frequencies, beacon frequencies) and you will immediately see when signals start to appear.

## Beacons

There are numerous propagation beacons on the 6m band. They are particularly useful in identifying when the band is open and in which direction. There are numerous lists on the internet. I find **Martin Harrison G3USF's** worldwide list of 50MHz beacons particularly useful because it has a last reported column, which gives a good indication of how up-to-date the information is:
www.keele.ac.uk/depts/por/50.htm

## Bandplan

Like nearly all amateur bands, the 6m bandplan follows the usual convention of CW at the bottom of the band, followed by SSB, Data, and finally FM and Digital Voice as the frequency increases. If you are new to the band, I'd suggest familiarising

| Contest Name | Modes | Starts | Ends |
|---|---|---|---|
| UKSMG Summer Contest | ALL (including digital) | 1st June 2019 13:00 UTC | 2nd June 2019 13:00 UTC |
| UKSMG Summer Marathon | ALL (including digital) | 4th May 2019 00:00 UTC | 4th August 2019 23:59 UTC |
| UKSMG Winter Marathon | ALL (including digital) | 1st December 2019 00:00 UTC | 31st January 2020 23:59 UTC |
| RSGB MGMAC | Datamodes only | 2nd Thursdays 19:00 Local | 19:55 Local |
| RSGB UKAC | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 2nd Thursdays 20:00 Local | 22:30 Local |
| RSGB VHF NFD | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 6th July 2019 14:00 UTC | 22:00 UTC |
| RSGB 1st MGM | Datamodes only | 20th April 2019 14:00 UTC | 21st April 2019 14:00 UTC |
| RSGB 1st 50MHz | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 14th April 2019 09:00 UTC | 12:00 UTC |
| RSGB 50MHz Trophy | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 15th June 2019 14:00 | 16th June 20019 14:00 |
| RSGB 50MHz CW | CW only | 23rd June 2019 09:00 | 12:00 UTC |
| RSGB 50MHz AFS | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 20th October 2019 09:00 | 13:00 UTC |
| RSGB 2nd MGM | Datamodes only | 14th December 2019 14:00 UTC | 15th December 2019 14:00 UTC |
| RSGB Christmas Cumulatives | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 26th December 2019 14:00 UTC | 16:00 UTC |
| RSGB Christmas Cumulatives | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 27th December 2019 14:00 UTC | 16:00 UTC |
| RSGB Christmas Cumulatives | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 28th December 2019 14:00 UTC | 16:00 UTC |
| RSGB Christmas Cumulatives | SSB, CW, FM, AM, JT6M, ISCAT and FSK441 | 29th December 2019 14:00 UTC | 16:00 UTC |

**Table 2: Some popular 6m contests.**

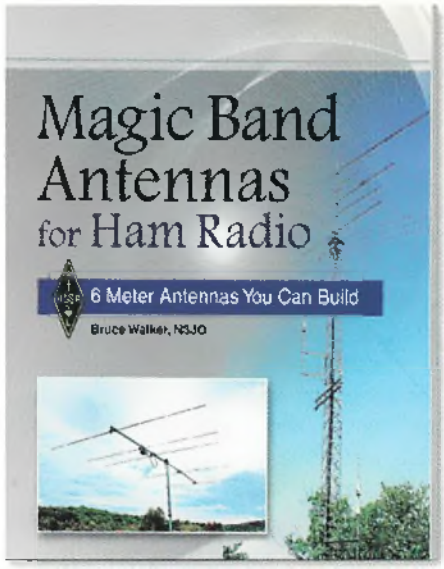


**Fig. 4: The new book Magic Band Antennas for Ham Radio by Brice Walker N3JO from the ARRL.**

yourself with the 6m bandplan at:
https://tinyurl.com/ycntdkkc

I'd highlight that the band segment 50.100 to 50.130MHz is designated for intercontinental contacts, so UK stations should not be using this part of 6m for contacts with other UK or European stations.

The published bandplans do not detail where various data modes are to be found, however **Table 1** shows the usual frequencies employed.

## Contests

If you enjoy contests, then you'll be pleased to know that the RSGB and the UK Six Metre Group organise a number of 6m contests throughout the year. I have summarised the main contests in **Table 2**. You'll need to refer to the relevant contest rules if you are planning to enter.

There is always plenty of activity for the UKSMG's Sporadic E contest. This year it takes place from 1300 UTC on Saturday June 1st to 1300 UTC on Sunday June 2nd.

## UKSMG

If you want to keep up with activity on the 6m band, then I would recommend joining the UK Six Metre Group (UKSMG). Subscriptions are £15 per annum. The UKSMG produces a quarterly magazine, **Fig. 2**, with loads of information on past, current and planned activity on the band as well as information on new equipment for the band. You can visit the group's website at the URL below – the 'desktop' page usefully brings together lots of current 6m-related information (current activity, propagation data, Cluster spots and the like):
www.uksmg.org

## Books

For those wanting to know more about the 6m band, there are a couple of books I'd recommend. The first was written by *PW*'s editor, **Don Field G3XTT**. *Six and Four*, **Fig. 3**, as its title suggests, is a complete guide to the 6m and 4m bands, and is far more wide-ranging and covers topics in more depth than I can possibly do in three pages.

The second is a new book from the ARRL called *Magic Band Antennas for Ham Radio*, **Fig. 4**, by **Brice Walker N3JO**. The book presents a number of very practical antenna designs, including some very basic ones for domestic and mobile installations. Of particular note are some 'stealth' designs, which may be helpful for those amateurs unable to put up large arrays. Readers considering purchasing the book should note that dimensions are all in imperial units (feet and inches) rather than metres and other metric units.

## Awards

The UKSMG offers a range of awards for contacts made on the 6m band. These include awards for working so many DXCC entities in various continents. The Group also has some awards for 6m contacts made using EME and others for working 10, 25 or 100 locator squares using data modes.

The RSGB also offers a range of three awards for contacts made using 6m. These include awards for working ten DXCC entities and multiples of ten. Others include awards for working 25 locator squares and multiples of 25. The final RSGB award also allows for crossband contacts where 6m is used by your station for transmission. Proof of contact is required.

As might be expected, the ARRL also offers a range of awards for 6m contacts. For example, 6m contacts can contribute to an application for DXCC.

## Conclusions

I hope I have encouraged readers to try the 6m band. I am sure that **Tim Kirby G4VXE** will be pleased to receive readers' reports for his column. E-mail him at
longworthtim@gmail.com

## Exam Syllabus – Updates

Finally, a reminder to readers involved in training that the new exam syllabus is effective from September 1st. The latest version of the new syllabus, which incorporates a few minor corrections from the version published last autumn can be found at:
https://tinyurl.com/yyyle83y

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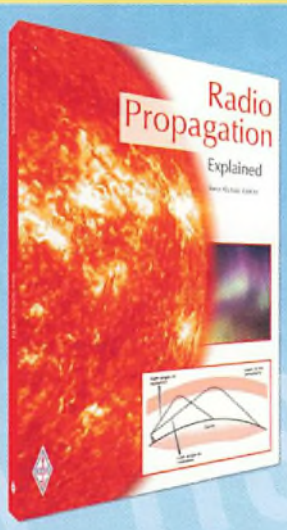


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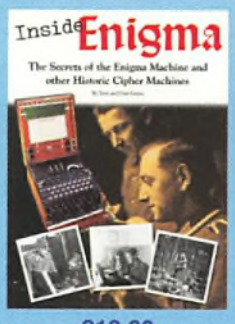


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# A Mixed Bag!

**It's a bit of a mixed bag from Internal Fire – Museum of Power. Last summer's season went very well, the new Steam Hall is open and the museum improves day by day.**

**In recognition of Gugliemo Marconi's achievements, International Marconi Day is held every year on the Saturday closest to his birthday (April 25th 1874), hence in 2018 the event was on the April 21st.**

GB2MOP was on the air for Marconi Day and it was a privilege to be able to put our 1950s Marconi Radio Room Oceanspan Transmitter, Mercury and Atalanta Receivers on the air. We had a number of interesting contacts, including many special event stations. I am particularly grateful to **Eric** of Telford & District Amateur Radio Society (GB8MD), who were operating from the historic Marconi receiving station (MUV) at Tywyn in Mid Wales, **Fig. 1**. MUV was built in 1912 as a Long Wave receiving station working alongside the high-power transmitter at Waunfawr, which was opened in 1914. Waunfaur was reputedly the most powerful transmitting station in the world at that time, so powerful that the receiving station had to be situated some 30 miles away at Tywyn to avoid overloading the receivers. The original transmitter was a rotary spark discharger taking its power from a hydroelectric station at Cwm Dyli.

The site was commandeered by the Post Office during WW1 and used primarily by the Admiralty for worldwide communications to America, Russia and Egypt as well as the many corners of the Empire. As a receiving station, Tywyn was able to eavesdrop on enemy traffic and because we were in possession of German codes, we were able to decipher most of their messages. Thus, Tywyn may be seen as a precursor to the 'Y' Listening Service established during WW2. The raw messages would, I am sure, be passed to Whitehall for decoding. Room 40 at the Admiralty no doubt!

Marconi had established a transatlantic telegraph service at Clifden in Ireland in 1907. When the facility was damaged by Republican forces during the Irish Civil War in 1922, the service was transferred to the Waunfawr/Tywyn stations.

At Waunfawr a substantial number of the original buildings, together with concrete bases for masts survive, **Figs. 2** and **3**, while at Tywyn only some Marconi worker's bungalows remain as reminders of Tywyn's wireless history.

We received a 58 report from **Stuart** of South Dorset Radio Society (GB0MFH) who was operating from Flat Holme Island, the site of some of Marconi's early experiments and his first transmissions across open sea. Having failed to interest the Italian government in his wireless experiments, 22 year old Marconi came to Britain in 1896. **William Preece**, GPO Chief Engineer, was more accommodating and assisted with many of his experiments as did **George Kemp**, Cardiff Post Office Engineer. The following year, 1897 in May, Marconi, Preece and Kemp set up wireless stations on Flat Holme Island in the Bristol Channel and at Lavernock point, about 6km away on the most southerly point of Wales, **Fig. 4**. After a disappointing first two days, on May 13th 1897 the following CW exchange took place, 599 as we would say today:

*"Are you ready"*
*"Can you hear me"*
*"Yes loud and clear"*

This was the first successful exchange across open sea, although Preece succeeded in 1889 in transmitting and receiving signals across Coniston Water, a distance of about one mile. Marconi then extended his range to ten miles, by relocating his equipment from Flat Holme Island to Brean Down Fort, near Weston-super-Mare. After further experiments to increase range and patenting his apparatus, Marconi went on, as we all know, to bridge the Atlantic by wireless in 1901.

I was pleased to make contact with G2LO operating from Daventry. G2LO is one of the many callsigns of the Ariel Radio Club, the BBC staff radio club. Other interesting calls held by the club include G2BBC, G3BBC, G6BBC, G7BBC, G8BBC, GW0BBC, G3PPG, G3SUT and G5XX. I don't know any more about Ariel but it would be interesting to hear more about this fascinating club from one of the members

1

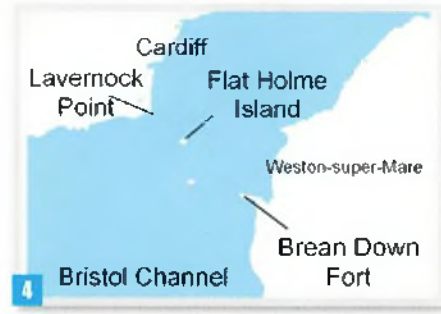
2

**Fig. 1: Tywyn Receiving station in 1918. Fig. 2: Waunfawr transmitter house, Plas-y-Celyn on the western slopes of Cefn Du, showing a clear take off to the west. (Photo © Eric Jones).**

I must also thank **Kev M0TNX** from Bootle, **Ian G6TVS**, **Mervyn GW8TBG** Swansea, **Stuart G0TBI** Kinver and **Jeff GW3UZS** Cardiff who all took the trouble to respond to my AM transmissions. They had to be patient because, at that time, there was still an issue with the transmit/receive switching. Output from the transmit VFO was breaking through on receive. I had to remember to turn the VFO output off on receive and on again for transmit. It doesn't sound a lot but it takes you back to the old days before simple press-to-talk when a number of circuits would have to be switched when changing over to transmit and vice versa. I did try running a line from the Oceanspan de-sense circuit to switch the VFO output but there was so much RF present that it interfered with the VFO.

It's apparent that there are high levels of RF present in the radio room and that this will become more of a problem when the Marconi Challenger and Kelvin Hughes Transmitter come on line. To reduce this and improve antenna efficiency, I have in mind a remote-tuned coupling unit to mount at the

**Fig. 3: Waunfawr in 1912. The buildings are substantially unchanged today. Fig. 4: Bristol Channel showing location of Flat Holme Island. Fig. 5: On June 14th 2018 we had a visit from Aberystwyth and District Amateur Radio Society. Pictured from left to right: Daniel Pugh MW0ZXY (ADARS Chair), Simon Lloyd-Hughes GW0NVN, Richard Shipman MW0RCZ (ADARS Ctte), Mark Edwards GW4LHL, Robin Clews GW1LWA, Peter Biekens, Graham Taylor GW7GWT, Will Eldridge MW0CBD, Bob Southwood GW7GNF, Ray Ricketts GW7AGG (ADARS Sec). Fig. 6: Rohde and Schwarz XK2100L. In use until recently with the Royal Navy; an all-mode, 100W transceiver covering 1.5 to 30MHz.**




base of the main transmit antenna. Each of the three main transmitters will be routed through this. Perhaps more on the coupling unit in another issue.

## Museums on the Air

GB2MOP was active for Museums on the Air, June 16/17th and 23rd/24th, but conditions were distinctly unfavourable in West Wales.

The museum welcomes visits from special interest groups, usually engine related but not always. On the evening of June 14th 2018 we were pleased to host a visit from the Aberystwyth and District Amateur Radio Society, **Fig. 5**. The Rohde and Schwarz XK2100L, **Fig. 6**, was in use by club members. Among the contacts made was the Greek special event station SX18FIFA. This station was participating in the radio marathon for the 2018 FIFA World Cup series in Russia and was run by the Radio Amateur Association of Greece. **Simon GW0NVN** at the mike was pleased to exchange 59 reports both ways. Other contacts included **Zeby SP9IEK** from Poland. These are always pleasant occasions when acquaintances can be renewed and information exchanged. Members have, for instance, identified a large disk seal water cooled triode in the museum's valve collection that had hitherto been unidentified. Visits usually wind up in the coffee shop for a casual natter before heading off home.

The Museum's end of season 'Crank-up' was held on Saturday October 13/14th, **Fig. 7**. The 1950s Radio Room was put on the air for the VMARS 80m AM net (3.615MHz) on the Saturday morning. It was very gratifying to receive a good number of complimentary reports from around the country. Comments still report low modulation. The circuitry appears to be in order, the only anomaly is the microphone. It should be a carbon Siemens Type 500, which I suspect is a noise-cancelling type. I am using a standard GPO carbon insert. I may, though, be grasping at straws because, logically, the output from the GPO insert is probably quite high in order to carry down the telephone lines.

Saturday October 13th turned out to be the day of the worst flooding in South and West Wales in 30 years. We had a power failure just as I was expecting to be called onto the net for my second over. Power was soon restored and with many thanks to net controller **Keith G3XGW** I was able to make some final comments just as he was closing down the net. I am particularly grateful for this opportunity because it enabled a very special contact to be made. **Mike G4EJM** from Stoke happened to be on the net, running his Oceanspan transmitter. We were able to enjoy a two-way contact Oceanspan to Oceanspan – something possibly not heard for some decades. It was speculated that Mike's and the Museum's Oceanspans may be the only two working examples in the UK. However, I do know that **Bruce GW4XXF** has a working Oceanspan installation. I don't know whether he's been on the air with it recently. However, I do know that Bruce, an ex-Marconi Radio Officer, is a keen CW man so he'll probably be found down the bottom end of the bands.

## Other Museum Work

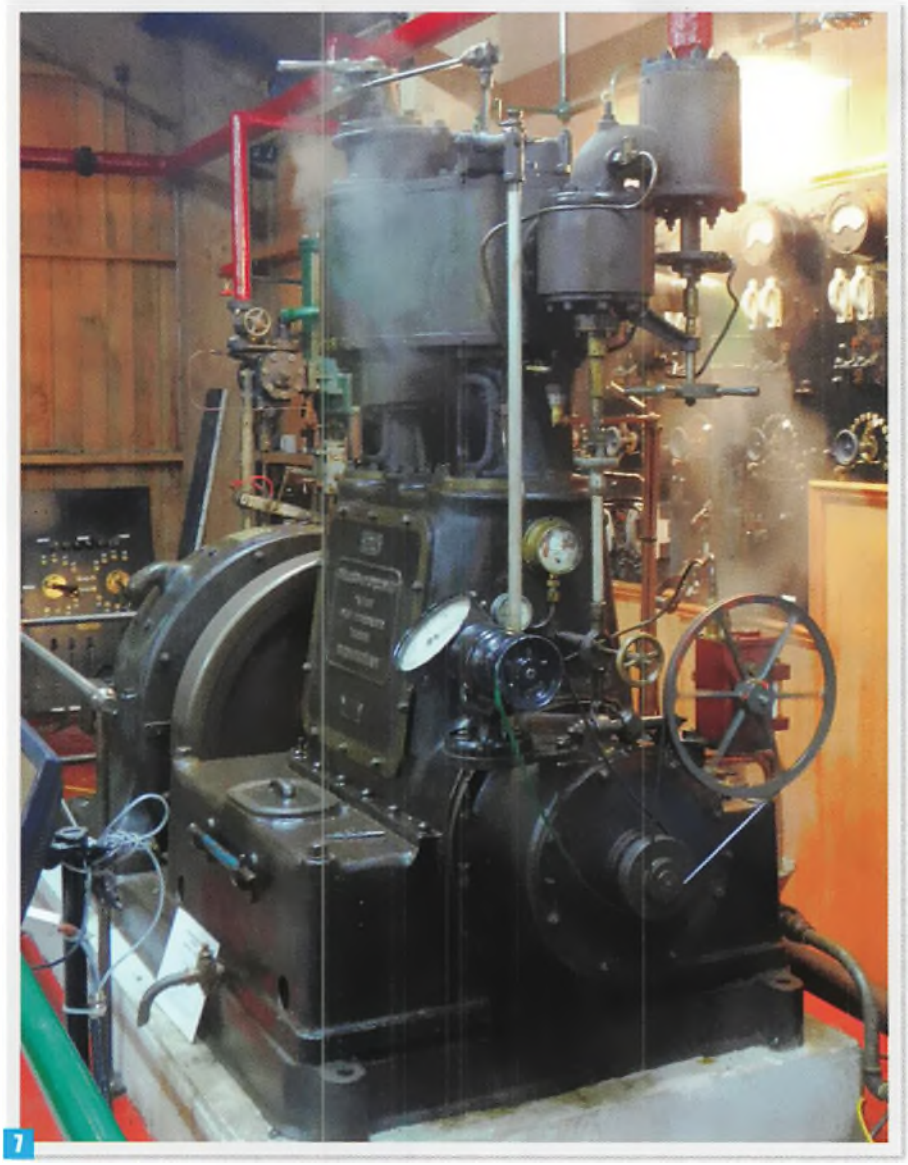
I am not overly concerned about the Oceanspan modulation issues because reports usually indicate clear audio, albeit a little low. I did make up a microphone amplifier based around a dynamic microphone insert to fit inside the telephone handset, **Fig. 8**, but the amount of RF coming up the bias line that I used for the power supply made it unusable.

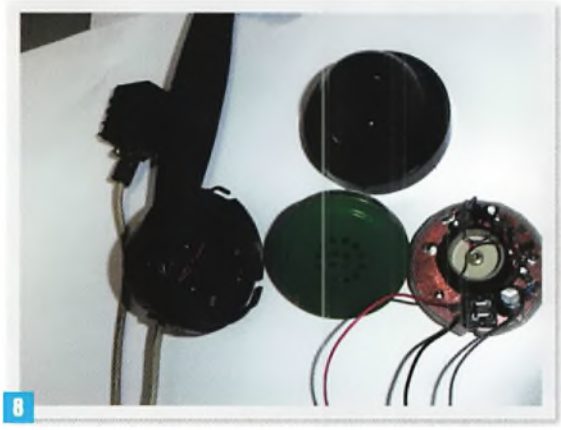
Some further work has been done to

**Fig. 7: Bellis and Morcom in steam during end of season 'Crank-up'. Next Crank-up will be Easter weekend. Fig. 8: Oceanspan handset with standard carbon microphone in centre, dynamic replacement two transistor preamp built in. It all worked well on the bench but temporarily defeated by RF in practice! Fig. 9: De-sense and audio routing switches for 1950s Marconi Radio Room.**

integrate the 1950s equipment (Oceanspan, Atalanta and Mercury) into a working station. First of all the de-sensing circuits have been sorted out. We amateurs have become accustomed, since the 1960s, to having a single antenna automatically switched between transmit and receive upon pressing the key or PTT. In maritime use separate transmit and receive antennas were used. Upon keying up, a 24V DC line from the transmitter to the receiver is activated. This usually switches a relay to disconnect the antenna and ground the receiver input, thus de-sensing the receiver to the transmitter output. In some receivers, such as the Atalanta, the valves in the front end may have the cathodes driven into cut-off to completely silence the receiver. In our setup the 24V de-sense line is also used to disable the VFO output because this was breaking through into the receiver at all times. The whole station is now much easier to use. Previously, when switching from receive to transmit and vice versa. I had to remember to enable VFO, turn receive to standby, then PTT. It might not sound much but it was frustrating during a contact to find my own audio coming back through the receiver and rising to a howling crescendo. As a bonus, break-in keying is now functioning correctly. If any CW types would like to try it, let me know.

Another small addition is a switch to select which receiver audio is patched through to the handset. Handset audio can also be switched off to allow listening solely through the loudspeaker. The handset audio can be quite deafening if sudden interference breaks through. A simple panel has been added between the Atalanta and Mercury to house both of these switches, **Fig. 9**.





## Winter Shutdown

Over winter, the work schedule included new exhibits and improvements to existing displays for 2019. I started looking at the Marconi Challenger last winter and planned to resume this investigation during the winter. I may also look into the Kelvin Hughes Zealand M1250 Transmitter. There's always material for *PW* here, I just need more time to prepare it!

By the time this goes to press *Internal Fire – Museum of Power* will be closed for the winter and is due to reopen at Easter, soon after this magazine is published – see website for information:
www.gb2mop.org
www.internalfire.com

Although the Radio Collection is open during normal museum hours I am not there every day, so if you are planning a visit, contact me either via *PW* or at
michael@internalfire.org
and I will try to be there to show you round.

E-Mail: practicalwireless@warnersgroup.co.uk

# Es'Hail-2 Progress

## Mike Richards G4WNC continues his quest to work through amateur radio's new geostationary satellite.

**Another busy month as I get to grips with Es'Hail-2 and my station setup.** Judging by reports from those already using the satellite, it looks as though smaller dish sizes (down to 65cm) are workable, at least in the southern parts of the UK. I've had a very interesting time following the progress of others so I can work out the best way forward and I've learned lots. The Octagon Optima LNB, that I recommended last month, seems to have disappeared from the shelves and there are none to be found anywhere in Europe! I've since spoken to the importers and a fresh batch is on its way to the UK and due to arrive at the end of March or early April, so keep a look out for those or get your back-order in. To keep the project moving, I managed to find an Avenger PLL LNB that should do the job.

The LNB is a critical component in the receive chain because it is responsible for the performance of the 10GHz downlink from Es'Hail-2. If you look at the details of most LNBs, you will see that they claim a noise figure of 0.1dB! That's highly unlikely but a low noise figure at the LNB is important because the LNB defines the overall performance of the system. Equally important is the LNB's local oscillator stability. Many consumer-grade LNBs use DROs (Dielectric Resonance Oscillators) for the local oscillator but they are unusable for narrowband modes due to excess drift. However, some of the newer models, such as the Octagon model, use a 27MHz crystal reference with a PLL-based local oscillator chain. These are far superior and nearly good enough for use without modification. However, there have been some ingenious attempts to improve local oscillator stability and there are currently two main approaches. The first is to remove the crystal and replace it with a surface mount TCXO (Temperature Compensated Crystal Oscillator). A look through the Mouser or Digikey websites shows there are plenty of 27MHz TCXOs available with stabilities of ±1ppm (Part per Million) or better over the temperature range –40°C to 85°C. Cost is very low at around £2 each for ±1ppm. You could even go for a higher stability of ±140ppb (Parts per Billion) for about £10 but that's probably unnecessary.

The second approach to LNB stability is to use an external GPSDO (GPS Disciplined Oscillator), a popular example being the **Leo Bodenar** units that are available from SDR-Kits. This approach is clearly the best solution, especially if you want to experiment with narrowband data modes. To use an external clock source, the internal crystal in the LNB needs to be removed. This is a tricky job. Some crystals can be removed with a small but powerful soldering iron. However, the track lifts very easily so you need to be careful not to overheat. In some cases you'll need to use a heat gun. For mine, I used Kapton (polyimide) heat resistant tape to keep the other components in place while I gently heated the board to melt the solder and release the crystal. When doing this, I find it's better to keep the airflow at low to medium because it gives you better control and minimises the risk of blowing other components out of place. Once the crystal is off, you need to make a buffer for the feed from the GPSDO. This comprises a DC block capacitor and a terminating resistor as shown in **Fig. 1**. Space is limited so you'll probably need to use 0603 size SMD components. This buffer will need a separate cable, RG174 or similar and a small access hole drilled in the LNB housing. If you are using one of the Leo Bodenar units, Leo has done some work to determine the settings for the cleanest 27MHz output. I've shown these in **Fig. 2**. To use these settings, ignore the output 1 and 2 boxes. Just enter the new values into the lower section and press Update. The values will be sent to the clock chip and the frequency values will be updated.

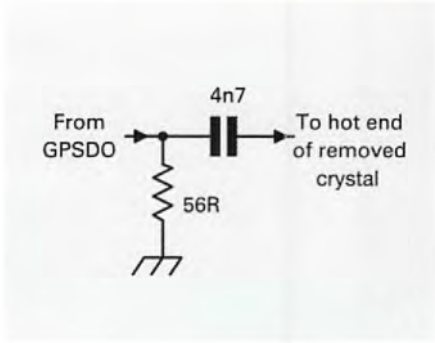



**Fig. 1: Termination and DC block circuit for modified LNB.**

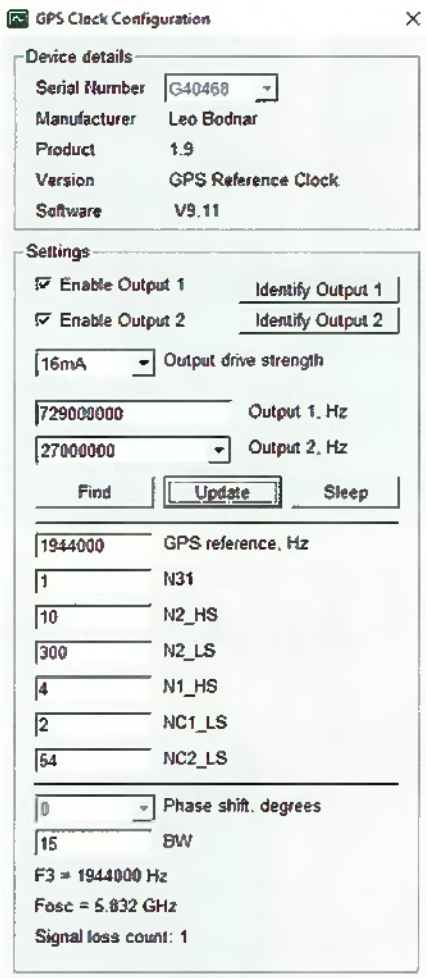



**Fig. 2: Settings for optimum 27MHz reference from the Leo Bodenar GPSDO.**

For the cleanest output, you can press the Sleep button, which will shut down the internal processor but hold the frequency settings. For most LNBs, the output level from the GPSDO should be set to 6mA. If this doesn't work, gradually increase the level until the receiver locks and you can start receiving.

I'm using a variation of the GPSDO solution that I first saw **on Michael Fletcher OH2AUE's** website. To avoid drilling an extra hole in the LNB and compromising the weather sealing, Michael uses a Triplexer. This combines the LNB IF signal, 27MHz reference clock and the 12V DC

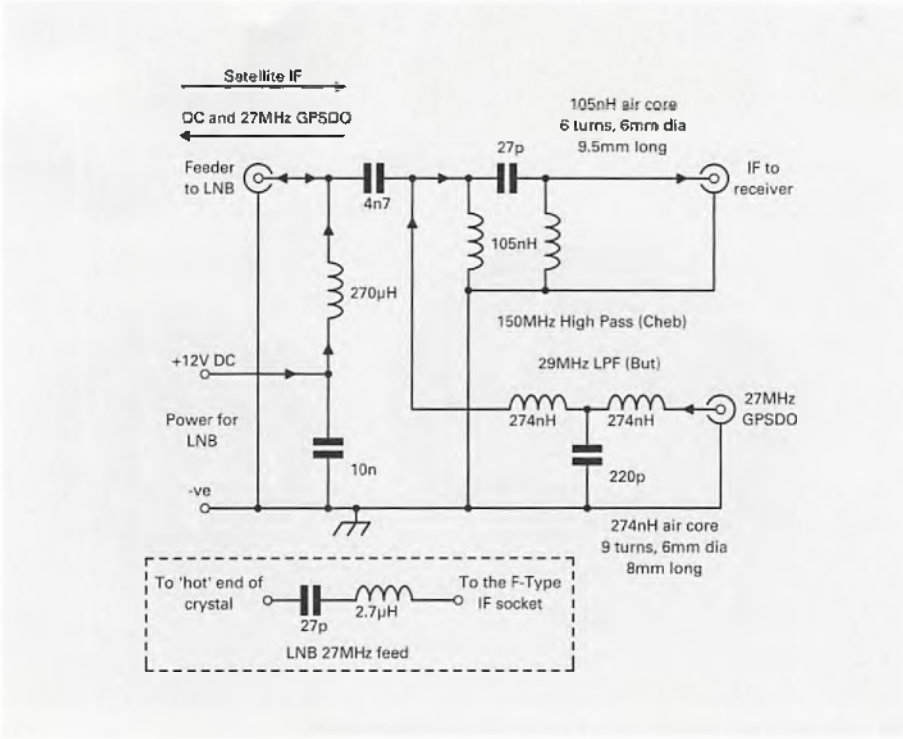



**Fig. 3: 2.4GHz, 27MHz and DC power triplexer.**

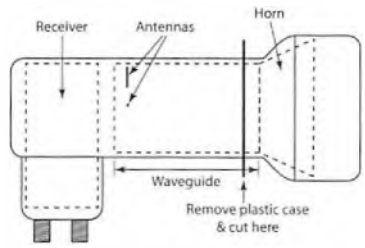



**Fig. 4: Typical LNB showing the 10GHz waveguide section.**

power feed onto the LNB's F-Type coax socket. You still need to remove the 27MHz crystal and add a matching circuit but it's a very neat solution. The matching circuit is simply a 2.7µH coil and a 12pF capacitor (both SMDs) to make a 27MHz series resonant circuit, **Fig. 3**. We don't have to worry about separating the IF and DC signals because that's already handled in the LNB. You can see some photos of Michael's work on his website at:
**https://tinyurl.com/y2vtwoed**

At the shack end of the feed, we need to build a triplexer to separate the DC power, Satellite IF and the 27MHz reference signals. Michael hasn't published details of his design so I put together my own triplexer, **Fig. 3**. There are three elements to the design. At the top is a 150MHz highpass filter that passes the satellite IF feed, while the lower section is a 29MHz lowpass filter to allow the 27MHz reference to pass. Because a 12V DC feed is required to power the LNB, I've built that into the design. The 4.7nF capacitor, 270µH inductor and 10nF capacitor form a standard bias-tee to inject the DC power into the coax feeder.

The current receiving setup here is an 80cm offset dish from SystemSat with an Avenger S321 S2 LNB, though I'll probably change to the Octogon LNB when that arrives. Because the LNBs have so much gain there's no real need for expensive low-loss cables so I've used standard NX-100 satellite cable. At the shack end, I've modified a dual F-Type wall socket to serve as the bias-tee power feed.

## Es'Hail Transmit

The Es'Hail-2 transponder uses a 10GHz downlink and 2.4GHz uplink so there is an antenna challenge to solve. There are two main approaches. The first is to use separate dishes for transmit and receive. There are plenty of options for feeding the transmit dish and a popular choice is to use one of the 2.4GHz patch antenna designs. I even saw a tweet from George Smart M1GEO where he managed to access Es'Hail-2 directly with a quad patch array driven with just under 2W – CW only. Reports so far indicate that the satellite is accessible for data modes signals using relatively low power, which is encouraging. The second approach for transmission is to stick with a single dish but use a dual-band feed.

I've decided to go with the single dish option because I've already got an embarrassing amount of hardware littering the garden and two dishes won't go down at all well. A dual-band feed is not a trivial task and there's a steep learning curve for those just starting to dabble in the squeaky bands (microwave!). Fortunately for us, a team comprising **Mike Willis G0MJW, Remco den Besten PA3FYM** and **Paul Marsh M0EYT** have come to the rescue with a brilliant homebrew antenna design. You can find full details on the uhf-satcom site at:
**https://uhf-satcom.com/blog**

The antenna construction is straightforward and uses a sheet of 1mm thick copper and standard 22mm copper plumbing pipe. The transmit section employs two plates that act as a pair of antennas with a 90° phase difference at 2.4GHz; this creates left-hand circular polarisation. That polarisation reverses on reflection from the dish to give the correct right-hand circular polarisation for the satellite.

On the receive side, the 22mm copper pipe acts as a waveguide to carry the 10GHz signal to the LNB that's mounted on the rear of the copper pipe. Most consumer LNBs have a small horn antenna, **Fig. 4**, that gathers the received signal from the dish and then passes that signal along a circular waveguide to the internal antennas. In order to fit the LNB to the 22mm copper pipe you will need to take a saw to your LNB and remove the horn antenna, while leaving the waveguide intact. The 22mm copper pipe and waveguide are very similar diameters so the easiest way to join them can be with a 22mm plumbing coupling. There are also 1in to 22mm plumbing couplings available that could be useful for some LNBs. The final addition is to fit a Dielectric lens, **Fig. 5**, to the front of the waveguide. This is required to match the waveguide and properly illuminate the dish. The easiest way to get a lens is to buy a cheap 'Rocket' LNB and remove its dielectric lens. Rocket LNBs are very slim units designed to be mounted as a group of LNBs. As a result, there's no room for the usual horn antenna so the dielectric lens is provided to serve a similar purpose. The lens is normally a plastic assembly that can be levered off with a screwdriver. It's often a tight fit so I suggest you warm it up on a radiator or very carefully apply a heat gun to soften the plastic.

## USB and Raspberry Pi Power

Last month I briefly covered the shortcomings of some microUSB cables when used to supply power. Although this was aimed at Pi users, it applies to any situation where the USB directly powers the device. Radio dongles such the Airspy range, SDRPlay and similar all use USB power so it's worth making sure those cables are suitably low resistance. It's also worth adding ferrites to help reject common-mode signals. Pi users can avoid the USB cable problem by connecting the power via the GPIO pins. However, you need to add some additional protection. The power protection systems on the Pi have simplified over the years and the latest Pi-3B+ has just two protection devices, **Fig. 6**. The first is a Polyfuse resettable fuse, which is a Bourns MF-MSMF250X device. This has a 2.5A holding current and blows slowly at 5A. This is supported by an SMBJ5.0A TVS (Transient Voltage Suppression) device that starts to break down at 6.4V and can stand a very short pulse discharge of up to 65A. When the Pi is fed from the GPIO pins, **Fig. 6**, you can see that the supply bypasses the Polyfuse, which negates the over-current and over-voltage protection. The simple fix is to add a polyfuse in your external power lead. Polyfuses are readily available from the larger component resellers and come in SMD and wire-ended forms. A couple that I have used successfully are the Bourns MF-MSMF250X (SMD as fitted in the Pi) or a Multicomp MC36253, which is a cheaper, wire-ended, equivalent. If do you power the Pi via the GPIO pins, don't connect the micro SD socket to your computer because there's no longer any back-feed protection on the Pi-3B+ or the Pi-Zeros.

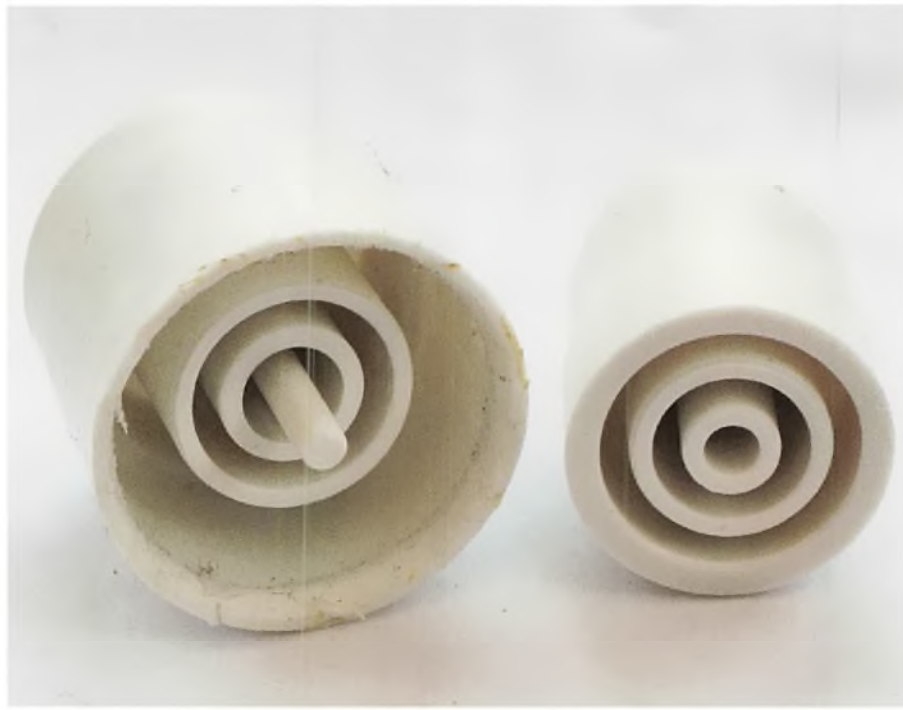


**Fig. 5: Dielectric lens removed from a rocket LNB and disassembled.**

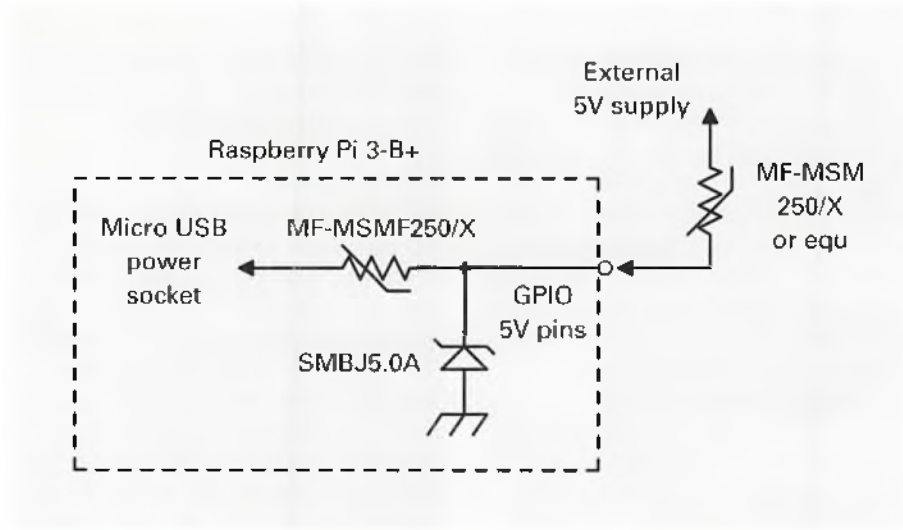



**Fig. 6: Schematic extract showing the Pi-3B+ power protection.**



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# Getting More Done

## Lee Aldridge G4EJB presses on with both antenna work and shack projects.

**With strong winds forecast, I brought down both of my masts leaving only my basic W3EDP antenna strung up the garden.** This would give me an idea how the 20m and 30/40m antennas had fared and the opportunity to make improvements.

I inspected the 30m/40m inverted dipole. As expected, the temporary croc-clip connectors were rusty so how well was the 40m section working? The old TV coax connection (not the best to start with) was checked and surprisingly free of water ingress – though moisture must have been trapped at some point, see photo, **Fig. 1**.

The antenna was made into a 30m and 40m inverted-V dipole with a single coaxial feed. Yes, I know I said I would make a trapped version but this just required additional wire and rather than wrestle with traps at the moment, I thought, given that the two bands are not harmonically related, this was a quicker fix. The wire lengths were adjusted in accordance with **George Dobbs G3RJV's** advice in his book, *QRP Basics*. I wound an RF choke based on W7EL's work detailed in **Peter Dodd G3LDO's** book, *Building Successful HF Antennas*, using new and inexpensive RG6/U 75Ω feeder secured with cable-ties and tape to the top of the mast. The coax feed was inverted (as recommended by many antenna builders to stop water ingress – I still have the scars), taped up with self-amalgamating tape, insulation tape and roof and gutter seal mastic, **Fig. 2**. When dry, the mastic is not very flexible but is strong and hasn't, in about five months, shown any signs of deterioration on a previous antenna waterproofing joint.

Needless to say, using low power transmit levels I don't have to consider the possibility of breakdown voltage in the same way that those using higher power levels must.

It took quite a few days' work to get the mast and attached antennas ready. Apart from the upgrades, I assessed the existing wire, guys and masts for wear and any damage. All of the wires and guys had to be in the right places when the mast was put in position, particularly as I was performing this task unaided. Another factor was to ensure there would be sufficient daylight to complete the guying and the antenna wire fixings. So allow sufficient time, don't rush it because there's then more likelihood of mistakes. Things like, where's the screwdriver? Why can't I reach the wound-up wire and guying rope? Just that little bit of thought and planning can make the tasks safer and easier.

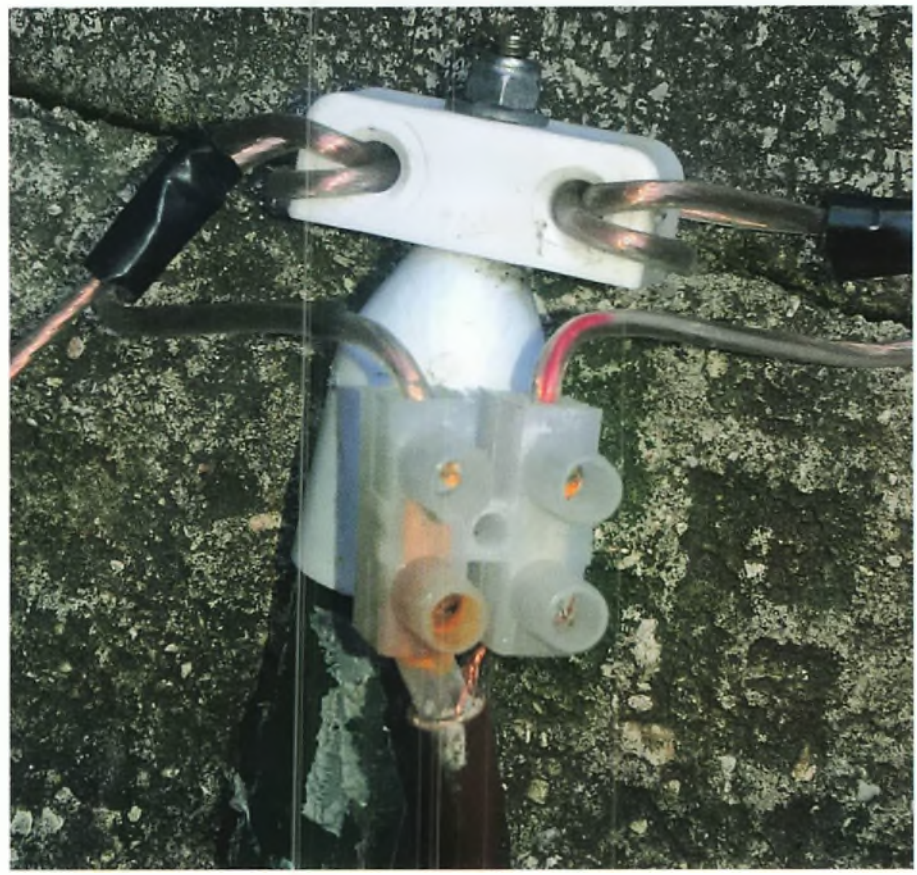

**Fig. 1: Old inverted-V coax connection.**

### A Success

Well, the dual-band antenna is quite a success. Yes, the SWR of the 40m antenna was better than 1.3:1 and the 30m dipole was about 1.7:1. Then, by raising the ends of the 30m dipole, the SWR went up to 2.5:1 so had I cut it short? Adding a piece of wire to both ends suggested I had. To confirm my findings, I tried out my FET dip oscillator on the 30m inverted-V while perched on some steps. I thought it would give the neighbours something to talk about...something like, what's he up to now? He's waving around some box and fiddling about with some of that wire? Should he have a parachute on? Anyway, I digress. Trying to keep the unit and myself steady, the oscillator frequency no doubt being pulled about, combined with the slowness of a DVM, wasn't ever going to work that well in practice.

To reduce the less than constant coupling to the antenna wire, I crudely tried using one turn of wire around the oscillator coil windings and a couple of turns on the dipole wire. The outcome? I refer to my earlier comments – spending a bit more time preparing might have helped but I needed to build one of the LED arrays I'd bought the parts for.

### Other Tasks

Meanwhile, I've been building and refurbishing boards to add an 80m transmitter

to my Howes DC2000 80m DC receiver. I'm also building a 40m CWAZ lowpass filter. I've got the bits ready for 30m and 80m filters as well. To get the correct value capacitors for the filters, I will use my budget component tester (see **Geoff Theasby G8BMI's** *Kits & Modules* in *PW* April 2019), supplied by an old 12V mains adaptor and a small 9V regulator I have constructed more than once, see photo, **Fig. 3**.

The 9V regulator has a resistor and LED connected in series across the input and output to provide failsafe indication – an idea from **Jim Brett G0TPF** in in the G-QRP magazine *Sprat 100*.

However, the biggest constructional task has been to refurbish a Howes 40m Daventry receiver (and plenty of other boards to follow) kindly given by a local fellow QRP constructor. So I'm gradually making my way to having more bands and shall be building up to using a microphone once the companion SSB transmitter has been through the refurbishment process.

Technology-wise, the biggest leap this month followed on from a RSGB newsletter I received detailing the QO-100 geostationary satellite and providing the link to the Goonhilly SDR that I could link onto my smartphone.I had played with a number of SDRs online but this was something else. I have to say, if it wasn't possible to operate on any other of the multitude of bands and modes from anywhere, then this would be a great option. The chance to build or modify some antennas and equipment is still alive and well – I just hope my eyesight lets me get as far as QRP via QO-100. If you haven't listened then, courtesy of the British Amateur Television Club, here's the link to the webSDR at Goonhilly:
https://eshail.batc.org.uk/nb

**Fig. 2: New 30/40m inverted-V dipole connections.**

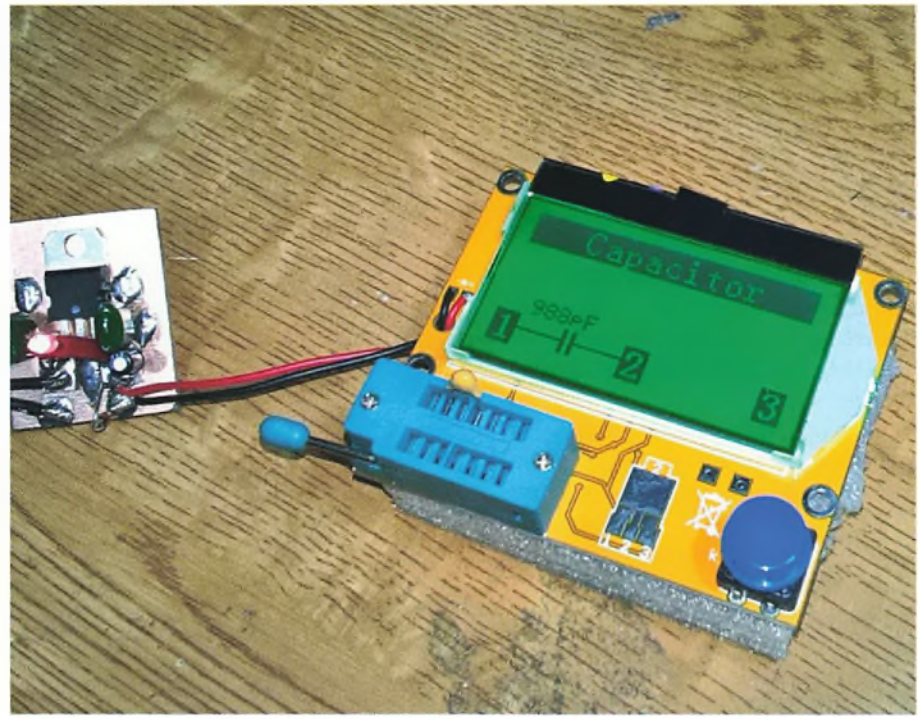


**Fig. 3: 9V regulator and component tester.**

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# How about LF and MF?

## Dave Pick G3YXM offers a beginner's guide to the 136 and 472kHz bands.

**Anyone who knows their electromagnetic spectrum can tell you that the 136kHz band is in the LF part of the spectrum while 472kHz is an MF band, like topband.** In this article I will just call them both LF to keep things simple.

The 136kHz band has been available to all UK radio amateurs, and many others, since it was approved by the 2007 World Radio Conference. Before that we had to get a special Notice of Variation from Ofcom if we wanted to use it. No such restrictions exist now. Even if you have a Foundation licence, you will find 135.7kHz to 137.8kHz listed in the Ofcom schedule.

The 472kHz band (472-479kHz) has been with us since 2012 and in the UK it is only available to Full licence holders. Like 136kHz, this band used to be authorised by a Notice of Variation but that isn't required now.

Both of these bands are international allocations so there is ample opportunity to work DX if you fancy. After a very long wait US radio amateurs recently got access to both bands, so they are keen to work across 'the Pond' to Europe.

What do you need if you want to join in?

### A Big Antenna?

The first thing that most people think about is the antenna. *"I haven't got room for one"* is the common refrain, but the way the licence is specified means that many people could get a signal out, even from quite a small garden. This is because the power limit is specified as Effective Radiated Power (ERP), which means that if your antenna is inefficient, then you just turn up the power until you reach the ERP limit. There is no legal limit on transmitter power.

Let's look at an example. If Fred has a G5RV up at 10m above ground and he straps the feeders and loads it up as a 'T' configuration, then its efficiency on 472kHz will be about 0.75%. On this band we are allowed to run 5W EIRP, which is ERP relative to an Isotropic source, and is equivalent to about 2W of 'real' ERP. To radiate 2W with an antenna which is 0.75% efficient Fred will need a 266W transmitter, not too difficult to do.

**Fig. 1: The unfortunate aftermath of the fire!**

On 136kHz the efficiency drops markedly, in this example to about 0.06%! We are allowed to radiate 1W of ERP on this band so Fred will now need a 1.66kW transmitter, a little more challenging but still possible. Of course, with high efficiency modes like WSPR we can still get good results even if we don't manage to reach the maximum allowed ERP.

Theoretical calculations are all very well but a practical system will not be in the middle of a clear, flat field with excellent ground conductivity. It'll be squeezed in beside the house, wrapped around a tree and next to the support mast. Practical measurements have shown that, due to local losses, typical amateur antennas are around 6dB worse than the calculations might lead us to think. Therefore, Fred could probably increase his transmit power by a factor of four without exceeding limits. However, running 5kW into a small antenna on 136kHz is not advisable.

### A Fiery Lesson

Let me relate a short tale. I was in the shack one day, tuning up my recently built

2kW 136kHz transmitter when my daughter asked, *"Daddy, should the garden be full of smoke?"* The answer to this question was obviously *"No"* so I ran outside to see what was happening. My small 'antenna tuning hut' was ablaze and was about to set fire to the garden fence and the hedge behind it, **Fig. 1**. By the time I had extinguished the flames with the garden hose the fire-brigade had turned up. Most embarrassing!

The reason for this unfortunate occurrence is revealed if we work out the voltage generated when applying high power to a relatively small antenna on a low frequency. The reactance of the large inductance required to resonate the antenna will generate some tens of kilovolts on the whole antenna. If there are any sharp edges on the connections, a corona discharge will take place, effectively a spark dancing around the sharp point. This can set light to any nearby flammable material. In my case I had separated parts of the tuning system with blocks of expanded polystyrene packing material. Polystyrene is a very good insulator but highly flammable, don't use it! I recommend using glass and ceramic insulating materials such as jars and plates. Use good 'dog-bone' insulators on the antenna wires and make sure that no part of the antenna system is liable to touch anything conductive or even just a bit lossy such as the branch of a tree. If you are considering running high power, then you must ensure that no part of the system is within reach of passers-by or people hanging the washing out (as my wife will tell you...).

The numbers are not quite so frightening on 472kHz and you are unlikely to set anything on fire when running a couple of hundred Watts on this band.

## Key Considerations

The key things to remember about antennas for LF are these:

- Height is very important. Doubling the height will give you more than three times the efficiency. Make sure that all parts of your antenna are as high as you can get them. Keep it well insulated to reduce losses.
- Feeding a high RF current into the antenna is the key to good results. The more current flowing along the wire, the stronger the signal. A longer antenna is easier to feed current into because it has higher capacitance, therefore needing less inductance to resonate it. Inductances tend to be lossy.
- The loading coil used to resonate the antenna should be as large as practical so as to reduce loss. Use good quality wire on a low-loss former. A large plastic water-cooler bottle is good. Litz wire may be advantageous on 136kHz.
- The quality of the earth system is also very important. The earth resistance is effectively in series with the antenna system. The poorer the earth, the more difficult it is to make current flow up the antenna.

An easy way to optimise your antenna system is to monitor the current in the wire. An old thermocouple ammeter will do the job but good ones are hard to find these days. Fortunately, it's easy to make a simple RF current meter. Go for a full-scale reading of about 5A if you are aiming for the maximum ERP. It is straightforward to calibrate the meter using a 50Ω dummy load and a 100W 1.8MHz transmitter. Place the meter in series with the dummy load and at 100W it should be reading 1.4A while at 50W it should read 1A. Just use the formula P(power) = $I^2$ (Amps squared) x 50 (the resistance of the dummy load) to work out the current for other power levels, **Fig. 2**.

When adjusting the resonance of the system, which will be very sharp, a common practice on LF is to use a variometer, **Fig. 3**. This is a simple thing to make. It's just a small coil that can rotate inside a large one. The coils are connected in series and the inductance of the whole thing changes as the small coil is rotated. People use this method because of the expense of purchasing a suitable capacitor that will stand very high voltage.

In some places it might be better to use a loop antenna. Loops are less affected by lossy structures around them. If you have some handy trees, a large circumference loop made from coaxial cable could be strung between two trees and tuned at the bottom with, preferably, a vacuum capacitor, **Figs. 4** and **5**. Such a loop can be fed via a ferrite transformer, the loop conductor passing through the centre of a toroid and a few turns of wire on the toroid coupling via a coax feeder to the shack.

The great thing about LF is that you can be inventive. Making a variometer out of some plastic bins is easy, there's no great precision required. My experimental loop needed 13,000pF to resonate it on 136kHz so I series-paralleled 100 2kV 1000pF capacitors to make a suitably rated padder to go across the vacuum variable. These can be seen on the board adjacent to the tuner in Fig. 5. It did drift a bit as the capacitors warmed up though!

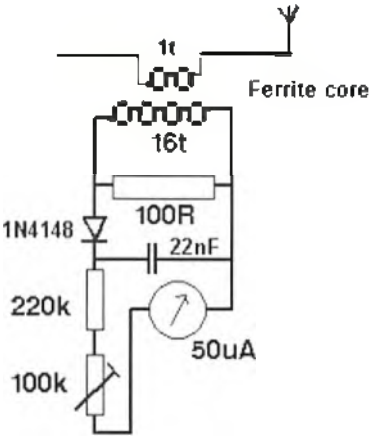


**Fig. 2: Suitable circuit for a simple RF current meter.**

**Fig. 3: The author's homebrew variometer.**

## How to Transmitters

If you are a Foundation licence holder considering operating on 136kHz, your licence conditions state that you can't use a home-constructed transmitter. Unfortunately, there aren't many ready-made ones to choose from. To my knowledge there were only two commercial 136kHz transmitters on the market, the Ropex 'First' and the Thamway TX2200A. The Ropex was crystal controlled, which isn't much use these days, and the Thamway was very expensive, but it might be worth trawling the second-hand market for one. There is a rather nice Juma TX136 kit, **Fig. 6**, which a full licensee could probably build for you?

For most of us the solution is to build some sort of homebrew transmitter if we want to get onto 136kHz. The most

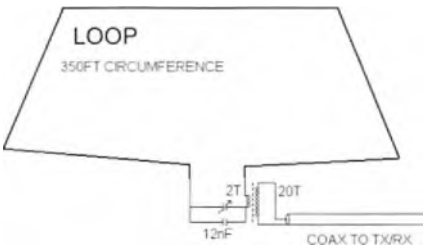


**Fig. 4: Suitable arrangement for coaxial loop antenna.**

common type is 'class-D'; basically a switch-mode power-supply arrangement generating square-waves, which are then filtered to produce a clean sinewave output. This type of transmitter is very efficient but requires careful control if it isn't to go pop. There are many such designs on the internet. A good place to look is PG1N's website where he has links to most transmitter designs:

**www.pg1n.nl**

If you own an Icom transceiver that has been 'opened up' to transmit anywhere, then it will most likely put out a small amount of RF on 136kHz and about 10W on 472kHz. The output will be very distorted and will need filtering and then amplifying to the desired level. Be careful when using your transmitter outside its design limits and make sure that the PA isn't getting too hot – it will be very inefficient! I suggest not drawing more than about 5A on transmit.

Some modern transceivers will produce a low-level output from a 'transverter' socket. This should work well on both bands but, because the output is probably only a few milliwatts, you will need a high gain amplifier.

If your transceiver doesn't transmit below 160m, a transverter could be the answer. Minikits produce a 630m (472kHz) transverter kit, **Fig. 7**, which you can use with a 5W 80m transceiver such as an FT-817:

**www.minikits.com.au**

If you want a ready-made solution, then Monitor Sensors make both 630m and 2200m (136kHz) transverters, **Fig. 8**, but they are quite expensive and only run 50W:

**www.monitorsensors.com**

Unless you have lots of space for huge antennas you will probably need more power. **David G0MRF** sells kits for LF amplifiers via his website (below) and the new Linear Amps UK Gemini HF-1K is specified to produce at least 200W on 472kHz.

**www.g0mrf.com**

**Fig. 5: Tuner for the loop antenna of Fig. 4.**


**Fig. 6: An assembled Juma TX136 transmitter.**

## Receivers

Most modern transceivers cover both bands on receive but will be insensitive and require input filtering to prevent cross-modulation from strong medium and long-wave broadcast transmissions. G0MRF has a bandpass filtered preamplifier available for each band, which should make any transceiver useable on the bands. In recent tests of common transceivers G0MRF found that, in general, Kenwood radios and the new breed of SDRs were consistently good on LF, but most sets are useable with care.

Old 'boat anchor' receivers generally work well on LF but will not be stable enough for the modes in use these days. In fact, a receiver with a high stability master oscillator is a good idea.

## What Mode to Use?

The bands are so narrow that you can't use SSB or any kind of voice transmission. CW is still moderately popular in the evenings on 472kHz but signals are often weak and you will need to have your receiver set up well to copy it. CW operation takes place in the lower part of the band, generally between 472.1 and 473.5kHz. A good calling frequency to try is 472.5kHz.

High-efficiency digital modes are most used on LF, the commonest of which is WSPR. As a first step in listening on the bands, tune to 136.00kHz USB or 474.20kHz USB and run the WSPR

Fig. 7: The Minikits 630m transverter.

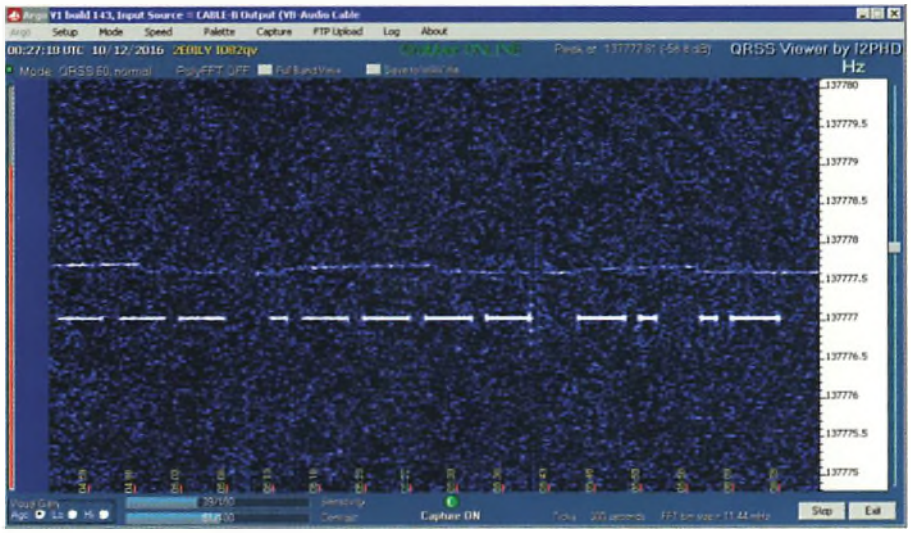


Fig. 9: A big signal from VO1NA on Argo.

software, which will give you an idea of what you can receive. There is plenty of activity, especially on 472kHz during the evenings. If you use the WSJT-X software package, then that will also give you JT9 and FT8 modes to try. These are QSO modes, not just for beaconing, so are more suitable for serious operators. JT9 is designed to work well on LF. All these modes use time slots for their transmissions so it's very important that your computer's clock is accurate. A utility such as Dimension 4 can be used to keep the clock synchronised with a time server.

Also popular is OPERA, which works in a similar way to WSPR but is technically easier to transmit because it is a single-frequency carrier keyed on and off by the software. Search the internet for 'EA5HVK software' to find OPERA.

The first mode to yield real DX on LF was QRSS, which is basically just Morse code sent very slowly, too slowly to read by ear. A 'waterfall' FFT program such as Argo, **Fig. 9**, or Spectrum Laboratory is used to display the dots and dashes and the Morse can be read directly from the screen. This mode is still very effective and is used occasionally. At one of its slowest speeds, 30 second long dots, it gives a 24dB advantage over 12WPM CW!

A new up-and-coming mode is EbNaut, which is being developed for use on the LF bands. At the moment it's a little tricky to use but it is capable of extremely good weak-signal performance. There is more information at:
www.abelian.org/ebnaut


Fig. 8: The Monitor Sensors 2200m transverter.

## Propagation

Both bands behave similarly except that the daytime range on 136kHz is longer than that of 472kHz, assuming a similar ERP. For most people with limited facilities, 472kHz will give better results.

Using WSPR as an example, daytime range is up to 500km or so on 472kHz, maybe double that on 136kHz. At night in winter, East coast USA stations should be workable on both bands. The distance records span the world with VK and ZL being within reach of really serious operators!

Don't imagine that everything has been worked though. There are always new countries becoming active on these bands. Just recently Argentina, Brazil and the Canary Islands have been heard for the first time.

## More Information

If you would like to find out more about LF operation, there are plenty of resources on the internet. A great source of news and technical advice is on ON7YD's site (below), which has links to almost every other internet site containing amateur LF information.
www.472khz.org

To find out what's going on at any particular time it's a good idea to subscribe to one of the LF forums such as
rsgb_lf_group@blacksheep.org

You don't have to be a member of RSGB to join. There are members from all around the world. Just send the message 'subscribe rsgb_lf_group' (no subject) to
Majordomo@blacksheep.org

and you will receive a lot of messages about upcoming activity on LF. There is also a 'groups.io' group called rsgb-lf-group, which you can search for on the groups.io site.

E-mail: practicalwireless@warnersgroup.co.uk

# Broadcast Antennas

## Steve White G3ZVW looks at Short Wave broadcasting antennas and how they go about 'making waves'.

**Although Short Wave broadcasting is on the decline there remain lots of high-powered Short Wave broadcast sites, all across the World.** The sites where these stations are located are carefully chosen by the broadcasters to give the required coverage and something important to note is that broadcasts don't necessarily take place from the country of a broadcaster's origin. The BBC is a prime example. In addition to UK-based sites, for many years they also had a network of relay stations around the world, although this has now shrunk to two – the Far East Relay Station in Singapore and the South Atlantic Relay Station on Ascension Island. This instalment of *Making Waves* will be about how typical short wave broadcast antennas work and specifically about some of the antennas on Ascension Island.

### A Different Kind of Problem

As radio amateurs, the majority of us who operate on the High Frequency bands don't have very efficient antennas. Most of us live in properties with small gardens so we simply cannot aspire to use antennas that have the directivity, effectiveness or efficiency of commercial broadcasters. Although not everyone even thinks about it, we are lucky if most of the power that leaves the transmitter actually reaches the antenna, which then gets sprayed around in all directions. Despite these inefficiencies a little of it can often reach the far corners of the Globe... propagation permitting!

When the BBC broadcast a short wave programme, they want it delivered with accuracy and certainty, often to one country or region that is thousands of miles away.

### Radiation Patterns

Most of us are familiar with the radiation pattern of the dipole antenna. Basically, in free space, it is a doughnut shape that exists at right angles to the wire. This means that with a horizontal dipole, even if the station you wish to communicate with is in the most favourable direction, broadside to your antenna, most of the radiation from it goes up, down or in the opposite direction. Hardly an efficient recipe! The early short wave broadcasters wanted a better way and it was discovered about 90 years ago. The antenna most often used goes by various names, including the Phased Array or Curtain Array. I will go through one step-by-step, to help you understand how it works.

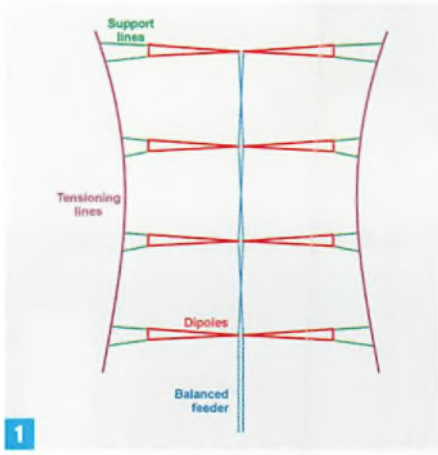


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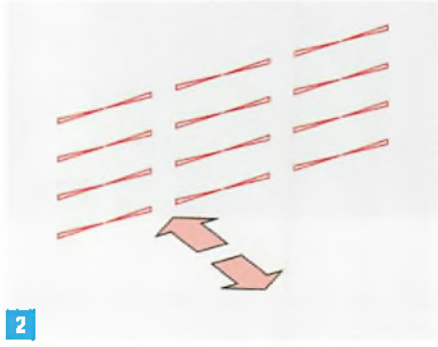
**Fig 1: How dipoles can be connected to squash down the radiation.**



2

**Fig 2: How stacks of dipoles can be used to squeeze the radiation in.**

The first thing I'm going to point out is that if you stack horizontal dipoles on top of one another and connect them appropriately, the signal radiated by them gets squashed from a doughnut shape down into two wide, flat lobes, rather like oval shapes. A simplified illustration of how such dipoles are connected is shown in **Fig. 1.** I have colour coded the individual parts; red for antennas and blue for feeders. I show the dipoles as being long thin triangular shapes, because constructing them this shape helps them to cover a broader range of frequencies, but the shape isn't always triangular. It can also be a parallel-sided cage shape or a series of parallel dipoles connected to the same feeder. They can even be folded dipoles. The green support lines and purple tensioning lines are not part of the antenna itself; they just hold everything in place. In the world of amateur radio we would probably make the support and tensioning lines from rope of some kind but in commercial antennas they will be steel because it is more durable. The trouble is, steel is conductive and will affect the antenna's radiation pattern so there will also be a lot of insulators in the support and tensioning lines to break them up into short lengths, which then don't affect the radiation pattern. To keep things simple I don't show them in the illustration. Bear in mind that this array will still fire a signal broadside to itself in two directions but at least there will now be little signal wasted by going straight up or into the ground.

The next development is to duplicate the stack of dipoles, as shown in **Fig. 2.** Often there will be three stacks of dipoles, evenly spaced, side by side. For clarity I now omit the feeders and all the support structures in the illustration. What happens is that if you feed one third of your transmit signal into each of the vertical stacks of dipoles at precisely the same time (in phase, in other words), they will work in conjunction with one another to squeeze the transmitted signal narrower vertically. **Fig. 3** shows the signal getting squeezed flatter, then narrower.

So far we have squeezed the signal down vertically into a narrower horizontal 'slot' and squeezed it horizontally into a narrower beam but the antenna still fires a signal in two directions. What you can do

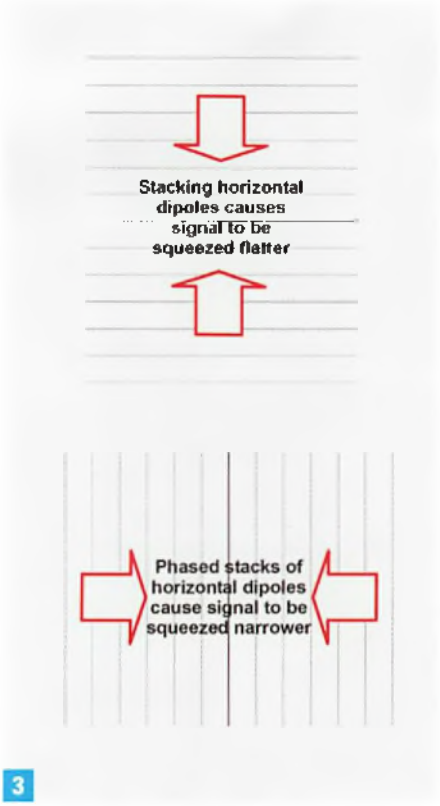



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**Fig 3: Squashing down and squeezing-in the radiation.**

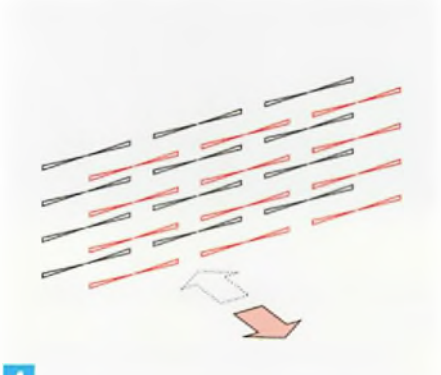

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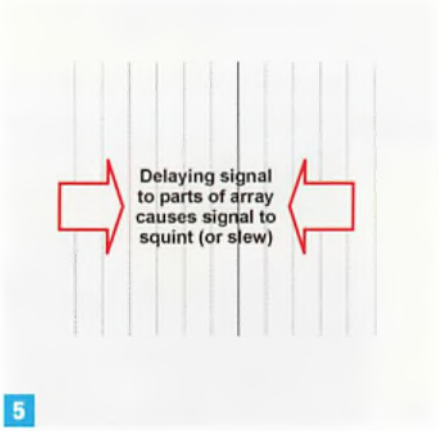
**Fig 4: Introducing a reflector allows the array to beam in one direction.**




5

**Fig 5: The effect of slewing the radiation to one side.**

**Fig. 6: North-South line of towers.**

to eliminate the unwanted lobe is introduce a whole second array, behind the first. **Fig. 4**. If you configure one half of the array to be a reflector (which can be done electronically), you can eliminate the half of the signal that would go in the opposite direction to the one you want. In this diagram I show the reflectors as black, so the signal will be firing out of the page, but such antennas can be configured to fire either way (to be reversible).

If you think the antenna array is complex so far, wait for the next bit! It's really clever. If you now delay your transmit signal very slightly to certain parts of the array that is allocated as the driven elements, you can cause the transmit signal to take on a squint and fire slightly to one side or the other. Professionally it is known as slewing. Depending on how much a broadcaster is prepared to invest in switching, signals can be slewed by as little as one degree. The maximum seems to be about 15° before the radiation pattern becomes too compromised. The effect is demonstrated in **Fig. 5**.

## Realisation

The BBC South Atlantic Relay Station on Ascension Island is located roughly midway across the Atlantic Ocean, slightly south of the equator. The distance from Ascension to South America and Africa is about the same and not too far, so each continent is ideally placed for a single- or two-hop path. The transmitting site is on the coast, giving it a low-loss take-off straight out across the ocean.

At the South Atlantic Relay Station there are lots of towers and masts, arranged in rows that are at 30° to one another. I am going to concentrate on just one row of five towers. Those shown in **Fig. 6** are aligned North-South, so the antennas strung between them can be configured to fire East (90°) or West (270°). Bear in mind that the antennas can then be individually slewed by up to 15° in either direction, so from the antennas between these towers it is possible to broadcast signals with precision from 75° to 105° and from 255° to 285°. This takes in a good part of Africa and South America but not all. Antennas that are slung between other rows of towers (at different angles of the compass) cover directions outside of these limits.

Now comes the point when you might be glad I simplified the earlier figures. Take a close look at **Fig. 7**. It's an absolute forest of wires and quite difficult to work out what's what, but each one is cut

**Fig. 7: One of the electronically steerable arrays.**

and tensioned precisely. The antennas are designed to be broadband but even so, antennas of various sizes are required to cover all the Short Wave broadcast bands.

With such complex antennas, containing hundreds of wires and insulators, there are lots of points of potential failure. Ascension Island is very windy and the atmosphere is salt-laden so insulator breakdown and fractured wires are not unusual, but with these antennas strung at great height (the tallest towers are about 400ft), it isn't possible to climb or use a crane to repair them. Instead the arrays are pulled up and tensioned from the ground using steel cables, with pulleys at the tops of the towers. When a failure occurs, an array can be lowered, repaired safely and in relative comfort, then pulled back up.

The bottom line is that with six 250kW transmitters and antenna arrays that can be electronically steered by as little as one degree, the South Atlantic Relay Station can broadcast formidable Short Wave signals to any part of Africa or South America.

• E-mail: geofftheasby@gmail.com

# A Fun Clock Project

**Geoff Theasby G8BMI has a fun project based around the speech module featured in his February piece.**

**As someone with a passing interest in clocks, but without the tools or patience to make one, I hit upon the following idea, which includes the ISD1820 speech memory module costing about £2 (see my February *Kits and Modules*).**

The photo, **Fig. 1**, is the finished clock, built on an A4 sheet of Plastikard. The dial was found on the internet, with a conventional quartz movement behind it. Piggy-backed on this is another, just to drive the second hand, which has a separate dial. This is supported by a short piece of plastic electrical ducting, which is self-adhesive on the back, ensuring no screw heads penetrate the clock face. Furthermore, the clip-on lid is adjustable sideways for correct alignment with the second hand location. Then, a further backplate is mounted on spacers to get the right distance. The motors are not synchronised but have you ever checked this in 'real' clocks? Because the second hand driver module was not flush with the rear of the dial, an extension made out of the narrow plastic tube which came with a can of WD-40 and some small diameter heatshrink tubing provided a good grip on the spindle and the second hand, which also had an M3 washer glued to it as a counterbalance and blackened with a permanent marker pen. A black sequin would be better, but **Debs** didn't have any, and the clock movement seems to handle it without problems. Use only the tiniest dab of glue or everything will gum up. I used a 1mm diameter mandrel to ensure the heatshrink didn't close up completely. The heat from the soldering iron will activate the heatshrink.

The second photo, **Fig. 2**, shows the reverse. The speech module is middle right, powered by the batteries at middle left. The 100mm speaker is chosen for a good quality 'tick'. An LM386 audio amplifier is bottom right, driven by the PP3, bottom left. I found the 'tick' on YouTube: https://tinyurl.com/y3vl55ks

There are many others but I preferred this one. The ISD1820 will record for up to 20 seconds but there is a 'loop' function. Make a recording that is timed so that the start of the loop is consistent with the end, i.e. that there is no noticeable changeover when a new loop begins. A direct electrical connection would eliminate extraneous noise pickup, but is not required in a quiet location, using the built-in microphone.

1


2

**Fig. 1: The finished clock. Fig. 2: The reverse, showing how the modules are located.**

A switch controls power to the amplifier, another begins playback of the 'tick'. The module draws only 1mA on standby and 10mA when in use, so is not switched. The quartz movement is, of course, always on. Chimes may be added using extra modules, if a movement with hourly contacts is used. The choice of bell sounds online is extensive too, even digital bells. Great Tom, Lincoln, Great Paul, St Pauls, Great George, Liverpool Anglican are all on YouTube. This clock is modular because it developed piecemeal, but the ticking and the LM386 could be handled by one DPDT switch, while the other could switch any chimes.

Decoration of the lower half of the clock is up to the reader. I intend to obtain a suitable picture frame and fit some decorative mouldings to make it look more Victorian.

No maintenance is needed save occasional battery replacement, so clock oil is not required (by which I mean lubrication, not a recess for the clock!).

# Letters

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## £20 STAR LETTER

### Fun on 2m

***Dear Don,***
Well, it's the morning after the regular RSGB 2m SSB Activity Contest and I'm still stunned by my experience – in a good way! After temporarily giving up on HF and not being completely convinced by the data modes, I thought it was time to try 2m SSB. My strongest memory of my early days of using a class B licence back in 1982 was a 2m FM 'DX' contact from a Norfolk coast beach to the Netherlands, using an old Trio crystal-controlled FM-only 2m rig. I remember being blown away by that experience but last night was in a different league.

Some very quick background information. Due to living on a modern housing estate with a tiny postage-stamp garden and draconian rules on antennas, I've had to make severe compromises. This means the 2m antenna is a compact VHF/UHF log periodic in a fixed position in the attic, about 10m AGL. I'm also using a masthead preamp and a 40-year-old Yaesu FT-221R. The house is in a 'sub optimal' position RF-wise, on the side of a hill, screened to the north by the North Downs and to the west by the rising hill at the front of my house. Even facing East, the path profile shows clear land mass between my house and Europe. Output from the transceiver is about 12W on SSB and, from memory, the log periodic gives just over 5dB of gain.

I was astonished to make contact with an operator on the Isle of Wight, then two in Eastbourne. None of these path profiles were clear and in theory a VHF link should not have worked, given the geography. More amazingly, I heard very strong calls from Woking to my west and off the side of the beam a clear call from the other side of the North Downs. From the rear of the beam I heard two very strong calls from the Netherlands. To cut a long story short, not one of these paths was line-of-sight and path profile analysis shows huge land mass in the way. To anyone who thinks, like I did, that VHF won't work from where they live, try it. You will probably be shocked at how well it performs using SSB, low power and a medium gain antenna. I am so blown away by this experience it's time to start saving now for a rotator and an external antenna mount! How many other hobbies have the scale, scope and possibilities of amateur radio?
**Richard White G6NFE**
**Ashford, Kent**

***(Editor's comment:** Your enthusiasm is palpable, Richard! Thanks for this. The 2m band has always been a mainstay of VHF amateur radio activity and I believe that well-equipped stations can make up to 200 or so contacts in the two and a half hours of the RSGB Tuesday Activity Contests. As you say, we tend to think of VHF as line-of-sight but extended ranges are by no means unusual, especially if there is any sort of temperature inversion. Apropos of which, I was fascinated by the most recent presentation at my local (Reading) Club by **Dr David Hooper** of the Rutherford Appleton Laboratory, who was talking about atmospheric refraction and its effect on electromagnetic waves, both radio waves and light (leading to mirages, rainbows and more). I'm sometimes asked why we radio amateurs persevere in these days of the internet but it's often these surprises with propagation that make the hobby so much fun. I do hope you continue to enjoy your radio and that others will be inspired by your experiences.)*

**The Star Letter** will receive a **voucher worth £20** to spend on items from our **Book Store** or other services offered by ***Practical Wireless***.

### EME

***Dear Don,***
I read with interest, but disappointment, the *Making Waves* feature in the March 2019 *PW*. **Steve G3ZVW** is usually very positive and supportive in encouraging people to try something new but I counted eight sections saying how difficult it all was followed by one, in effect saying, *"you need deep pockets"*.

I am not personally active on Moonbounce (EME) but did chair the organising committee for EME2012 held in Cambridge and have provided input to the recent RSGB publication *Getting Started in EME* so do have an understanding of the issues.

Steve's section headed *How it's Done* may summarise what is needed to be a regular EME operator but it isn't necessarily needed. For those interested in trying something new, it's perfectly possible to work one of the 'big stations' on 144MHz with a standard 100W black box plus preamp at the antenna and an 8-element horizontal beam if you choose the correct time when the moon is relatively low and you co-ordinate with the distant station. On 432MHz, the Essex DX Group have had an EME contact running just 60W to a single dipole and also one of their Foundation licensees has had a contact running 10W to a 17-element Yagi mounted two metres above the ground!

I was also disappointed that there was only one sentence relating to WSJT. **Joe Taylor K1JT** initially developed the software for weak-signal EME operation (specifically JT65). The subsequent development of other modes such as FT8 was as a result of the EME challenge. JT65 has allowed many more stations to successfully work stations off the moon.

At this time when spectrum is under threat, we should all be encouraging as much 'on the air' activity as possible rather than telling each other how difficult it is. It doesn't matter whether you operate on HF, VHF or Microwaves or whether you exchange '59', '599' or '–18'. These are all aspects of our wide-ranging hobby of amateur radio. Please can *PW* live up to its title and focus on the practical and positive?
**Graham Murchie G4FSG**
**Woodbridge, Suffolk**

***(Editor's comment:** Thanks Graham. Your points are well taken. WSJT has certainly made EME a lot more accessible and enabled many more operators to achieve success via the moon. We have indeed carried reports in the past of very low power EME contacts on the 70cm band. It's more of a challenge than working through a local repeater on FM but I agree that EME is very achievable from a typical back garden. Gone are the days when large dishes*

*were essential – older readers may well recall photos of the enormous dish at **G3LTF, Peter Blair**. For those who do give it a go, I'm sure our VHF columnist **Tim G4VXE** would welcome reports.)*

## 5MHz Operation and High-Speed Morse

***Dear Don,***
With certain modern rigs, to operate in the 5MHz band, some owners have their rigs 'broad-banded'. However, some manufacturers do not like this practice, citing warranty problems. However, in the case of Yaesu, the company have sorted out a modification to activate the transceiver in the 5MHz band without broad-banding. It consists of a series of push buttons being used. The rigs that this can be carried out on are: FTdx5000, FTdx3000, FTdx1200, FT-991/991A, FT-891 and the FT-450D.

I carried out this modification on my FTdx3000, namely two buttons held down while you switch on, release those buttons and press one button then press one button again. And with that the operation is complete. However, you do not get coverage of the whole of the 5MHz band, only from 5.250 to 5.406MHz, which is the UK allocation. To carry out this procedure for the above-named rigs, please ask Nevada Radio for the brochure.

On another topic, the letter by **Rich Langford G4FAD** (April) in support of high-speed Morse was interesting. He mentioned That from 45WPM upwards sending was done by keyboard. Also, that the requirement for the Speed Operators Club (SOC) was 80WPM. Does that mean receiving? If so, this is a strange requirement because the world record set by **T R McElroy** in 1939 was 75WPM for receiving. Unless, of course, a computer is used for reception.
**Ross Bradshaw G4DTD**
**Roche, Cornwall**

*(**Editor's comment:** Thanks Ross. 5MHz is a problem for manufacturers because the allocations continue to vary from country to country. Broad-banding is indeed a concern, if only because it then becomes too easy to inadvertently transmit on a frequency outside the amateur bands. Readers might wonder why it is even possible but some amateur radio transceivers are actually sold for commercial or military use in other parts of the world, especially in countries that cannot afford high-specification commercial kit.)*

## PW Metal Box

***Dear Don,***
In last month's *Letters*, **Andrew Humphriss 2E0NDZ** was asking about the metal box that was pictured. I also have this metal box and can state it was given away by *PW* in the 1930s. It should contain tools, a few spanners and a small screwdriver. This relates, of course, to a time when not much soldering was done but plenty of home construction. Mine does contain all the tools although I don't have it to hand just now.

I hope this helps. Excellent magazine as always. I took it way back and 50 years on restarted.
**David Higginson G8JET,**
**BVWS Archivist**
**Scunthorpe**

## BC221

***Dear Don,***
Having read Duncan James M0OTG's interesting article on the BC221, it evoked a fairly

recent occasion when a friend of mine used the vestiges of a less fortunate BC221 to support his truck during repairs. Please see photo.
**Stuart Atkinson G3YPS**
**Gainsborough**

## Hearing Aids

***Dear Don,***
Please may I have the help of *PW* readers. I have poor hearing and use hearing aids. It's fine when receiving but I have difficulty when transmitting. I am 90 and would like to be on amateur radio again. I am sure many older readers will have had the same problem and perhaps could be able to help.
**Jim Shewan G3UZB**
**Redcar**

*(**Editor's comment**: Jim, you don't say exactly what the problem is. Is your hearing aid suffering interference from the transmitted signal, for example? But I know we have readers with hearing problems so would welcome reader feedback, which I am happy to publish here and to pass on to Jim.)*

## IC-R2 programming problem via USB

***Dear Don,***
With reference to my article *Baofeng Computer Interface* in the March issue of *PW*, I commented that I had a problem programming my IC-R2 using an RS-232 to USB adaptor via my homebrew interface, which worked fine when connected directly to the RS-232 port. Talking on air to **Jon Fulcher G7ICH**, keeper of GB3PB in Parkstone, Dorset, he suggested that, compared to modern radios, an older radio might require more current than some USB ports are able to give. An external 5V PSU connected to the interface could solve the problem. I remembered that when I originally made the RS-232 interface I had powered it via a 5V PSU but removed it when I found the serial port gave enough power. Taking Jon's advice, I reconnected the external PSU and lo and behold, the IC-R2 programmed successfully.
**Peter Julian G7PRO**
**Wimborne, Dorset**

# Classified Adverts

DISCLAIMER Some of the products offered for sale in advertisements in this magazine may have been obtained from abroad or from unauthorised sources. Practical Wireless advises readers contemplating mail order to enquire whether the products are suitable for use in the UK and have full after-sales back-up available. The publishers of Practical Wireless wish to point out that it is the responsibility of readers to ascertain the legality or otherwise of items offered for sale by advertisers in this magazine.

## Antennas

**G4TPH MAGLOOPS** Remote tune and manual tune models. 40m through 10m. 100 Watts, SSB. See PW review on website. Details at www.g4tph.com



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**CTCSS ENCODER AND DECODER KITS.** DTMF kits and modules. Pic development kits. **https://cstech.co.uk**

## Wanted

**VINTAGE FIREWORK COLLECTOR** – do not light the blue touch paper and burn British Heritage, private collector will pay cash and collect from anywhere, licensed explosive storage. Call Tony on 07956 506300

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## Valves

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**RADIO AMATEUR GIVING UP.** B29. National HRO with 11 coils, Eddystone 680X, Marconi V2 receivers and 31 other items. Please e-mail kelwood@talktalk.net for list. Sorry but buyer must arrange collection. **Tel: Harry G3MFW 01872 858648 (Truro)**

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**REALISTIC PRO 2042 SCANNER.** VGC, GWO, manual. £75
AOR 202 Scanner. VGC, GWO, manual. £75
Howes CTU 8 ATU RX Only. VGC, GWO, manual. £35.
Price includes p&p all items. **Tel: Rob 01273 834355 (Mid Sussex)**

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**ERA MICROREADER,** ERA RS232 Display. **Tel: James 0208 6895149**

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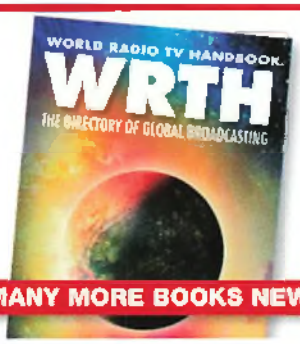


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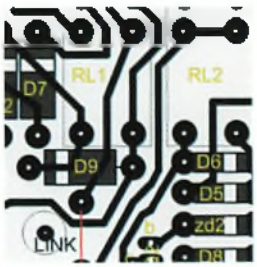


**TRAPEZING ANTENNAS? – YEH?** Tom Morgan ZS1AFS offers a photo diary of how he managed to get a new HF Yagi onto the tower. Not a challenge most of us face in the UK but a stirring tale of derring do!

**CREATE YOUR OWN PRINTED CIRCUIT BOARDS** Clive Mott G4ODM explains how to go about fabricating your own PCBs.

**THE 36TH ANNUAL PW 144MHZ QRP CONTEST** Colin Redwood G8MXL brings you the rules of the ever-popular PW 144MHz QRP Contest, with full details of how to take part.

**PERSONAL DIGITAL NODE** Tim Kirby G4VXE introduces the Personal Digital Node for Yaesu Fusion users.

**TECHNICAL FOR THE TERRIFIED** Tony Jones G7ETW repairs an SX-600 VSWR meter and, along the way, explains how such a meter functions.

There are all your other regular columns too, including *The Morse Mode, HF Highlights, Valve & Vintage, Carrying on the Practical Way, World of VHF and Data Modes*, along with your Letters and our regular Rallies listing.

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